ARISTOTLE READS HIPPOCRATES

Edited by
HYNEK BARTOŠ AND
VOJTĚCH LINKA

BRILL

Aristotle Reads Hippocrates

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Contents

Acknowledgements VII
Notes on Contributors VIII

Introduction 1
Hynek Bartoš and Vojtěch Linka

1 On Aristotle's Use of His Sources for Medical Ideas and Their Features 26
Lorenzo Perilli

2 Physicians and Philosophers on Well-Balanced Mixtures 70
Hynek Bartoš

3 *On Ancient Medicine* and Aristotle on the Structure and Function of Bodily Parts 100
Stavros Kouloumentas and Stasinos Stavrianeas

4 Art and Nature in Aristotle's *Physics:* Some Antecedents in Early Greek Medicine 126
Sean Coughlin

5 Aristotle and the Medical Tradition on Sleep and Food 169
Claire Bubb

6 The Hippocratic Background to Aristotle's Gynaecology 188
Sophia Connell

7 Aristotle's Indebtedness to Early Greek Medical Texts on Wind-Pregnancies 223
Mariska Leunissen

8 The Power of the Example: When Aristotle Read the Hippocratic *On the Nature of the Child* … 249
Giouli Korobili

9 Environmental Causation in Aristotle and in *Airs, Waters, Places* 276
Tiberiu Popa

10 On the Character of Citizens: Aristotle's *Politics* 7.7 and *Airs, Waters, Places* 306
Karel Thein

11 The Enigmatic Presence of Medicine and Physiology in Aristotle's Ethical Writings 329
Pierre-Marie Morel

12 The Medical Background and Inductive Basis of Aristotle's Doctrine of the Mean 351
Monte Ransome Johnson

13 Medicine and the Emotions: The *Problemata* in Dialogue with the Hippocratic Writings 375
Chiara Thumiger

Index locorum 409
Index rerum 430

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H. Bartoš and *V. Linka*
January 2024

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Introduction

Hynek Bartoš and Vojtěch Linka

This volume focuses on Aristotle's relationship to medicine and physicians, especially in relation to 'Hippocratic' writings. Given the complexity of the topic and its long history, we will first provide a brief overview, surveying its historical roots, later development, and the current *status quaestionis*. We shall then return to the specific aims and content of this volume.

1 Aristotle and Medicine

Aristotle's father Nicomachus was a court physician to the Macedonian king Amyntas III (reigning from c. 393 to c. 370 BCE).[1] Although Nicomachus died at an early age, it is reasonable to assume that Aristotle was brought up in a medical environment and that he received some medical education (formal or informal) before he left for Athens to enter Plato's Academy.[2] Apart from this family context, medical literature at this time was accessible to lay persons as well as physicians,[3] and medical topics and theories were frequently discussed among Athenian intellectuals, not least by Plato himself.[4] Therefore, it comes as no surprise that Aristotle was exceptionally well acquainted with contemporary medical knowledge and literature, to the extent that he even wrote several treatises on medical topics, of which only *On Sterility* (*Hist. an.* 10) has survived.[5] In addition, throughout his biological as well as ethical works, we

1 According to some sources, Aristotle's mother Phaestis also came from a medical family. See van der Eijk (2022) 105, Natali (2013) 8–11, Oser-Grote (2004), 17–18, and Düring (1957) 29 and 82.

2 In medical families, as Galen (*On anatomical procedures* 2.1) reports, the sons of physicians "practiced dissection from childhood under parental instructions, as they did reading and writing." On medical education in classical antiquity, see Kudlien (1970). For details concerning Aristotle's family and early biography, see Pellegrin (1996) and Amadio-Kenny (2021).

3 On the inappropriate use of medical texts by lay persons, see Aristotle, *Pol.* 3.16, 1287a37–41.

4 See Lloyd (2003) 142–175, Levin (2014), and Torres (2020, 2021a, 2021b, and 2021c).

5 On Aristotle's *Hist. an.* 10, see van der Eijk (2005) 259–275. Other candidates would be *Hist. an.* 7.19–28, 602b12–605b22, and some parts of *Problemata*, especially in Book 1. In addition, the list of Aristotle's works in Diogenes Laertius (5.25) includes several texts on medical topics, such as *Dissections* (*Anatomōn*), the *Selection from Dissections* (*Eklogē anatomōn*), and the *Medical Issues* (*Iatrika*). See Kollesch (1997), van der Eijk (2005) 263–264 and (2022) 107, and Perilli (in this volume).

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find a striking number of medical examples and references to medicine and physicians. Yet the latter are rarely mentioned by name,[6] and with only two exceptions (*Hist. an.* 3.2–3, see below), he never quotes their works. Instead, he most often speaks about "physicians" as a general group,[7] or more specifically about "some", "many", or "ancient" physicians, for example.[8]

Aristotle was apparently well aware of the diversity among medical authorities and their theories, and also of the various sorts of medical experts in terms of their education, experience, and theoretical interests.[9] For instance, in his account of the process of acquiring knowledge and skills through experience in the first book of *Metaphysics*, he makes it clear that in medicine as well as in any other *technē*, the master craftsman (*architekton*) is superior to a mere practitioner, for the practitioner knows the facts (*hoti*) and how to do things, while the master also "possesses the theory and knows the causes".[10] In other words, "art (*technē*) rather than experience is scientific knowledge (*epistēmē*)".[11] Accordingly, only some physicians and medical authors are to be considered scientists in the proper sense, and their views deserve special attention in discussions on causality and other topics pertaining to natural philosophy.

The most notable examples of Aristotle's recognition of exceptional medical authorities can be found in the treatises collected in the *Parva Naturalia*. In *On Prophecy in Sleep*, to begin with, Aristotle asks whether some dreams can be interpreted as "signs of what happens in the body". In support of a positive answer to this question, he reminds his readers about the opinion of medical authorities:

> At any rate the distinguished (*charientes*) doctors, too, say that close attention should be paid to dreams. And this position can reasonably be held also by people who are not experts, but inquire into the matter to a certain extent and have a passion for knowledge (*philosophousin*).[12]

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6 Aristotle refers to Hippocrates as a paradigmatic physician in *Politics* (7.4, 1326a15–16), and he briefly refers to the practice of "Herodicus the physician" in *Eudemian Ethics* (7.10, 1243b24). He also mentions Alcmaeon (e.g. *De an.* 1.2, 405a29; *Gen. an.* 3.2, 752b24–26; *Hist. an.* 1.11, 492a14), Diogenes of Apollonia (e.g. *De an.* 1.2, 405a21; *Hist. an.* 3.2, 511b30–512b11; *Gen. corr.* 322b13–14), and Leophanes (*Gen. an* 4.1, 765a24–25), who may be implicitly included among medical authorities as well.

7 E.g. *Hist. an.* 3.4, 514b2, 5.19, 551a12–13; *Eth. Eud.* 2.10, 1226a34; *Mete.* 384a21; *Pol.* 7.16, 1335a40–41.

8 E.g. *Eth. Nic.* 10.9, 1180b18–19, *Hist. an.* 10.7, 638b15, *Part. an.* 4.9, 685b5.

9 Cf. van der Eijk 2022, 110–112.

10 *Metaph.* 1.1, 981a12–b7. If not mentioned otherwise all translations are our own.

11 *Metaph.* 1.1, 981b8–9.

12 *Div. somn.* 463a5–6. As van der Eijk (1995) persuasively argues, Aristotle is most likely referring here to the author of *On Regimen*.

A clear distinction is drawn here between medical expert and lay person, as well as between a practical approach to medical diagnosis and a general or theoretical interest, which is conveyed by the verb *philosophein*.[13] Yet this interest has its limitations ("to a certain extent", *ti*), and philosophical inquiry does not compete with but instead overlaps with the experience and authority of the medical experts.

The relationship between medicine and natural philosophy is also addressed explicitly at the beginning of *On Sensation*, which opens the *Parva naturalia* and introduces the various topics covered in the series of treatises on phenomena common to body and soul:

> It is the business of the student of nature to inquire into the first principles (*archai*) of health and disease. For neither health nor disease can come to be in things deprived of life. So generally speaking, most of those who study nature end by dealing with medicine, while those of the doctors who practise their art in a more philosophical manner (*philosophōterōs*) take their medical principles from the study of nature.[14]

And towards the end of *On Respiration*, which concludes *Parva naturalia*, Aristotle reformulates the idea:

> As for health and disease, it is not just the business of the doctor, but also of the student of nature, to discuss their causes (*aitiai*) up to a point.[15] But we should not fail to recognize the way in which they differ and consider different issues, since the facts show that up to a point these inquiries border one another. For those doctors who are more subtle (*kompsoi*) and inquisitive (*periergoi*)[16] have something to say about the study of nature

13 Van der Eijk (2005) 192–193.

14 *Sens*. 1.436a17–b1, tr. Lloyd (2003) modified. Cf. Plato's remark in the *Charm*. (156b3–c5) about the "good physicians" who practise their discipline from a more theoretical perspective.

15 Cf. Aristotle *Part. an*. 2.7.652b36–653a10. Representative examples of medical questions pertaining to natural philosophy are to be found in the first book of *Problemata*, which contains numerous parallels with Hippocratic texts: see Jouanna (1996), Thomas (2015) and Thumiger (in this volume).

16 The adjectives *kompsoi* and *periergoi* are both double-edged, and Aristotle (as well as Plato) mainly employs them in contexts that lend them a rather negative connotation (see Hutchinson 1988, 41, and Korobili 2022, 177–179). Nonetheless, in our passage it is more natural to render it in a positive sense, by analogy with the physicians with a more "philosophical" (*philosophōterōs*) approach in *Sens*. 1 and the *charientes* physicians in *Div. somn*. Cf. Aristotle, *Protrepticus* (fr. 46, trans. Düring): "All intelligent (*kompsoi*) physicians

> and claim to derive their principles (*archai*) from it, while the most distinguished (*charieis*) of those who study nature generally end up by considering medical principles (*archai*).[17]

In both passages, Aristotle distinguishes between medicine and physicians on the one hand and the study of nature and philosophers on the other, and he mentions the principles of health and disease as paradigmatic concepts common to both fields of expertise.[18] His remarks are clearly addressed especially to students of natural science, encouraging them to study medical principles. The final sentence of the second passage (as well as the introductory passage in *On Length and Shortness of Life*)[19] even seems to announce a philosophical discussion dedicated to health and disease (which has either been lost or was never written).[20] Alternatively, it is also possible here that Aristotle is explaining and justifying his own remarks on health and other medical topics that we find throughout the *Parva naturalia* and other texts.[21]

As for the medical authorities, Aristotle states that some adopt their principles from philosophical thought instead of deriving them solely from medical experience. This practice is attested and criticized by the author of the Hippocratic *On Ancient Medicine*, who names Empedocles as a prime example of an influential philosophical authority, and the hot and the cold as examples of theoretical principles co-opted from philosophy by the medical authorities he has in mind. Aristotle evidently sides with the criticized physicians, and although he does clearly demarcate between the two groups, at the same time he advocates a certain reciprocal exchange of ideas between them.[22]

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and most experts in physical training agree that those who are to be good physicians or trainers must have a general knowledge of nature". In any case, it is noteworthy that the two adjectives refer to different styles of speech (Leigh 2013, 164–165, and Korobili 2022, 178), namely to the oral style (*kompsos*) and the written style (*periergos*), which clearly indicates that medical texts are considered a specific channel for the communication of medical knowledge.

17 *Resp*. 21, 480b22–30, tr. Lloyd (2003) modified.

18 On the relationship between medicine and natural philosophy, see Lefebvre (2019) and van der Eijk (2022, 1), who suggests that "Aristotle's engagement with health and disease was motivated, *inter alia*, by the idea that the best and most effective medicine is medicine built on the foundations of Aristotelian philosophy". See also van der Eijk (forthcoming).

19 *Long*. 464b30–33, trans. Hett (adapted): "We have previously discussed sleep and the waking state, and later on we must speak of life and death, and similarly of disease and health, as far as they appertain to natural philosophy".

20 Cf. Johnson (2012) 107; Nutton (2004) 120, 356 n. 35.

21 Van der Eijk and Hulskamp (2010) 65.

22 Cf. Mihai (2016), Bartoš (2021b) and Kouloumentas-Stavrianeas (in this volume).

Despite the various special problems associated with these two passages and the multiplicity of modern interpretations, we may reasonably conclude that in both of them Aristotle strongly encourages his students and readers to pay attention to contemporary medicine and especially to medical theories and principles. And unless one was born to a medical family or studied in a medical school (such as the one at Cos), the most convenient way to do so was to study medical literature. This brings us to the so-called "Hippocratic Corpus", the main body of medical literature from the Classical period.

2 Hippocrates, Hippocratic Writings and the "Hippocratic Question"

Hippocrates, the founder of the medical school at Cos, was the most celebrated and respected Greek physician of the Classical period.[23] Although we have no reliable evidence that Hippocrates himself put down any of his ideas or observations in writing, a number of medical texts or accounts almost certainly circulated under his name as early as in the fourth century, if not before. According to Galen,[24] Ctesias of Cnidus had already reproached Hippocrates for his method of setting a dislocated hip, attested in the Hippocratic *On Joints*. Plato mentions Hippocrates' method of investigating nature as a widely known procedure in the *Phaedrus* (270c1–5), which may refer to passages in the Hippocratic *On the Nature of Man*,[25] *On Ancient Medicine*,[26] *On Regimen*,[27] or in *Airs, Waters, Places*.[28] According to the *Anonymus Londinensis*, Aristotle produced a detailed account of Hippocrates' theory of the causes of diseases, and the detail

23 Regarding Aristotle's family background and personal connections with the Macedonian court, it is worth noting that Hippocrates and his family also had close professional relationships with the kings of Macedonia. If we can believe tradition (see Galen *Commentary on Hippocrates' Nature of Man*, prooem., and Suda s.v. Hippocrates [III and IV]), the first ties were made between Hippocrates and the Macedonian king Perdiccas II (448–413). Hippocrates had two sons, Thessalus and Dracon, and both followed in their father's footsteps. Thessalus was physician to Perdiccas' successor Archelaus (413–399), and Dracon's son Hippocrates was physician to Roxane, the wife of Alexander the Great (336–323). Cf. Jouanna (1999) 45.

24 Galen, *Hipp. Art.* 4.40 (18a.731.9 K.).

25 Galen, *HNH*, prooem. (15.4–5 K. = Mewaldt 4.19–5.9).

26 Littré (1839) 295–320.

27 Smith (1979) 44–60, rejected by Mansfeld (1980) and Lloyd (1991), reiterated in Smith (1999). For similar views, see also Hutchinson (1988) 23, Cooksey (2010) 46, van der Eijk (2004) 188.

28 Mansfeld (1980). Vegetti (1965) 44–46 considers both *On Ancient Medicine* and *Airs, Waters, Places* to be the Hippocratic theory reflected by Plato. See also Bartoš (2020).

provided in the *Anonymus Londinensis* closely corresponds with the account in the Hippocratic *Breaths*.[29] Finally, Aristotle's contemporary Diocles of Carystus criticizes Hippocrates for having admitted three kinds of fever in addition to the four traditionally recognized,[30] a criticism that most likely refers to the first book of *Epidemics*.[31]

This early evidence suggests that some medical texts ascribed to Hippocrates circulated in Plato's and Aristotle's time, although, as van der Eijk has noted, "one gets the impression that disagreement or confusion about the precise teaching of Hippocrates existed already in the 4th c."[32] And it is perhaps this initial confusion about the authorship that paved the way for the existence of various collections of Hippocratic texts in the following centuries. The earliest evidence for a collection of texts attributed to Hippocrates comes from the early Hellenistic period, and the evidence grows over time. Bacchius of Tanagra, a disciple of Herophilus of Alexandria and a commentator and glossator of Hippocrates, attests about twenty texts attributed to Hippocrates. Three centuries later, Erotianus mentions about forty,[33] and the 1526 Aldine edition (as well as most subsequent editions, including Littré) consist of 60 or so treatises.

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29 In the second part of the papyrus, the anonymous author draws on a Peripatetic doxographic source, identified in the text with Aristotle (*Anon. Lond.* 5.35–6.18 and 6.31–44 = Manetti 10–12 and 12–13). On the basis of Galen's *HNH* (15,26–16,11 K.), Plutarch's *Quaestiones convivales* (733c9 Hubert), and testimonies about the doxographic work *Iatrikē sunagōgē* (also called *Menoneia*) by Aristotle's pupil Meno, it is commonly assumed that the author of the papyrus draws on this particular text. Yet, as Manetti (1999, 98–99) and van der Eijk (2022,15–18) argue, it is no less possible that the second part of *Anon. Lond.* reports on Aristotle's lost doxographical account of the views of earlier writers on the causes of health and disease announced in the passages from the *Parva naturalia* (and also *Part. an.* 2.7 653a8–10). "As Aristotle repeatedly says […], health and disease are the business not only of the doctor, but also of the natural philosopher, at least up to the point of discussing their causes or principles. The latter is exactly what the doxography in *Anonymus Londiniensis* is about" (van der Eijk 2022, 18). See van der Eijk (2012) and (forthcoming) and Camden (2023) 92–104.

30 Diocles of Carystus (fr. 55b van der Eijk).

31 Jouanna (1999) 61. Van der Eijk (2016, 25 n. 17) holds the contrary view that the explicit reference to Hippocrates in fr. 55b "is very likely to be a later doxographical construction and cannot be used as evidence that Diocles was familiar with Hippocrates or regarded *Aphorisms* 2.34 as 'Hippocratic'". See also van der Eijk (2001) 121–122.

32 Van der Eijk (2016) 25.

33 For the complicated and rather obscure history of these early collections, see Roselli (2000), Alexander (2007), Pöppel (1959), and Beccaria (1959, 1961, and 1974). It should be noted that these collections provide variations of the corpus that vary significantly among themselves and that there are no common treatises attested in all of them. Concerning Hippocratism in antiquity and the various roles 'Hippocrates' played in ancient medical discussions see Manetti (2014). See also Perilli in this volume p. 27, n.3.

In other words, the Hippocratic Corpus is the final product of a long process of canonization with a strong accretive tendency, which gradually absorbed practically all extant non-fragmentary medical literature from the Classical period.[34] Nutton goes so far as to conclude that the Hippocratic Corpus as we know it "is a renaissance construct".[35]

Modern editions often claim that they represent a 'complete' collection of the Hippocratic texts, such as Littré's *Oeuveres complètes d'Hippocrate*. However, this assertion needs qualification. "From the Early modern period onwards," explains van der Eijk, the claim to completeness (*opera omnia, œuvres complètes*) seems meaningful only in the practical sense of "comprising all extant works that are known to have, at some stage of their transmission, been attributed to or associated with Hippocrates … regardless of when, by whom, on what grounds and with what justification, these attributions were made".[36] Moreover, even these allegedly 'complete' collections are selective and do not include all texts that have been preserved under Hippocrates' name. For instance, Littré's *Oeuvres complètes* does not incorporate *Testamentum* and some of the so-called *Letters*.[37]

In any case, the majority of the texts included in modern Hippocratic collections can be dated within Hippocrates' lifetime (i.e. between the middle of the fifth and the beginning of the fourth century BCE). Some may be even older (such as *Epidemics*),[38] and others evidently came later, i.e., from the Hellenistic and later periods, such as *On the Heart*, *On Decorum*, *On the Physician*, and *Precepts*.[39] Even if we exclude from consideration all post-Aristotelian texts, the diversity of the Hippocratic writings and the variety of their (often conflicting) views and theories makes it quite impossible for all of them to have been

34 Cf. Craik (2015) xxiii: "The argument that equal weight ought to be accorded to surviving medical material that falls outside the Aldine edition of 1526—and it is undeniable that some works in contention did not make it into the earliest published collections—is at first sight appealing; but the fact remains that other extant material is, by comparison with the works in the recognized Corpus, sketchy and largely confined to titles or fragments." See also van der Eijk (2016) 26 n. 19: "No strictly medical texts from the 5th and 4th c. survived beyond the 'Hippocratic writings' ".

35 Nutton (2008) 174.

36 Van der Eijk (2016) 22–23 n. 10.

37 E.g., *Epistola ad Ptolemaeum regem de hominis fabrica* (Ermerins 1840/1963, 278–297), *Epistula ad Ptolemaeum regem* (Boissonade 1931, 422–428). For a critical edition of the *Testamentum*, see Sideras (2006) and Jouanna (2011).

38 Cf. Lane Fox (2020) who argues on historical and epigraphical grounds that *Epid.* 1 and 3 were written as early as 470 BCE.

39 For approximate dating of the individual Hippocratic texts, see Jouanna (1999) and Craik (2015).

written by a single author or even a group of authors within one school. Accordingly, Littré, for instance, believed that only 11 out of the 60 or so treatises can be ascribed to Hippocrates himself.

The so-called Hippocratic question regarding whether or not Hippocrates wrote these texts stretches back to antiquity. Galen already distinguished between authentic and inauthentic Hippocratic texts according to his "thoroughly subjective notion of what was worthy or unworthy of Hippocrates".[40] He even devoted an entire treatise to the topic (*On the Authentic and Illegitimate Writings of Hippocrates*), which unfortunately has been lost. Modern debate on the issue practically ceased during the second half of the twentieth century, with a number of scholars independently coming to the conclusion that none of the Hippocratic writings can with reasonable certainty be ascribed to Hippocrates.[41] Accordingly, "statements prefaced by 'Hippocrates said …' or 'Hippocrates knew …', all too common in general writings about early medicine, are fundamentally misplaced", as Craik concludes.[42]

This scepticism gives rise to a new dilemma. The roughly sixty medical texts in the Hippocratic Corpus have little in common (apart from their Ionian dialect and interest in medicine, diseases, or therapy)[43] and none of them can

40 Jouanna (1999) 62.

41 Cf. Mansfeld (1983), Joly (1983), Scarborough (1988), Lloyd (1991) 194–223, Craik (2015) xxi–xxiii.

42 Craik (2015) 286. On the other hand, the fact that there is no consensus on the Hippocratic authorship of any of the medical texts does not resolve the Hippocratic question or preclude speculations about authorship. As Craik (2015, 289) put it, "it would surely be strange if Hippocrates were to be completely absent from the corpus given his name". In the concluding paragraphs of her book, Craik (2015, 289–290) reiterates a handful of candidates: "The case for *On Fractures* and *On Joints* is strong […] At the same time, the case for Hippocratic authorship of *Prognostic* is similarly strong […] However, attention must be paid to the valuable early testimony of the *Menoneia* (the *Anonymus Londinensis* papyrus) which, with some Aristotelian authority, seems to suggest Hippocratic authorship for *On Winds*. And again, the views expressed by Plato in *Phaedrus* have seemed to indicate Hippocratic authorship for *On Regimen* […] It is plausible to suppose that the compiler of *On the Nature of Bones* was (one of the writers) responsible for (parts of) *Epidemics*, perhaps Hippocrates himself."

43 It should be noted that despite the lack of integrity across the whole corpus, there are numerous similarities and commonalities between the individual texts, which in some cases allow us to assume a single author for multiple treatises (e.g. *Nat. hom.* and *Salubr*; *Fract.* and *Artic.*; *Aer.* and *Morb. Sacr.*; *Genit.*, *Nat. Pue* and *Morb.* 4) or to identify several groups of texts relating to a more or less clearly delimited area of expertise. For instance, Craik (2015) 287 distinguishes texts on scientific principles, on anatomy and physiology, on nosology, pathology and therapy, on surgery, on cases and signs, on gynaecology and embryology, and on guidance and ideals.

be definitively ascribed to the historical Hippocrates. Yet, outside the Hippocratic Corpus, practically no other medical literature of the Classical period survives:[44] there is no 'non-Hippocratic' medicine. Why then should we even speak about 'Hippocratic' medicine, or 'Hippocratic' physicians, accounts, and ideas?

Two different approaches have been suggested by two leading Hippocratic scholars, J. Jouanna and P. van der Eijk. Jouanna presents a rather conservative approach that acquiesces in the traditional ambiguity as follows:

> And without wishing to ignore these differences and contradictions, we may speak from now on of the 'Hippocratic physician' in the broad sense of the phrase—indeed, for the sake of convenience, of 'Hippocrates'—without thereby prejudging the question of authorship. The name Hippocrates signifies in fact two things. It signifies, first of all, Hippocrates the historical figure. But it also stands for the work that has been bequeathed to us under his name. For as long as this collection of medical manuscripts has been known, this ambiguity in the use of the name has been constant. It cannot really be gotten away from. The essential thing is that we are aware of it.[45]

Van der Eijk, by contrast, proposes a more radical solution and recommends discarding the term 'Hippocratic' and replacing it with less potentially misleading phrases such as 'Classical Greek medicine', or 'fifth and fourth centuries Greek medicine'.[46] This applies equally in the case of the Hippocratic Corpus:

> Rather than continuing to refer to the 'Hippocratic Corpus', I would argue that the Hippocratic body needs to be dismembered in order for the individual texts to be properly contextualized and historicized and, eventually, regrouped in new mappings. That, I suggest, is one of the major challenges facing current Hippocratic scholarship.[47]

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44 As for other extant texts that are not included in the Hippocratic corpus but may perhaps be included among medical literature preceding or contemporary with Aristotle, we should also consider Plato's *Timaeus* and Theophrastus' *On Sweats*, *On Fatigue*, and *Inquiry into Plants*, book 9. See van der Eijk (2016).

45 Jouanna (1999) 71.

46 Van der Eijk (2016) 18.

47 Van der Eijk (2016) 43.

Our approach in this volume adopts a kind of middle position. In line with tradition, our contributors retain the adjective 'Hippocratic' in their references to individual texts of the Hippocratic Corpus, their authors and ideas. On the other hand, they avoid Hippocrates' name on such occasion, except for references to the historical physician. The only exception is the title of this volume, where we take the liberty of using Hippocrates' name in a general sense as a shorthand description of medicine and physicians preceding and contemporary with Aristotle.[48] In any case, with the exception of Perilli in the first chapter (p. 27–30) none of our contributors directly address the Hippocratic question in terms of the authorship of the medical writings or the unity of the Hippocratic Corpus in general. It is rather the individual texts themselves and their content that form the focus of attention.

3 Aristotle and the Hippocratic Writings

The idea that Aristotle was "an attentive reader of Hippocrates", as Jouanna puts it,[49] goes back to Galen, who took for granted that, in some of his theories and accounts, Aristotle drew on the very same medical sources and authorities that Galen was familiar with under Hippocrates' name. And since Galen believed that at least some of the texts were written by Hippocrates himself, he called Aristotle an "interpreter of Hippocrates' reasoning on nature".[50] As for Hippocratic texts, given the fact that most of them can be dated before Aristotle, it is highly likely that at least some of them were already circulating in Plato's Academy and Aristotle's Lyceum.[51] Accordingly, assuming that Aristotle, together with his colleagues and students, paid considerable attention to medical theories and their written accounts, the question arises as to whether they read and discussed the very same medical texts that we read today. Provid-

48 About this and other simplifications and ambiguities concerning our title, see the discussion by Perilli in chapter one.

49 Jouanna (1999) 231. See also van der Eijk (2012), who asks: "Comment Hippocrate était-il vu, et lu, par Aristote?" On the basis of the evidence in *Anonymus Londinensis*, he argues that Aristotle "read" the treatise *On Breaths* and regarded it as having been written by Hippocrates.

50 Galen, *Meth. Med.* 1.2.14–16. The whole passage is quoted and commented on by Perilli (see below, p. 31)

51 Craik (2015) xxiii. Regarding the Hippocratic texts most likely to have been known to Aristotle, van der Eijk (2012, 1520 and 2022,10, n. 26) suggests the following works: *Nat. Hom.*, *Aph.*, *Epid.* 2, 5 and 7, *Loc. Hom.*, *VM*, *Morb.* 2, *Genit. Nat. Pue. Morb.* 4, *Vict.*, *Flat.*, and *Aër.*

ing an overarching answer, however, is impossible: the question can only be approached in relation to individual texts.

Two significant quotes in Aristotle's *Hist. an.* 3 may suggest that the most likely candidates for such texts are *On the Nature of Man* and *On the Nature of Bones*. Aristotle quotes at length two distinguished medical authorities to demonstrate that they are both wrong about the origin of blood vessels in the human body, for they both make the head (instead of the heart) the starting point of the system of vessels. The first account of vessels is ascribed to Syennesis, "the physician from Cyprus", (*Hist. an.* 3.2, 511b25–30), and the second one to Polybus (*Hist. an.* 3.3, 512b10–513a8). Both of these accounts happen to be found in the Hippocratic *On the Nature of Bones* (chap. 8 and 9). Yet the possibility is weakened by the fact that the first part of the treatise (chap. 1–10) consists of a series of disjointed passages on various anatomical questions that the author may well have gathered from other sources. One possible source is *On the Nature of Man*, which in chap. 11 introduces the very same account of vessels that Aristotle ascribes to Polybus.[52] Accordingly, it seems possible that both Aristotle and the author of *On the Nature of Bones* copied this specific account from *On the Nature of Man*, a highly original work that introduces the theory of four humours and which can also be ascribed to Polybus on the basis of the evidence in *Anonymus Londinensis*.[53] On the other hand, one cannot exclude the possibility that the author of *On the Nature of Man* also borrowed this passage from some earlier source.[54] In any case, it is likely that the Hippocratic versions of the second passage preserve the original wording of this authoritative medical *endoxon*, for they are much closer to one another than to Aristotle's citation.[55] Di Benedetto has observed that there are suggestive discrepancies between the Hippocratic versions and Aristotle's report and that Aristotle may have made deliberate changes in his transcription.[56] It is also

52 Cf. Jouanna (1968) 55: "Only two generations separate Aristotle from Polybus, and one can reasonably think that Aristotle, son of a doctor and himself passionate about medicine, had in his hands the work of Polybus."

53 The author of the papyrus ascribes the theory of the four humours (cf. *Nat. Hom.* 3–4) to Polybus (*An. Lond.* 19 = Manetti 49.11). Yet in his report on Aristotle's views, another passage from *Nat. Hom.* 9 (*An. Lond.* 7 = Manetti 15.15–32) is quoted and attributed to Hippocrates. Cf. Ricciardetto (2014), van der Eijk (2012), and Manetti (2011).

54 According to Galen (*HNH*, prooem. 15.9–11 K = Mewaldt 7.15–8.18), the treatise consists of many textual units stitched together. See Perilli below, p. 61 who argues that *Nat. hom.* exemplifies "the case of medical works consisting of originally separate textual units, possibly used by different authors and adapted to different contexts".

55 Perilli (2009) 97.

56 Di Benedetto (1972) 233.

significant that Aristotle omits the last ten lines of the account, which do not relate directly to the point at hand, and that he modifies the initial qualification of the report.[57] Accordingly, despite the fact that the extant evidence does not allow us to conclude with certainty that Aristotle quoted directly from one or the other of these two particular Hippocratic treatises, it does indicate his serious engagement with (and criticism of) authoritative medical accounts. In some cases, as in the two passages discussed so far, such accounts are taken into consideration as authoritative sources in terms of evidence or theory that needs to be supplemented and refined by Aristotle's own observations and arguments. In other cases, however, medical *endoxa* are mentioned anonymously alongside opinions of pre-Socratic philosophers and other thinkers relevant to Aristotle's accounts. Occasionally, conceptions and terminology of medical origin are adopted and tacitly integrated into Aristotle's own expositions.

As for modern discussions of this evidence, Littré recognized numerous significant parallels between the Hippocratic texts and Aristotle's writings in the preface to his critical edition, and even concludes that they share "the same doctrines, same hypotheses, same details".[58] A few decades later, Poschenrieder listed over 30 passages in Aristotle's biological works that he thought bore the traces of Hippocratic influence.[59] Yet the proposed similarities with Hippocratic texts have been rejected by Fredrich and Balme on the basis that they represent mere "commonplaces".[60] Some have evinced a more extreme scepticism by concluding that Aristotle was "apparently unacquainted with the Hippocratic writings" and simply "not interested in medicine".[61] Nevertheless, since the pioneering work by Poschenrieder, the relevance of Hippocratic texts to Aristotle's zoological works has been revisited more systematically by Byl and Oser-Grote, who collected hundreds of passages containing correspondences between Aristotle and the Hippocratic writings, and took these to reflect Aristotle's dependence on these particular texts.[62] Yet Oser-Grote has emphasized the lack of direct quotations from the Hippocratic writings and proposed

57 Both Hippocratic versions of the 'Polybus' account start with a qualification that what follows concerns "the widest of the vessels (*hai pachytatai tōn phlebōn*)", while Aristotle presents it as an account of vessels without qualification (*tōn phlebōn*), cf. Althoff (1999) and Perilli (2009).

58 Littré (1839) I.73.

59 Poschenrieder (1887).

60 Fredrich (1899), Balme (1987a) 16, (1991) 10. Similar positions are defended by Anastassiou and Irmer (2006) as well as Perilli in chapter one.

61 Fredrich (1899) 78–79, Sarton (1952) 537, 561.

62 Byl (1980), Oser-Grote (2004).

that we should more accurately speak of a "relaxed dependence". In addition to these comprehensive accounts, dozens of more specialized studies have been published (especially in recent decades) arguing for significant Hippocratic influence on Aristotle's discussions of the vascular anatomy, the relationship between philosophy and medicine,[63] the nature of elements and their attributes,[64] the concepts of teleology and spontaneity,[65] the various aspects of the generation of animals,[66] issues concerning dietetics, food, and health,[67] as well as sleep and dreams,[68] and other topics pertaining to the philosophy of nature.[69] In other areas of Aristotelian studies, the relevance of the Hippocratic literature to Aristotle's ethical writings has recently been discussed by a number of authors.[70]

Despite these developments and the considerable amount of evidence adduced to support the idea that Hippocratic texts provide unique and invaluable evidence for natural science (and other fields of knowledge) prior to and contemporary with Aristotle, scepticism has remained in some quarters, especially from those who argue that Aristotle's biological research reflects a categorically more sophisticated level of scientific methodology than medicine. Edelstein, for instance, claimed that "if one holds that biological research culminated in Aristotle's philosophy, one must realize that the concept of the organism which acts according to purpose was the discovery of the philosopher Aristotle". His conclusion was that, in this case, "the assumption of an influence of Greek medicine on Greek philosophy must be regarded as historically incorrect".[71] Several decades later, Richard Owen flamboyantly declared in favour of Aristotle's achievements and originality that "zoological Science sprang from his labours, we may also say, like Minerva from the head of Jove, in

63 E.g. Mihai (2016), van der Eijk (2012), Althoff (1999), Longrigg (1995).

64 E.g. Mirrione (2021), Popa (2021) and (2014), Betegh (2020), Macfarlane (2020), Lefebvre (2018) 286–300, Mihai (2016), Chiaradonna (2013), Cambiano (2012), van der Eijk (2012), Rashed (2005), Demont (2005), Lombard (2004), Althoff (1992), Longrigg (1993), Vizgin (1980).

65 E.g. Craik (2017), van der Eijk (2017), Johnson (2012), Bartoš (2010).

66 Dean-Jones (2023), Connell (2016), Louguet (2015), Dean-Jones (2012), van der Eijk (2007), McGowan Tress (1999), Coles (1995).

67 E.g. Wilkins (2015), Bartoš (2015) and (2021a), Korobili (2022).

68 Van der Eijk (1995).

69 E.g. Camden (2023), Cheng (2018) and (2015).

70 E.g. Francis (2011), Hutchinson (1988), Tracy (1969), Lloyd (1968), Jaeger (1957), and Wehrli (1951). Connections with Aristotle's *Politics* were discussed by Jouanna (1980) and Schütrumpf (2005), and with *Poetics* by Janko (1992).

71 Edelstein (1967) 354.

a state of noble and splendid maturity", implicitly denying the scientific significance of medical knowledge prior to Aristotle.[72] And most recently, Lennox, who quotes Owen's witticism in his entry "Aristotle's Biology" in the *Stanford Encyclopaedia of Philosophy*, states that Aristotle is properly recognized as the originator of "the scientific study of life" despite the fact that "many earlier Greek natural philosophers occasionally speculated on the origins of living things and much of the Hippocratic medical corpus, which was written before or during Aristotle's lifetime, displays a serious interest in human anatomy, physiology and pathology."[73] Before Aristotle, Lennox explains, "only a few of the Hippocratic treatises are both systematic and empirical, and their focus is almost exclusively on human health and disease". Accordingly, no medical evidence is taken into consideration in Lennox's account of Aristotle's biology.

In light of this state of affairs, with enthusiastic proponents offset by radical sceptics, our volume intends to reassess the relevance of medical knowledge and literature to Aristotle. More specifically, we aim to revisit some of the previously suggested parallels and correspondences between Aristotle and the Hippocratic writings, as well to adduce new evidence and topics. Ultimately, we would like to encourage future research in this specific area of study at the crossroads between Aristotelian studies and the history of ancient medicine, a field that has flourished remarkably in recent decades and yet remains far from being exhaustively explored. Rather than presenting a systematic survey of previously published work, our volume provides a series of new case studies, each focusing on a specific discussion within the Aristotelian Corpus for which we have identified some potentially relevant precursors in the medical literature. Each of these studies focuses on a different set of texts and draws different conclusions.

In the opening chapter, Lorenzo Perilli critically examines the very title of our volume, *Aristotle reads Hippocrates*, and asks three crucial questions: what is meant by 'Aristotle', what is meant by 'Hippocrates', and what is meant by 'reading and writing' medicine in classical Greece? These three questions are explored in several steps, in which Perilli shows that neither Aristotle nor Hippocrates can be taken simply as names of concrete historical figures and that in making any claims about their relationship, one must take into account the various ways in which they can be approached and studied (e.g., Aristotle as the author of works intended for publication, Aristotle as the author of the lec-

72 Owen (1992) 91.
73 Lennox (2021).

tures, notes, and drafts which later served as the basis of the extant writings, Aristotle of Aristotelianism, etc.). He further examines the complicated nature of medical texts, their authorship, and the process through which the Hippocratic corpus was collected. Also, in order to understand how Aristotle could have 'read' Hippocrates, we need to take into account Aristotle's methodology and especially the way he works with his sources. After considering all these methodological and contextual issues, Perilli concludes that Aristotle's interest in medical knowledge proper was functional to his more general philosophical ideas. What interested Aristotle was not so much the detailed observations and technical expertise of medical texts of the extant *CH*, but rather the speculative synthetic perspective, which is rarely found in medical accounts. Accordingly, he classifies medicine as an applied and subordinate practice. Perilli is sceptical about any direct influence of the medical texts on Aristotle, instead suggesting that most of the parallels can be explained by reference to shared common knowledge among the educated or to common (but no longer extant) sources.

In the second chapter, Hynek Bartoš analyses the concept of a well-balanced mixture (*syn*/*krasis*), according to which human and animal bodies need to retain a kind of balance among their elemental constituents in order to remain alive and healthy. Contrary to the usual assumption that this notion was common to all Greek medicine and could already be found among pre-Socratic philosophers, Bartoš argues that the concept originated in the second half of the fifth century BCE amidst discussion of the principles of dietetics, a relatively new and progressive branch of medicine. Having identified the dietetic origins of the idea, Bartoš tracks its history in Plato and Aristotle. He shows that Plato experiments with the medical concept and thus introduces it into philosophical discourse, while Aristotle employs it with full confidence and in conformity with the Hippocratic accounts and elaborates on it in his discussions of health, procreation, sensation, intelligence, and other key concepts of his philosophy of nature.

In the third chapter, Stavros Kouloumentas and Stasinos Stavrianeas offer a detailed discussion of some key themes of *On Ancient Medicine* such as the nature and constitution of bodily parts and the method of studying them, as well as Aristotle's contribution to these topics. The authors show that, even though *On Ancient Medicine* is never referred to by Aristotle, there is a strong affinity between the two approaches to the problems discussed. For instance, both the 'Hippocratic' author and Aristotle criticise Empedocles and other medical and philosophical authors, and their criticism is based on similar grounds: the crucial point is to understand how the structures of a living being are interrelated to its functions rather than how it was shaped. Moreover, it

seems that in some instances Aristotle supplements or revises the analysis of *On Ancient Medicine*. This indicates that Aristotle was engaged in dialogue with thinkers who shared the views articulated in the 'Hippocratic' treatise, if not with the text itself.

In chapter four, Sean Coughlin focuses on Aristotle's use of the phrase "art imitates nature". He challenges Jaeger's teleological interpretation of the phrase and defends the claim that, for Aristotle, it does not express a novel belief about teleology, but a belief common to Aristotle and his predecessors about how artistic methods of production were first discovered and how arts progress. Coughlin traces the history of this belief from early Greek medical writings through Democritus and Plato to Aristotle. He shows that by looking at how early Greek medical and philosophical writers understood discovery and progress in the arts, we can better understand Aristotle's expectations for a scientific investigation into nature and what motivated the method of inquiry he claims the natural scientist should adopt. One advantage of this approach is that it accounts for resemblances among Aristotle's claim and similar ones in other writers, from Democritus to Dante.

In the fifth chapter, Claire Bubb discusses Aristotle's account of sleep and its relation to other philosophical and medical thought of the 5th and 4th centuries. Bubb pays special attention to the fact that while previous philosophers had linked sleep with heat and blood, in Aristotle's explanation of sleep and waking it is digestion that plays a critical role. Bubb shows that there was a wide range of medical authors who closely associate the processes of sleep and digestion, and that all basic elements of Aristotle's theory of sleep as a digestive process were already present in the medical thinking available in his day. Even though Aristotle develops and modifies the physiology relevant to the explanation of sleep, his discussion of sleep and digestion remains remarkably consistent with the medical tradition.

In the next chapter, Sophia Connell focuses on the overlaps between the ancient medical works on women's health and Aristotle's discussion of these topics in the *Generation of Animals* and book 7 of the *History of Animals*. After discussing Aristotle's methodology of natural science, she identifies a tension in Aristotle's reproductive science, in that humans are both paradigmatic and exceptional. Connell demonstrates that in his general theory of sex difference and reproduction, Aristotle focuses on medical debates which concern only humans and which he extends to all animals. She also discusses contrasts as well as similarities with medical experts in Aristotle's view of women's pathological condition. While certain characteristics of women are open to reasonably straightforward Aristotelian explanations, others are more problematic and seem to indicate the strong influence of a medical framework.

Aristotle's indebtedness to medical authors in the area of conception and pregnancy is further explored by Mariska Leunissen in chapter 7, focusing on a specific gynaecological phenomenon called wind-pregnancies. Leunissen argues that Aristotle's accounts of this phenomenon in the *History of Animals* and *Generation of Animals* rely heavily on specific facts and opinions found in the Hippocratic *On the Nature of the Child* and *Airs, Waters, Places*. Despite Aristotle's affirmation of the epistemological authority of women concerning the timing of conception, Leunissen demonstrates that his main source of knowledge of the facts concerning *gunaikeia* were the medical experts writing about these issues rather than women themselves.

Giouli Korobili discusses correspondences between the Hippocratic *On Generation* and *On the Nature of the Child* (written most likely by a single anonymous author), and Aristotle's *On Youth and Old Age, On Life and Death*, and *On Respiration* (taken as one continuous account). She argues that Aristotle knew the contents of the two medical texts "in a form close to what has come down to us today", and that he paid special attention to them due to the fact that the author combined medical knowledge with topics, ideas, and examples which pertained to the field of natural philosophy. Thus, both the Hippocratic and Aristotelian texts illustrate the exchange of ideas between medicine and natural philosophy, two kindred yet theoretically demarcated fields of knowledge.

Tiberiu Popa explores environmental causation in Aristotle: the way in which animals are influenced by interaction with their habitat. Even though Aristotle's approach to the nature of particular species predominantly relies on concepts such as essence, form, and function, he also discusses the way in which determinants such as climate, location, and exposure to winds influence physical structure, biochemical mixtures, longevity, and other features. These environmental explanations can supplement those based on essential features. Popa adduces evidence that environmental explanations owe much to early medical theories and, particularly, to ideas present in the treatise *Airs, Waters, Places*, where environmental explanations are central. Popa discuses similarities and differences between the way in which the Hippocratic author and Aristotle deploy environmental explanations. Through this analysis, Popa offers a tentative answer to the question of whether Aristotle actually read *Airs, Waters, Places*. Popa concludes that while Aristotle was indeed acquainted with the main causal explanation offered in the Hippocratic text, it cannot be determined with certainty whether or not he had direct access to the text.

Karel Thein focuses on Aristotle's *Politics* 7.7, which discusses the influence of climate on humans as citizens. Thein shows that even though this passage is usually compared with Plato's *Republic* 4.435d–436a, the Hippocratic treatise *Airs, Waters, Places* seems to be a prominent source for Aristotle's argument.

Thein demonstrates that the opposition between spirit (θυμός) and intellect (διάνοια) in *Pol.* 7.7. corresponds closely to the Hippocratic text. Yet despite these similarities, there are also differences due to the specific context of Aristotle's political science. Hippocratic biological theory is thus used (and simplified) by Aristotle in order to support his political theories, which Thein also illustrates in his discussion of natural slavery in *Pol.* 1 and the passages in *Pol.* 7.7 and *Airs, Waters, Places*.

The role of medicine and physicians in Aristotle's political science (including both ethics and politics) is further explored by Pierre-Marie Morel in chapter 11. Morel attempts to make sense of Aristotle's references to medicine and physiology in his ethical and political works and argues that, although knowledge about the natural world is important for political science, it does not follow that ethical assertions epistemologically depend on natural science. Morel demonstrates how medicine and physiology supply Aristotle's political science with objective facts about human life and nature without requiring him to accept the particular explanations of these facts by the physicians and *physiologoi*. In other words, although it is crucial for politicians to take into consideration the physiological aspects of moral states, neither medicine nor physiology can provide them with practical solutions or prescriptions for the political and ethical spheres.

Monte Ransom Johnson explores Aristotle's definition of moral virtue as a mean state in book 2 of the *Eudemian Ethics*. He observes that in discussing the definition of moral virtue, scholars usually neglect *Eudemian Ethics* and focus solely on *Nicomachean Ethics* and so overlook the inductive form of argument in the *Eudemian Ethics* passage. In focusing on the inductive form of the argument, however, the reader may notice that Aristotle uses examples from arts and sciences such as gymnastic training and medicine. Yet neither in *Eudemian Ethics* nor in any other extant work does Aristotle supply or discuss the evidence that makes these inductive arguments clear. Monte goes on to establish that this evidence can be identified in certain Hippocratic texts, mainly *On Ancient Medicine* and *On Regimen*. He thus illustrates the influence of medicine on Aristotle's philosophy in general and on his ethics in particular.

In the concluding chapter, Chiara Thumiger explores the relationship between medicine and the emotions. While the usual source for the study of emotions in Aristotle is his *Rhetoric*, she focuses rather on *Problemata*, a text that not only differs from *Rhetoric* in its understanding of the emotions, but is also in many places more akin to what Hippocratic authors had written on the subject. The chapter thus enhances our understanding of the way in which Aristotle (or rather his school) read medical authorities. Through numerous examples, Thumiger sheds light on the way in which the author(s) of *Problem-*

ata approached their Hippocratic predecessors: details and experiences from clinical observations are used, developed, and expanded in relation to the emotions. At the same time, *Problemata* deals with much broader psychological territory, including more complex emotions and their bodily manifestations. In drawing upon the medical material to investigate the emotions, *Problemata* thus offers a complementary approach to the socio-cognitive view on emotion in *Rhetoric*.

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CHAPTER 1

On Aristotle's Use of His Sources for Medical Ideas and Their Features

Lorenzo Perilli

Aristotle reads Hippocrates is a fascinating title. In three words, it poses three decisive problems. What is meant by 'Aristotle', and what is the nature of the writings referred to by this name? What is meant by 'Hippocrates', a name that lingers on undefined? And what is meant by 'reading'—and therefore 'writing'—medicine in classical Greece? This paper will consider certain features of Greek medical texts in the Hippocratic Corpus, especially the more technical ones, whose legacy has often been detected in 'Aristotle', as well as some distinctive features of Aristotle's texts, especially *Hist. an.* We will furthermore examine Aristotle's working method as described by himself, and consider his lost works on medicine and animals (*iatrika* and *zoika*) as listed in ancient catalogues, including their possible structure. Finally, the paper will seek to explain the 'variations within similarity' that characterize the relationship between Aristotle and the still extant medical texts.

1 Introductory Remarks

1.1 *'Aristotle'*

The name 'Aristotle' has different connotations. (1) The definitive Aristotle—namely, the author of works intended for publication—being irrecoverably lost, we use the name to define (2) the author (or authors) of mainly records of lectures, notes and drafts gathered together and organised at a later point, sometimes by others; on the base of these extant writings, we draw conclusions and establish relations with other authors and works. (3) Later, the Aristotle of Aristotelianism passed through filters that adulterated the original contribution, as is the case of the collection of material known as *Problemata*, important as they are for the connections with medicine. (4) The Aristotle of the Anonymus Londiniensis, for all its relevance to our knowledge of ancient medical theories on the causes of diseases and names of medical authors, is an indirect, 'doxographic' Aristotle—an Aristotle by hearsay—requiring a specific approach in itself. Additional information is provided by (5) the Aristotle that

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emerges from the titles of his works, as preserved in the three ancient indexes (Diogenes Laertius, *Vita Menagiana*, Ptolemy el-Gharib): here, especially as regards those works of which nothing survives, we glimpse an Aristotle in silhouette, the breadth of whose interests was matched only by Democritus.

1.2 *'Hippocrates'*

The second preliminary problem concerns the identity of Hippocrates, the subject of important studies and conferences in recent years.[1] In this case, the issue is much simpler: Hippocrates, *as an author of the treatises of the CH*, does not exist. Not a single reliable element provided by the tradition can prove that a doctor named Hippocrates put his ideas or experiences into the writings we know. The two references in Plato, or the single mention by Aristotle, do not refute this matter of fact. Attributing to the father of medicine one or more of the treatises of the Corpus that bears his name is but an exercise in philological creativity and historical passion.[2] All we glean from the sources is that there was a well-known non-Athenian physician, an excellent doctor with a new approach, indeed a paragon—and only presumptively a writer of medical works. From both the classical and Hellenistic periods, no single passage, no single line can reasonably be attributed to the historical 'Hippocrates'. It was only at a later stage that the association of a number of works with that name-label coalesced to make a variegated reality uniform—as happened in the case of 'Homer' and others.[3] That the historical Hippocrates did indeed have his own ideas about medicine is beyond doubt; that he gave them a coherent written form, and that this form is preserved in the *CH*, cannot be proved. Acknowledging this fact facilitates a structural analysis of the works of the *CH*.

Consequently, the notion of 'Hippocratic doctrine', itself the result of *a posteriori* reasoning, likewise reflects a process of homogenization, a quest for identity among differences. Indeed, the authoritativeness of the name 'Hippocrates', if attributed to a theoretical nucleus among many, endows it with a primacy that is not justified by historical data. Many were the doctrines at stake.

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1 I mention here only the XIII International Hippocrates Colloquium, "Ancient Concepts of the Hippocratic" (2016), especially van der Eijk (2016); see also Perilli (2009); Witt (2022). Translations of ancient texts are my own unless otherwise stated. My thanks to Philip J. van der Eijk for his insightful remarks and criticism on an earlier draft of this paper.

2 For a recent example, see Lane Fox (2020), Part II, and Endnotes.

3 For some fruitful considerations about the origin of 'Hippocratism' between the IV and the III centuries BC and the construction of the Hippocratic Collection at Alexandria (including a reevaluation of the once familiar hypothesis according to which the personal library of some doctor from Cos might have constituted its original nucleus), see Manetti (2014).

In order to understand what, of the heterogenous miscellany called *Corpus Hippocraticum*, can be related to 'Aristotle', one must therefore clarify what this miscellany consists of. There is no need to delve into what is commonly accepted about the multiple and irreducible typology of the writings contained in the *CH*—their differences, writings intended for physicians or the more general public, collections of clinical cases and sophistic lectures, compilations and notes. More useful for our purpose is to recall the *uncertainties of chronology*—where a convincing case can be made for only a handful of works[4]—, and what I call *structural uncertainties*.

Such uncertainties in chronology and structure introduce a critical yet often underestimated element of instability in any attempt at establishing relationships. As to structure, it is essential to remember that there are very few works—and these the least interesting in relation to a possible connection with Aristotle, with the sole exception of *De aëribus*—for which a unitary structure and an author with a defined personality can be determined; much else, especially in the more technical fields, consists of assemblages of material from various origins, made no one knows when, from what, by whom, or for whom. We are often faced with *attempts at amalgamation*, with *blocks of text* more or less thematically related to each other, works with a *catalogue-structure*, occasionally supplemented, at some stage, by more or less sensible appendices.[5] The repetition of the same passages in different assemblages is particularly remarkable, as e.g. in *Epidemics* books 5 and 7. It is typically with these kind of texts that connections with Aristotle have been identified. A list of such works, as investigated by V. Langholf and others,[6] would contain at least:

1. De affectionibus
2. De anatome
3. Aphorismi
4. Coa praesagia
5. Epidemiae 5, 6, 7
6. De humoribus
7. De liquidorum usu
8. De locis in homine
9. Mochlicon
10. De morbis 1
11. De natura hominis
12. De natura muliebri

4 See Craik (2015).

5 See Langholf (2004) and (1989); Smith (1983); Perilli (2009).

6 See Langholf (1989) 67–73.

13. De ossium natura
14. Prorrheticon 1
15. Prorrheticon 2

For the incorporation of additional sections to pre-existing chapters, one can mention for instance:

16. Epid. 2 (e.g. 5.1–6.32 L.)
17. De morbis 3
18. De morbis 4
19. De morbis mulierum 1.92–109
20. De superfetatione
21. De victu acutorum (spurium),

but also works like

22. De carnibus chs. 15–19
23. De vetere medicina (chs. 20–24).

Other works like, for example, *On internal affections*, systematic and consistent as it is, are themselves the result of a reorganisation of catalogue material and a combination of sources.[7]

The list could be easily supplemented, and the useful descriptions by Craik (2015) facilitate the task.

With some important exceptions, I propose to extend and generalise Langholf's idea that many of the authors of medical texts now classified as 'Hippocratic' used to write on a single piece of writing material, i.e. they wrote a self-contained text unit on a sheet of papyrus or a tablet, which in turn may have been an excerpt either from their own earlier work or from someone else's text. Once copied, the boundaries existing between the original pieces of writing material (text carriers) disappeared, and can only rarely be identified today. According to Langholf, such texts might have been archive documents or files in which the scientific findings of doctors were recorded in order to be reused at a later point by someone else. Doctors acted as writers and excerptors at the same time, so that treatises might consist entirely or partially of a series of different texts, possibly written by different authors at different times.

The largest part of the works for which parallels between Aristotle and CH have been identified are technical writings, and they often fall into precisely those categories of composite works described above. Among works of the CH for which parallels have been identified in Aristotle are:

1. De aëribus aquis locis
2. Aphorismi

7 See Craik (2015) 140.

3. De articulis
4. De capitis vulneribus
5. De carnibus
6. Coa praesagia
7. Epidemiae 2
8. Epidemiae 5
9. Epidemiae 6
10. De flatibus
11. De glandulis
12. De humoribus
13. De internis affectionibus
14. De locis in homine
15. De morbis 1
16. De morbis 2
17. De morbis 4
18. De morbis mulierum
19. De morbo sacro
20. De natura hominis
21. De natura ossium
22. De natura pueri
23. De victu 1
24. De victu 2

especially for Aristot. *Hist. an.* 7:

25. De genitura
26. De morbis mulierum 1
27. De octimestri partu
28. De salubri diaeta
29. De sterilibus
30. De superfetatione.

It is no coincidence that many of these works fall into the typology that Langholf studied and are listed above.[8]

A partial answer to the 'Hippocratic problem' lies therefore in the concept of *fluidity*: *fluid texts* that, as such, make it very difficult to ascertain stable entities, mark out identities, and look for direct contacts. What can be established is that, as far as the possible connection of the *CH* with 'Aristotle' is concerned, a concept such as that of *influence* is inappropriate (see also below, 4.1 nr. 5).

8 More on this in Perilli (2024).

1.3 *Aristotle as Exegete of Hippocrates*

The direct link between Aristotle and Hippocrates is an ancient one. It was Galen who created an image that was to cast a long shadow. According to Galen, Aristotle is an ἐξηγητὴν … τῶν περὶ φύσεως λογισμῶν Ἱπποκράτους, someone who endeavoured to understand and follow up the reflections and reasoning of 'Hippocrates' on the natural world, and to appropriate Hippocrates' 'principles of physiology' (ἀρχὰς τῆς φυσιολογίας), i.e. the principles of the study of nature:

> Moving on, shall I now summon for you as a witness the other chorus, that of the Peripatos, which posits the principles of Hippocrates for natural science? (15) But of course I have also given evidence for this in other writings (δέδεικταί μοι δι' ἑτέρων ὑπομνημάτων) … Now, anyone who reads these writings will clearly see that *Aristotle is an interpreter of Hippocrates' reasoning on nature* (ἐξηγητὴν ὄντα τῶν περὶ φύσεως λογισμῶν Ἱπποκράτους Ἀριστοτέλη). (16) In particular, concerning *the variety of diseases* (περὶ τῆς τῶν νοσημάτων διαφορᾶς), how many and what kind (ὁπόσα καὶ ὁποία) they are, and the symptoms as well as the causes for one and the other, it appears that *Hippocrates*, first among all those of whom we know anything, *inaugurated this research* in a correct way, and that, after him, *Aristotle* interpreted it more than anyone else. Those willing to read the writings I have composed (ὑπομνήματά μοι γεγραμμένα) on each of these subjects will be informed about them as well. So that if indeed the Peripatetics sit as judges, Hippocrates will win, I think.
>
> (GAL. *Meth. Med.* I.2, 14–16, 20,14–22,11 Lorusso = X.14,15–15,17 K.)

Galen offers here an example of his idea of medicine and philosophy in the classical age: a framework of interactions, with 'Hippocrates' at its core, and with Plato, Aristotle, the Stoics and others drawing on him for both the material on which to reflect and the questions to be answered. Rather than making Aristotle a 'disciple', or the heir, of Hippocrates, Galen here conceives of Hippocrates as the forerunner of Aristotle, and attributes to him Aristotelian terms and concepts such as those of cause and difference (διαφορά, on which see below, 3.6).

As the son of a physician and having grown up in a region where many practising doctors were active, it has always been assumed that Aristotle must have had some interest in medicine[9] and that whoever had an interest in medicine in the fifth and fourth centuries must have been aware of the *Corpus Hippo-*

9 See van der Eijk (2022).

craticum and made use of it. Thus, in 1887, Franz Poschenrieder began collecting parallels between the two corpora, including the *Problemata*; in 1980, Simon Byl augmented this collection with much new material, drawing upon the work of Robert Joly, and emphasising with some enthusiasm the numerous examples attesting to the influence of the works of the *CH* on Aristotle; in 2004, C. Oser-Grote reviewed the evidence, focusing on anatomy and physiology. Although she was more cautious in her conclusions, her general approach was still comparable to that of her predecessors. A contrary stance was adopted by Wilamowitz and Carl Fredrich at the end of the 19th century, and in the 20th by David Balme in his works on Aristotle and George Sarton from the more general point of view of the historian of science:[10] their rather sceptical conclusion was that Aristotle had little, if any, knowledge of the medical works later attributed to the *Corpus Hippocraticum*. Fredrich also argued that the comparison between Aristotle and the *Corpus Hippocraticum* as proposed by Poschenrieder could be accepted only in respect to the link between the first book of *Problems* and *De Aëribus*, and added: "*alles übrige sind Allgemeinheiten*, all the rest are generalities that Aristotle could either know himself, or see, or find *in many other books* as well".[11] We shall reconsider this aspect later.

2 Features of Medical Texts

2.1 *Reading, Discussing, Sharing Knowledge: Epicrates*

The third preliminary problem concerns the notion of 'reading'—i.e. the way in which the ancients became aware of data, doctrines, information and theories, not only in science but also in poetry, law and any other field of knowledge; the issue also involves the way in which data, once acquired, were used and disseminated. We should set aside the modern idea of 'reading' in the sense of perusing a comprehensive work of authorship—a work with a beginning and an end, an internal coherence, a defined theme: *books*, in the modern sense. That is not, or not necessarily, what we are talking about. Conceptions found in 'Aristotle' and similar to those occurring in the works of the *CH* in its current form do not imply a reading of those works in that form. Rather, one must look at such relationships in terms of *dynamic interaction*.

Reading a work, especially in the philosophical environment of ancient Athens, accompanied and complemented direct participation in oral discus-

10 See Balme (1987) 16; on *Hist. an.* Sarton (1952) 537. *Status quaestionis* in Bartoš (2021) 48 f.
11 Fredrich (1899) 9 n. 4.

sion, the use of notes, memos, ὑπομνήματα for personal use, or the words heard in lectures, such as Plato's Περὶ τἀγαθοῦ, or in discussions among 'academics', or other forms of knowledge-sharing for the many intellectuals and *technitai* of Greek cities. Although Aristotle was famously defined as the ἀναγνώστης, the reader,[12] and extended this mode of study even to texts written for the stage,[13] there are illuminating examples of the more varied way in which knowledge was circulated in his time.

A scene from a comedy by Epicrates of Ambracia conveys a vivid image of the Platonic and Aristotelian circle as a perfect context for the formation, circulation, exchange and contestation of technical knowledge. An author of the Middle Comedy, Epicrates presents a scene set in Plato's later years, when Speusippus, Menedemus, and Aristotle himself were attending the Academy in Athens (Aristotle stayed there between 367 and 347). The lengthy fragment (fr. 10 K.-A.) portrays a group of philosophers in the Academy discussing biological classifications (in particular, how to classify a gourd within a botanical system), in front of a doctor who makes a vulgar mockery of them. Plato, Speusippus and Menedemus are on stage, and this provides evidence for a dramatic date between 360 and 349 BC: Epicrates looks at them with the eyes of a contemporary.

The scene enacts a dialogue between two characters. One of them has just returned from Athens, where he listened to a remarkable 'academic' conversation while attending the Panathenaic games:[14]

> —What about Plato
> and Speusippus and Menedemus?
> What are they spending time on now?
> What deep thought, what discourse
> is being explored at their establishment?
> Give me an insightful account of these things, if you
> have come with any knowledge of them, by the Earth.
> —Well, I know enough to give a clear report of these things.
> For at the Panathenaea I saw a herd
> … of youths
> *in the exercise grounds of the Academy,*
> *and I heard unspeakably strange discussions!*

12 *Vita Marciana* 6 (p. 98 Düring); Blum (1991) 52, 70.

13 *Poetics* 26, 1462a11–17.

14 See Nesselrath (2016), Gaiser (1968) 450, nr. 6, Douglas Olson (2007) 229. Source is Athenaeus II 59 D/E.

For they were attempting definitions of natural phenomena (περὶ γὰρ φύσεως ἀφοριζόμενοι)
and trying to differentiate (διεχώριζον) *the life of animals*
and the nature of trees and the genuses of vegetables.
And in the course of these discussions it was the—gourd,
the genus of which they tried to decide (κολοκύντην ἐξήταζον τίνος ἐστὶ γένους).
—And how did they define it (ὡρίσαντο) and what genus (did they suppose) the plant to have? Reveal this, if you have any information!
—Well, first of all, they all, without a word,
just stood there and, bowing their heads,
thought and thought for quite some time.
Then suddenly—while the (other) lads
were still bowing their heads and seeking a solution—
one said that it was a round vegetable (λάχανόν τις ἔφη στρογγύλον εἶναι),
another: a type of grass, and a third: a tree (ποίαν δ' ἄλλος, δένδρον δ' ἕτερος).
When hearing this, a doctor
from the land of Sicily (ἰατρός τις Σικελᾶς ἀπὸ γᾶς)—
farted on them for talking nonsense.
—So, did they get terribly angry? Did they shout about being mocked?
For that is not a fitting thing to do in such discussions!
—It did not even bother these boys.
And Plato was there and quite gently,
not at all upset, he ordered them
again …
to try to define the genus,
and they went on to make *differentiations* (διῄρουν).[15]

Four elements are of special interest for us. 1) The topic, i.e. natural sciences, and in particular an ἀφορίζεσθαι περὶ φύσεως (v. 13), attempting definitions and classifications (as Galen above, ὁπόσα καὶ ὁποῖα) of living beings, both animals and plants, by "differentiation" (διαχωρίζειν) of ζῷα, δένδρα and λάχανα, in order to define their life, nature, and gender. The pattern is that of divisions, typical of both Plato and Aristotle, and clearly visible in the Anonymus Londiniensis. 2) The oral character of a discussion taking place in the Academy (ἐν γυμνασίοις Ἀκαδημείας), and open to guests, such as the interlocutor who reports to

15 Transl. Nesselrath, with minor changes.

his friend.[16] 3) The answer to the question comes from an unnamed *someone*, τις (although the author had mentioned the names of the main participants at the beginning), as is typical of Aristotle, mostly when concerned with medical texts.[17] 4) Most important is the intervention of "a doctor who came from Sicily" (ἰατρός τις Σικελᾶς ἀπὸ γᾶς), unnamed as well (τις), who listens to the discussion. This *medicus Doricus*[18] has been identified, more or less likely, with Philistion of Locri:[19] the Doric forms of his few words fit well, but the absence of names is significant in itself. Both content and language seem to refer to the actual presence in the Platonic school of doctors visiting from abroad: after all, to be effective, comedy needs verisimilitude and must evoke experiences familiar to the audience. For Aristotle himself, knowledge originating from Western Greece, and Sicily in particular, provided insights that would prove decisive for the development of important physiological concepts.

Significantly, this fragment represents what can be considered the typical interaction between (named) philosophers and (unnamed) doctors: the philosophers' attention is devoted to topics of natural science and classification, whereas the doctor has a more practical, and therefore critical, stance. It also indicates one of the mechanisms for the transmission of technical and theoretical knowledge, that of the public demonstration or debate, taking place before, or in parallel to, any written circulation of texts and possibly influencing the latter.

2.2 *Writing: Bits of Text and Their Features*

Reading is the flipside of writing, and both accompany the oral interaction portrayed by Epicrates. As to the character of written medical texts, Wesley Smith and Volker Langholf have delineated a fundamental feature of many medical works of the *CH*, especially the more technical ones, many of which are among those that Aristotle seems to have known. This is the so-called 'catalogue struc-

16 Lectures at the Academy were open to the public. Key testimony is Aristot. ap. Aristoxen., *Harm. elem.* II p. 30 f. Meibom = Test. 7 Gaiser, 452, on Plato's lectures On the Good. See also Düring (1957) 357–361.

17 Aristotle uses forms such as τις or τινες also for identifiable authors, including Plato, as part of an argumentative strategy. Von Staden (1999) 148 lists the forms for anonymous references, such as ἔνιοι, τινες, τις, ἄλλοι, οἱ ἔμπροσθεν, οἱ πρότεροι, οἱ ἀρχαῖοι, οἱ παλαιοί, οἱ πάλαι, οἱ νῦν, οἱ νεώτεροι, οἱ πλεῖστοι, etc., and remarks that "anonymous references to predecessors were part of the polemical armature available to Greek philosophical and scientific writers"; the case of medicine is peculiar. On Aristotle's references to physicians, see van der Eijk (2012) 1503 f.

18 Kassel and Austin (1986) 163 ad l.

19 The name of Philistion was proposed by Jaeger (1938) 9 f., see also Gaiser (1968) 451.

ture', according to which "the author … offers each item as though it is the whole of what he has to say, but then adds another which he presents in the same manner … The treatise never describes its own structure, it only proceeds to present its material in surges of argument."[20]

This catalogue-structure, in which one unit of text is added to another and then again, and in some cases is copied as is, in other cases modified, updated or abbreviated, can explain some features of Greek medical writings that seem to depend on the existence of separate textual units, later put together to form a treatise as we know it. Clearly distinct textual units are composed more or less methodically, and share a common topic, but are often arranged together chaotically. The fact that the same textual units are sometimes repeated in different works, in the same or in a different position, as in *Epidemics* V and VII, presumably implies that different tablets, or individual sheets of papyrus, were stored as such and could be used and reused individually, each time in a different context or sequence. The evidence provided by Egyptian medicine seems to confirm this (see below).

Whether the individual textual units were original compositions or copies of earlier texts is not known—but this is not especially relevant for our purposes. One wonders whether this way of working on medical texts *is a feature peculiar to a discipline like medicine, intrinsic to its character*, that induces practitioners to take notes, assemble materials, and order them in such a way as to make them readily available for consultation. In any case, the key point—and one that helps explain a number of instances in Aristotle—is that the Greek approach (somewhat similar to the situation in Egypt) envisages that from the available material, from the individual textual units, *one draws not exact copies, but re-elaborations* on the basis of new data, new experiences, or even just rough copies, intended for practical use and so not requiring absolute fidelity (see below, 4.1). *The individual textual unit does not have the identity-value of a work of authorship*, and this, together with the anonymity that many texts certainly had from the beginning, provides an *'open' text*. This mechanism must be taken into account when considering 'Aristotle' and the nature of his relationship to medical texts.

2.3 *How Medicine Is Written: Authorship and the Case of Egypt*

Ancient Egyptian medical papyri were often independent of each other in terms of source: one did not descend directly from the other. As Hermann

20 See Smith (1983), Perilli (2009), (2014), (2024).

Grapow and Wolfhart Westendorf put it,[21] there were individual texts common to groups of papyri that could be located in a different context in different papyri. The source, a large reservoir, must have consisted of papyrus slips, on which the recipes were written down individually or in small groups. These were 'collective manuscripts' (as the Egyptians themselves named them: see e.g. chs. 4–103 of PapEbers) compiled from originals stored in temple libraries (the 'houses of life'), each compilation under a heading (a 'book on swellings', a 'book on head diseases', etc.). After searching the library for texts, the compiler, possibly the doctor himself, transcribed the relevant papyrus leaves that served as intermediate carriers for the new 'work' to be created.

Similarly in Greece, medical-biological knowledge of the fifth and fourth centuries BC appears to be the result of a phenomenon of contamination, of hybridisation. A broader construction, such as that attempted by Aristotle, could thus rest on foundations composed of elements of different origin, more or less formalised, written and oral. Anyone reading 'Aristotle' and wishing to attempt to delineate precisely the identity of his sources must bear in mind that *Aristotle had no interest in preserving that identity*, even when he seems to have known it, with very rare exceptions (as in the case of Syennesis and Polybus).[22] His method of working on extracts and quotations might also have played a role in this sense.[23] A large amount of material is lost to us, preventing any generalisation; yet a work like the Anonymus Londiniensis shows that the names and ideas of many doctors were familiar to the Aristotelian circle. Still, the defining characteristic of the extant medical writings of the earliest phase, as (later) collected in the *CH*, remains their anonymity and the absence of any reference to 'authors', even when the first person singular or plural is used. *It is the very concept of authorship that seems to have become blurred* to the point of disappearance; it is a structural feature of some of these texts, which cannot but influence any evaluation.[24]

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21 In Langholf (1989) 64. Already Jouanna (1975) 141.

22 Leophanes occurs in *Gen. an.* 4.1, 765a25, but he seems to be a philosopher rather than a physician, since Pseudo-Plutarch's *Placita* (*Dox. Gr.* 420,7) lists him together with other *physiologoi* (Empedocles, Parmenides, perhaps Hipponax, Anaxagoras, Leucippus and Democritus) for his doctrine of ἐπικράτεια, and Theophrastus (*De caus. plant.* II 4,12) mentions his interest in the dark soil (τὴν μελάγγεων); a reference to the doctor Herodicus can be found in *Eth. Eud.* 7.10, 1243b20–25. H. Grensemann acknowledged Polybus' authorship for *Nat. hom.*, *Octim.*, *De salubri diaeta*; Jouanna is more sceptical about the reliability of late sources. On Polybus in *Hist. an.* see Di Benedetto (1972).

23 On this, see below 3.4 and Perilli (2025).

24 Other hypotheses are of course possible: on this see van der Eijk (2012) 1503 f., and (2016), who instead argues that anonymity is not to be considered the norm for ancient medical

2.4 *Textual Units vs Books*

The passages in the acroamatic works of Aristotle that allow a comparison with the *CH* seem to show that he often *drew on an 'Urform' of the works* that we read today in the *CH*, on unstructured materials, on the *individual 'textual units'* from which those works were later put together.

I assume that Aristotle often did not quote from the 'accomplished works' of the physicians who had preceded him; at the time of writing, he did not have on his desk, say, *De natura hominis* or *Diseases* 2 or *Epidemics*. He did not read *De locis in homine* in order to quote from it a couple of lines. Instead, he drew on a collection of files, arranged by subject, on memos, notebooks, diagrams, as well as on excerpts taken from his reading and on notes taken from lectures he had heard and debates he had attended.

In his files, he could find, arranged by subject and sometimes in alphabetical or chronological order, the extracts he might need; in the case of poets and philosophers, these are often accompanied by names, as recommended in the first book of the *Topics* (see 3.4), while in the case of physicians they remain unlabelled, missing a παράσημον (in the sense of *Soph. El.* 177b6): because technical medical 'texts' (not 'works') are made up of individual blocks of text, textual units that have no author, they are bricks with which, *later*, someone will construct buildings: the 'works' as we read them. It is a matter of distinguishing between books and texts (or, better, textual units), and between a library and a repository (*grammatophylakeion*), turning loose sheets into organized and indexed arrangements of related items.[25] The *structural uncertainties* of the resulting unity require due consideration.

2.5 *Some Characteristics of Textual Units*

These *textual units*, which Aristotle may have had in front of him when working on medical issues, correspond to those individual passages which Volker Langholf has convincingly identified as the various original nuclei that, at a later point, after having been assembled together more or less casually, gave rise to some of the works within our *CH*. This explains, at least partially, three phenomena that are characteristic of Aristotle's so-called 'quotations' or 'direct references', or of the numerous alleged indirect references to Hippocratic passages:

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writings. Still, as regards the early history of the works later merged together in the *CH* and their connection with Aristotle, I believe that the anonymity *of textual units* has played a role.

25 See Henrichs (2003) 210 f. On medicine and writing, Perilli (2009) and (2014).

1. The *anonymity* of his references to physicians (with the exception of Syennesis and Polybus, see above), parallel to the systematic anonymity of these writings throughout the whole ancient tradition;
2. The presence of more or less significant *differences* between the passage as quoted by Aristotle and as present in other sources (this is in fact the case in almost all passages for which a relation with the *CH* has been posited, including the famous description of blood vessels in Aristotle and in *De natura ossium* and *De natura hominis*);
3. The *circulation of the same passage*, in the same or different form, in several authors or works, as well as the presence of the same passage repeated *in a different position* in related works (such as *Epidemics* 5 and 7).[26]

On the first point: many works (not all: unitary works, e.g. *De morbo sacro*, *De vetere medicina*, *De arte*, require a different explanation) are anonymous because *the individual 'textual units' on which they are based were themselves anonymous*, materials written by physicians or by assistants to whom the physicians dictated during their visits and activities, then collected together in archives. They were often no more than 'worksheets' written by different persons for everyday use, not works by 'authors' intended for a public and therefore typically 'signed', as Herodotus and Thucydides did with theirs.

On the second point: it is revealing that those convinced of an 'influence' of the writings of the *CH* on Aristotle, of a direct link between the two, of an Aristotle as reader of 'our' Hippocrates, have found that Aristotle never or almost never reproduces his 'model' verbatim, but reports it with variations, additions, cuts, and changes in both form and substance. Thus, "le biologiste ne copie jamais textuellement son modèle", and "dans tous les cas, il modifie le vocabulaire du texte original; parfois, il transforme une information médicale en la présentant sous une forme différente, celle d'une 'verité' réciproque par exemple; souvent aussi, il résume ses lectures, les corrige ou amplifie les renseignements qu'il a trouvés",[27] or "le biologiste a nuancé l'affirmation du médecin … il n'a pas reproduit littéralement les reinsegnements hippocratiques".[28] Sometimes there are important terminological differences, and we read that "le biologiste adapte, en le corrigeant, un développement qu'il a lu dans le traité *De la generation*".[29]

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26 Lane Fox (2020) assumes that a unitary work "later became divided and one part of it was copied twice over", and split in two book-rolls (ch. 9, §111). Perhaps acceptable for *Epidemics* 1–3, the hypothesis is unlikely for other books.

27 Byl (1980) 48 and 92. Similar remarks may be found in every comparison.

28 Byl (1980) 49.

29 Byl (1980) 70 and 73.

On the third point, see below, 4.1 nr. 7. As to *Epidemics* 5 and 7 and the repetition of the same or similar texts (clinical records) in different positions in the two books, the most convincing explanation follows the approach of Langholf: the clinical records are in different positions in the two books because they were based on texts written on individual tablets or sheets of papyrus that could be selected, put in a different order and copied (after some changes, if needed) according to the needs.

Based on an unproven assumption—that Aristotle 'read' the works of *CH* as they were to appear in the following centuries—it is claimed that he knew them in the very same form that we read them today. Linguistic and substantive differences are thus overlooked, as well as additional or missing elements, while every discrepancy is regarded as a deliberate variation. We should rather recognise that the sources had different features, or at least that the process is not as straightforward as the terms 'works', 'influence', or 'reading' would suggest.

3 Aristotle's Working Method and the Features of His Texts[30]

3.1 *Knowledge Step by Step and Aristotle's* Historia animalium

To better understand the acroamatic Aristotle, as evidenced particularly in *Hist. an.* (a collection of data serving as a basis for the conceptually more elaborate works), one should keep in mind the features of the possible sources, i.e. 'textual units' on medical topics, kept in repositories and archives, sometimes in sanctuaries, such as in the Egyptian House of Life.[31]

The type of practice we have been describing had direct consequences on style, language and syntax: doctors needed to log the information that patients provided and to preserve it for consultation in future cases. This implies a clipped and utilitarian style, including the use of abbreviations, and with no literary pretensions. We are lucky enough to have a remarkable example of this style in *Epidemics* 6, section 8, paragraphs 7–9, the pages "drawn from the small tablet".[32] There are various instances of this in the technical works of the *Corpus Hippocraticum*. Outside the *CH*, the nearest parallels are to be found in Aristotle.

30 Lennox (2021) provides insightful reflections on Aristotle's method from an epistemological perspective.

31 In Greece, sanctuaries were usually administered by political authorities: see Aristotle, *Athenian Constitution* 6. 44, 1.

32 See Bardong (1942); Perilli (2007) 65.

The investigation thus turns into a comparison between two types of collections of cards, notes—*hypomnemata* in the most ancient sense of the word—with profound consequences for the interpretation of the relationship between Aristotle and earlier literature, his way of working, and the form in which medical writings and technical knowledge circulated during the fifth and mid-fourth century. This also has potential consequences for the use of Aristotle as an indirect witness in constituting the text of medical writings, as well as for the attribution of medical works to specific authors, such as Polybus. If the analysis proposed in this paper is correct, Polybus should be credited with the authorship not of the entire *De natura hominis*, but only of the part explicitly ascribed to him by Aristotle—also considering the fact that the work is a varied conglomerate of material (see below, p. 41, Galen's opinion on the many different textual units constituting the work).

There are many examples in the Aristotelian corpus of his peculiar way of collecting data and presenting knowledge. We have notes (ὑπομνήματα); research results (ἱστορίαι); but also collections of Constitutions of Greek cities in alphabetical order; collections of proverbs catalogued as Παροιμίαι α' (Diog. Laert. v 26, 361, l. 392 Dorandi = title 138 in Moraux, *Listes*); registers of dramatic competitions ordered by year and including names of authors and titles and directors/actors; lists of winners in the Pythian and Olympic games; *gnomologiai* (*Rh.* 2.21, 1394a19), i.e. collections of γνῶμαι scattered throughout Aristotle's writings, see also Isocrates on selections from the best poets: ἔτι εἴ τις ἐκλέξειε τῶν προεχόντων ποιητῶν τὰς καλουμένας γνώμας, ἐφ' αἷς ἐκεῖνοι μάλιστ' ἐσπούδασαν (*Or. 11 ad Nicoclem* 44 = 23c6).

Each person individually, Aristotle writes, attains to a small part of the truth, and makes his own contribution; the many small parts must then be put together, like bricks in a building (*Eth. Nic.* 1.7, 1098a20–26):

> For this, I think, is the proper method—*first to sketch the outline, and then to fill in the details* (ὑποτυπῶσαι πρῶτον, εἶθ' ὕστερον ἀναγράψαι). But it would seem that, the outline once fairly drawn, *any one can carry on the work and fit in* the several items (παντὸς εἶναι προαγαγεῖν καὶ διαρθρῶσαι τὰ καλῶς ἔχοντα τῇ περιγραφῇ) *which time reveals* to us or helps us to find. And this indeed is the way in which the arts and sciences have grown; for it requires no extraordinary genius to fill up the gaps. (transl. F.H. Peters)

Knowledge is built step by step, with the contribution of many, cf. *Soph. El.* 183b17–20:

> For in the case of all discoveries the results of previous labours (πρότερον πεπονημένα) that have been handed down from others have been advanced bit by bit (κατὰ μέρος ἐπιδέδωκεν) by those who have taken them on.

3.2 κολλῶν τε καὶ ἀφαιρῶν

Theophrastus, too, explicitly acknowledges the role of public collective discussions: "Reading in front of an audience leads to corrections and improvements of the text (αἱ δὲ ἀναγνώσεις ποιοῦσιν ἐπανορθώσεις)," as he writes in a letter quoted by Diogenes Laertius (v 2,37). The phenomenon of the continuous reworking of texts was already described by Plato in the *Phaedrus*, where he compared the philosopher—who has more important concerns (τιμιώτερα)—with those who devote their efforts to writing, be it a poet, or one who puts speeches in written form, or a writer of laws, who spend their time messing up what has been written (ἄνω κάτω στρέφων ἐν χρόνῳ), *gluing different parts together, or cutting out this or that* (πρὸς ἄλληλα κολλῶν τε καὶ ἀφαιρῶν). Theophrastus speaks of oral communication, Plato of written texts. In Aristotle, the concept of παρεκβῆναι, of making an excursus or adding marginal notes based on the available materials, also refers to the use of making additions and appendices.

Düring drew the following interesting conclusion on the Aristotelian corpus: "die im Corpus erhaltenen Schriften müssen letzter Hand von den Originalmanuskripten des A. abgeschrieben worden sein, und zwar von einem Redaktor, der sich die große Mühe gab, *alles zu bewahren, auch das, was am Rande oder auf Zettelchen geschrieben war* … Dieser Redaktor ist also für die heutige Form der Lehrschriften verantwortlich. Zusätze, die in Sprache oder Form unaristotelisch sind (die z.B. Theophrast eingetragen haben könnte), kommen sehr selten vor (z.B. *Cat.* 11b10–16; *eine Ausnahme bildet die* HA, *die zahlreiche nach-aristotelische Nachträge enthält*)."[33]

3.3 *How Aristotle Worked*

Hypotheses about how Aristotle the naturalist used to work stretch back to antiquity. Hermann Usener[34] was convinced it had to be teamwork, encouraged and guided by the Master himself, "eine großartige Organisation der gemeinsamen Arbeit", a result of the συσχολάζειν and συμφιλοσοφεῖν that Strabo refers to the collegiality of Aristotelian studies, συνεφιλοσοφήσαμεν ἡμεῖς τὰ Ἀρι-

33 Düring (1968) 192.

34 Usener (1884/1914).

στοτέλεια.[35] According to Usener, following the model of the Platonic Academy, the Master issued instructions for the collection of material to "eine ganze Schar mitforschender Freunde", friends and collaborators (*aliquot milia hominum*, Pliny exaggerated, *Nat. hist*. VIII 16,44), with an historical perspective based on the awareness that to understand human vicissitudes one must observe them in their historical flow: the third book of Plato's *Laws* exhibits a similar approach.

For Aristotle, this was the case in politics and the organisation of city-states, as well as in poetic creation. His work was based on the preliminary collection of data, the above mentioned Constitutions of States on the one hand, and the registers of theatrical competitions on the other. These lists were ordered by year, and gave an account of the performances while *indicating the names* of who wrote what, and who staged what. The same applies to rhetoric and to lists of winners in the Pythian and Olympic games, which would later become the standardised dating system used for events in Greek history. The same happens with works on natural science as well, especially those concerning animals.

Usener's reconstruction was widely influential but also criticized for its naive positivism and anachronism, and must be treated with caution. But in some respects, the resulting image might not have been too far from the truth. Scholars have often wondered about the origin and structure of even the more philosophical works, as we read them today. As H. Jackson put it in his still entertaining paper on Aristotle's lecture-room: "Are the philosophical writings of Aristotle books, or records of lectures? And if they are records of lectures, are they drafts or memoranda prepared by Aristotle himself, or summaries and notes preserved by his hearers? Now I find in Aristotle's writings certain peculiarities which I should not expect to find either in published works or in the notes of pupils, but which lead me to think that here are Aristotle's notes for his lectures, or, more exactly, memoranda covering the ground of the lectures which he was about to deliver … Aristotle repeats himself, corrects, substitutes, adds, omits. The consequence is that his writings sometimes resemble a waste-paper basket." These questions are familiar today, and even more so in the case of the biological writings, especially the *Historia animalium*. Still, it is useful to recall them for present purposes.

3.4 *Aristotle's Method: Extracts, Diagrams, Tables*

The acroamatic Aristotle himself provides valuable indications about how a scientist should proceed. This is presented in a well-known passage, at the

35 Strabo XVI 2,24.

beginning of the *Topics*.[36] After hinting that his aim was to discover a method (μέθοδον εὑρεῖν, 1.1, 100b18) for the study of certain subjects, he argues that a good dialectician must be familiar with the opinions of others (1.10, 104a8–15). Medicine and geometry are chosen as suitable *technai* for illustrating how dialectics works and how to make use of received opinions.[37] Medicine, as a typical example of 'shared knowledge', was by nature cumulative wisdom that grew over time through the contributions of many people in an additive process. Aristotle gives specific advice on how to learn about what he calls 'common opinions', the opinions "of all, most, or the wise", τὰς πάντων δόξας … ἢ τὰς τῶν πλείστων ἢ τὰς τῶν σοφῶν (*Top*. 1.14, 105a34–36). In reviewing the ideas of others, he says, one must examine them (προχειρίζεσθαι), and choose. How is this best accomplished? By making *extracts from the written texts* (ἐκλέγειν δὲ χρὴ καὶ ἐκ τῶν γεγραμμένων λόγων), by making separate *diagrams* ("Verzeichnisse" Düring; "lists … under separate headings" Mansfeld-Runia) for each genus (τὰς δὲ διαγραφὰς ποιεῖσθαι περὶ ἑκάστου γένους ὑποτιθέντας χωρίς), e.g. 'on the good' or 'on the living', and on the good in its entirety, *beginning with what it is*, its entity (or substance) (ἀρξάμενον ἀπὸ τοῦ τί ἐστιν).

One must also then gradually *write down next to* the opinions of each (παρασημαίνεσθαι δὲ καὶ τὰς ἑκάστων δόξας), e.g. that it was Empedocles who said that four are the elements of bodies (οἷον ὅτι Ἐμπεδοκλῆς τέτταρα ἔφησε τῶν σωμάτων στοιχεῖα εἶναι), because *one can take as a starting point what has been said* by an authoritative person (θείη γὰρ ἄν τις τὸ ὑπό τινος εἰρημένον ἐνδόξου).[38] In the *Nicomachean Ethics*, Aristotle encapsulates this principle in the following words: εἴ τι κατὰ μέρος εἴρηται καλῶς ὑπὸ τῶν προγενεστέρων, πειραθῶμεν ἐπελθεῖν.[39] The text of the passage from the *Topics* uses technical terms like διαγραφή and παρασημαίνεσθαι; ἐκλέγειν too has a specialised meaning. It is an activity not dissimilar to the one described by Plato in the *Laws*, when the Athenian host recommends nourishing the youth until they are sated (τρέφειν καὶ διακορεῖς ποιεῖν) by drawing on the many epic poets (ποιηταὶ πάμπολλοι), making them listen to the reading of the verses (πολυηκόους τ' ἐν ταῖς ἀναγνώσεσιν ποιοῦντας),

36 See Mansfeld and Runia (2009) 158–172 (ch. 14: *Problems and excerpts: Aristotelian instructions and a bit of practice*). They render παρασημαίνεσθαι with "note separately".

37 Herophilus' Πρὸς τὰς κοινὰς δόξας must have been along the same lines. The expression κοιναὶ δόξαι was used by Aristotle, e.g. *Physics* (4.6, 213a19–22). See von Staden (1999) 144: such *doxai* included, for Herophilus, "views shared by at least some scientist-philosophers who reflected on the issue".

38 *Top*. 1.14, 105b12–18.

39 *Eth. Nic*. 10.10, 1181b16.

proceeding *to extract the most relevant parts from the texts and then to collect entire sentences* together: ἐκ πάντων κεφάλαια ἐκλέξαντες καί τινας ὅλας ῥήσεις εἰς ταὐτὸν συναγαγόντες (Plat. *Leg*. 7. 810e10–14).

The method recommended by Aristotle is clear, as H. Throm summarised: "Man soll sich also einen regelrechten Zettelkasten anlegen, natürlich für praktische Verwertung."[40] The verb ἐκλέγειν does not simply mean 'to choose', but describes a more technical compilation of extracts (even single sentences, as Plato's text indicates) that can later be gathered together elsewhere. The verb παρασημαίνεσθαι describes the subsequent phase in which the different conceptions on the same topic, having been collected together, receive additional notes, probably in the margins, including the name of the author or the person referred to: παρασημαίνομαι has a juridical value; it means authorising a document by the stamping of a seal.[41] The διαγραφαί are also found elsewhere in Aristotle, for example *Eth. Nic*. 2.7, 1107a33 (cf. *Eth. Eud*. 2.3, 1220b37), where they refer to lists, the tables of virtues and vices that could be seen hanging on the wall of the classroom or drawn on 'whiteboards', λευκώματα; in an interesting example Theophrastus reports on a διαγραφὴ τῶν φύλλων, the drawing of the outline of leaves (*Hist. plant*. III 13,1).[42]

A similar concept is expressed by the terms ὑπογραφή (see e.g. *De interpr*. 22a22 and *Hist. an*. 3.1, 510a30), διάγραμμα and παράδειγμα.[43] The reference is to a graphic representation of what is described in words. The resulting activity is often expressed by the verb θεωρεῖν: it is a matter of θεωρεῖν ἐκ τῆς διαγραφῆς or ἐκ τῆς ὑπογραφῆς; both διαγραφή and διάγραμμα in *HA* refer to schematic representations or actual drawings of dissections.[44] The case of diagrams, or drawings, which might also have been in colour, illustrates a way of working: thus, *tables summarising the opinions of philosophers and scientists* on the various topics studied and debated must have been available in both Plato's and Aristotle's schools.[45] These visual aids therefore consisted in lists of opinions of various authors drawn either from written works or from notes taken at con-

40 Throm (1932) 69, quoted by Mansfeld and Runia (2009) 159.

41 More on this and on Aristotle's passage in Perilli (2025).

42 Althoff (1999) 61, based on Beriger, remarks: "hier empfiehlt Aristoteles also das Literaturstudium, das mit einem gegliederten Exzerpt einhergehen soll. Wahrscheinlich ist mit dem zweiten Satz (παρασημαίνεσθαι …) gemeint, daß die einzelnen Doxai den betreffenden Autoren namentlich zugeordnet werden sollen."

43 On *diagraphe*, *hypographe*, *diagramma*, *paradeigma*, see Lennox (2018); Keyser (1992) n. 3; Wesoly (2018); Natali (2013) 113–117. Also Jackson (1920) 193.

44 See *Hist. an*. 1.17, 497a32; 3.1, 510a11–14, a29; 4.1, 525a7–9; 6.10, 565a2–13; 6.11, 566a13–15, and Natali (2013) 114; Lennox (2018) 264.

45 See Natali (2013) 113.

ferences and debates, and apart from lists they included drawings, diagrams, schemes of various kinds, maps, maps of the sky and the winds, anatomical illustrations, etc.[46] All this involves oral exposition and direct, dynamic interaction.

Among the many examples of texts based on a written extract, oral testimony or 'widespread knowledge', a passage from *De partibus animalium* (3.10, 673a10–26) may be quoted:

> *It is said* (φασι) that when in war men are struck in the part around the diaphragm, they laugh on account of the heat which arises owing to the blow. This may be so; and *those who assert it* are more credible (ἀξιοπίστων ἀκοῦσαι λεγόντων) than those who tell the tale of how a man's head speaks after it is cut off. Sometimes *they cite Homer* (ἐπαγόμενοι καὶ τὸν Ὅμηρον) in support, who (so they say, λέγουσι γάρ τινες) was referring to this when he wrote "As it spake, his head was mingled with the dust", (not "As he spake, his head was mingled with the dust".) In Arcadia, this kind of thing was at one time *so firmly believed* (διεπίστευσαν) that one of the inhabitants was actually brought into court on the strength of it. The priest of Zeus *hoplosmios* had been killed, but no one knew who had done it. *Certain persons, however, affirmed* that they had heard (ἔφασάν τινες ἀκοῦσαι) the man's head .... (Transl. A.L. Peck)

3.5 *Aristot.* Top. 1.14 *γεγραμμένοι λόγοι*

In the above-mentioned passage of *Topics* (1.14, 105a34–36), in which Aristotle recommends making extracts from written texts, preparing διαγραφαί organized according to topics, and adding the *doxai* of the experts on a case-by-case basis, written texts are γεγραμμένοι λόγοι (105b13).

Andreas Beriger explains: "Man darf diese Stelle durchaus so verstehen, dass *aus philosophischen Werken* Exzerpte gemacht werden, die rubriziert werden, thematisch geordnet—und dadurch einen Grundstock von Meinungen garantieren, in Form einer systematischen Doxographie. Möglicherweise ist die Rubrik 'Über Lebewesen' sogar als Beispiel für eine bestimmte τέχνη zu verstehen".[47] What kind of writings should be understood under γεγραμμένοι λόγοι? Beriger translates *geschriebene Argumente* and paraphrases (with a substantial jump) with *philosophische Werke*; Mansfeld and Runia render "relevant literature"; Italian translations usually have "discorsi scritti".

46 See e.g. *Post. An.* 2.14, 98a1–12, and generally *Rh.* 2.22, 1395b31–1396b5: for any argument, one needs facts and sources following a selection by topics.

47 Beriger (1989) 41.

Logos is, without further specification, the speech, the public oration. οἱ λέγοντες are those who speak, and, as explained in *Rhetoric* 3.1, 1403b1–22, it is a staged speech, an action that falls within the dimension of ὑπόκρισις. With the term λόγοι, the Neoplatonic commentators referred to their meetings (συνουσίαι), which were indeed lectures.[48] These spoken λόγοι can be written down, becoming γραφόμενοι λόγοι, as in *Rh*. 3.1, 1404a18, οἱ γὰρ γραφόμενοι λόγοι μεῖζον ἰσχύουσι διὰ τὴν λέξιν ἢ διὰ τὴν διάνοιαν; similarly ἄγραφοι *vs* γεγραμμένοι νόμοι, as in *Pol*. 6.5, 1319b40 and *Rh*. 1.13, 1373b5–7, etc. In *Rhet. ad Alex*. 37, 1444a19, the meaning becomes clearer:

> If they misrepresent us by saying that we *read our speeches* (γεγραμμένους λόγους λέγομεν) or practise them beforehand, or that we are pleading for the sake of some reward, we must meet such accusations with irony and say with regard to *the writing of speeches* (περὶ μὲν τῆς γραφῆς) that the law does not forbid a man *to read out a written speech* (γεγραμμένα λέγειν) any more than it forbids his opponent *to speak without notes* (ἄγραφα); for, while it prohibits the doing of certain actions, it allows a man to make a speech in any way he likes. You must also say: 'My opponent considers that the wrongs which he has committed are so serious that he does not think I am doing justice to the accusation which I am bringing against him, unless *I write out and take a long time to think over my speech* (εἰ μὴ γράφοιμι καὶ πολὺν χρόνον σκεψαίμην).' Such then is the way in which we must meet the *misrepresentation of having written out our speech* (τὰς τῶν γεγραμμένων λόγων διαβολάς). If our opponents declare that we learn and rehearse our speeches (λέγειν μανθάνειν καὶ μελετᾶν), we shall admit it. (transl. E.S. Forster)

λόγος γεγγραμμένος is thus primarily, and literally, the transcription of a text that can be or was intended to be or was in fact delivered orally (see also the beginning of *De interpr*. 16a2 ἔστι μὲν … σύμβολα … τὰ γραφόμενα τῶν ἐν τῇ φωνῇ, "written words are the symbols of spoken words"): thus the meaning is not, or not necessarily, that of written 'works', and not 'philosophical works', but any text that had been recorded in writing, including transcriptions of lectures, or notes taken while listening to an orator: not *syngrammata*, but *hypomnemata*.

48 See Düring (1957) 359.

3.6 ὑπαρχούσης τῆς ἱστορίας*: the Availability of Data*

At the beginning of the most representative example of this way of working, the *Historia animalium*, after concluding the methodological introduction, Aristotle reiterates the same operative principle, followed this time by hundreds of pages of examples of its application. He observes (*Hist. an.* 1.6, 491a6–14):

> This has now been said in this way as an *outline* (ὡς ἐν τύπῳ), as a foretaste of the many things that must be considered. We shall speak of it later in detail, so as to grasp first of all the *differences* that exist (τὰς ὑπαρχούσας διαφορὰς) and the characteristics common to all. After that one must try to discover the causes. This is how *the method must be put into practice*, in accordance with nature, *once the results of research* (ἱστορία) *on individual* (*animals*) *have been made available* (Οὕτω … ποιεῖσθαι τὴν μέθοδον, ὑπαρχούσης τῆς ἱστορίας τῆς περὶ ἕκαστον). From this it becomes clear on what and from what the demonstration is to be carried out.

In line with what he says in *Topics*, *Rhetoric* and elsewhere, Aristotle makes it clear at the outset of *Hist. an.* that his first aim is to collect data, to gather the results of his own research and that of others. His personal and original contribution will consist in organizing them according to an aetiological perspective. Aristotle is clearly referring to a *collection of data on animals*, descriptions put together over time as a starting point for his work, of which *Hist. an.* reflects the first phase, *Part. an.* and especially *GA* the highest point of conceptual development. The verb ὑπάρχω, and the derivative ὑπάρχοντα (typical of Aristotle's logic), are used in these passages in a sense that LSJ (s.v. ὑπάρχω, B 4b) render as *a man's record*.

Being a collector of notes, for Aristotle *hypomnemata* and *historiai* are *not a literary genre* or a kind of work, but *a way of organising his work*. Data are necessary "to grasp the differences". When, in *De generatione animalium*, he moves on to survey the differences (διαφοραί) between the genera of bee-like animals, Aristotle takes as his starting point "what is written in the researches (περὶ τὰς ἱστορίας)":

> πόσας δ' ἔχουσι διαφορὰς ἢ πρὸς ἄλληλα τῶν τοιούτων γενῶν ἕκαστον ἢ πρὸς τὰς μελίττας ἐκ τῶν περὶ τὰς ἱστορίας ἀναγεγραμμένων δεῖ θεωρεῖν. (*Gen. an.* 3.10, 761a10)

Such ἱστορίαι act as a detailed repertory for *Gen. an.* to further develop its argument and to delineate a theoretical framework. What are these 'researches'? The reference, in this case, is usually considered to be *Historia animalium*

8.41–43 (627b23–629b5); but to render ἱστορίας with the title of the work as we have it (*Researches*, sc. *on animals*), as is done in translations, can be misleading. The term evokes not so much a crafted piece of writing, but a way of working; these ἱστορίαι may well have been the collection of notes, gathered both by Aristotle and others, on which the current form of *Hist. an.* is based.

This collection of data, as Düring has argued, can be identified with the so-called *zoika*, on which the excerpts on animals by Aristophanes of Byzantium and other works were based, well into the Imperial age of Rome.[49] It was perhaps during this period that compilations—which stretch back at least as far as Hippias and the Sophists—became widespread and circulated side by side with original creation.[50]

3.7 *Aristotle's* Zoika (*and* Iatrika)

In order to understand Aristotle's relation to the medical literature of his time, one must understand certain features of his writings on animals, *HA* being the most important work.[51] From the 112 quotations that Athenaeus, via Hellenistic intermediaries, draws from Aristotle's works on animals, about half are taken from a Περὶ ζῴων or Περὶ ζωικῶν, a work (or works) that has not survived. The other half, which Athenaeus says are taken from the Περὶ ζῴων μορίων, correspond to the actual text of *HA*, a text that even in the certainly authentic books shows traces of reuse and interpolated phrases or sections, more or less extensive additions, which are often difficult to identify. Otto Regenbogen once summarized this fact as follows: "Wir haben also hier die Möglichkeit des stringentem Beweises, daß in der h.a. des Aristoteles durch oder auch nach Theophrast, unter Durchbrechung des ursprünglichen Aufbauprinzips, *Stücke anderer Herkunft* eingelegt worden sind, die keine Verarbeitung mehr gefunden haben. Wir haben uns vorzustellen, daß die von Aristoteles hinterlassene h.a. ein Grundbuch der peripatetischen Schule über diesen Gegenstand gewesen und geblieben ist, aber daß folgende Generationen von Peripatetikern in *Zusätzen* auf Grund eigener Beobachtungen *den Text vermehrt und erweitert*

49 See Berger (2012).

50 Düring (1957) 368, goes further: "His (*sc.* Aristotle's) collection of notes was the beginning of hellenistic doxography which soon put an end to original thinking: it was replaced by compilations of doxographic notes." This is too much; but the role of Aristotle has been well described by Mansfeld and Runia (2009, 158), in that "Aristotle is not the inventor of doxography, but he certainly bequeathed it with a well-founded technical procedure, and considerably widened its scope."

51 I refrain from comment on the controversial issue of the structure and authenticity of the ten books of *Hist. an.*

haben; das hat sich augenscheinlich *lange fortgesetzt*, denn die Stelle der h. a. Γ 21, 522 b. 24 (mit der Anmerkung von Dittmeyer) reicht klärlich bis mindestens in die Zeit des Königs Pyrrhos von Epiros hinab."[52]

The third part of the Anonymus Londiniensis presents us with a concrete example of this way of working that was apparently familiar to the ancients. As far as we can reconstruct, the Anonymus seems to have first transcribed the material, often concise texts, that he had in front of him without aiming at exhaustiveness, and later made additions and corrections to make the content easier to understand. Such additions may at times also have been based on oral tradition, medical teaching, or debates (similar to those staged by Epicrates of Ambracia, described above), but of course also on other written sources, and some of them had notes in the margins.[53]

Historia animalium represents the evolution of collections of material after some such reorganisation; the *zoika* were apparently the starting point. *Zoika* is the name given to those writings (whether one or several works, or merely a collection of notes) that in Athenaeus are identified with ἐν τῷ ζωϊκῶν, ἐν τῷ ἐπιγραφομένῳ ζωϊκῷ ἢ περὶ ἰχθύων, ἐν τῷ περὶ ζῴων ἢ ἰχθύων, and other titles. The hypothesis, according to which these 'titles' are to be identified with the work of Aristophanes of Byzantium, has now been set aside in favour of the hypothesis that Aristophanes drew on Aristotle's *zoika*, as well as on other works.[54]

It is probably to the *zoika*, and to comparable materials such as the *iatrika*, that Aristotle refers when he speaks of ἱστορία ὑπάρχουσα περὶ ἕκαστον, as in *Hist. an.* 1.6, 491a12 (above, 3.6).[55] These were collections in which Aristotle's personal contribution was intermingled with that of others, starting with Theophrastus.

It is therefore a matter of *collective works, of common, shared knowledge*—just like that of the doctors, which Robin Lane Fox has recently described as a 'database', i.e. material that continued to be expanded during Aristotle's lifetime and afterwards, as was the *Hist. an.*; material that did not start from scratch but drew on what already existed, including the different types of texts, written in various formats or circulating orally, on medical topics. The *Problemata*, which in their current form are certainly post-Aristotelian, offer an example of how this material could grow and change: book ten, probably from the

52 Regenbogen (1961) 274.
53 See Manetti (1999) 137 f.
54 So Berger (2012); already Kroll (1940).
55 See Düring (1966) ch. IX (Italian transl. 577).

age of Strato, has been regarded as essentially an epitome of Aristotle's zoological writings;[56] I would rather say a select reorganization of Aristotle's *written material* on zoology.

Categories like 'original' or 'authentically Aristotelian' have no place among these texts, just as it is pointless to search after what is authentically 'Hippocratic' in the writings aggregated under the label 'Corpus Hippocraticum'.

By looking at Aristotle's fragments, one realizes that each animal was first introduced by a name, which was followed by specific descriptive information.[57] It is certain, as Düring notes, that the *zoika* also incorporated material from the seven zoological works of Theophrastus; indeed, this type of collection *never had a first, or final, 'finished form'* to which other blocks of material could be added later, but was a work in progress from the beginning. *There is no authorial identity to search for*.

3.8 Zoika *and* iatrika *in the Catalogues of Aristotle's Writings*

Support for this argument can be found in the catalogues of Aristotle's works preserved by both Greek and Arabic sources. More than one third of these titles are certainly preparatory material and collections of notes,[58] while many others, including those preserved today, are lecture notes, texts meant for internal use, reorganised notes or, as in the case of the *Historia animalium*, notes that served as a starting point for further elaboration. As has been observed,[59] the index in Diogenes Laertius includes 550 βιβλία, a huge number that could hardly all derive from the hand of Aristotle alone. Among the works that refer to collections, judging by their title, there are many ὑπομνήματα, to which we can add ἀπορήματα, διαιρέσεις, ἐπιχειρήματα ("Aufzeichnungen von Argumenten für und wieder", Düring), ἐνστάσεις (dialectical oppositions), θέσεις, ὅροι, προβλήματα, παραγγέλματα and προτάσεις. Many of these descriptors refer not to works, but to material that Aristotle or those around him kept for their own use. The Hippocratic corpus also contains similar collections of sayings of various kinds,

56 Flashar (1962) 322. On the *Problemata*, see Mayhew (2015). The *zoika* became the source for collectors of curiosities, including Pliny. The difference between Pliny's *cabinet of curiosities* and Aristotle's work is illuminating: only in the latter (*Part. an.*, *Gen. an.*, but also *Hist. an.*) is a search for sense at stake, a systematic *interpretation*, with a heuristic aim, of the sheer amount of data. It is the principle of τὰ ὁμολογούμενα συνορᾶν of *De gen. et corr.* 1.2, 316a5.

57 Interesting structural similarities are in the first part of the Egyptian ophiological papyrus Pap. Brooklyn Museum n. 47.218.48 and 85.

58 "Klassifikatorische Vorarbeiten und Materialsammlungen" according to Düring (1968) 326.

59 Düring (1968) 187.

e.g. *Aphorismi*, *Coan Prenotions*, *Prorrheticon* book I,[60] or collections of textual units, such as the majority of the technical works. It is difficult, and perhaps fruitless, to attempt to distinguish between original and spurious writings in the catalogues of Aristotle's works, or to identify titles that were inserted at a later stage: recent studies have shown that the different catalogues may mirror different stages of the transmission of Aristotle's works.[61]

The tradition of lists of Aristotle's works in Greek and Arabic is intricate, and the topic has seen a resurgence of scholarly interest, including the CUF edition of Ptolemy's Life, Testament and Catalogue.[62] There is a generally sceptical attitude towards the several titles referring to medicine, which is not surprising given the inconsistencies in position of these titles in the various catalogues. The catalogues exhibit differences also as regards titles on medicine (ἰατρικά / περὶ ἰατρικῆς): although considering all three, for the sake of clarity I will mainly follow Diogenes' text.[63] The impression is that the data transmitted do not cohere with the schemes to which we are used and into which we try to pigeon-hole and normalise the data. Let us focus on just a few elements.

Several works on animals are listed in the catalogues: among them the περὶ ζῴων α' β' γ' δ' ε' ς' ζ' η' θ' (D.L. 102) corresponds, according to Moraux, to *Hist. an.* I–IX; no information is available on the ὑπὲρ τῶν συνθέτων ζῴων α' (105) and ὑπὲρ τῶν μυθολογουμένων ζῴων α' (106), and Moraux considers them as works preliminary to *Hist. an.*; scholars agree that the work listed as ἀνατομῶν α' β' γ' δ' ε' ς' ζ' (103) will have contained descriptions accompanied by tables.

Then comes a writing referred to as ἰατρικά β' (D.L. 110). Moraux hastily condemns this as spurious, but his argument sounds unconvincing. He refers to the work of Heitz on the lost writings of Aristotle, and remarks that "le philosophe se comptait parmi les profanes (μὴ τεχνῖται) en matière médicale [the reference is to *De div. somn.* 463a6–7], et le περὶ νούσου καὶ ὑγιείας qu'il avait écrit était l'oeuvre d'un physicien, non d'un médecin". Others have identified the *iatrika*[64] with the Anonymus Londiniensis (on the basis of Galen, who mentions an

60 See Witt (2022).

61 See Moraux (1951), Dietze-Mager (2015), Primavesi (2007), Rashed (2021).

62 The three catalogues are Diogenes Laertius; *Vita Menagiana*; Ptolemy el-Gharib, recently published in a critical edition by M. Rashed. An MA Thesis (2020) by E. Rovati at the University of Zürich also contains a translation and study of Ptolemy's life and catalogue. See also Hein (1985).

63 ἰατρικά is D.L. item 110; περὶ ἰατρικῆς β', *Vita Menagiana* 98, περὶ ἰατρικῆς ζ' ibid. 167; (περὶ) ἰατρικῆς in Ptolemy 99 (Düring's numbers); the last item in Ptolemy's text lists one book in which Aristotle "had gathered *Definitions on medicine*".

64 It is not always clear whether scholarly references to *iatrika* in relation to the *Anonymus* or *Problemata* refer to the item with this title in Aristotle's catalogues (D.L. 110).

iatrike synagoge attributed to Aristotle and says it is instead the work of Meno),[65] or with the *Problemata*, or with the source of those writings; Hermann Diels in his edition (p. 414) thought that the Anonymus had only indirect access to the *iatrika / Menoneia* by way of the *areskonta* of Alexander Philaletes, a work that he surely knew, but Manetti has argued instead in favour of a direct use.[66]

Indeed, contrary to the Arabic scholars of late Antiquity, Moraux considers as suspicious all testimonies referring to any medical activity by Aristotle, and writes that "tout indique donc que *les* ἰατρικά *ne sont pas authentiques*. On a voulu retrouver, sous ce titre, le premier chapitre de notre collection des Problèmes [the chapter in question is entitled ὅσα περὶ ἰατρικά] … le titres de l'ouvrage aurait alors été déplacé, car il devrait figurer dans la section réservée aux *Problèmes*. Nous eroirions plus volontier que les ἰατρικά de la liste ne sont autres que le fameux ouvrage médical de Ménon, un disciple d'Aristote, car les anciens attribuaient d'ordinaire cet ouvrage au Stagirite. L'auteur y énumérait les causes et les variétés des maladies; il exposait aussi les placita de ses prédécesseurs. L'ouvrage se situait donc dans la tradition historiographique péripatéticienne qu'avaient illustrée les δόξαι de Théophraste et les histoires des mathématiques et de l'astronomie d'Eudème".[67]

These attempts to remove the problem of the ἰατρικά from the catalogues of Aristotle's writings seem unwarranted, and already Gigon conceded that Aristotle may have written on medical topics from the point of view of the *physikos* ("also nicht in der Absicht eine Therapie zu empfehlen, sondern einen Befund zu erklären").[68] Yet, as with the *zoika*, I am inclined rather to think of a collection of materials, or a collection of 'files', comprised of notes and memos. The title itself may suggest this,[69] and there are parallels in other titles of lost writings, such as the *physika* (cf. Moraux 115), *optika* (p. 113), *mathematikon* (p. 93), *politika* (p. 95), *mechanikon* (p. 120), *methodikon* (p. 97). There are, moreover—especially in the Arabic catalogues—, books labelled as "Notes", "Other Notes", or *Memorandum* (i.e., ὑπομνήματα *vel* μνημονικόν, see Ptolemy nr. 94 Düring), and others.[70] Moraux wonders whether the *optika*, for example, is a work by

65 Gal. *In Hipp. Nat. Hom. comm.* 1.1 (XV 25,15–26,2 K. = Aristot. fr. 354 Gigon). See Manetti (1999) 98.

66 See Manetti (1999) 99.

67 110 f. Moraux adds (p. 186 f.): "La présence des deux écrits apocryphes que sont le φυσιογνωμονικὸν α′ (D.L. 109) et les ἰατρικὰ β′ (D.L. 110) ne laisse pas non plus d'être fort suspecte: ce sont quasi le seuls ouvrages *indubitablement apocryphes*", etc. See also 188 f.

68 Gigon (1987) 511. On titles of medical works in Aristotle, see also van der Eijk (2022) 106 ff.

69 In Thrasyllus' catalogue of Democritus' writings, *mousika, physika* etc. indicate the thematic titles of the sections according to which his catalogue is organised.

70 For Aristotle's catalogues and this *genre*, see also Dorandi (2016); Blum (1991).

Aristotle; the *Problemata* refer to them (I, 913a27), and the quotation suggests that, as with zoology and medicine, it is a matter of a collection of memos and notes that can be considered 'Aristotelian' only in the broad sense in which this label is applied to this kind of compilation. If this is accepted, and if this collection also, perhaps indirectly, formed the basis of the Anonymus Londiniensis, it would help to explain the seemingly perfunctory character of the last part of the papyrus.

There have also been attempts to identify the 38 books of φυσικῶν κατὰ στοιχεῖον with the *Problemata*, but insuperable difficulties stand in the way. Here, *the ordering* κατὰ στοιχεῖον is significant, since the alphabetical order is typical of works intended for quick consultation, not for continuous reading, exactly like repertories of various kinds, especially lexica. They are tools, *Hilfsmittel*: and the alphabetical order requires that either the text be transcribed at least twice, and probably three times, in order for the items to be gradually ordered (first on the basis of the first letter only, then perhaps also on the basis of the second or third); or, the items must be written on 'slips', small pieces of papyrus, that could be moved around and put in the right order before copying them on the final support (as in *Zettelkästen*). In my opinion, the latter is more likely.[71]

For Aristotle, this type of arrangement is attested in the collection of Constitutions that he and his followers assembled; it therefore suggests that here too a collection of materials had already undergone a phase of reorganisation, introducing an arrangement that is typical of a working tool as opposed to a work of authorship. This can be considered as a confirmation that this kind of work—*zoika, iatrika, physika, optika*, etc.—were collections of notes for personal use. In some cases, authors' names would have been available; in others, probably not. The latter must have been the case with medicine and the ἰατρικά.

3.9 *The Catalogues of Aristotle's Writings: The Arabic Tradition*

Arguments against the authenticity of this kind of title also take into account the position, inconsistent as it is, in which they were inserted into the list.

71 On alphabetical ordering, see Perilli (2017) 94–101, with bibliography. Some recently published papyrus fragments (collectively identified as *P.Köln Lexikon*) have significantly altered the picture as regards the age in which full alphabetical order (i.e. taking into account whole words and not only the first two or three letters) was introduced: if the proposed date of composition of the papyrus is correct, as it seems, full alphabetical order was already current in the third century BC (i.e., much before the second century AD—Galen and Harpocration—as previously hypothesised, also by myself). See Vecchiato (2022). This is a remarkable novelty, which might have consequences also concerning the use of alphabetic ordering by Aristotle and his school.

According to most recent studies, however, especially those on the Arabic catalogue attributed to a Ptolemy, a specific interest lies in the variations between the versions of the manuscript and of Ibn al-Qifti and Ibn Abi Uṣaybi'a. These three different drafts seem to correspond to different phases of the manuscript tradition of the works, and therefore the view that Apellicon of Teos and his library were among the ancestors of the list of Ptolemy el-Gharib also becomes an issue of further consideration.[72]

We can assume[73] that at a certain point in history the ancients had to deal with Aristotelian writings, or collections of materials, which had become difficult to find (and this, one may add, precisely because they often were *hypomnemata*, unfinished 'writings' that did not seem worth reproducing).[74] A copy had however remained in the library of Neleus, which was later rediscovered by Apellicon of Teos. The fact that Ptolemy's catalogue differs from Andronicus' *pinakes* and reflects a different stage of the story of the Peripatos, rather than implying inauthenticity and interpolated titles, often in the wrong place, instead suggests that some titles were added from one list to another when the drafter realised that something was missing: it was at this point, namely when it became possible to compare different lists, that some titles were inserted from one index into the other, and were inserted either at the end of a column or wherever space was available, and thus usually out of order.[75] This apparent inconsistency cannot therefore be used to classify the works listed in the indexes as 'non-Aristotelian'.

Primavesi sums the matter up: "Ptolemaios al-Gharib führt neben vielen anderen Titeln auch nahezu sämtliche echten Schriften des uns überlieferten Corpus Aristotelicum an, wobei auch die angegebenen Buchzahlen mit denen der uns überlieferten Schriften weitgehend übereinstimmen. Im hellenistischen Verzeichnis hingegen werden diese Schriften teils gar nicht genannt, teils werden einzelne Bücher oder Büchergruppen größerer Werke unseres Corpus als selbständige Schriften gezählt … Das Verzeichnis des Ptolemaios al-Gharib … würde dann ein Stadium der Überlieferung repräsentieren, in dem jene Schriften wieder zugänglich geworden waren". The texts that had not reached the Alexandrians became available again when the library of Neleus

72 Primavesi (2007); Dietze-Mager (2015) 158.

73 Following Primavesi.

74 See Dietze-Mager (2015) 108: "Als wahrscheinlichste Hypothese ergibt sich, daß die meisten Schriften des Aristoteles … zugänglich waren … Andererseits scheinen Bücher aus der Bibliothek des Aristoteles und Theophrasts in Skepsis gelagert gewesen zu sein, die erst im 1. Jh. v. Chr. wieder zum Vorschein kamen und für die Öffentlichkeit zugänglich wurden."

75 See Dietze-Mager (2015) 124.

of Scepsis came to light: the indexes could now be supplemented and the 'edition' of Aristotle's works could be enriched and improved.

Finally, it should be remarked that ibn Abi Uṣaybi'a lists Aristotle's titles in a work devoted not to Aristotle but to *physicians*: at least in the Arab world, the image of an Aristotle with truly medical interests was not an aberrant one.[76]

Given Aristotle's method of working and collecting data, as sketched above, and given the features of the written material of medical argument that was part of his corpus, as attested especially by the indexes, it is possible to form a more consistent and historically reliable picture of his use of medical sources, which themselves had the peculiarities that we previously described.

4 Aristotle and the Features of Some 'Hippocratic' Texts

We have excellent examples of the way in which these medical texts originated from preliminary materials variously assembled or used. For both Aristotle and the *CH*, categories such as epitomes and expansions are better avoided, as well as the idea of pieces of information that are extant in one work and *not yet* in another—notions that instead are often adopted in this case of Aristotle's use of medical material. A different perspective can help when comparing the acroamatic Aristotle and individual works of the *CH*, and also in the post-Aristotelian period associating, for instance, *Problemata* and *De aëribus*: it may rather be a matter of different possible versions of the same doctrine. More generally, although it cannot be excluded that in some cases there may have been an influence, the very fact that in Aristotle the coincidences with the *CH* usually consist of short passages, often just of a few lines, seems to corroborate this hypothesis.

Some cases, internal and external to the *CH*, can briefly clarify the point.[77] The first book of the *Problemata* would require a separate analysis, because it reveals a profound familiarity with medical topics (and therefore sources) and also pays attention to those aspects of therapeutics that are often overlooked in the acroamatic Aristotle. A systematic comparison between the latter and *Probl.* 1, going beyond and deepening what has been done by Marenghi (1961) and Flashar (1962), among others, might throw light on the attitude of Aristotle himself, as the attitude not of a doctor but of a natural scientist who takes an approach to medicine functional to his own broader perspective.

76 The work is 'Uyūn al-anbā' fī ṭabaqāt al-aṭibbā, "Wesentliche Nachrichten über die Klassen der Ärzte"; see Savage-Smith et al. (2020).

77 More details in Perilli (2024).

Moreover, *Probl.* 1 may be seen as directly based on Aristotle's lost medical writings, as argued by R. Mayhew especially in relation to the last three chapters (55–57), which have an unusual structure and omit the initial question.[78] In this paper, however, I am dealing only with the acroamatic Aristotle.

4.1 *Some Examples from the* CH*, and the Case of Praxagoras.*

1) **Mochlicon**. In analysing the description of bones in *Fractures* and *Joints*, Dieter Irmer once tried to clarify a difficult passage of *Joints* (*Artitc.* IV.194.3 L.) by referring to a *Parallelversion* offered by the first chapter of *Mochlicon* (4, IV.340.15 L.), a work that is thematically connected to the two major surgical works. He thought that the latter version was "teils epitomiert …, jedoch auch sachliche Erweiterungen enthält", i.e. a partial epitome with factual additions.[79] This sounds quite similar to the abovementioned descriptions of Aristotle's alleged use of Hippocratic passages (see 4.2) and to statements like "Aristote a repris les informations du médecin en les amplifiant" etc. The case of *Mochlicon*, however, has been correctly assessed by A. Roselli, who demonstrated that it is not a matter of direct derivation of material, but of the autonomous use and editing of a shared knowledge base, a different draft of the same doctrine, which in one case is adapted to therapeutic needs (*Fract. / Joints*), whereas in the other to a more general frame (*Mochl.*).[80] This is directly applicable to a comparison of the works of the *CH* with the acroamatic Aristotle and the Aristotle of Aristotelianism: correspondences of various kinds, some more and some less faithful, and at the same time divergences, are often to be explained not in terms of Aristotelian reworkings of Hippocratic texts but, on the contrary, as a different use of the same textual units from a common knowledge base.

2) Attention should be drawn to two cases from *De generatione animalium*. The first because in it Aristotle has been seen to reproduce almost verbatim[81] a passage from *De natura pueri*, one of the works that are most 'present' in Aristotle's writings; the second because in it a shared conception between Empedocles and the Hippocratic *De victu* is believed to have reached Aristotle precisely by way of *De victu*.

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78 I agree with Mayhew (2015) in considering the last three chapters of *Probl.* 1 as "taken from a lost medical treatise of Aristotle". I would not be surprised to learn that these were notes and transcriptions from medical sources that Aristotle kept in his archive for further use (as I imagine his *iatrika*); but this might well be a topic for a future investigation. I thank Philip van der Eijk for bringing to my attention Mayhew's article.

79 Irmer (1980) 272.

80 Roselli (1996) 220 f.

81 See Joly (1970) 68 n. 1; Byl (1980) 87.

2a) ***Gen. an.* and *On the nature of the child*.** The first case: according to some interpreters, Aristotle literally takes up the doctor's explanation that the infant is born with its head forward "because the upper parts, measured from the navel upwards, are heavier": χωρεῖ δὲ (τὸ παιδίον) ἐπὶ κεφαλὴν ἢν κατὰ φύσιν ἴῃ· βαρύτατα γάρ ἐστιν αὐτῷ τὰ ἄνω ἐκ τοῦ ὀμφαλοῦ σταθμεόμενα (*Nat. puer.* 30, VII.532 L. = 218,11–13 Giorgianni).

Aristotle writes (*Gen. an.* 4.9, 777a28–31): ἐπὶ κεφαλὴν δ' ἡ γένεσίς ἐστι τοῖς ζῴοις πᾶσιν ἡ κατὰ φύσιν διὰ τὸ τὰ ἄνω τοῦ ὀμφαλοῦ μείζω ἔχειν ἢ τὰ κάτω. καθάπερ οὖν ἐν ζυγοῖς ἠρτημένα ἐξ αὐτοῦ ῥέπει ἐπὶ τὸ βάρος. ἔχει δὲ τὰ μείζω πλεῖον βάρος. "La confrontation des textes est éclairante et démontre la dépendance du biologiste par rapport au médecin".[82] This is one of the few instances where a dependence is so emphatically asserted; but even in this case, which seems more difficult to refute, the hypothesis of a 'resumption with expansion', in which Aristotle develops his own conception having been inspired by the doctor's statement, is the result of a pre-conception based on modern practice. If anything—and if the dating of the two works had allowed it and a direct relationship were to be assumed—after reading the two texts one could say that the doctor, whose statement is generic and reflects no more than common knowledge, depends on Aristotle's text. But the relationship is probably indirect, no more than a thematic nexus, a sharing of common knowledge, disseminated both orally and in writing in a dynamic system of complex interactions, reported from copy to copy, presented in lectures and readings, and variously put in writing by listeners. "From copy to copy" does not mean that the work circulated in its entirety as we read it: as with Aristotle's description of blood vessels and the parallels in *Nat. oss.* and *Nat. hom.* (see below, nr. 6), it is likely that individual blocks of text were filed separately, copied as such, put into circulation, then joined with others to form a 'work'.

2b) ***Gen. An.*, Empedocles and *De Victu*.** The second example of a direct relationship between Aristotle and Hippocrates, that of *Gen. an.* 5.7, 788a22–26, concerning passages already pointed out by Fredrich, Byl and others, is also significant: Aristotle is said to have adapted and transposed here an earlier theory that must have been that of Empedocles as attested by *De victu* 1.36 (VI.524 L. = 156,28–32 Joly-Byl).[83] The theory concerns the cause of the roughness or smoothness of the voice, which is made to depend on the surface of the organ, itself rough or smooth. Of course, it is said, Aristotle's scientific prose is not that of the author of *De victu*, which remains influenced by the Empedoclean vocab-

82 Byl (1980) 87.

83 See Fredrich (1899) 109 and 140; Joly (1960) 82.

ulary, but nevertheless it must be acknowledged that the explanation proposed by the two authors, Aristotle and the physician, is identical. Yet if the vocabulary with respect to *De victu* is so different as to require an explanation, what prevents us from thinking instead that Aristotle knew Empedocles directly and referred to him, Empedocles being an author whom Aristotle knows, quotes, holds in high esteem, and mentions as an example of an authoritative predecessor whose views are always worth quoting (see above, 3.4)?

3) **Praxagoras.** Comparable assessments were reached concerning the possible influence of the 'Hippocratic' writings on Praxagoras of Cos.[84] Diethard Nickel convincingly concluded that, contrary to what had previously been argued, "critical comparison of these texts with Praxagoras' fragments 70/71 clearly shows that *there is no connection between the respective doctrines*." Although it is easy to detect common elements between Praxagoras and *De morbo sacro*, "*these do not prove that Praxagoras was dependent on this text, but that both Praxagoras and the author of this work were woven into a more general network of relations*." It is a matter of commonly shared ideas, of a network of relations in a shared context.

4) ***Gen. an.* and *On Airs, Waters, Places***. This approach can also be applied to the example of *Gen. an.* 4.2, 767a30–35 and its comparison with *De Aëribus*. Since Aristotle states that the condition of the body depends on the weather and the food ingested, it is commonly stated he must have known ch. 1 of *Aër.* (a report of a medical doctrine typical of the environment called Hippocratic), although the similarity between the two texts may appear superficial, as said.[85] Moreover, the words with which Aristotle continues ("because water is available in abundance, it is present in all foods, even solid foods, and for this reason hard and cold waters produce sterility in some cases, in others the birth of females"), are taken as evidence that he has before his very eyes the treatise *De Aëribus*, and that in chap. 8 of this work he read that "there is liquid in everything", ἐξ ἁπάντων ἐν ὁκόσοισιν ὑγρόν τι ἔνεστιν· ἔνεστι δὲ ἐν παντὶ χρήματι, while in chap. 4 he learnt that many women are sterile because the waters are hard, indigestible and cold. Byl (p. 81f.) provides a characteristically explicit articulation of this argument: "La comparaison des textes est édifiante: Aristote a repris les informations du médecin en les amplifiant; selon lui, les eaux dures et froides provoquent non seulement la stérilité mais parfois aussi la naissance de femelles, ce qui, dans une mentalité préscientifique, n'est guère très différent".[86]

84 Nickel (2005) 315 and 322. My italics.

85 Byl (1980) 92.

86 The notion of prescientific mentality is no longer acceptable.

This type of analysis presupposes a rather simplistic idea of the circulation of knowledge in the ancient world, as though only these two works existed and so had to be mutually related despite all variations. Moreover, even here one is forced to concede that Aristotle amplifies and develops, which is unmethodical. That being said, a writing like *De Aëribus* could certainly have been among the most interesting for Aristotle, and known to him, as it was presumably known to the authors of the *Problemata* or at least of some chapters of that work.

5) **Humoral theory**. The case of the theory of humours, as studied by Philip van der Eijk and Paul Demont, also offers interesting insights.[87] The notion of ὑγρόν, 'fluid', in Aristotle (who classifies it among the uniform parts, 'homoeomeries') has nothing to do with the 'Hippocratic' idea of humour, and in particular nothing to do with the idea of a system of four humours such as that elaborated in *De natura hominis*. The very idea of humours as *residues*, a typical Aristotelian notion, is unknown in the *CH*. Examples from *Hist. an*. on the use of ὑγρόν and χυμός confirm this absence: the idea of influence is quite out of place here ("kaum von hippokratischer *Beeinflussung* geredet werden kann", van der Eijk, a conclusion shared by Demont), and it is rather, once again, a matter of a broader network of dynamic interactions within a common context, a particular type of shared source material, and of the modalities of the circulation of knowledge.[88]

6) **Blood vessels in *Hist. an.*, *Nat. hom.* and *Nat oss*.**: The famous case of the description of blood vessels in Aristotle *Hist. An*. as well as in two medical texts contained in the *CH* calls out for comment.[89] The text is *Hist. an*. 3.3 (512b12–513a7), as compared to *De natura hominis* 11 (VI.58–60 L. = 192,15–196,5 Jouanna), while also showing a close resemblance to *On the nature of bones* 9 (IX.174–178 L. = 144,18–146,22). The Hippocratic texts are similar to each other, whereas Aristotle introduces several changes. Irregularities and differences are also found in the texts of the *CH*, and in *Nat. oss*. we can see repetitions, and an irregular style devoid of literary quality.

Scholars have tried to explain away these irregularities and remove the difficulties; however, it is in fact *precisely these variations and difficulties that are*

87 For what follows, see van der Eijk (1990), mainly 52 f., and Demont (2005) 278 f.

88 'Shared knowledge', and interaction in a debate, is how I would also describe the relationship between Aristotle's biological writings and earlier philosophically inclined medical tradition (e.g. *Regimen*, *On Fleshes*, *On Ancient Medicine*) as investigated by Bartoš (2021) 48 f., and (2021a), e.g. 149; also Bartoš (2010).

89 This description has been much studied—e.g. Fredrich, Duminil, Grensemann, Jouanna, Althoff.

decisive. We should *enhance, not remove them*: the 'knapper Notizstil' of the final part, as Althoff has defined it, presumably refers to a different unit of text added to the previous one, a text that Aristotle in turn does not add or that he simply does not have. Both an *irregular miscellany* such as *Nat. oss*. (of which chs. 11–19 circulated as a separate work entitled *Vessels*, and so were known to Galen), and a *miscellany without coherence* such as *Nat. hom*. (that according to Galen was composed of *many textual units* stitched together,[90] see *Comm. in Hipp. Nat. hom*. XV 10 K., and above p. 41 on Polybus' possible authorship), exemplify the case of medical works consisting of originally separate textual units, possibly used by different authors and adapted to different contexts. If this hypothesis is correct, then Aristotle does not manipulate the text of *Nat. hom*. and rather might have used a different version of a theory of blood vessels that circulated in a variety of forms. It would follow that Aristotle did not necessarily know and use a work like *Nat. hom*. in the form that would eventually be known to Galen and to ourselves.

7) **The story of Aristagoras at Epidaurus**. For an extant example of the circulation of the same text in similar yet different forms, on two different media (stone and papyrus), for two different audiences, the story of the miracle healing of Aristagoras of Troezen can be mentioned, as this is attested on the one hand among the inscriptions of the sanctuary of Asclepius at Epidaurus, and on the other hand in several but not substantial differences in *On the nature of animals* IX.33 (II cent. CE) by Aelian, who claims to have found the story in the work of the historian Hippys of Rhegium (fifth or fourth century BC).[91]

4.2 Anonymus Londiniensis *and the 'Wrong' Hippocrates*

The question remains whether the Aristotle of the *Anonymus Londiniensis* is compatible with the others. In trying to answer, additional problems arise. The author is certainly more compatible, but still to a limited extent, with the Aristotle of Aristotelianism and the *Problemata*, probably because both works draw on collections of notes that were circulated and also enlarged and revised after Aristotle; but he is much less compatible with 'our' acroamatic Aristotle. The Anonymus shows a familiarity with physicians and medical theories on the causes of disease that is usually traced back to the Lyceum (the main one being the notion of *perittoma*, 'residue'), but the chronological distance is considerable and, when added to the problem of the sources of the papyrus (the

90 See Fredrich (1899) 13 f., 21 ff.; Craik (2015) 210–212. The fact that the work bears traces of the stitching together of several independent parts is not at odds with Galen's idea that the first part of the work was typically Hippocratic.

91 See Perilli (2009) and (2023).

Menoneia? The *iatrika*? The *Menoneia* = *iatrika*?, or rather, as Manetti argues, not a single text but a combination of different texts?),[92] it becomes even more difficult to identify information that can be traced back to Aristotle himself rather than to some undefined stage in the history of the reception of his theories.

On the other hand, according to the author of the papyrus, Aristotle had only an approximate knowledge of the figure referred to there as 'Hippocrates', so that the Anonymus himself feels the need to reassert what he believes to be the historical truth (*Anon. Lond.* VI 43 ff.). True, this may be due to the fact that the figure of Hippocrates had undergone a dramatic change in the Alexandrian age as compared to the previous century, and that the Anonymus is therefore mirroring a later state of affairs—a different image of 'Hippocrates'—but still, "it is very difficult to identify the Aristotelian stratification within the manipulation carried out by the Anonymus".[93]

While the Aristotelian section of the Anonymus and common sense make it difficult to believe that Aristotle was not sufficiently familiar with medicine and with contemporary or earlier physicians, the impression one has from the papyrus is that the opinions of physicians were indeed known within the Peripatetic milieu (though it is not easy to pinpoint when), but not studied in their own right. It is also worth noting that among the names mentioned in the 'Aristotelian' section it is problematic (if not irrelevant) to distinguish between physicians and physiologists, and that the authors are mentioned for more general theories on disease. Moreover, it is remarkable that the doctrines that this 'doxographic' source declares to be Hippocrates' own correspond mainly to *De natura hominis*—a work that Galen dismissed as a disorderly assemblage and that Aristotle himself, at least for one section, associated with an author who was not Hippocrates (i.e., Polybus).[94] Since our aim is to identify the features of Aristotle's sources, it appears that the papyrus provides valuable information but no clarification.

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92 See above, 3.7 and 3.8. A detailed analysis of the 'Aristotelian' section in Manetti (1999; on the mix of sources, see p. 105).

93 Manetti (1999) 120.

94 On this, see van der Eijk (2012) 1509. See also above, p. 61 and n. 90. The Anonymus himself (ch. XIX 2–18) mentions a doctrine of four humours/qualities that, if the reconstructions of the text are reliable, attributes to Polybus a theory similar to the one of *Nat. hom.* 3–4. The section on Hippocrates that the Anonymus attributes to his 'Aristotle' has been said to correspond to *De flatibus* (whose theory 'Aristotle' seems to have misunderstood), but I generally agree with those who, like L. Edelstein and G.E.R. Lloyd, are sceptical about the possibility of identifying precisely, from among the extant works, the sources of the doxographic account.

5 Conclusion

5.1 *'Sachliche Kongruenzen' and 'Similienstatus'*

While it is undeniable that the acroamatic Aristotle was familiar with medical doctrines, it appears that, given his outlook as a *physiologos*, his interest in medicine was focused on its capacity to help construct his more general ideas about causes, nature and man. Plato, too, had described Socrates' impatience with doctors and their language, those "ingenious sons of Aesculapius" with all their "newfangled and monstrous strange names of diseases": Socrates had heard the new terms, he had observed a process of innovation, and was convinced of their uselessness.[95]

No matter how attentive Aristotle was to the long tradition of observations he could refer to, what really interested him was undoubtedly the speculative synthetic perspective.[96] He demotes medicine to an applied and therefore subordinate technique, equivalent to the other specialised forms of knowledge he addresses.[97] It is a rare good fortune that we still have writings such as *Hist. an.*, *Metaphysics* and others that exhibit the traits we have discussed so far, rather than being coherent and polished works: we can thus observe the specialist at his workbench and in the 'lecture room'.

We can accordingly accept the cautious but conscious conclusion proposed by A. Anastassiou and D. Irmer in the Introduction to *TeCH* I: there are factual congruences (*sachliche Kongruenzen*) between the acroamatic Aristotle and the *CH*, just as there are, albeit fewer, with Plato. These are partly *Allgemeingut der Gebildeten*, common knowledge shared among the educated, whether it be anatomy or folk medicine, and partly due to common sources, given the frequent stylistic, linguistic, and sometimes even substantial distance. In short, as compared to the *CH*, "die … Aristotelischen Perikopen haben somit den *Similienstatus*".

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95 Plat. *Resp.* 405 d. 1–6. See Demont (2005) 276.

96 On Aristotle on philosophy and medicine, see van der Eijk (2022).

97 Vegetti-Lanza (1971) 19; van der Eijk (1995) 449–452, and (2005) 196.

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CHAPTER 2

Physicians and Philosophers on Well-Balanced Mixtures

Hynek Bartoš

Introduction

Both Plato and Aristotle describe sensible objects as a kind of mixture of elements (and their qualities), they both agree that bodies of living organisms and their parts come into existence and remain alive and healthy only as long as the elemental parts of their mixtures retain in a kind of balance, and they both typically use the terms (*syn*)*krasis* and (*sym*)*metria* when discussing these topics. The philosophic discussions of mixtures in Plato and Aristotle are commonly interpreted against the backdrop of pre-Platonic philosophy, especially Parmenides, Alcmaeon, Empedocles, and Democritus, while the Hippocratic precursors of the idea often remain unnoticed.[1] This is unfortunate not only from the historical point of view, as it gives a false impression that Early Greek philosophy and medicine developed independently from each other, but also because it underestimates the value of the Hippocratic evidence for our understanding of Plato's and Aristotle's own accounts.

In this paper, I focus on the early history of the concept of a well-balanced mixture, which is denoted by the terms *krēsis* (or *synkrēsis*) and *metriē* (or *symmetriē*). In the first part, I make the case that this conception originated in a specific medical tradition, and that practically all non-medical evidence from the end of the fifth century BC employs the terminology in medical contexts or in analogy with medicine. In the second part, I focus on Plato and argue that he was not only well informed about the medical theory but also that he employed it occasionally in his own accounts and thus introduced it into philosophical discussion. In the remaining parts, I shall successively discuss all occurrences of *krasis* and *synkrasis* in Aristotle's works and divide them thematically into three

1 E.g. Hershbell (1983), Wright (1990) 217, Hussey (2006) 17, Sassi (2015), Gulley (2017). See also Jouanna (2002) 256. The significance of the Hippocratic evidence has been noticed by Peck (1937) 37–39, (1942) lv–lvii, (1965) lxxv–lxxvii, and Tracy (1969) 32–76, and most recently revisited by Mirrione (2021), Popa (2014) and (2021), Morel (2021), and Bartoš (2021) 51–53. All translations are listed in the 'Texts and editions used'.

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groups. I start with the relation between *mixis* and *krasis* (part 3) and then focus on the use of *krasis* in respect to health, environment and procreation (part 4). Finally, I discuss the concept of *krasis* in relation to blood, intelligence and soul (part 5). In these parts, I will explore the extent to which Aristotle draws on the medical theory and accommodates it into his own accounts, and also how much he innovates and broadens its scope of application.

1 Krasis *before Plato*

The ancient Greek term *krasis* derives from the verb *kerannymi* and refers to the tradition of mixing wine with water in order to make it a healthier, more drinkable and less harmful beverage.[2] Homer already uses the verb in this context, although he never employs the noun *krasis*.[3] And, apart from a limited number of medical texts and a few isolated occurrences of the expression in non-medical authors, the term *krasis*/*krēsis* (as well as *synkrasis*/*synkrēsis*) is almost entirely absent from pre-Platonic literature. It is extremely rare in Greek drama; one can find it neither in Herodotus nor Thucydides, nor in the Greek orators, such as Gorgias and Lysias. There is no reference to *krasis* in Plato's "early" dialogues, and there is only one isolated occurrence in Xenophon.

Probably the earliest piece of evidence for *krasis* as a blend of wine and water is a fragment from Aeschylus describing libations of wine.[4] There are also a few pre-Platonic passages in which *krasis* is used metaphorically (i.e., as something that is likened to the blend of wine and water): Sappho speaks about the *krasis* of "wealth and virtue";[5] Euripides about the *synkrēsis* of "good and bad deeds";[6] and Charmides in Xenophon's *Symposium* about the *krasis* of young people's beauty and the notes of music.[7]

The only possible pre-Hippocratic evidence for *krasis* (as a mixture in the human body) is Parmenides' fragment B 16[8] and Empedocles' B 22.[9] There is

2 Cf. Plato, *Leg*. 773d1–4, Xenophanes DK 21 B 5, and the Hippocratic *VM* 20 (1.622 L. = 52,2–4 Heiberg).

3 See Montanari (1979) 99–104, and Sassi (2015) 11.

4 Aeschylus (Tetralogy 9, play A, fr. 67,12, ed. Nauck).

5 Sappho, fr. 148,2 (ed. Lobel-Page).

6 Euripides, *Aiolos*, fr. 21,4 (ed. Nauck).

7 Xenophon, *Symp*. 3,1.

8 Parmenides DK 28 B 16: "ὡς γὰρ ἑκάστοτ' ἔχει κρᾶσιν μελέων πολυκάμπτων, τὼς νόος ἀνθρώποισι παρίσταται·" A literal rendering of *krasis* as "mixture" or "blend" is by no means certain, as Hershbell (1983, 48) points out. "A metaphorical meaning of *krasis* is possible, and given the interpretation of *meleōn* as the limbs of the human body, almost necessary." Cf. Sassi (2015) 11: "Parmenides is not so much interested in the problem of health and disease as he is in understanding how the process of cognition normally works. In fact, his concept of *krasis* does not regard that issue which will be central to the Hippocratic discourse, namely, the interaction

no doubt that both philosophers played an important role in the pre-Platonic philosophy of nature and that they also considerably influenced (directly or indirectly) medical speculation on the concept of a balanced mixture. However, it should be noted that—apart from these exceptional fragments—Parmenides, Empedocles and other pre-Platonic philosophers did not use the term *krasis* but rather expressions like *mixis*, *diakrisis* and *synkrisis*.[10] Moreover, in comparison with the Hippocratic authors, the exceptional two fragments neither attest to a specific concern with health and disease, food and environment, nor to the idea of balance. The only pre-Hippocratic evidence for the idea of healthy balance is Alcmaeon's fragment DK 24 B 4, which defines health as *isonomia* of bodily *dynameis*. On the one hand, this fragment provides a unique precursor of the concept of balance and its prominent role in medicine before the Hippocratic authors. On the other hand, it neither articulates the theory in terms of *krasis* and *sym/metriē*[11] or the technical terminology of the Hippocratic texts, nor does it suggest any relation between the human body and food, exercise, environment, and other features specific for the medical discussion or for Plato's and Aristotle's accounts of health and related topics.

Given the traditional connection of *krasis* with wine, in combination with the fact that wine mixed with other ingrediencies (such as water, honey, vinegar, etc.) was a widely used remedy in ancient Greek medicine,[12] and also that both Plato and Aristotle use the term frequently in medical contexts, one may easily assume that the idea of health as *krasis* is inherent to Greek medicine in general and that it is commonplace in the Hippocratic collection. Nonetheless, it should be noted that out of the 60 or so treatises included in Littré, only six

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of the individual body with a certain food and regimen." See also Drvota-Vítek (2020), who suggest that B 16 is possibly a fragment from Empedocles, falsely ascribed to Parmenides by Aristotle (and Theophrastus).

9 Empedocles DK 31 B 22. It should be noted that Aristotle never ascribes *krasis* to Empedocles. In all passages quoting, referring to, or criticizing his theories, Aristotle consistently uses the term *mixis* (e.g. *Part. an.* 1.1, 642a17–22, *De an.* 1.4, 408a13–23).

10 Cf. Parmenides DK 28 B 8,27–28; Empedocles DK 31 B 8 and A 40; Anaxagoras DK 59 B 4 (*symmixis*). See also Aristotle *Gen. corr.* 2.6, 333b13–20, quoted below, p. 80.

11 Cf. Sassi (2015) 11: "One must note, however, that the use of *krasis* to explain the concept of *isonomia* in the context of this fragment belongs to the doxographer." See also Kouloumentas (2014). The same applies to the use of *krasis*/*krēsis* in Theophrastus' reports on Democritus's explanation of thought (*Sens.* 58) and Diogenes' account of perception (*Sens.* 39).

12 Cf. Lonie (1977). See also Aristotle *Gen. corr.* 1.7, 324a29–30: "for we speak of the doctor, and also of wine, as healing".

contain the term *krēsis* or *synkrēsis*[13] and only five of them are generally agreed to precede or to be contemporary with Plato, namely *Airs, Waters, Places*, *On the Nature of Man*, *On Regimen*, *On Ancient Medicine* and the fifth book of *Aphorisms*. Significantly, all of them promote a dietetic approach to health and all connect *krasis* with the concept of "moderation" or "balance" (formulated in terms of *metriē/symmetriē* and *metriōs/symmetrōs*, occasionally also *isomoiriē*,[14] but never with Alcmaeon's *isonomia*[15]).

Krēsis/*synkrēsis* stands in the five Hippocratic texts as a technical term for a mixture of the opposite qualities (a) in the environment, (b) in food, (c) in the human body,[16] or (d) in the soul.[17] And although there is no agreement among them as to the number and nature of the elementary parts of human bodies (e.g., two elements in *Vict*.; two humours in *Aer*.; four humours in *Nat. hom*.; and the innumerably many qualities in the *VM*), they all work on the hypothesis (or criticize it, as does the author of *VM*) that all the various kinds and states of human bodies can be diagnosed as well as cured according to an excess or surplus of hot, cold, dry and wet.[18] Some of the texts also contain the idea that both environment and regimen substantially influence and precondition our mental capacities and even characters.[19] *On Regimen*, the most elaborate account of dietetics, integrates most of these aspects into one single theory, discussing mixtures within the body as well as within the soul and providing

13 According to the analysis by W. Smith (1992) 270–271, there are 27 occurrences of the terms *krēsis* and *synkrēsis* in the Corpus Hippocraticum, 19 of them in *On Regimen* (all in book 1), five in *On Ancient Medicine*, two in *On the Nature of Man*, and one in *Airs, Waters, Places*. There are two passages omitted by Smith, one in *Aphorisms* (*Aph.* 5.62.5, IV.554–556 L.), which seems to draw on *On Regimen* (especially chap. 37), and another in *On Sevens* (*Hebd.* 24, VIII.647.25–26 L.). Given the disputable date of *Hebd.*, it will not be taken into consideration in this chapter.

14 E.g. *Aer*. 12 (II.54.3 L. = 54,16 Diller).

15 Cf. Kouloumentas (2014) 872.

16 Cf. *Aer*. 12 (II.52.19 L. = Diller 54,13); *Nat. hom*. 3 (VI.38 L. = 172,1 Jouanna); *Aph*. 5.62 (IV.556 L.); *VM* 5 (I.582 L. = 39,22 and 24 Heiberg) and *VM* 16 (I.606 L. = 47,15 Heiberg).

17 E.g. *Vict*. 1.7 (IV.480 L. = 130,18–20 Joly-Byl), 1.25 (VI.496 L. = 142,6–8 Joly-Byl), 1.35 (VI.512 L. = 150,29–31 Joly-Byl).

18 In line with the original meaning of *kerannymi* (which derives from the ancient custom of tempering the strong potency of wine with the weak potency of water, or hot water with cold water), *krasis* in Hippocratic texts can be seen as a procedure (as well as its result) by which the physician mixes the qualities of different strong and weak substances in order to obtain a moderate qualitative average between the two extremes. See Festugière (1948) 37–38, Tracy (1969) 37–38, and Mirrione (2017) 19–20.

19 *VM* 10 (I.595 L. = 42,22–25 Heiberg) and *Vict*. 1.35–36. See also *Prorrh*. (2.4, IX.14.16–23 L., and 2.12.22, IX.34.11–13 L.), and *Aff*. 46 (VI.254.16–18 L.).

practical instructions on how to achieve the best possible conditions for our sense perception, memory and intellect.[20]

The impact of these new medical conceptions and terminology was almost immediate, supposing that most of the five Hippocratic texts can be dated between the middle and late fifth century BC.[21] Probably the earliest non-medical evidence of *krasis* in the new sense is *Prometheus Bound* (a play attributed to Aeschylus in antiquity but nowadays generally considered spurious), which cannot be dated later than 430 BC.[22] In the play, Prometheus proclaims his merit in showing mankind, who used to waste away "for lack of medicine (φαρμάκων)", how to "mix soothing remedies (κράσεις ἠπίων ἀκεσμάτων) with which they now ward off all their disorders (νόσους)".[23] It is evident that *kraseis* in this passage refers to food, drink and *pharmaka* prepared and used for specifically medical purposes.[24]

Another early reflection of the medical discussion is attested in a fragment from Euripides' lost play *Phaethon*,[25] in which the main hero is advised not to enter the air (*aither*) of Libya, for the "mixture" (*krasis*) there is void of moisture. This clearly references the concept of *krasis* as employed in the medical accounts of climate and its impact on human health,[26] especially in *Airs, Waters, Places*, which includes comprehensive discussions of the differences in the climate/weather (*krasis*) in different continents,[27] at different places,[28] and during different seasons.[29]

Thucydides, as mentioned above, never uses the term *krasis*, although on one single occasion, towards the end of the last, unfinished book 8 of his *Histories*, he does use the word *synkrēsis* in a reflection upon the constitution of the

20 *Vict*. 1.35–36. E.g. *Vict*. 1.36 (VI.522 L. = 156,19–20 Joly-Byl): "It is this blending (*synkrēsis*), then, that is, as I have now explained, the cause of the soul's intelligence or want of it".

21 For approximate dating of individual Hippocratic texts, see Jouanna (1999) and Craik (2015).

22 *Prometheus Unbound* (a part of the same trilogy as *Prometheus Bound*) was parodied in Cratinus' *Ploutoi* (429 BC), and *Prometheus Bound* in Cratinus' *Seriphioi* (c. 423) as well as in Aristophanes' *Acharnians* (425 BC). See West (1990) 65.

23 Aeschylus, *PV* 476–483.

24 This terminology is best documented in *On Ancient Medicine* (5, I.580–582 L. = 39,6–26 Heiberg).

25 Euripides, *Phaethon*, fr. 779,2 (ed. Nauck).

26 E.g. *Vict*. 2.38 (VI.532 L. = 160,22–26 Joly-Byl), tr. Jones: "in the most adjacent countries it [i.e. the sun] must impart such a hot and dry quality, as it does in Libya, where it parches the plants, and insensibly dries up the inhabitants."

27 *Aer*. 12 (II.52–54 L. = 54,10–17 Diller).

28 *Aer*. 5 (II.24 L. = 32,20–24 Diller). See also *Vict*. 2.37.

29 *Aer*. 10 (II.42 L. = 46,16–22 Diller).

Five Thousand. At that time, Thucydides reports, Athenians enjoyed the best government that they ever had, for they had a "balanced mixture" (*metria … synkrēsis*) of the rich and the poor, i.e. of oligarchy and democracy.[30] Although there is no explicit reference to medicine in the passage, the phrase "balanced mixture" itself may be informed by a specific concept of health that Thucydides uses to illustrate the healthy nature of the constitution under consideration.[31] Given the fact that we can date Thucydides' report between 411 and Thucydides' death (perhaps 399–396 BCE), it is most probably the earliest non-medical evidence of the conjunction of *sym/metriē* and *synkrasis*,[32] which defines the medical concept of "balanced mixture" in the Hippocratic *On Ancient Medicine* and *On Regimen*.[33]

2 Plato on *Krasis* and Symmetry

In contrast to the isolated references to the medical terminology in pseudo-Aeschylus, Euripides, and Thucydides, Plato is the first "non-medical" author to employ the terms *krasis* and *synkrasis* (in conjunction with *metria* and *symmetria*) on a regular basis, often explicitly in a medical context. Altogether, there are 17 occurrences of *krasis* and 9 of *synkrasis* in Plato's dialogues. In addition, Plato also used (and possibly coined) the noun *eukrasia* (*Ti.* 24c6), which is unattested in the Hippocratic texts.[34]

In the *Symposium*, to start with Plato's most explicit reflection on the medical theory, the physician Eryximachus suggests that "our very bodies manifest two species of love", namely "love manifested in health" and "love manifested in disease" (186b5–6). Then he draws an analogy with music (187c4–5: "music is therefore simply the science of the effects of Love on rhythm and harmony") and proclaims that the same principles must also be recognized in medicine

30 Thucydides *Hist.* 8.97.2.6–7 (ed. Jones-Powell).

31 Thucydides is most probably the very first non-medical author who recognizes dietetics as a specific medical approach, different from other means of therapy (*Hist.* 2.51.3), cf. Bartoš (2015) 37–38.

32 Cf. Rocher (1994, 41): "The political pattern, which is implicit in the text of the great Athenian historian, is compared to the paradigms of perception fitness in the fifth century views of cognition, and of health in Hippocratic medicine".

33 The term *synkrēsis* is attested once in *VM* (24, 1.634 L. = 55,8 Heiberg) and seventeen times in *Vict.* (especially in ch. 32, 35, and 36).

34 Nonetheless, the Hippocratic authors already occasionally use the adjective *eukrētos*, e.g., *Aer.* 24 (II.90 L. = 80,9 Diller) and *Vict.* 3.68 (VI.600 L. = 198,10–11 Joly-Byl).

and all other disciplines. "Even the seasons of the year exhibit their influence", as he claims with the following explanation:

> When the elements to which I have already referred—hot and cold, wet and dry—are animated by the proper species of Love, they are in harmony with one another: their mixture is temperate (ἁρμονίαν καὶ κρᾶσιν λάβῃ σώφρονα), and so is the climate. Harvests are plentiful; men and all other living things are in good health; no harm can come to them. But when the sort of Love that is crude and impulsive controls the seasons, he brings death and destruction. He spreads the plague and many other diseases among plants and animals; he causes frost and hail and blights.[35]

There is no doubt that Eryximachus reflects upon the specific medical tradition attested in the Hippocratic texts in which matters of health and prosperity (including fertility) on the one hand, and pain and disease on the other, are discussed in terms of a proportional or disproportional mixture of the elementary qualities, and special attention is devoted to the effects of environmental conditions on men, animals and plants.[36]

There are three occurrences of *krasis* in the *Phaedo*, one of which also discusses the blend of seasons. In the final myth, Socrates speaks about the inhabitants of a fictitious land with a climate of such a "mixture of seasons" (τὰς δὲ ὥρας αὐτοῖς κρᾶσιν) that the inhabitants "are without disease and live much longer than people do here; their eyesight (ὄψει), hearing (ἀκοῇ) and intelligence (φρονήσει) and all such are as superior to ours as air is superior to water and ether to air in purity".[37] A similar idea is also expressed in a story told by Critias in the *Timaeus*, according to which Athena, when founding Athens, "had chosen the region in which your people were born, and had discerned that the temperate climate (τὴν εὐκρασίαν τῶν ὡρῶν) in it throughout the seasons would bring forth men of surpassing wisdom (φρονιμωτάτους ἄνδρας)".[38] In these and

35 *Symp*. 188a4–b3, tr. Nehamas and Woodruff. See also *Symp*. 186d5–e3.

36 Craik (2001) and Thivel (2004) argue specifically for *Vict*.; Vegetti (1995, 69–70) for *Aer*. and *Epidemics* I. Most recently, Marino (2016, 241–252) makes the case that Plato draws on the Hippocratic *VM*, *De arte*, *Flat*. and *Vict*. See also Edelstein (1945).

37 *Phd*. 111b1–6.

38 *Ti*. 24c4–7. In terms of the impact of a balanced climate on human character, the author of *Aer*. holds that Europeans are more courageous than Asiatics because in Europe there are greater variations of seasons while the climate in Asia is mild and free of changes: "for uniformity engenders slackness, while variation fosters endurance in both body and soul; rest and slackness are food for cowardice, endurance and exertion for bravery" (*Aer*. 23, 11.84 L. = 76,22–78,1 Diller, tr. Jones).

other passages discussing the influence of environment on human health,[39] one can identify numerous analogies with the Hippocratic texts, most notably with *Airs, Waters, Places* and *On Regimen*.[40]

Another remarkable use of *krasis* in the *Phaedo* is attested at the very beginning of the dialogue. Phaedo describes his mood during his last meeting with Socrates as "a strange feeling, an unaccustomed mixture (*krasis*) of pleasure and pain at the same time",[41] as he enjoyed the philosophical discussion but, at the same time, reflected that Socrates was about to die. This inconspicuous remark opens the discussion of the concept of mixture in the dialogue and also foreshadows the idea of mixtures of pleasure and pain in the soul and the body, discussed in detail in the *Philebus*.[42]

And finally, within the discussion of the immortality of the soul in the *Phaedo*, Socrates argues that the soul is akin to things that are unperishable, invisible, and divine. Simmias objects that "one might make the same argument about harmony, lyre and strings, that harmony is something invisible, without body, beautiful and divine in the attuned lyre", and he therefore suggests that "the soul is a blend and harmony[43] (κρᾶσιν εἶναι καὶ ἁρμονίαν) of hot, cold, dry, wet, and other such things when they are mixed with each other rightly and in due measure (καλῶς καὶ μετρίως κραθῇ πρὸς ἄλληλα)".[44] Later in the dialogue (91c–94e), Socrates vigorously refutes this idea, although his criticism targets neither the concept of health as a balanced mixture of elemental qualities (as attested in the speech by Eryximachus in the *Symposium*, or as it is implicit in

39 E.g. *Cri*. 111e4–5, *Plt*. 272a6–b1, *Phlb*. 26a6–b1, *Epin*. 976a1–4.

40 The author of *Aer*. makes the case, for instance, that the persons of the inhabitants [of a city oriented eastward] are "of better complexion and more blooming than elsewhere", and that "they are clear-voiced, and with better temper and intelligence (*xynesin*) than those who are exposed to the north" (*Aer*. 5, 11.22–24 L. = 32,1620 Diller, tr. Jones). In *On Regimen*, we find the idea that seasons (as well as all other external sources of hot, cold, dry, and wet) directly influence not only our health but also perception, cognition, and memory. In ch. 35, the author discusses seven types of fire-water *krasis* in the soul and for each type suggests what to do or avoid during each season of the year.

41 *Phd*. 59a1–7.

42 Cf. *Phlb*. 47c1–d6 and 50c10–e2.

43 As for the musical terminology, *harmoniē* is attested only seven times in the Hippocratic corpus (four in *Vict*. 1.8, VI.482 L. = 132,6–15 Joly-Byl), and *symphonia* (also mentioned in the speech of Eryximachus in *Symp*. 187b4–5: "harmony [*harmonia*] is consonance [*symphonia*], and consonance is a kind of agreement") is attested only in *On Regimen* (*Vict*. 1.8, VI.482 L. = 132,6 and 9 Joly-Byl; and 1.18, VI.492 L. = 138,25 Joly-Byl). Cf. Marino 2016, 250.

44 Plato, *Phd*. 85e3–86c2.

the meteorological use of *krasis* in the final myth of the *Phaedo*[45]), nor the idea that both *krasis* and *harmony* can be fittingly used in discussions of soul.

In the *Timaeus* (37a2–4, see also 43c7–e4), we read that the world soul "is blended (συγκραθεῖσα) of three components", namely the Same, the Different and Being. And in the *Philebus*, Socrates speaks about the *krasis* and *synkrasis* of pleasure and pain "in the body" (47c1–5 and 63c5–7) as well as "in the soul" (47d8–9). Moreover, the mixtures of the affections in the body and in the soul are further mixed together into one single blend: "There exists the possibility, for the body without the soul, for the soul without the body, and for both of them in a joint affection, to contain a mixture of pleasure and pain" (50d4–6). For these and many other mixtures, as Socrates stresses, there must be a certain appropriate proportion of the mixed opposites that secure the existence of the mixture as such:

> Any kind of blend (σύγκρασις) that does not in some way or the other possess measure or the nature of proportion (μέτρου καὶ τῆς συμμέτρου φύσεως) will necessarily corrupt its ingredients and most of all itself. For there would be no blending (κρᾶσις) in such cases at all but really an unconnected medley (τις ἄκρατος), the ruin of whatever happens to be contained in it.[46]

In summary, Plato in his late texts uses the terms *syn*/*krasis* and *symmetria* (as well as *metriotēs* and other terms for "right measure") in a literal sense, i.e. as a physical and sensible mixture, and identifies the right measure as the essence of each and every mixture.[47] This explains his confidence that "even physical entities can attain a relatively stable state", as D. Frede (2017) fittingly remarks, suggesting that Plato was encouraged to embrace such theories "by the advances of astronomy and harmonics in his own lifetime". As I have tried to substantiate so far, the specific use of *krasis* and related terminology in Plato's texts clearly indicates that also medicine and especially dietetics (as represented in the five Hippocratic texts) must be added to the list of Plato's sources of inspiration in matters of balanced mixtures.

45 Cf. Wöhrle (1990) 137.

46 *Phlb*. 64d9–e3, tr. Frede (modified).

47 Cf. Aristotle (*Gen. corr*. 2.3, 330b16–17) quoting from Plato's *Divisions*: "The middle makes a mixture" (*to gar meson magma poiei*).

3 Aristotle on *mixis*, *krasis* and the Generation of homoiomera

Altogether, there are 26 occurrences of *krasis*, two of *eukrasia*[48] and one of *synkrasis*[49] in Aristotle's 'genuine' works.[50] And most of them are related—directly or indirectly—to health and conditions of life and prosperity. As I shall illustrate in the following two sections (4–5), most of the occurrences can be divided into four groups that we already know from the Hippocratic texts and Plato: those referring to a blend (a) in the body (in general or in a specific part of the body), (b) in things that enter the body (i.e. the air, water, and nourishment), (c) in the environment, including weather conditions, seasons, and climate, and (d) in the soul.

Before we proceed to the particular passages, it is necessary to make clear that Aristotle distinguishes *krasis* from *mixis*, *synthesis* and other kinds of material compositions.[51] According to his own standards, many of his predecessors (including Plato)[52] used the terms *mixis* and *krasis* incorrectly and interchangeably, while others confused *mixis* (and *krasis*) with *synthesis*. Hence, on several occasions, Aristotle makes considerable effort to define these terms and to clarify the difference between them. In *Topics*, Aristotle makes the distinction between *mixis* and *krasis* one of his main examples of an incorrect use of terminology regarding the genus-species difference:

> Further, you must see whether your opponent has placed the genus inside the species, taking, for example, contact as conjunction or mixture as blend (μεῖξιν ὅπερ κρᾶσιν), or, according to Plato's definition, locomotion as impulsion. For contact is not necessarily conjunction … Similarly also with the other instances; for mixture is not always blend (οὔτε γὰρ ἡ μεῖξις ἅπασα κρᾶσις)—for the mixture of dry substances is not blend (ἡ γὰρ τῶν ξηρῶν μεῖξις οὔκ ἐστι κρᾶσις)—nor is locomotion always impulsion.[53]

This passage makes it sufficiently clear that *krasis* is a specific kind of *mixis*. Accordingly, *mixis* can be used as a generic name for *krasis* but not vice versa.

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48 *Part. an.* 3.12, 673b26; *Gen. an.* 2.6, 744a30.

49 *Gen. corr.* 2.10, 336b20–21.

50 Another 50 or so occurrences of these terms are attested in spurious works, most remarkably in *Problemata* 14 (909a12–909b9) in the section entitled ΟΣΑ ΠΕΡΙ ΚΡΑΣΕΙΣ.

51 Nonetheless, Carter complains that "Aristotle's theory of mixture is not very precise" (2019), 129. Cf. Bogen 1996.

52 See Plato, *Phlb.* 47c3–d3 and 63e9–64a1; *Ti.* 74c5–d4.

53 *Top.* 4.2, 122b26–33. See also *Top.* 4.2, 123a4–5: οἷον κράσεως τὴν μεῖξιν διαφοράν.

Aristotle's specific understanding of *mixis* is discussed in detail in *Generation and Corruption*,[54] in which he aims to explain how sensible natural objects in general (and homoiomerous parts of animal bodies in particular) come into existence out of the four elements and their qualities. In his review of previous theories, he pays special attention to the theories of Empedocles and the Atomists. Empedocles taught that "there is no origin of anything, but only a mingling (μίξις) and separation (διάλλαξίς) of things which have been mingled (μιγέντων)".[55] Accordingly, Empedocles "gives all the credit to the mixing process (*mixis*)", as Aristotle admits, and yet "he says nothing about nature" because he holds that "all this happens according to chance (*tychē*) rather than to proportion (*logos*)".[56] Moreover, Empedocles' theory fails to explain how elements come into existence, as Aristotle complains in *Gen. corr.* I, 8: "as regards the elements themselves, it is not clear how the mass of them as it is piled up comes to be and perishes".[57]

Neither the atomistic theory of Leucippus and Democritus, which Aristotle acknowledges as the most advanced and consistent philosophical explanation concerning matter and the coming-to-be of sensible objects,[58] succeeds to explain what happens when two or more components are mixed together. On this theory, "the primary bodies, from which originally bodies are composed and into which ultimately they are dissolved, are indivisible (*adiaireta*), differing only in structure (*schēma*)".[59] In other words, the atoms of the mixed substances remain intact and change only in respect to their relation with each other.[60] Hence, it is wrong to say that "things have been mixed" when the things being mixed are preserved at the level of small particles. "For this will be composition (*synthesis*)", explains Aristotle, "and not blend (*krasis*) or mixture

54 Aristotle is well aware of the novelty of his understanding of *mixis*. See *Gen. corr.* 1.6, 322b8–9: "Now, aggregation (*synkrisis*) is mixing (*mixis*); but what we mean by 'mixing' (*mignysthai*) is not yet clearly determined."

55 *Gen. corr.* 1.1, 314b6–8. Cf. *Vict.* 1.4 (VI.476 L. = 128,6–7 Joly-Byl), tr. Jones: "Whenever I speak of becoming or perishing I am merely using popular expressions; what I really mean is mingling and separating (συμμίσγεσθαι καὶ διακρίνεσθαι)".

56 *Gen. corr.* 2.6, 333b13–20. According to Empedocles, homoiomerous parts, such as bones (DK 31 B 96, cf. Aristotle *Part. an.* 1.1, 642a16–23), flesh (DK 31 A 78), and blood (DK 31 B 98), are made of the four elements in a particular ratio.

57 *Gen. corr.* 1.8, 325b20–24. Later in the text, Aristotle identifies a paradox as to "how flesh and bones and any of the other compounds will result from the elements" (*Gen. corr.* 2.7, 334a18–21), which is immanent in every doctrine in which elements do not come to be from each other, as is the case in the doctrine of Empedocles (*Gen. corr.* 2.7, 334a26–31).

58 Cf. *Gen. corr.* 1.2, 315a33–35; 1.8, 324b35–325a3; and 1.8, 325b13–16.

59 *Gen. corr.* 1.8, 325b18–20.

60 Cf. Williams (1982) 142.

(*mixis*), nor will the part have the same proportion (*logon*) as the whole".[61] "But we say", clarifies Aristotle, "that if things have in fact been mixed (*memiktai*) the mixture has to be homoiomerous, and that just as a part of water is water so it is with what has been mingled".[62]

After the thorough discussion of the shortcomings of the predecessors' theories, Aristotle finally defines *mixis* in chap. 10 as "the union (*henōsis*) of mixables (*miktōn*), when they have undergone alteration".[63] And "mixable" is "anything which, being easily modified in shape, is capable of acting or being acted upon, and is mixable with something else of the same kind as itself".[64] Aristotle specifies that only materials that are easily divisible and modifiable in their form are capable of mixture, "since they divide easily into small parts, which is precisely what it is to be easily bounded; for instance, liquids are the type of bodies most liable to mixing; for liquids are the most easily bounded of divisible things, unless they are viscous (these have the effect only of multiplying and increasing bulk)."[65] And since only a *mixis* of liquids[66] can be properly called *krasis*,[67] and given the fact that liquids are the most mixable of all bodies, *krasis* is the most perfect form of *mixis*.

It is critical to every *mixis* that each of its constituents brings a specific quality to their union. Accordingly, when many divided pieces are juxtaposed to a few or large ones to small, "then indeed they do not give rise to mixing". "Thus a drop of wine is not mixed with ten thousand pitchersful of water, for its form

61 *Gen. corr.* 1.10, 328a9–10.

62 *Gen. corr.* 1.10, 328a11–13, tr. Williams. See Joachim (1904), who suggests that Aristotle draws a distinction between a mechanical mixture (*synthesis*) and a "chemical combination" (*mixis*), which gives rise to homoiomerous bodies. Nevertheless, as Joachim admits, Aristotle occasionally uses the term *mixis* (and *meignymi*) in a less technical sense, for example when referring to the mechanical mixture of barley and wheat in *Gen. corr.* 328a2. This ambiguity of the term *mixis*, which in common language covers both "chemical combination" and mechanical mixtures, may explain Aristotle's marked preference for the term *krasis* in his zoological works. I owe this suggestion to Claudia Mirrione.

63 *Gen. corr.* 1.10, 328b23.

64 *Gen. corr.* 1.10, 328b20–22.

65 *Gen. corr.* 1.10, 328b3–5, tr. Williams. Cf. *Gen. corr.* 2.2, 330a5–7.

66 It should be noted that the expression *hygron* has two different meanings: "Dry (*xēron*) and moist (*hygron*) are used in several senses; for both moist and damp (*deiron*) are opposed to dry, and again, solid (*pepēgos*) as well as dry is opposed to moist" (*Gen. corr.* 2.2, 330a13–15). Within the discussion of mixtures, the liquidity (as opposed to a solid state) is essential (cf. 327a18).

67 *Top.* 4.2, 122b26–33. Even solid substances, such as tin and copper (e.g. *Gen. corr.* 1.10, 328b7–9), can be blended if we melt them to form a liquid. See also *Vict.* 1.32 (VI.506 L. = 148,9–10 Joly-Byl).

dissolves and it changes into the totality of the water." Nonetheless, as Aristotle stresses, "when the two are more or less equal (*isazēi pōs*) in strength (*dynamesin*), then each changes from its own nature in the direction of the dominant one, though it does not become the other but something in between (*metaxy*) and common to both (*koinon*)".[68]

In the second book of *Generation and Corruption*, the concept of *mixis* plays a crucial role in Aristotle's explanation of the transformation of elements from the opposite qualities and the generation of *homoiomera* and other compounds from the elements and their qualities.[69] The elements are transformed when the hot and the cold mix together in such a way that they achieve some proportion (*logos*).[70] And also other bodies result from a mixture of the contraries:

> In this way what comes to be is a mixture (*mixis*), in that way it is matter. Since the contraries are also acted upon as stated in the definition in Book I [...] first, the elements change in this way; but flesh and bones and suchlike come from these [elements], the hot becoming cold and the cold hot when they approach the mean (*to meson*), for here they are neither one thing nor the other, and the mean is large and not an indivisible point. Similarly dry and wet and suchlike produce flesh and bone and the rest in the middle range (*kata mesotēta*).[71]

Although the mean or proportion between the opposite qualities of the ingrediencies in the mixture has some extension, mixtures in general are essentially unstable and permanently susceptible to change, given the fact that it is characteristic for mixtures that they consist of substances that are easily modifiable and that the mixture of them must also be easily modifiable.[72] And the same holds for blends, i.e., mixtures of liquids, the most modifiable and mixable of all bodies.[73] Despite the fact that the term *krasis* is mentioned only once in

68 *Gen. corr.* 1.10, 328a26–32, tr. Williams.

69 The significance of the specific accounts of elements and qualities in the Hippocratic *On Regimen* and *On the Nature of Man* for Aristotle's theory of matter has been stressed by several scholars, including Vizgin (1980); Althoff (1992) 12–13, n. 8 and 9; Longrigg (1993) 220–226; Burnyeat (2004) 18–19 n. 24; Rashed (2005) XXV, n. 1, and XXVI; Lefebvre (2018) 286–300; and Mirrione (2021).

70 Aristotle describes in detail the origin of homogeneous materials in *Mete.* 4, in which the concept of proportion plays a fundamental role. Cf. Lennox (2014) and Popa (2020).

71 *Gen. corr.* 2.7, 334b20–31, tr. Williams.

72 Cf. *Gen. corr.* 1.10, 328b1–5.

73 As Aristotle remarks in *Rhetoric* (1.12, 1373a32–35), thieves in general often steal "objects

Aristotle's account of *mixis* in *Generation and Corruption*,[74] in other works he strongly prefers it when speaking about mixtures in animal bodies (and their parts), in food or in the environment.[75]

4 Aristotle on Health, Environment and Procreation

In *Topics*, Aristotle defines health as a symmetry (*symmetria*) between the hot and cold qualities (in the body),[76] while in *Physics* he describes it in terms of *krasis* and *symmetria*:

> Thus bodily excellences such as health and fitness (ὑγίειαν καὶ εὐεξίαν[77]) we regard as consisting in a blending (ἐν κράσει) of hot and cold things[78] in due proportion (συμμετρίᾳ), in relation either to one another within the body or to the surrounding.[79]

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that can easily be changed in shape, colour, or blend (τὰ εὐμετάβλητα σχήμασιν ἢ χρώμασιν ἢ κράσεσιν)".

74 *Gen. corr.* 1.10, 328a9 (quoted above). There is also one occurrence of *synkrasis* in *Gen. corr.* 2.10, 336b20–21, tr. Williams: "Often, however, it happens that things perish in a shorter time on account of the mingling (*synkrasis*) of things with one another."

75 As for the use of *mixis*, Aristotle occasionally employs it as a generic term for a blend in the physical sense, e.g., a mixture of wine and water (*Gen. an.* 2.8, 747b6–8) or of colours (e.g. *Sens.* 440a, 28–29; 442a12–13), while elsewhere he speaks of *kraseis* of colours (*Rhet.* 1.12, 1373a31) or drinks (*Pol.* 2.1, 1262b18). On several occasions in *Politics*, Aristotle speaks rather metaphorically also about a *mixis* of political constitutions, for instance *politeia* can be defined as a mixture (*mixis*) of oligarchy and democracy (*Pol.* 4.6, 1293b33–34, see also 1293b17–18 and 1294b13–14). In his biological works, Aristotle—as a rule—reserves the term *mixis* to cases of mixing male and female in sexual intercourse, reproduction and breeding (e.g. *Gen. an.* 1.2, 716b1–3; 2.7, 746b12–15 and 746b21–24; 2.8, 748b31–33; 4.2, 767a22–23; see also *Hist. an.* 7/8.28, 607a1–5).

76 *Top.* 6.2, 139b19–21 and 6.6, 145b7–11.

77 The authors of *On Regimen* (*Vict.* 1.32, VI.506 L. = 148,4 Joly-Byl; 3.81, VI.630 L. = 214,4 Joly-Byl; 3.82, VI.632 L. = 214,26 Joly-Byl; 4.89, VI.644 L. = 220,20 Joly-Byl) and *On the Nature of Man* (*Nat. hom.* 9, VI.52–54 L. = 188,15–17 Jouanna; and 22 [= *Salubr.* 7], VI.84 L. = 218,2–4 Jouanna) both speak about health and disease in terms of *hexis* of the body, i.e., the condition of a particular individual in a particular situation, that must be allowed for in dietetic treatment.

78 In *Ph.* 3.1 (201a34–b3), Aristotle suggests that the subject to the healthy or unhealthy condition may be "the moisture (*hygrotēs*) or blood", while in *Ph.* 2.2, (194a23–24) he specifically considers it to be "bile and phlegm". In *Hist. an.* 3.19 (520b19–31), the healthy condition of the blood is discussed in detail.

79 *Ph.* 7.3, 246b4–6, tr. Hardie and Gaye (modified).

Given the fact that the proportion between the hot and cold (and, accordingly, also dry and moist)[80] in the body is not fixed (for it is neither the same in all human bodies nor always the same in one individual),[81] the bodily equilibrium is delicate and vulnerable. Not only are there people of inherently unstable *krasis* (such as melancholics, who need permanent medical attention, "because their *krasis* keeps their bodies in a constant state of irritation, and their appetites are continually active"),[82] but also individuals with a relatively healthy constitution and stable *krasis* who are under permanent threat of losing the healthy balance when exposed to an imbalanced climate, seasonal changes or unhealthy regimen. As for the climate and seasons, our sense of hearing, for instance, is impaired "during damp seasons and in damp climates (ἐν ταῖς ὑγραῖς ὥραις καὶ κράσεσι)".[83] As for the unhealthy regimen, imbalance and disease can result from excessive (or deficient) eating and drinking, or excessive (or deficient) physical work and exercise, or both.[84]

Aristotle is perfectly in line with the Hippocratic authors in all these accounts of health,[85] and it seems obvious that he uses the dietetic terminology (*krasis*, *symmetria*) in the same way as his medical forerunners.[86] In regard to his confidence in the medical concept, it is no surprise that he recommends his readers to follow doctors' instructions in matters of healthy diet[87] as well as in matters of procreation.[88] However, it is remarkable that, apart from these definitions and occasional remarks on health, he rarely speaks about specifically medical topics or about the effects of seasonal changes or extreme environmental conditions on the body of individual men or women.[89] Instead, Aristotle employs the dietetic terminology in his environmental explanations of the

80 Cf. *Gen. corr.* 2.1. See also *Part. an.* 2.2, 648b2–6.

81 Cf. *Eth. Nic.* 10.3, 1173a24–28.

82 *Eth. Nic.* 7.14, 1154b12–15. For medical aspects of Aristotle's account of *akrasia*, see Francis (2011).

83 *Gen. an.* 5.2, 781a33–b2. Cf. the Hippocratic *Carn.* 15 (VIII.602–604 L. = 152.23–154.5 Potter, tr. Potter): "There are many proofs that what is driest echoes best … now nothing moist echoes, but rather what is dry, and it is what echoes that gives rise to hearing".

84 C.f. *Eth. Nic.* 2.2, 1104a12–19; *Pol.* 7.16, 1335b6–8; *Eth. Eud.* 2.1, 1220a22–27, and 2.5, 1222a28–31.

85 See also Aristotle's remarks on health in *Ph.* 4.3, 210a20–21 and 210b24–27; *Cat.* 7, 8b35–39a1; *Gen. corr.* 1.7, 324a15–19, and 324b1–4.

86 Cf. Bartoš (2021) 51–53.

87 *Eth. Nic.* 3.5, 1114a14–16.

88 *Pol.* 7.16, 1335a39–b12.

89 Cf. *Pr.* 14, 909a13–18: tr. Hett: "For the best mixture (*aristē krasis*) benefits the mind but excess disturbs it, and just as they cause distortion to the body, so do they also affect the mental temperament (*tēs dianoias krasin*)."

variations among animal species and populations regarding their natural habitat, nourishment, fertility, longevity,[90] differences in sizes, and other remarkable features of their bodies and lives.

In *Hist. an.* 7/8, Aristotle holds that animals in general "differ according to localities (*topous*)", and explains that "just as in some places certain animals do not occur at all, so in certain places they do occur but are smaller and shorter-lived and do not thrive."[91] For instance, some animals are larger in Egypt than in Greece, such as cattle and sheep, some are about the same, for example crows and goats, and some are smaller, such as wolves and asses and hares and foxes and ravens and hawks. For these differences Aristotle suggests the following explanation:

> The cause is said to be the food (*tas trophas*), in that it is unstinted for some but scanty for others … in many places the climate (*krasis*) too is a cause,[92] for example in Illyria and Thrace and Epirus the donkeys are small, while in Scythia and the Celtic country they do not occur at all; for these animals winter badly.[93]

Apart from variations in size, different localities also produce "difference in character": "for example mountainous and rough places produce character different from those in level and soft places: even in their look they are wilder and fiercer" (7/8.29, 607a9–12). And in general, "the wild (*agria*) animals are wilder (*agriotera*) in Asia, but those in Europe are braver (*andreiotera*), while those in Libya are most varied in form", holds Aristotle with a reference to a proverb that "Libya ever bears something new".[94]

It should be emphasized that, in these passages, Aristotle ascribes the same environmentally conditioned characteristics to wild animals as the author of the Hippocratic *Aer.* ascribed to various human tribes and nations of Europe, Asia, and Libya.[95] And the delicate connection between the blends in animal

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90 Cf. *Gen. an.* 4.10, 777b7–8, tr. Peck: "The reason why any animal is long-lived really is that its blend (τὸ κεκρᾶσθαι) is about the same in comparison with the air which is around it (πρὸς τὸν περιέχοντα ἀέρα)". See also *Gen. corr.* 2.10, 336b20–21, tr. Williams: "Often, however, it happens that things perish in a shorter time on account of the mingling (*synkrasin*) of things with one another."

91 *Hist. an.* 7/8.28, 605b22–24.

92 For *krasis* as a climate zone, see *Mete.* 2.5, 362b12–20.

93 *Hist. an.* 7/8.28, 606a25–b6, tr. Balme.

94 *Hist. an.* 7/8.28, 606b17–20. Cf. *Gen. an.* 2.7, 746b7.

95 Cf. *Aer.* 12 (II.52–54 L. = Diller 54,10–17 *Aer.* 16 (II.62 L. = 62,1–6 Diller); and *Aer.* 23 (II.84 L. = 76,17–78,8 Diller).

bodies, food, and environment, which is discussed in detail in the other Hippocratic texts (esp. *On Regimen* and *On the Nature of Man*), is taken into account in Aristotle's distinction between land and water animals in *Hist. an.* 7/8. 2:

> But we speak about this difference [i.e. the difference between land and water animals] in two ways: (i) some are called land or water animals because they take in air or water respectively; (ii) others, not taking it in but being satisfactorily constituted naturally in relation to the blend of cooling (πρὸς τὴν κρᾶσιν τῆς ψύξεως) that is found in the one or the other element, are called land or water animals not because they breathe air or take in water but in virtue of feeding and living in the one or the other.[96]

After having discussed water animals in the primary sense, i.e., according to what they take in (air or water) for the sake of cooling, Aristotle turns to the second aspect of the division and makes it clear that there is a close relation between the species-specific *krasis* and the quality of food appropriate to the dietetic needs of the species:

> Those that are water animals in the second way, that is, because of their blend and their life (διὰ τὴν τοῦ σώματος κρᾶσιν καὶ τὸν βίον), include all that take in the air but live in the wet, or take in the wet and possess gills but go on to the dry and get food.[97]

In his concluding summary of this discussion, Aristotle enumerates three aspects of the distinction between the land and water animals ("by taking in air or water, and by their bodily blend [*krasis*], and thirdly by their feeding") that allow him to identify two approaches to the distinction: (i) those who follow blend, feeding and taking-in, and (ii) those that follow blend and feeding alone.[98]

In *Gen. an.*, book 4, the nutritive and environmental conditions are discussed with regard to fertility and procreation. In the following passage, for instance, Aristotle brings together the condition of the body with the quality of the air, food, and water:

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96 *Hist. an.* 7/8.2, 589a11–18, tr. Balme.

97 *Hist. an.* 7/8.2, 589b23–26, tr. Balme.

98 *Hist. an.* 7/8.2, 590a13–19. Cf. Balme 1991, 80–81. See also *Part. an.* 3.6, 669a7–14, and Empedocles DK 31 A 72.

> Also, one country differs from another in these respects, and one water from another, on account of the same causes, for the quality of the nourishment especially and of the bodily condition (τοῦ σώματος ἡ διάθεσις) of a person depends upon the blend of the surrounding air (διά τε τὴν κρᾶσιν τοῦ περιεστῶτος ἀέρος) and the foods which the body takes up, and especially upon the nourishment supplied by the water, since this is what we take most of, water being present as nourishment in everything, even in solid substances as well. Hence hard, cold water in some cases causes bareness, in others the births of females.[99]

The question of procreation is further discussed a few pages later when Aristotle speaks of the periods suitable for procreation and draws his argument from the assumption that the symmetry between hot and cold is vital for all kinds of procreation ("it is heat and cooling in their various manifestations which up to a certain due proportion [μέχρι συμμετρίας τινὸς] bring about the generation of things, and beyond that point their dissolution").[100]

It is no coincidence that the fundamental assumption (that nothing comes into being and exists without some sort of symmetry within a mixture of opposite but complementary elements or/and their qualities) is mentioned in all five Hippocratic texts that contain the term *syn/krasis*.[101] In the Hippocratic *Aphorisms*, for instance, we read that only those women who "have a just blend (*krasin symmetron*)" of hot, cold, dry, and moist elements in their body (*Aph.* 5.62 = L 4.556) can conceive. The author of *Aer.* 5 describes the condition of a city oriented eastwards and holds that it is like spring, "because the heat and the cold are tempered (*kata tēn metriotēta*)", that the diseases in the city are "fewer and less severe" than in a city oriented to the south, and that "women there very readily conceive and have easy deliveries".[102] Probably the most complex formulation of the idea is provided by the author of *On the Nature of Man* in his attack against monism:

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99 *Gen. an.* 4.2, 767a30–35. On the basis of this and several other passages from *Gen. an.*, book 4 (e.g. 766a16–22; 766b12–16; 767a13–23; 767a23–28; 767b16–23; 768b27–33), van der Eijk (2007) argues that Aristotle's account was inspired by *On Regimen*.

100 *Gen. an.* 4.10, 777b18–29.

101 Cf. *Nat. hom.* 3 (VI.38 L. = 170,11–172,2 Jouanna), *Vict.* 1.4 (VI.474 L. = 126,20–28 Joly-Byl) and 2.56 (VI.566 L. = 178,16–18 Joly-Byl), *Aph.* 5.62 (IV.556 L. = 174,18 Jones), *Aer.* 5 (II.22 L. = 32,12–13 Diller, and II.24 L. = 32,20–21 Diller), *VM* 14 (I.602 L. = 46,1–4 Heiberg) and 19 (I.618–620 L. = 50,28–51,4 Heiberg).

102 *Aer.* 5 (II.24 L. = 32,20–24 Diller).

> Moreover, generation will not take place if the combination of hot with cold and of dry with moist be not tempered and equal (μετρίως πρὸς ἄλληλα ἔξει καὶ ἴσως)—should the one constituent be much in excess of the other, and the stronger be much stronger than the weaker. Wherefore how is it likely for a thing to be generated from one, when generation does not take place from more than one unless they chance to be mutually well-tempered (κρήσιος τῆς πρὸς ἄλληλα)?[103]

5 Aristotle on Blood, Intelligence, and Soul

The most obvious bodily part that can be described and analysed in terms of *krasis* is the blood, "the most indispensable and most universal" part of blooded animals,[104] the final form of nourishment and the material principle of reproduction.[105] In a sense, "blood is the matter of the entire body; for nourishment is matter, and blood is the last stage of nourishment."[106] And there are great variations in the quality of this vital liquid: "it can be thin (λεπτότερον) or thick (παχύτερον), clear (καθαρώτερόν) or muddy (θολερώτερον), cold (ψυχρότερον) or warm (θερμότερον), and it can be different in different parts of the same animal".[107]

Given the fact that blood is the final form of nourishment, its quantity as well as quality depend on what one eats and drinks: "This explains why the blood diminishes in quantity when no food is taken and increases when it is; and why, when the food is good, the blood is healthy, when bad, poor".[108] In addition to food, the operation of various internal organs also influences the quality of blood, such as the blood vessels (including the heart, "the source of blood", and "the primary blooded part"),[109] the liver, and the gallbladder. In *Part. an.* 3.12, Aristotle explains the fact that some viviparous animals have both liver and gallbladder while others have only a liver as follows:

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103 *Nat. hom.* 3 (VI.38 L. = 170,11–172,2 Jouanna), tr. Jones (modified).

104 *Hist. an.* 3.19, 520b10–11.

105 Menstrual blood is the female semen and the prime matter (*prōtē hylē*) of animals (*Gen. an.* 1.20, 729a32–33), while male semen is a derivate of blood (cf. *Gen. an.* 2.3, 736b25–27).

106 *Part. an.* 2.4, 651a13–15.

107 *Part. an.* 2.2, 647b31–34. Cf. *Part. an.* 2.4, 651a14–17: "It therefore makes a great difference whether it is hot or cold, thin or thick, muddy or pure".

108 *Part. an.* 2.3, 650a35–b2.

109 *Part. an.* 3.4, 666a36–b1.

> This is also why some of the live-bearing animals have no gallbladder; for the liver contributes considerably to the proper blend and health of the body (πρὸς εὐκρασίαν τοῦ σώματος καὶ ὑγίειαν); for their end is present most of all in the blood, and the liver is, after the heart, the most bloody of the viscera. The livers of most of the four-footed egg-layers and fish are yellowish, and those of some are in fact completely foul, even as their bodies have taken on a foul blend (φαύλης κράσεως), e.g. the livers of toad, tortoise, and other such animals.[110]

Apart from health, "the nature of blood is the cause of many features of animals with respect to both character and perception",[111] as we can see, for instance, from Aristotle's account of the brain. The brain is the coldest of all the parts in the body[112] and its main function is "to counterbalance the region of the heart and the heat in it".[113] Hence, it is the brain that "makes the heat and the boiling in the heart well-tempered (*metrias thermotētos*)".[114] Yet, in *Part. an.* 4.10, Aristotle introduces an additional function to the brain:

> The head is present above all for the sake of the brain; for the blooded animals must have this part, and in a place opposite the heart, owing to the causes stated previously. And nature placed some of the modes of perception on the outside of it as well, on account of the blend of the blood being well proportioned (διὰ τὸ σύμμετρον εἶναι τὴν τοῦ αἵματος κρᾶσιν), i.e. adapted for the warmth of the brain and for the quietness and accuracy of perception.[115]

Accordingly, the optimal condition for the performance of the sensory organs in the head is relatively colder than the optimal condition of blood in the heart.[116] But it should not be too cold either, because "when the parts around

110 *Part. an.* 3.12, 673b24–31, tr. Lennox (modified).
111 *Part. an.* 2.4, 651a12–15, tr. Lennox.
112 *Part. an.* 2.7, 652a28–29.
113 *Part. an.* 2.7, 652b20–22.
114 *Part. an.* 2.7, 652b26–27.
115 *Part. an.* 4.10, 686a5–11, tr. Lennox.
116 Aristotle situates the seat of perception into the heart (cf. *Part. an.* 2.10, 656a27–31, *Sens.* 2, 439a1–2, 7, 449a17, *Somn.* 2, 455b10; *Insomn.* 3, 461a6–7). Concerning the communication between the peripheral sense organs and the heart, it is unclear whether it is due to the connecting blood vessels, the blood in the blood vessels, or the pneuma in the blood (see Roreitner 2020).

the brain are colder than the well-proportioned blend (συμμέτρου κράσεως)", pathological fluxes can originate in the head.[117]

In addition to health and sensation, the quality of blood also influences one's character, physical strength, intelligence, and emotions. "Thicker and hotter blood is more productive of strength, while thinner and cooler blood is more perceptive and intelligent".[118] Best of all are animals "with hot, thin, and pure blood, for such animals are at once in a good state relative to both courage and discernment."[119] On the other hand, the animals that have exclusively watery blood are more timid:

> This is because fear cools; accordingly, those having such a blend in the heart (ἐν τῇ καρδίᾳ κρᾶσιν) are predisposed to this affection, since water is solidified by the cold. This is also why the other bloodless animals are, generally speaking, more timid than the blooded, and when afraid become immobile, discharge residues, and in some cases change their colours.[120]

Other emotions can also be related to the quality of the blood: as fear cools it down, passion (*thymos*) produces heat in it (650b35–36). And anger, as we know from *On the Soul*, can be defined as "a boiling of the blood and heat surrounding the heart".[121]

In these accounts on blood, Aristotle evidently draws on two conceptions developed already by his predecessors: the concept of balanced mixture identified with the soul, and the idea that blood is causally connected with sense perception, thinking, and soul. In *On the Soul*, Aristotle attests that some of his predecessors identified the soul with the blood, such as Critias, who supposed that "sensation is the peculiar characteristic of the soul, and that this is due to the nature of blood".[122] Hippo, on the other hand, rebutted those "who say that

117 *Part. an.* 2.7, 652b33–36.

118 *Part. an.* 2.2, 648a2–4.

119 *Part. an.* 2.2, 648a9–11. Cf. Aristotle's explanation of the fact that *bregma* (i.e. the anterior fontanelle) is the last of the bones to be formed and still soft in the case of children in *Gen. an.* 2.6, 744a26–31: "The reason why this occurs especially in man is that in man the brain is more fluid and greater in volume than in any other animal, and the reason of this, in its turn, is that the heat in the heart is purest in man (τὴν ἐν τῇ καρδίᾳ θερμότητα καθαρωτάτην). The fineness of the blend in man is shown by his possession of intellect (τὴν εὐκρασίαν ἡ διάνοια): there is no other animal which is so intelligent (φρονιμώτατον)."

120 *Part. an.* 2.4, 650b27–33, tr. Lennox. For the connection between fear and cold, cf. *Part. an.* 3.4, 667a16–19, and 4.11, 692a22–25; *Rh.* 2.13, 1389b31–32.

121 *De an.* 1.1, 403a32–b1.

122 *De an.* 1.2, 405b5–8.

the soul is blood, on the ground that the seed is not blood; and seed, he says, is primary soul".[123] Some of the Hippocratic authors also presupposed a strong connection between blood, perception, and thought, such as the author of *Diseases* in his aitiology of *phrenetis*,[124] or the author of *On Breath* in his account of the so-called "sacred disease" and its causes.[125] There is a certain link between blood and thinking in *On Regimen* as well, for instance when the author suggests that an inflammation of the blood can cause madness of the soul.[126] Yet, despite the fact that these passages confirm a close relation between blood and intelligence (or soul), there is no explicit Hippocratic evidence that it is the *krasis* of the blood that influences the sensation and thinking. The application of the specific concept of *krasis* in the account of blood seems to be Aristotle's novelty.

Concerning the concept of *krasis* and its relation to the soul, Plato's Socrates was already confronted with the view that the soul is a kind of blend or harmony between the hot, cold, dry, and wet, which are mixed with each other "rightly and in due measure" (*Phd.* 85e3–86c2). Aristotle in *De an.* 1.4 mentions the same idea ("the soul is a kind of harmony, for harmony is a blend or composition of contraries [τὴν ἁρμονίαν κρᾶσιν καὶ σύνθεσιν ἐναντίων εἶναι], and the body is compounded out of contraries")[127] and admits that many of his contemporaries find it one of the most credible of all current theories and that "it has rendered public account of itself in the court of popular discussion".[128]

There is no doubt that both Plato and Aristotle understood this materialistic theory of the soul as a respected rival theory that deserves special attention.[129]

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123 *De an.* 1.2, 405b1–5. Cf. Empedocles' DK 31 B 105 attesting the opinion of common men that "the blood around the heart in human is thought".

124 *Morb.* I, 30 (L 6.200).

125 *Flat.* 14 (VI.110 L. = Heiberg 99,20–100,3).

126 *Vict.* 1.35 (VI.518 L. = 154,21–156,3 Joly-Byl). Also, the circuit of the soul (e.g. *Vict.* IV.90, VI.654 L. = 226,14 Joly-Byl) can be related to the flow of blood, according to Hüffmeier (1961,) 76) and Jouanna (2012, 217).

127 *De an.* 1.4, 407b30–32.

128 *De an.* 1.4, 407b27–29. Cf. *Pol.* 8.5, 1340b10–19, tr. Jowett: "There seems to be in us a sort of affinity (*syngeneia*) to musical modes (*harmoniais*) and rhythms, which makes some philosophers say that the soul is a harmony, others, that it possesses harmony (*harmonia*)". See also Plato's *Laws* (10.889b–d) in which a similar doctrine is considered as one "which many people regard as the highest truth of all".

129 Despite the fact that both philosophers speak about a widespread theory, the Hippocratic account in *On Regimen* (chap. I, 35–36) is the only extant pre-Platonic evidence for a theory identifying the soul and its conditions with *krasis* of the bodily constituents.

Moreover, Aristotle's own conception of the soul as the form of the living body is in some respects very similar to the concept of *harmony*/*krasis*.[130] And although he eventually admits that it is appropriate to employ this concept in accounts of health and excellences of the body,[131] he holds it inappropriate for discussions on the soul. He distinguishes between two versions of the conception, both of which can easily be disproved: (a) that the soul is a composition (*synthesis*) of the bodily constituents, and (b) that the soul is a certain proportion (*logos*) of the constituents.[132] The latter one must be disproved because "the mixture of the elements which makes flesh has a different ratio from that which makes bone". "The consequence of this view will therefore be", Aristotle infers, "that distributed throughout the whole body there will be many souls, since every one of the bodily parts is a mixture of the elements, and the ratio of mixture is in each case a harmony, i.e. a soul".[133]

In regard to the idea that the soul is a composition (*synthesis*), Aristotle finds it absurd because "there are many and various compoundings of the parts".[134] Aristotle's point is that there are various ways in which materials are combined in animals and their parts and that they cannot be all reduced to one overall *krasis*. For the same reason, Aristotle in *Metaphysics* 8.2 criticizes Democritus for reducing the variety of material forms to differences in shape, position, and arrangement of the atoms. "But evidently there are many differences", Aristotle objects, "for instance, some things are characterized by the mode of composition of their matter, e.g. the things formed by blend (*krasei*), such as honey-water, and others by being bound together, e.g. a bundle; and others by being glued together, e.g. a book; and others by being nailed together, e.g. a casket;

130 Similarities between Aristotle's theory of the soul and the theory of *harmonia/krasis* mentioned in *De an.* I, 4 (407b27–32) have been noted by Hicks (1907, 263) and supported by Ross (1961, 195), Gottschalk (1971, 188), and M. Frede (1992). Polansky (2007, 103–104) suggests that the harmony theory "might be supposed very close to Aristotle's own", and most recently Carter (2019, 125) concludes that "it is not clear how this theory of soul differs from Aristotle's". See also Betegh (2021) and Bartoš (2015, 241–289).

131 *De an.* 1.4, 408a2–4: "It seems more in accord with the facts to connect harmony with health or generally with good condition (*tōn sōmatikōn aretōn*) of the body than with the soul." Carter 2019, 123 acknowledges that "the harmony theory of soul was a live one for members of the Lyceum, since two of Aristotle's students—the famed musical theorist Aristoxenus (fl. 335 BC), and the philosopher Dicaerchus (c. 350–285 BCE)—are reported by Cicero to have believed in it."

132 *De an.* 1.4, 407b32–34.

133 *De an.* 1.4, 408a13–18. A direct attack against the theory of Empedocles follows this passage (408a18–24) in which Aristotle speaks consistently about *mixis* instead of *krasis*.

134 *De an.* 1.4, 408a9–12.

and others in more than one of these ways …"[135] And the same holds also for the parts of animal bodies, especially the anhomoiomerous parts, such as hand or foot:

> And the being of some things will be defined by all these qualities, because some parts of them are mixed (*memichthai*), others are blended (*kekrasthai*), others are bound together, others are solidified, and others possess the other differentiae; e.g. the hand or the foot. We must grasp, then, the kinds of differentiae, for these will be the principles (*archai*) of the being of things […].[136]

Conclusion

In a well-known and much discussed passage closing *Parva Naturalia*, Aristotle acknowledges that there is an overlap between natural philosophy and medicine. He admits that "the more subtle and inquisitive" doctors "have something to say" about natural science, and claims that "the most polished of those who study nature [i.e., philosophers] end up by considering medical principles (*archai*)".[137] In my analysis, I aimed at illustrating that the concept of a well-balanced *krasis* provides us with one of the best documented examples of a principle (*archē*) of medical origin that was carefully considered and even adopted (with emendations, extensions, or limitations) by the most polished natural philosophers, such as Plato and Aristotle.

I made the case that Plato belongs to the first generation of authors who reflect upon the new medical concept and terminology. In some of his accounts of the nature of material structures (i.e., *Ti.* and *Phlb.*), he even makes *krasis* (and/or *symmetria*) one of the most fundamental principles of material structures. Although he refuses the idea of the soul as a *krasis* of bodily constituents, he occasionally employs the specific terminology in his discussions of the soul and caring for it. Unlike Aristotle, Plato uses the dietetic terminology (*syn/krasis*, *kerannymi*) rather loosely, sometimes interchangeably with *mixis* (and *meignymi*). However, he can probably be credited with the medical concept gaining full recognition in philosophical discussions.

Aristotle, on the other hand, employs the medical vocabulary mostly in perfect accordance with the Hippocratic authors. Throughout his biological works,

135 *Metaph.* 8.2, 1042b15–19, tr. Ross.
136 *Metaph.* 8.2, 1042b27–32, tr. Ross (modified).
137 *Resp.* 480b22–30.

he agrees that the condition in which the bodily constituents are blended together in due proportion and in which its opposite qualities counterbalance each other is the best one, the healthiest, and most optimal for procreation and many other natural activities, including perception and thinking. Nonetheless, Aristotle also develops the theory further and adjusts it to his own methodological framework, for instance when he defines *krasis* (as a specific form of *mixis*) against other forms of material arrangements and thus confirms its status as a *terminus technicus* and one of the most important principles of natural science. Moreover, his definition includes the concept of homoiomerity (as a necessary condition of each and every *mixis*), which paves the way for his own explanation of how homoiomerous parts in general, and those of animal bodies in particular, come into existence out of the elements and their qualities. Aristotle's second addition (and innovation from the perspective of natural science) consists in the transposition of the dietetic principles from human individuals and populations to other zoological species and their specific bodily designs (which are presupposed to be adapted to specific environmental conditions, climates, kinds of nourishment, etc.). And thirdly, Aristotle shifts the focus from the body as a whole (as was the standard perspective in the Hippocratic texts) to the particular bodily parts and organs and their mutual cooperation, most significantly to the blood as the most vital bodily fluid, and to the heart as the most vital bodily organ.

Five centuries later, Galen opens his own account of the topic in *On Mixtures* (*Peri kraseōn*) with the assumption that it "has been adequately demonstrated by men of ancient times, the best of both philosophers and doctors" that the bodies of animals "consist of a mixture (κέκραται) of hot, cold, dry and wet" and that "there is not an equal portion of all these in the mixture (ἐν τῇ κράσει)".[138] As for the best medical authorities, he refers most often and most importantly to "the wonderful Hippocrates"[139] and quotes from (or refers to) the Hippocratic *Nat. hom.* (II.3, I.603 K.), *Aphorisms* (I.4, I.527 K.; I.7, I.554 K.), *Epid.* 2 and 3 (I.4, I.530–532 K.), and *Alim.* (III.2, I.660 K.). Concerning the philosophers, apart from a few brief notes on Athenaeus of Attalia and his followers, Theophrastus and the Stoics (I.3, I.522–523 K.), Galen repeatedly refers to Aristotle and recognizes his original contributions to the study of mixtures and related topics. For instance, in the criticism of "many very highly thought-of doctors" who consider each individual body as one overall bodily mixture but do not realize that the various bodily parts also have specific mixtures of qualities,

138 Galen *Temp.* I.1 (I.509 K.), tr. Singer. On the specifics of Galen's theory of mixtures, see van der Eijk (2015) and Mirrione (2017).

139 Galen *Temp.* II.4 (I.605 K.).

Galen suggests paying special attention to the balance between these individual parts and concludes: "This area has been very well and fully covered by Aristotle" (II. 6, I.624 K.). Elsewhere, he proclaims that the activities of the body and its parts must be appropriate to the character of the soul, "as was shown by Aristotle, and no less fully by me" (I.9, I.565–566 K.).[140] In other words, Galen's reflection seems to confirm not only that the concept of *krasis* originated roughly in the time of Hippocrates from medical discussions on human nature, as attested in *On the Nature of Man* and several other medical texts of the time, and that Aristotle draws on the very same tradition, but also that Aristotle's numerous emendations to the theory and its amplification to the study of animal life had a significant impact on medical theory and practice.[141]

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140 See also *Temp.* II.6 (I.628 K.), tr. Singer: "This distinction, too, was well made by Aristotle, who applied it in many cases."); and *Temp.* III.4 (I.672 K., tr. Singer: "The solution lies in the distinction, given to us by Aristotle, between something cold in its own nature and something cold incidentally").

141 I am grateful to the audiences in Prague, Athens, and Paris for their suggestions and criticism of earlier versions of this paper, especially to Philip van der Eijk, Jim Lennox, Gábor Betegh, Karel Thein, Tiberiu Popa, Claudia Mirrione, David Lefebvre, and Cristina Cerami.

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CHAPTER 3

On Ancient Medicine and Aristotle on the Structure and Function of Bodily Parts

Stavros Kouloumentas and Stasinos Stavrianeas

Introduction[1]

In this paper, we attempt a comparative discussion of some key themes in the Hippocratic treatise *On Ancient Medicine* concerning the bodily parts, their constitution, and the method for studying them, as well as Aristotle's contribution to these topics in his writings on natural philosophy. Although Aristotle never refers to *On Ancient Medicine*, some of the questions he himself raises seem to have strong affinities with the questions that the Hippocratic author (henceforth, the author) tries to resolve.[2] Further, on the one hand, some of the Aristotelian answers to such questions are formulated through criticism and opposition to earlier thinkers, including Empedocles, who is castigated by the author, and significantly on similar grounds with Aristotle. On the other hand, some Aristotelian answers can be interpreted as supplementing or even revising the analysis of *On Ancient Medicine*. One instance of the former is that both Aristotle and the author criticise their predecessors for focusing on the origin of bodily parts rather than on how they are. One instance of the latter is Aris-

1 Research on this topic was conducted as part of the research project 'Commented Editions of Aristotelian Texts' funded by the Greek Foundation for Research and Innovation (ELIDEK).

2 Despite the fact that Aristotle rarely mentions physicians by name, he examines the medical doctrines of his era, especially in the biological treatises, and regards the theoretical principles of his natural philosophy as the foundation of medicine: "Aristotle must have realized that the superiority of his own natural philosophy had implications for medicine as well. He must have regarded his own natural philosophy as being of vital importance and relevance to medicine, especially those parts that were concerned with the living world and with the health and disease of living beings" (van der Eijk 2022, 113). For the numerous parallels between the Hippocratic corpus and Aristotle's biological treatises, see Oser-Grote (2004), who excludes *On Ancient Medicine* from the medical writings with which Aristotle might have been familiar (Oser-Grote 2004, 294). On the other hand, Mihai (2016) 91 and Bartoš (2021) 54–56 argue that Aristotle is well acquainted with the methodological theses introduced in *On Ancient Medicine*. Although we agree with the thesis that Aristotle's position can be read as criticising the author's methodology, we will argue that it can also be interpreted as correcting and supplementing views expressed in that work.

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totle's attempt to discover the processes that explain in a systematic way how from a relatively poor collection of elemental powers we get a variety of materials together with their characteristic tangible properties. This attempt can be seen as what the author complains is missing from the account of the doctors and natural philosophers who try to explain health and death by appealing to 'hypotheses' concerning the four elements or similar material powers. Such instances suggest that Aristotle is in dialogue with thinkers who share the views voiced in *On Ancient Medicine*, if not with this work itself, and that the critical or polemical stance the latter treatise displays is a stance that has affinities with Aristotle's treatment of the views of natural philosophers.

The paper consists of two parts. The first part examines some ideas of *On Ancient Medicine* that we will compare to corresponding Aristotelian doctrines: first, the author's attack on rival theories; second, his discussion of the origin of medicine on the art of cooking and the principles governing the latter; third, his insistence on empirical research and his focus on particular cases, which leads him to draw some conclusions concerning the exceptional precision that medicine can attain. The author focuses on the discussion of 'powers' (δυνάμεις) and 'structures' (σχήματα), which indicates that he leans towards the priority of form and function in his study of the bodily parts over other factors such as the material constitution. Turning to Aristotle in the second part, we first examine the role of the concept of structure in his argument for natural teleology in *Part. an.* 1.1, which suggests that the focus on structure was a significant step in the history of the study of nature for the discovery of final causes. Moreover, we discuss his arguments against reductionist explanations of natural bodies, especially those attributed to natural philosophers, and argue that his anti-reductionism shares some features with the attack attested in *On Ancient Medicine*. We conclude with some brief comments on how Aristotle views the relation between philosophy and medicine. His line of thought seems opposed to the one defended in *On Ancient Medicine*, but this opposition is not as radical as it may seem at first sight.

1 *On Ancient Medicine* on the Methodology of Studying the Bodily Parts

On Ancient Medicine is a polemical treatise. It defends a particular approach concerning the method that medicine should follow against rival theories.[3] It

3 Detailed discussion in Lloyd (1963).

is also a programmatic treatise in that it proposes a genealogy concerning the origin of medicine that justifies the superiority of the author's own method against other alternatives. The polemical character is evident from the very beginning. The author attacks an alternative approach to medicine that tries to base medical knowledge on a limited number of general principles. This latter approach locates the primary causes of disease in the nature and function of the basic elements or opposites that constitute natural bodies such as the hot and the cold, the moist and the dry. These references suggest that the target of the critique may be natural philosophers such Empedocles or doctors with a philosophical agenda such as the author of *On Flesh*. Their theories aim not only at explaining cosmic processes but also biological phenomena. However, they are based on simple principles, the so-called 'conjectures' (ὑποθέσεις), which fail to explain the biological phenomena. Therefore, the text appears to be an important source of information not only for the dialogue within medicine, but also for dialogue between philosophy and medicine, although it is questionable to what extent the boundaries between these intellectual fields were clearly drawn before Aristotle.

1.1 *The Negative Thesis*

The treatise includes two attacks on views that seem to attempt to ground medicine in natural philosophy. It is useful to look briefly at these attacks because they both motivate the author's positive proposal and have important affinities to Aristotle's attacks on earlier theories. The attacks are levelled against two distinct philosophical theses, but the theses under attack do not necessarily represent two distinct philosophical traditions or trends. The first thesis is that (1) disease and death will have to be analysed on the basis of a reduction of the body to its basic components (ch. 1). The second thesis, (2), seeks to ground medicine and cure on a prior knowledge of the nature or being of the body conceived as a study of the origins of human beings and of the way they were generated (ch. 20). One can endorse thesis (2) without having to endorse (1), but the opposite does not seem to be possible. At any rate, what is interesting here is that the author's critique comes from the same angle in both instances. Both these two theses lead to the statement of very general claims that fail to capture the complexity of the human body and the resulting complexity of the phenomena medicine has to deal with. In both cases, the critique takes an anti-reductionist stance. In the first case against reducing organisms into a set of basic constituents (vertically, so to speak), while in the second against reducing what an organism *is* and how it functions to the way *it came to be* (horizontally, so to speak). The first critique is introduces as follows:

> All those who have undertaken to speak or write about medicine, having laid down as a hypothesis for their account hot or cold or wet or dry or anything else they want, [1] narrowing down the primary cause of diseases and death for human beings and laying down the same one or two things as the cause in all cases, clearly go wrong in much that they say. But they are especially worthy of blame because [2] their errors concern an art that really exists (*VM* 1.1, 1.570.1–7 L. = 118,1–9 Jouanna).[4]

These are the opening lines of the work, and our author raises two interrelated objections against the attacked position: theories such as these [1] are not rich enough with respect to the principles they adopt in order to explain disease and death; [2] they ignore that a developed and recognised art of medicine already exists. One of the main aims of the author is to explain what this art consists in, and why its method is the only one capable of discovering the principles of disease and death (ch. 2). We will discuss this method in some detail below, but one of its central characteristics is the analysis of a variety of powers that are active in the body.[5] These powers cannot be reduced to a limited number of principles such as the hot and the cold or the moist and the dry. Thus, the second objection seems in effect to support the first one. The explanatory power and the therapeutic efficacy of medicine are based on the discovery of a variety of powers that interact inside the body, or affect the body when taken in as nourishment. By contrast, an attempt to reduce these principles to something more basic is unable to grasp, with the required detail and exactness, what can benefit or harm the human body.

As far as the second thesis under attack is concerned, namely the attempt to base medicine on a general definition of human nature, the author criticises the general character of the suggestion, and he also points to the mistake these thinkers commit in studying the way organisms came to be instead of how they actually are and function:

> But some doctors and sophists say that it is impossible for anyone to know medicine who does not know what the human being is; anyone who is

4 All translations of the passages from *On Ancient Medicine* are from Schiefsky (2005).

5 Hippocratic authors and philosophers-cum-doctors, including Alcmaeon, Empedocles, and Diogenes of Apollonia, envisage the body as an organised and dynamic system consisting of various parts: organs with a specific structure, position, and function (e.g. the liver, the heart, the kidney); constituents with fluctuating power (e.g. humours, opposite qualities, physical substances) that cause elemental changes (e.g. heating, cooling, drying, moistening), thus affecting the bodily equilibrium and cognitive processes; and solid or flexible formations that have a connecting role (e.g. bones, joints, sinews). See further Gundert (1992); Holmes (2018).

> going to treat patients correctly must, they say, learn this. Their account tends towards philosophy, just like Empedocles or others who have written about nature from the beginning, what the human being is and how it originally came to be and from what things it was compounded. But I hold that [1] whatever has been said or written about nature by a sophist or doctor pertains less to the art of medicine than to the art of writing, and also that it is impossible to have any clear knowledge about nature from any other source than medicine. This knowledge can be acquired [2] when one has correctly grasped medicine itself in its entirety, but until then it is impossible—I mean this science that consists in knowing what the human being is and by what causes it comes to be and all the rest, with precision. For this I think is [3] what it is necessary for a doctor to know about nature and to make every effort to know, if he is going to do any of the things that he must: what the human being is in relation to foods and drinks, and what it is in relation to other practices, and what will be the effect of each thing on each individual—not simply that 'cheese is harmful food, for it causes trouble to one who has eaten too much of it' (*VM* 20.1–3, I.620.7–622.12 L. = 145,17–147,2 Jouanna).

The objection against some 'doctors and sophists' is expressed in [3]: medicine aims at a specific knowledge of what effect each type of food can produce in each body. Similarly, knowledge of human nature refers to the various constituents of the body (as we will see below, a maximum and a minimum) and, hence to the different effects that food may have on the body while interacting with those constituents. The author believes that medicine has not acquired full knowledge of these phenomena, although it has made considerable progress (2.1, I.572.9–13 L. = 119,12–15 Jouanna).[6] This knowledge is an ideal

6 According to Hippocratic authors, each bodily constituent exhibits its own strength and is capable of affecting the body in a particular way. The preponderance of one bodily constituent entails the partial weakening of the others, in particular of its antagonist, and so their power may fluctuate between. A human is healthy when an effective blending prevents any particular bodily constituent from manifesting itself more than necessary. Disease and pain, on the other hand, arise from the disruption of the proper equilibrium, when one bodily constituent prevails over the others or separates itself from the blending, and when a bodily part becomes excessively hot or cold or dry or wet. These kinds of disequilibrium occur for several reasons, which can be classified into two groups: first, the environmental conditions that are contingent on changes of climate, winds, water quality, the celestial revolutions, and the location of a residence; second, the state of the body that is contingent, apart from the aforementioned factors, on its internal functions, nourishment, consumption of liquids, digestive capacity, exertions, and wounds. See *Aer*. 1–13, *Aff*. 1, *Flat*. 2–15, *Hum*. 12–19, *Morb*. 1.2.

state described in section [2]. So the study needs to be directed towards these specific types and effects and, thus, while the 'doctors and sophists' attempt to define in a general manner, the study of human nature faces the wrong direction: generalisation instead of specification. But there is a further point that supports the negative verdict concerning their theories. The philosophical account is criticised for defining human nature by examining how it was constituted primarily and from what stuffs humans were originally composed. What the author thinks is wrong-headed here is not the target but the method. And the mistake in this method is not just that the philosophers seek the causes of the formation of humans (for this again is something the author wishes to include in his study, see [2]) but either that they are uniquely occupied by this interest, or that they seek these causes too far below, e.g., in the primary constituents of the body. Whatever the case, it is evident that the author's primary concern is what human beings *are* and not *how they came to be* in the first place.

The two critiques have some important affinities. In particular, as in the first one founding medicine on some basic material principles disregards and is unable to explain the complexity of the powers that are operative in the human body and can threaten its healthy state, so in the second one the attempt to define human physiology in a general way does not have the resources to explain why the same nutriments bring about different situations in the human body.[7] In both cases then the objection arises from the belief that medicine deals with a variegated plurality of phenomena.[8] The insistence of the author on variation and on the particularity of different cases has been interpreted as stemming from an anti-theoretical stance that rejects the statement of any general theoretical claims in favour of empirical observation.[9] However, the author

7 One of the main contributions of *On Ancient Medicine* is that the body is a complex system made up of various powers. As long as these powers remain in balance and none is separated, health is secured. But even when there is separation, it is not a single factor that causes sickness: "I think this is my strongest piece of evidence that it is not simply because of the hot that people are feverish, and that this is not the only cause of the harm; rather, one and the same thing is both bitter and hot, acid and hot, salty and hot, and myriad other combinations—and again cold, too, is conjoined with other powers" (*VM* 17.2, I.612.10–14 L. = 141,15–142,2 Jouanna). Hence the proposal that there is a single factor, e.g., an elementary force, in which we can locate the cause of sickness is misleading.

8 In chapters 1–19, the author focuses on the aspect of his opponents' theorising that has the most direct implications for medical practice: the reduction of the causes and cures of disease to a small number of factors. In chapter 20, he steps back to discuss more generally the kind of φύσις-theory on which such a position is often based (Schiefsky 2005) 24. Cf. Cooper (2009) 17.

9 As Cooper (2009) 3–4, 26–32 notes from the time of the original Empiricists in the third century B.C., and certainly later in authors like Heraclides of Tarentum or Zeuxis, the treatise

insists on the value of observation without negating the need for formulating some more general theses. He rather seems to hold that a theory of human nature has to be firmly based on personal experience coming from medical practice.[10]

1.2 *The Positive Thesis*

The positive thesis includes three levels of defence of the medical art as an independent domain of knowledge. We will discuss the three levels or features of this defence separately, because in this way it is easier to compare his views with some themes that are also central for Aristotle. The first relates to the successful history of medicine that leads to the formation of an authentic medical art, traced all the way back to the discovery of the art of cooking. The second relates to the priority of empirical research and observation of the symptoms in the body of the patient. Finally, the third consists in a series of theoretical postulates supporting the need for adopting certain principles defining human physiology irreducible to some more basic or elementary ones. We will deal briefly with these features, each one of which finds some echoes or responses in the Aristotelian corpus.

1.2.1 The Genealogy of the Principles of the Art of Medicine

As we mentioned earlier, one of the main aims of the author is to defend the autonomy of medicine. This aim is justified by tracing the genealogy of the art of medicine in the discovery of the art of cooking:

> For the art of medicine would never have been discovered to begin with, nor would anyone have sought for it—for there would have been no need for it—if it were beneficial for the sick to follow the same regimen and

was read by adherents of this sect as authorizing their anti-rationalist and anti-theoretical approach to medicine.

10 Schiefsky (2005) 358 argues that the Hippocratic author is ignorant of the later distinction between 'art' and 'experience' and summarises his differences from the empiricist principles as follows: "But whereas the Empiricists hold that discovery is *limited* to collecting and systematizing such observations, VM's account culminates with the discovery of a theory of the humors and internal organs. The author's use of analogy to draw conclusions about such matters involves exactly the kind of use of reason that the Empiricists were so determined to reject. Finally, the author's attitude towards speculation is quite different from the Empiricists. Whereas they confidently assert that the hidden nature of things cannot be grasped, the author holds that the knowledge of human origins and development sought by the Presocratic inquiry into nature *can* be acquired if one begins from medical experience."

> diet as the healthy, taking the same foods and drinks and following the same regimen in other respects, and if there were not other things better than these. [2] But in fact necessity itself caused medicine to be sought for and discovered by human beings, for it was not beneficial for the sick to take the same foods as the healthy, just as it is not beneficial for them to do so today. [3] And, to go still further back, I hold that not even the regimen and nourishment that the sick make use of today would have been discovered if it were sufficient for the human being to eat and drink the same things as an ox and a horse and all the animals other than man (*VM* 3.1–3, I.574.8–576.5 L. = 120,16–121,9 Jouanna).

The author connects the need that led to the discovery of medicine (the need for a special diet that will heal each patient from his/her particular disease) with the need that led to the discovery of methods in nutrition that were thought appropriate for humans. There are at least three important similarities between the two arts. First, the need that leads to their discovery stems from a common concern for a special diet that will protect from pain, disease, and finally death, regardless of whether the symptoms are due to inappropriate nutrition (*VM* 3.2, I.574.12–576.1 L. = 121,2–5 Jouanna) or to disease (*VM* 3.3, I.576.6 L. = 121,5–12 Jouanna). Second, in both cases the development of the corresponding art depends on the observation that a set of cases needs a special and differentiated diet (*VM* 3.4, I.576.9–20 L. = 121,15–122,8 Jouanna). Third, there is an evident overlap in the methods used by both arts (*VM* 3.5, I.576.20–578.7 L. = 122,8–123,3 Jouanna). The preparation of food through boiling, baking, and blending is used in order to manipulate the strongest elements or powers by moderating their power through counterbalancing them with the weakest ones.

For these reasons, the author does not hesitate to give to the art of cooking the name of 'medicine', establishing thus an ancient origin for his own art (*VM* 3.6, I.578.7–11 L. = 123,3–8 Jouanna). This identification is based on a teleological and a methodological consideration, as mentioned earlier. The two arts aim at securing the good functioning of specific types of body, and they use similar means by seeking the appropriate chemical process in nutrition that will neutralise possible harming effects (*VM* 7.2, I.584.11–16 L. = 126,8–14 Jouanna). The great difference between them is that the domain of medicine is far more complex. And one reason for that must be that the kinds of disease are numerous. However, from the comparison between cooking and medicine follow two principles common between them:

(1) The cause of pain relates to the fact that the most powerful nutriments harm more both the healthy and the sick.

(II) In order to restore the healthy state, we need to moderate the power of powerful nutriments and neutralise the elements that the body cannot assimilate.

1.2.2 Medical Knowledge: Focusing on Particular Cases and Its Exactitude

These two principles, (I) and (II) above, help us focus at the second feature of the author's defence of the autonomy of the art of medicine, namely the one that relates to the value of empirical observation. Observation will show us which nutriments are actually harmful and what methods are appropriate for taming their effect on the body. The value of empirical research is already stressed in the beginning of *On Ancient Medicine*:

> For it is not fitting either to investigate or to speak about anything other than the affections of these very people when they are sick and suffering. Now for them to learn about their own affections, how they come about and cease and on account of what causes they grow and diminish, is not easy, since they are lay people; but when these things have been discovered and stated by another, it is easy. For nothing is involved other than each person recalling the things that are happening to him when he hears them (*VM* 2.3, I.572.19–574.3 L. = 120,3–12 Jouanna).

Against an approach to medicine that seeks the first principles of health and disease in the domain of things that are obscure (*VM* 1.2, I.572.2–5 L. = 118,4–7 Jouanna), the author proposes focusing on the patient and trying to communicate with him/her in a way that will facilitate listing the symptoms (e.g., how the illness started or evolved). On the one hand, this means that the doctor needs to speak in familiar ways to the patient. On the other hand, this leads to a watering down of the two principles referred to above, (I) and (II). These rules are merely good guiding principles that need further analysis, differentiation, and precision. This becomes evident in the subsequent discussion, which focuses on differences between humans and urges the doctor to take into account such differences in his practice and his theory:

> Now if it were as simple as has been suggested, and stronger foods harmed while weaker ones benefited and nourished both the sick and the healthy, then things would be easy: for it would simply be necessary to lead a patient towards the weakest diet, and one could do so with a good deal of security. But in fact the error is no less, nor does it harm the human being less, if one administers food deficient in quantity and quality to what is

> needed: for the might of hunger penetrates forcefully into the human constitution to lame and weaken and kill. And many other ills, different from those arising from repletion but no less serious, also arise from depletion. For this reason the doctor's tasks are much more varied and require more precision. For one must aim at a measure; but you will find no measure—nor number nor weight besides—by referring to which you will know with precision, except the feeling of the body (*VM* 9.1–3, I.588.4–590.1 L. = 127,15–128,15 Jouanna).

The reference to 'the feeling of the body' may point to the subjective experience of the patient or the observation by the doctor, or it may include both. What is important for us here, however, is that the focus is on each particular body and the precise type it belongs to. Each type of human body, with the particular balance that defines it, provides a measure by means of which we should be able to judge what the appropriate diet is. This does not relativise medical knowledge. Rather, the author recognises that the subject is complex and presents us with such a number of variations that it is impossible to seek in medicine the precision that we get in other domains of science or art.

This issue concerning the precision that characterises medical knowledge is discussed in chapters 9–12. And at least two important claims there underline the attention our treatise pays to observation and particularity. First, the author widens the content of the common principles of medicine and cooking. Pain and disease are not only due to the consumption of nutriments stronger than what an organism can assimilate, but also due to abstinence from food or the consumption of food that is not wholesome (*VM* 9.2, I.588.8–11 L. = 128,3–7 Jouanna). Similarly, reparation does not uniquely depend on the mitigation of the power of some nutriments but also on the restoration of the normal eating habits of an organism that fasts (*VM* 9.2, I.588.11–13 L. = 128,7–9 Jouanna). So the aim now seems to be directed also towards a balance between fasting and overeating. Balance is achieved at different points in the continuum between the two extremes for different types of organisms. This leads us to a second claim from the same portion of the treatise. The author refers to the different effects that the same diet may have in different organisms. For instance, reduction of the number of meals or of their portions may have different results in each case (*VM* 10.2, I.592.2–7 L. = 130,3–9 Jouanna). These observations show, moreover, that not only excess but also deficiency can be harmful to the organism. Hence the advice is to seek for each particular type of organism the corresponding causes that lead to specific results (*VM* 11.1, I.594.6–12 L. = 131,11–18 Jouanna).

The impression from this discussion of particular differences is that the foundations of medical knowledge are the recorded cases of particular patients

to the extent that the symptoms and processes they describe can lead to distinguishing and understanding the different types or natures in human beings.[11] This constitutes at the same time a limit for the exactness one can demand from medicine. For there is a limit to the validity of the more general claims medicine can formulate, as we saw already with principles (I) and (II). Despite this limitation, the author is optimistic about the future of medicine:

> Rather, since it has been able to come, by means of reasoning (λογισμός), from profound ignorance close to perfect accuracy, I think it is much more appropriate to marvel at its discoveries as having been made admirably, correctly, and not by chance (*VM* 12.2, 1.596.10–598.2 L. = 132,15–18 Jouanna).

The reference to 'reasoning' is not making an epistemological point concerning the opposition between reason and experience,[12] but still it could be thought of as including an horizontal and vertical axis of investigation. On the horizontal perspective, the doctor will examine the causes of disease. As we saw, the doctor relies on reports of his patients in order to get clear on types of human beings, and as a blueprint of the causes that influence each type (either provoking disease or aiding recovery from it or sustaining a healthy state). On the vertical axis, the doctor generalises from the particular cases, formulating a number of statements concerning the nature of the nutriments and the procedures by means of which can be prepared or administered (which will not constitute unexceptional laws but rather law-like principles holding 'for the most part'). If these two axes are the parameters along which medicine can attain precision, we can throw some light on an unexplained remark in the treatise that makes a forward reference to an exposition of some components of medical knowledge that have attained the desired precision: 'Yet many aspects (εἴδη) of medicine, about which something will be said later, have arrived at such precision' (*VM* 12.2, 1.596.5–8 L. = 132,16–18 Jouanna). The forward ref-

11 The author begins with the statement of some general principles (common to cooking and medicine) that are true in some general way for human organisms. But then he proceeds to the variety of different types within this domain and calls attention to the peculiarities of each one. This reminds one of the methodological question Aristotle puts forward in *Part. an.* 1.1 on whether the biologist should examine animal types or kinds one by one or whether he should talk first about what is common and only then proceed to particular cases (*Part. an.* 1.1, 639a16–30). Like the author, Aristotle chooses the latter option.

12 According to Cooper, "his main point seems to be merely that good physicians' diagnoses and prescriptions are based on solid knowledge, so that their successes are not due to chance" Cooper (2009) 28. See also Schiefsky (2005) 222.

erence here might be to chapters 22–23 treating the parts of medicine that examine, on the one hand, the qualities of the humours and powers and, on the other, the structure of the external and internal parts of the body. In these domains, the doctor feels confident that he can locate with much accuracy the causes of health and disease (horizontal axis) as well as the genera that such causes fall under (vertical axis). Therefore, it is probable that medicine in the domains of physiology and anatomy is considered an art that has achieved the precision that other sub-domains still aim for. As we will see below, the theory of *On Ancient Medicine* contains a brief yet systematic approach to the biochemical properties of the human body leading to precise ontological claims concerning natural properties in general. This theory includes some general claims concerning humours and structures, abstracting some important properties from specific bodily parts (vertical axis), and also includes explanations of the causal role that humours and structures might play in the life of an organism (horizontal axis). This will become clearer as we examine the third feature of the positive thesis of the author.

1.2.3 Function vs Origin

At a third level, the author argues that medicine gains its credibility as an art as it examines in detail two spheres of phenomena in the body that are responsible for health and disease. The first relates to the powers; the second to the structures of the body (*VM* 22.1, 1.626.6–7 L. = 149,1–3 Jouanna). What is interesting is that both powers and structures are analysed in terms of their possible results for the changeable state of the organism. So the author seems very close to talking about what in Aristotle will be designated as final causation, although his analysis does not point to a teleological view concerning the presence of humours and structures in the organism. Still, his model of explanation turns the interest of the practitioner to the function (ἔργον) that a power or structure is capable of performing without focusing merely on to the origin that produces such parts, i.e., an investigation of the material or the efficient causes that generated them.[13] The thought that function takes preponderance in medical study is strengthened by the fact that the author insists that this study must be per-

13 Here the author of *On Flesh* and Empedocles seem to have a place in the story to cast into relief the originality of the author. The former lays emphasis on the interactions between blocks of matter such as the hot and the cold, the dry and the wet, the fat and the glutinous, to explain the formation of bodily parts (*Carn.* 3–14; see Kouloumentas 2021), while the latter refers to Love as the primary agent who mixes the four roots in different proportions in order to shape the blood, the flesh, and the bones (DK 31 B96, B98), as well as more complex structures like the eyes (DK 31 B84; see O'Brien 1969, 196–236), during the cosmic cycle.

formed by a consideration of analogous structures in the domain of artefacts. Let us then examine more closely the powers and the structures.

Powers are defined as 'the acuity and strength of the humours' (*VM* 22.1, 1.626.8–9 L. = 149,3–4 Jouanna). The reference to 'acuity' and 'strength' turns our attention to the cases where a humour breaks the balance of the mixture by separating itself and dominating in the organism, thus provoking a corresponding imbalance. The text focuses on the example of the consumption of cheese, which leads some organisms to sickness, while in others it has no negative effect whatsoever, and in still other cases it even contributes to the strength of the organism:

> Hence the natures of these people differ, and the difference concerns the very thing in the body that is hostile to cheese and is stirred up and set in motion by it. Those in whom such a humour happens to be present in greater quantity and to exert more power in the body will naturally suffer more. But if cheese were bad for human nature in general, it would harm all people (*VM* 20.6, 1.624.5–10 L. = 147,16–148,3 Jouanna).

The strength of the humour that is opposed to cheese is what leads to sickness. Its consumption somehow triggers the opposite humour and, to the extent that this is in some strengthened state (perhaps there is a great portion of it in the particular organism or it may become diffused throughout the body), results in some imbalance in the organism. It is interesting that here imbalance is provoked not by the consumption of the nutriment itself on its own, but by its interaction with the strength of the humours present inside the organism.

The same picture results from an earlier reference to the strength of the humours as causally responsible for disease (*VM* 14.3, 1.602.4–8 L. = 136,3–8 Jouanna). There it is clear that both the strong humours in the body, as well as the strong properties of the food consumed, can lead to sickness: when human nature cannot dominate what is strong and the latter surpasses it. The power of nutriments is referred to by the use of the superlative degree: for the sweet, the strong is the sweetest; for the bitter, the bitterest, and so forth. The same properties exist inside the organism but they are well mixed. When one of them separates off and comes to be on its own, it provokes sickness. So it is the interaction between food and internal humours that produces imbalance in the mixture. The text is silent on whether this imbalance may happen also when some other factor, either internal or environmental, intervenes. But if we were to entertain such a possibility, i.e., that there is constant pressure from the environment or from within the organism and not just from strong foods,

it would be natural to also think that some homeostatic mechanism is in place that keeps such mixtures in check (or the corresponding qualities and powers). Some such mechanism, moreover, would presuppose a corresponding power in the organism (such that by exercising its capacity it secures balance in the organism), analogous to the one that the discoverer of the art of cooking or, later, the discoverer of the art of medicine were trying to determine. The text does not allude to such a homeostatic power in the organism, equivalent to what Aristotle will attribute to the nutritive power of the soul.[14] However, the discussion of the structures of the body may point to some such factor if read in a certain way. So let us turn finally turn to structures.

The author's approach to the second set of entities considered in chapters 22–23 has striking affinities to his approach on powers. As the commentators stress, the author is analysing the form of these entities (the shape, the constituents, the texture, or their position and orientation) and not their functions.[15] Therefore, his explanation is not teleological in the sense that it explains the presence of such parts in the organism by means of arguing that their function is necessary or optimal for the organism. However, these structures are analysed with an eye on how they draw up and retain or release liquids, and this brings in consideration regarding their function. According to *On Ancient Medicine*, this study must be conducted in comparison with artefacts that have similar structures and, hence, similar functions. What is certain is that what interests the author is not the study of the material and efficient causes (in Aristotelian terms) of such structures but rather the formal and possibly the final causes. So despite the non-explicit teleological character of his account, he opens up a space where teleological explanations fit relatively easily:

> By 'structures' I mean all the parts inside the human being, some hollow and tapering from wide to narrow, others also extended, others solid and round, others broad and suspended, others stretched, others long, oth-

14 The nutritive and reproductive powers of living beings, including plants, are closely linked in *On the Soul* 2.4, 416a19–20 and they secure the maintenance of the organism as well as its reproduction. Cf. *De an*. 3.12, 434a22–30.

15 Jouanna (1990) 213; (cf. [1999] 310) argues that the term σχήματα corresponds to what we call organs. But he avoids using the latter term because the term σχῆμα denotes the configuration of the parts, while the term ὄργανον denotes the function of the parts, a common use in Aristotle and beyond. Schiefsky (2005) 328 notes that it is not only the shape but also other aspects of the parts that are in question here (such as texture and orientation). He thus renders the term as 'structure'. We tend to read the author as interested in the structures because of their functions, as will be clear in the main text.

> ers dense, others loose in texture and swollen, others spongy and porous. Now which structures would *best be able* (δύναιτ' ἂν μάλιστα) to attract and draw moisture to themselves from the rest of the body: the hollow and extended, the solid and round, or those that are hollow and tapering from wide to narrow? I think it is these, the ones that taper from wide and hollow to narrow. But one must learn these things from evident things outside the body (*VM* 22.1–3, 1.626.8–19 L. = 149,4–16 Jouanna; our italics).

The examination of the differences between the structures is brief. It refers mainly to difference in shape, composition, texture, and orientation. These differences are brought forward in order to examine how the structures contribute to a function that seems to be fundamental for the purposes of the treatise: how well they draw, store, or release liquids. The author does not pause to explain why he insists on these aspects of structures, but by now it is clear that the treatise directs our attention to how a balanced mixing of the constituents of the organism can be achieved so that health is maintained or restored. Hence we could arguably think of these structures as the locations inside the body that are appropriate for such a mixing to ensue and thus as what helps to maintain balance. To this end, it is also instructive to point to the injunction that 'we should learn these things [sc. what the structures are capable of doing] from evident things outside the body'. The author points to similar structures either in the external parts of the organism (e.g., the mouth) or in artefacts. By examining them, we can draw conclusions concerning the internal parts. But now the antithesis between external bodies or parts that are ὁρατά and internal ones that are by implication ἀόρατα, cannot concern their visibility, for the internal parts are not invisible. The author has examined them, since he knows their shape and structure. What he does not know and what is invisible and beyond his comprehension is their function. Therefore, the reason we should examine external animal parts and artefacts is to discover the functions such structures support. This is the direction that the author urges us to take in order to search for an explanation in the domain of medicine.

Let us look at some of these differentiations between structures. The main one concerns the difference between hollow structures (either with a narrow or wide opening) and solid ones with regard to their respective capacity to draw in fluids. A further class contains those that are spongy and porous (e.g., the spleen), which have the capacity 'to drink up what is in contact with them and become hard and large on the addition of moisture' (*VM* 22.6, 1.628.11–12 L. = 150,15–17 Jouanna). They then become hard and dense and they neither concoct nor discharge the fluids. A fourth class lists parts that are fleshy and soft (e.g., the liver) and are sensitive to the air that hits them,

producing sharp and frequent pains, abscesses, and tumours. Finally, the diaphragm seems to constitute a unique case: being broad and resistant, it could be vulnerable to similar pains, but being sinewy and strong, it is more protected.

What is interesting is that the author is abstracting from the several internal parts their basic structural properties that make a crucial difference for their function, thus proposing a classification of the various structures. He seems to believe that relying on this classification is necessary for formulating explanations of the internal organs both concerning their function and their possible malfunction. Thus the specific *differentia* for each structure becomes the explanatory term that the analysis of the changeable state of the organism should be based on. For instance, the structure can explain whether an organ can retain liquid, or whether the mixing or the concoction will be more effective, thus protecting from pain and disease. There is a further question on whether some of these structures, being best suited for such an activity, could play a central role in a mechanism that will balance the general state of the organism (a role that Aristotle will attribute primarily to the heart as the seat of the nutritive capacity of the organism and of the final concoction of the blood). However, the treatise does not offer any evidence for answering that question.

We have, then, at least three important themes in *On Ancient Medicine* that occupy Aristotle too, as argued below. First, the author rejects the postulation of abstract material principles that will serve to explain all aspects of bodies, including their state in sickness or death. But this is far from leading to a rejection of any theoretical frames (as is clear from his rudimentary theory of structures, for instance) nor to the idea that medical interests must be separated from a general interest in the natural world at large. The author invites us to approach not only human nature but also its surrounding nature (e.g., the nature of nutriments, plants, and other animals). And he holds that medical knowledge will lead us to knowledge of the principles that control the function of natural bodies in general.[16] Second, he follows an anti-reductionist line against the natural philosophers concerning the properties of the humours and their activities. He does not try to explain these materials and activities by

16 Schiefsky (2005) 304–305 argues that the references are connected with nature in *VM* 20.1–3, I.620.5–622.12 L. = 145,17–147,4 Jouanna. Even so, medical knowledge will extend beyond the investigation of human nature in particular since it will have to include knowledge of foods and drinks, environmental conditions, and natural phenomena that may affect human health. If so, it should be possible to extend this knowledge to a general knowledge of the cosmos as a whole (Cooper 2009, 41).

appealing to some lower-level material and its corresponding activity. Third, he distinguishes some areas where medicine has been successful in stating with considerable precision explanations of the facts it deals with, plausibly the domain of the activity of powers and the domain of the structures of bodily parts. In both cases, he relies on a comparative study of artifacts produced by craft. Thus, even if his theory is not teleological, it transpires an interest in function. These are themes that deeply concern Aristotle, to whom we shall now turn.

2 Aristotelian Answers to Medical Concerns

First, we will look at the significance of the structure of animals' parts for the Aristotelian teleological explanations (for reasons of brevity, we will look only to the shape and not to other aspects such as texture or constitution). Then, we will turn to Aristotle's stance against a radical reductionism of material properties to a basic elemental material level, such as the four elemental powers. Finally, we conclude with some brief comments on how Aristotle views the relationship between philosophy and medicine.

2.1 *Studying the Shape of Parts: A Preamble to the Study of Function*

Aristotle devotes the opening chapter of the *Parts of Animals* to a series of arguments justifying the importance of stating the final causes in zoological explanations. He defends the idea that bodily parts are formed in the way they are because they serve some *purpose* that relates to *the needs or activities of the organism*. Aristotle opposes his line of explaining the parts of animals to the views expressed by natural philosophers such as Empedocles. He criticises them because they attempted to explain bodily parts by seeking their material origin, for instance, the four elements, and the procedure that generated them, i.e., the material and efficient causes that led to their formation:

> Now the ancients who first began philosophising about nature were examining the material origin and that sort of cause: what matter is and what sort of thing it is, and how the whole comes to be from it and what moves it (e.g. whether strife, friendship, reason, or spontaneity). They also examined what sort of nature the underlying matter has of necessity, e.g. whether the nature of fire is hot, of earth cold, and whether the nature of fire is light, of earth heavy. In fact, even the cosmos they generate in this way. And they speak in a like manner too of the generation of animals and plants, saying, for example, that as water flowed into the body stom-

> ach and every part that receives nourishment and residue came to be; and as the breath passed through, the nostrils were burst open (*Part. an.* 1.1, 640b5–16).[17]

Aristotle's objection against his predecessors is that descriptions of the formation of parts (like the ones he mentions) that rely on the description of the elements, their properties, and their natural motions or the changes they undergo in order to form animate parts are insufficient for explaining the presence of such bodily parts and for explaining the necessity of the processes that produced them. For, in the last analysis, both depand on final causes, i.e., the specific processes and whatever parts they produce are determined by what is necessary or useful to the life of the organism. In the first example concerning the formation of the stomach, what is missing from the explanation is the function of this organ, i.e., the concoction and processing of the incoming food that the stomach is capable of completing. Only with reference to this function can the formation of the stomach be explained. Hence the description that ignores the final cause fails to explain the necessity of the formation of the part and constitutes an incomplete explanation. There is a crucial question, however, especially concerning the internal parts of organisms, whose purpose or function is not evident, namely how the final cause can be identified. Aristotle, like the author, turns to the art-analogue, and he notes that a first step in that direction is the identification of the shape or form of the instrument or part that we are trying to understand. Indeed, he credits Democritus for taking this direction by paying attention to the shape and colour of the parts, although at the same time he criticises him for not taking the next and crucial step in that direction by focusing on function. His explanations, then, are also incomplete:

> It is just as if we were speaking about a bed or any other such thing; we would attempt to define its form rather than its matter, e.g. the bronze or the wood. And if we could not do this, we would at least attempt to define the matter of the composite; for a bed is a 'this-in-that' or 'this-such', so that we would have to mention its configuration as well, and what its visible character is. For the nature in respect of shape (σχῆμα) is more important than the material nature. Now if it is by virtue of its configuration and colour that each of the animals and their parts is what it is, Democritus might be speaking correctly; for he appears to assume this. Note that he says it is clear to everyone what sort of thing a human being

17 All translations from the *Parts of Animals* are from Lennox (2001).

> is in respect of shape, since it is known by the way of its figure and colour (*Part. an.* 1.1, 640b23–34).

The use of the term σχῆμα in the text includes not only the outline of the entity in question but other properties as well, such as size, texture, and composition (colour may relate to the latter). The latter use of the term is close to the one we find in *On Ancient Medicine*. The focus on the σχῆμα of a part as opposed to the procedure that generated it is understood as a first stage in the explanation of bodily parts in exactly the same way as one would analyse an object produced by a craftsman. But of course such a description is insufficient, for we have to move on to the functions that the structural properties of a part support. The comparison between the dead and the living body and the introduction of the homonymy principle aims at making clear exactly this point.[18] Although there is no trace of the homonymy principle in the author, the idea that the principle supports, namely that we have to study a part or organ while it is functioning as the very organ it is, does not seem foreign to his account. For it is this idea he brings forward when he urges us to examine parts or artefacts whose function is more evident than that of internal parts of organisms.

In what follows in the *Parts of Animals*, Aristotle makes a further observation that continues in the same direction and goes a long way forward compared to anything we can find in *On Ancient Medicine*. When the earlier natural philosophers, Aristotle argues, talk about the material and efficient causes that contribute to the generation of living bodies, they resemble a craftsman who explains the artefact he produced by describing the materials he used, his movements and the changes these movements provoked. But such a description is insufficient, since the artefact, and by analogy the living being, is a specific form created in a suitable/specific material. So as the craftsman must say that he performed the aforementioned movements so that his artefact realises the corresponding form with its specific function, analogously the natural philosopher must explain the specific function that the form of a living body or part typically has. Similarly, the author accuses 'some doctors and sophists', and Empedocles in particular (attacked by Aristotle as well on the same grounds), of dealing merely with how human beings were formed and from what elements they were constituted (*VM* 20.2, 1.620.9–12 L. = 146,3–7 Jouanna). To borrow Aristotle's stock phrase, he accuses them for describing *becoming* instead of *being* or *substance*.[19] The critique then of the author may be seen as aiming at

18 The principle is explicitly stated several times in the biological works (*Gen. an.* 1.19, 726b22–24, 2.1, 734b24–27; *Part. an.* 1.1, 641a1; *Mete.* 4.12, 390a10–13).

19 Aristotle discusses the priority of being over becoming while explicitly criticizing Empe-

reorienting research from the study of material and efficient causes to the study of the form and the properties of the structures of the body. What is common between the two thinkers is the focus on the form of each part and the functional properties of such a form. With the crucial difference, of course, that Aristotle proposes a complete teleological story of why such parts belong to an organism.

2.2 *Aristotle against the Reductionist Theories of Natural Philosophers*

From the examination of this first theme, it becomes apparent that Aristotle and the author are also in the same camp with respect to the second theme, namely in regard to their opposition to the reductionist theories of early natural philosophers. We examined the author's objection to other natural scientists' reductionist approach, which he calls 'hypotheses'. As we have seen, Aristotle is similarly opposed to the analysis of living beings and their parts in terms of the lower-level material constituents that compose them.[20] This agreement of perspective, however, is limited, for Aristotle does in fact adopt the kinds of 'hypotheses' that the author finds fault with. The basic elemental powers are the building blocks for higher level bodies, mixtures, uniform animate parts, non-uniform parts, and whole organisms. Therefore, these elemental powers or potentials contribute to the determination of more complex bodies and equally to health and disease. However, this is a result of a detailed chemical theory that Aristotle lays down, with more or less detail, in *Generation and Corruption* 2 and *Meteorology* 4, aiming to show how from a small number of material powers more complex properties emerge. Hence we could understand Aristotle's project as aiming to get a clear grasp of how the basic principles function in a domain that, for the author, the theories of early natural philosophers leave obscure. In other words—and independently of how successful Aristotle's biochemical theory is—the mere fact that Aristotle tries to explain how from a few basic element potentials we get the complexity of the natural bodies around us allows one to think that he does not posit these elements as mere 'hypotheses', which is the position the author criticises. Instead, his account is a possible answer to that critique.

According to Aristotle, material bodies are structured from the bottom up by three layers of material, each one of which plays the role of matter for the next level higher up. At the bottom, we have the four elements (1st level). The four

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docles for failing to understand the principle in *Part. an.* 1.1, 640a10–33, 2.1, 646a24–29; cf. *Gen. an.* 5.1, 778b1–6. See also Schiefsky (2004) 304 for this parallel between Aristotle and the author.

20 See *Part. an.* 1.1, 642a13–24, 2.1, 646a12–a29; *Ph.* 2.1, 193a9–28.

elemental powers associated with the elements help to constitute the material uniform bodies, either inanimate or animate (2nd level). Such uniform parts help, in their turn, to constitute more complex bodies, such as the non-uniform parts in animals and plants (3rd level, although these non-uniform parts further constitute the bodies of whole organisms). One, perhaps the most important, chemical process that is responsible for the formation of bodies is the process of 'concoction'. It is directed by the active powers of heat (primarily) and of cold (secondarily as resistance or impediment to heat), which operate on the passive powers of moist and dry, which in their turn constitute the material that undergoes concoction. The most detailed discussion of concoction is found in *Meteorology* 4.1–3, where Aristotle divides this general process into three specific types (also distinguishing three corresponding types of 'inconcoction' or failure of the positive process). Aristotle links these types to similar processes in the art of cooking (naming the former after the latter), just as the author bases medicine on cooking.[21] The types of concoction and inconcoction provide a rich repertoire for Aristotle's chemical explanation of the variety of biochemical phenomena. Surprisingly, Aristotle does not exploit these fine distinctions in his biological works or elsewhere.[22] He seems to rely more on a different chemical process—the process of mixing—and describes its operations in considerable detail in *Meteorology* 4.4–11. There, Aristotle explains how portions of matter composed of different proportions of earth and water (and also of air in some cases) are formed by the activity of hot and cold and in ways that result in the various higher-level potentials such as meltable/unmeltable, flexible/inflexible, breakable/unbreakable, elastic/non-elastic, etc.[23]

Putting aside Aristotle's specific explanations of how higher-level potentials are generated from the four basic ones, what interests us here is, first, the fact that Aristotle undertakes just such a project of identifying the laws that govern the constitution of higher-level bodies from the four basic ones, and that this project, if successful, neutralises the author's objection against his opponents,

21 For the specific concoction processes (ripening, boiling, roasting) and their opposites (rawness, scalding, and scorching), see *Mete*. 4.2, 379b12–17.

22 The six terms corresponding to the three types of concoction and the three types of inconcoction are used almost exclusively in *Meteorology* 4.1–3. There are only two relevant uses of ἔψησις in the biological works (*Hist. an*. 10.7, 638b5; *Gen. an*. 2.6, 743a31). But there is abundant use of the generic term πέψις most pre-eminently in the *Gen. an*. (21 instances of the noun or the verb).

23 Aristotle offers a list of these contraries in *Meteorology* 4.8, 385a12–19. On a much smaller scale, *Gen. corr*. 2.2 attempts a reduction of all tactile properties of bodies to the four basic element potentials—see Stavrianeas (2022). For the biochemical project of the *Meteorology* 4 and its place in Aristotelian physics, see Lennox (2014).

and second, the fact that this explanatory framework does not lead to a reductive theory like those attributed to the early natural philosophers. This second point clearly emerges in the concluding chapter of *Meteorology*:

> Having dealt with these matters [sc. the way elemental matter behaves in constituting other bodies], let us proceed to give accounts of flesh and bone and the other uniform bodies. We can tell from their generation what is the constitution of the uniform bodies, what are the classes into which they fall and to which class each belongs; for the uniform bodies are composed of the elements, and serve in turn as material for all the works of nature. But while the material of uniform bodies is the elements we have mentioned, their essential reality is comprised in their formal definition. This is always clear in the higher products of nature, and, generally speaking, in things which are instrumental and serve a particular end. Thus it is only too clear that a corpse is a man in name only (*Mete*. 4.12, 389b23–32).[24]

Aristotle feels that he has completed his account of the way in which the variety of material properties that we encounter in natural bodies (animate or inanimate) arises from the four elemental powers. His reference, once again, to the principle of homonymy and to the dead body that looks much the same as a living one in respect to its structure (shape, size, texture) reminds us that the task of the natural philosopher is not complete yet. He still has to investigate the function of this structure. The reason why specific chemical processes produce the corresponding material parts depends ultimately on how the being of the body produced is defined, i.e., what type of body it is or, equivalently, what functions it performs. Hence Aristotle can be seen, first, as addressing the anti-reductionist objections of the author by describing a network of material processes that enable the constitution of liquid and solid bodies (which, on the one hand, we could relate to the humours or powers and, on the other, to the structures in the Hippocratic treatise). Second, Aristotle warns us that the changes this network supports depend on higher-level causes, i.e., the natures of whole organisms, which determine what will transform into what, as well as when and where. We can read Aristotle in the first case as answering a justifiable *aporia* of the author, but in the second as following the idea of the Hippocratic author's own 'hypothesis' to its logical conclusion.

24 All translations from the *Meteorology* are from Lee (1952).

Conclusion: From the Principles of Physics to the Principles of Medicine

We conclude with a brief comparison of Aristotle's views on the relation between natural philosophy and medicine with those of the author. Although the evidence is scarce in both cases (especially the latter), we can draw some modest conclusions about their respective positions. On the priority between natural philosophy and medicine, they seem to be diametrically opposed.[25] Yet there is a common element that must be emphasised. Here is the well-known Aristotelian passage on the topic:

> We have now virtually completed our inquiry into life, death, and kindred subjects. As for health and disease it is the business not only of the physician but also of the natural philosopher to discuss their causes up to a point. But the way in which these classes of inquirers differ and consider different things must not escape us, since the facts prove that up to a point their activities have the same scope; for those physicians who have subtle and inquiring minds have something to say about natural science, and claim to derive their principles therefrom, and the most accomplished of those who deal with natural science tend to conclude with medical principles (*Resp*. 480b21–31).

Aristotle relates the subject matter of medicine (health and disease) to the subject matter of natural philosophy, and the work of the doctor to that of the natural philosopher, in a way that at first seems to subordinate medicine to physics (as a discipline based on local principles compared to one based on more general ones).[26] The most accomplished natural philosophers will examine the causes of health and disease, but it is presumably not within their remit to examine specific symptoms and the development of a disease or the various types of disease—that is the doctor's business. On the other hand, the more sophisticated doctors ground their principles on natural philosophy. So research on the foundations of medicine, at least, is an undertaking common to both the most accomplished natural philosophers and the most sophistic-

25 For a detailed description of the antithesis, see Mihai (2016), who investigates this opposition to medicine in Aristotle's *Protrepticus*.

26 This view is proposed and defended in Lennox (2005) 67–68. Lennox concludes that for Aristotle the causes of disease are not to be found in the *genos* of medicine, but in the *genos* studied by the natural philosopher. Medicine deals with facts while natural philosophy can provide causal explanations for those facts.

ated doctors. This outlook seems contrary to that in *On Ancient Medicine*, in which the author criticises natural philosophers and other doctors for their hypotheses or other explanatory strategies.

Nevertheless, in chapter 20, the author calls upon doctors to turn their attention to human nature—its chemical constitution, the activity of the humours and the powers inside and outside the body, the nature of nutriments and the processes of mixture and blending, and presumably to features of the surrounding environment as well. Thus, the author does not reject natural philosophy altogether but instead advocates basing knowledge of the natural world on medicine.[27] He only criticises a popular trend in philosophy, which is not based on empirical evidence and observation when it proposes the ways in which natural phenomena are explained by its first principles, say, for instance, the elements. But the knowledge he aspires to—the knowledge to be gained by a perfected medical science—will ultimately explain health and disease by invoking insights on phenomena and properties of the natural world that have a direct or indirect bearing on the nature of human beings and the state of their health. Our author would perhaps insist that this is the kind of project that deserves the name of medicine. However, such a project would arguably bear a greater resemblance to the way Aristotle sees the relation between natural philosophy and medicine. Be that as it may, one might suppose that the author would not be hostile to Aristotle's observations on the relation between physics and medicine if the type of natural philosophy on the table were to follow Aristotle's standards.

Indeed, Aristotelian natural philosophy can in some sense be read as responding to certain concerns raised by the author by aiming to demonstrate in some detail how matter is structured from the four elements upwards by means of the processes of concoction and mixing—as well as their opposites—that lead to the generation/maturity of natural bodies or their death/corruption, thus making a connection between the spheres of inanimate matter and animate bodies, or by focusing on the form and function of the parts of living bodies rather than being solely preoccupied with their constituent elements and the process that generated them. Instead of reading this endeavour as a violation of the principles defended by the author, we could see here an attempt to analyse in greater detail and with empirical validation the natural phenomena that the doctor also wants us to study. If for him the natural philosophers failed to provide clear explanations and if, therefore, he believes that medicine must shoulder this responsibility, this does not entail that his verdict holds equally

27 See Cooper (2009) 40–41; Mihai (2016) 89.

against Aristotle's project. Conversely, from Aristotle's standpoint, it would not be unreasonable to think that works such as *On Ancient Medicine* are part of the intellectual climate that contributed to his formation as a natural scientist, with his distinctive interest in empirical verification and analysis of natural processes that aims to reveal how such processes explain the constitution of material bodies, as well as health and disease in living bodies in particular.

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CHAPTER 4

Art and Nature in Aristotle's *Physics*: Some Antecedents in Early Greek Medicine

Sean Coughlin

Introduction*

Aristotle is the first writer we know of to use the phrase "art imitates nature" (ἡ τέχνη μιμεῖται τὴν φύσιν).[1] On three occasions, he uses it to justify positing ends or purpose in nature: twice in the *Physics* and once in the *Protrepticus*.[2] Given

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1 The phrase occurs six times in total in works attributed to Aristotle: at *Physica* 2.2, 194a21 and 2.8, 199a17; *Meteorologica* 4.3, 381b6 (unrelated to natural teleology); twice in Aristotle *ap*. Iamblichus, *Protrepticus* 9 (49,3–51,6 Pistelli); and once in the pseudo-Aristotelian *De mundo* 5, 396b12.

2 Hutchinson's and Johnson's (2005) work on authenticating the fragments of Aristotle's *Protrepticus* have placed scholarship on much firmer footing and studies that explore this work in the context of the rest of the extant corpus are now finally appearing; however, partly because the *Protrepticus* is not a work of natural science, I will not look at these passages in any detail. Ronja Hildebrandt (2022, 195–200) explores them along similar lines to the ones I present here, and I point readers to her discussion. The *De mundo* passage has been used to suggest the phrase "art imitates nature" comes from Heraclitus, e.g., by Bernays (1885, 23) and Diels following him (as Heraclitus fragment 22B10 DK), although it is not included in Laks and

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the importance of natural teleology for Aristotle and given its prominence in the history of philosophy, it is worth trying to understand how the claim that "art imitates nature" is supposed to justify it. The problem, as with many aphorisms, is that it is difficult to say precisely what it means. Scholars generally agree that Aristotle is asserting something about how art depends on nature.[3] Yet there is little consensus about the nature of the dependency he has in mind, the kind of support it is meant to provide, or the senses of "art", "nature", and "imitation" involved.[4] He almost certainly does not mean to assert that human arts aim at natural goals (or imitations of them) since, in addition to being question-begging, it would not always be true.[5] Whatever else he might mean, however, and why he thinks his audience would find the claim persuasive, is unclear.[6] Nevertheless, Aristotle thinks his audience would find it persuasive, since when he appeals to it in these arguments, he does so without elaboration.

Most. See Lebedev (2014) for a contemporary defense of the attribution to Heraclitus. Theiler (1925, 55–56), Jaeger (1968, 75 n. 1), and Else (1958, 82) deny the attribution, followed by Halliwell (2002, 153 n. 5). Further doubts about a relation to Heraclitus are expressed by Gregorić (2020, 155–159).

3 See for example Ross (1936) 508 and 528; Jaeger (1968) 74–75 and (1986) 28; Johnson (2005) 81 and 148; Broadie (2007) 95–100; Lennox (2008) 175–181 and (2021) 128; Leunissen (2010) 16–17, 39, 218; Comay del Junco (2020) 179.

4 Johnson (2005, 260) takes the claim to provide evidence about art and nature as causes: since art is a cause that acts for a purpose and art imitates nature, nature is *a fortiori* a cause that acts for a purpose. Leunissen (2010, 38–39) thinks the argument: if art is limited to imitation and completion of natural goals and art acts for a purpose, so does nature. It is not clear from their reconstructions that both agree about what 'imitation' in this instance means: Johnson takes it to imply the priority of nature over art; Leunissen that it implies something about the shared goals of art and nature. Discussions of μίμησις and its development in early and classical Greek sources have basically been limited to discussions of it in relation to the theory and history of aesthetics, literature, and art (rhetoric, poetry, painting, sculpture, etc.). There are also studies of the term in relation to Platonic and Pythagorean ontology and Aristotle's element theory. A larger philosophical study of the idea that "art imitates nature" in the history of science would need to take these discussions into account; however, scholarship on this subject is vast. I point readers to Halliwell (2002) for discussion and relevant literature on aesthetics and the development of the term.

5 One might sing to imitate a bird's song on whistle to imitate the sound of wind in the trees. In only one of these cases would we be tempted to say a purposive was being imitated. Halliwell (2002, 26 and 154–155) notes the distinction between what Aristotle recognizes as mimetic arts, like painting, sculpture, etc., which are alluded to in his claim that some arts imitate nature, others complete it, and the claim that "art imitates nature", on which see below. Halliwell is followed by Witt (2015, 113–114). See also Lebedev (2014, 33).

6 As Broadie (2007, 89) points out, obscurity of this kind led John Cooper to claim that one ought to reject the suggestion that the analogy between art and nature is fundamental to Aristotelian teleology. See Cooper (2004) 107 n. 2.

One promising approach for understanding the claim "art imitates nature" is to look for parallels in earlier writers. If we can see how the claim was used by the people Aristotle was reading and responding to, then we would have some independent evidence for the sense he has in mind. His audience would more likely find persuasive a sense of the phrase that they already take to be true. As scholars have noted before, Aristotle is not the first ancient Greek writer to have said something like "art imitates nature". We find similar claims in the early Greek medical tradition (preserved in the Hippocratic Corpus), as well as in works of classical comic poets, the writings of Democritus, and perhaps even Heraclitus.[7] Most scholars, however, have not incorporated this evidence, relying instead on internal readings or on readings according to which Aristotle is asserting something paradoxical. Meanwhile, one of the few scholars to acknowledge such parallels, Werner Jaeger, admits the phrase is similar to ideas found in his predecessors, but claims Aristotle uses the phrase in a fundamentally different way.[8] He proposes what we can call the 'teleological reading' of the phrase "art imitates nature". Rather than represent a continuation of earlier thinking on the relationship between art and nature, for Jaeger, "art imitates nature" asserts something entirely new and distinctively Aristotelian: that the teleological character of art depends on the teleological character of nature.

In this paper, I challenge the teleological reading of Aristotle's claim "art imitates nature". I argue that parallels in early Greek medical and philosophical works are antecedents of Aristotle's view on the relationship between art and nature. By analysing the ways in which they are similar, I believe we can explain why Aristotle would find the claim useful when motivating his own approach to natural science. The phrase "art imitates nature" in these works does not imply a commitment to natural teleology. Instead, it expresses a common belief about how artistic methods of production were first discovered

7 See below, page 138–142.

8 See Jaeger (1968) 74–75, 75 n. 1; Jaeger (1986) 28–30. Jaeger is followed by most of those who consider the evidence. Halliwell (2002, 154 n. 5) follows Jaeger directly in distinguishing Aristotle's sense from Democritus and later authors. Johnson (2005, 123) claims Plato rather than Democritus is the target and that Aristotle is consciously inverting Plato's claim that art is prior to nature in *Laws* 10 (Plato, *Leges* 10, 889b1–d6). I think Johnson is right that Aristotle has the *Laws* in mind, but where Johnson emphasizes the differences, I would emphasize the similarities, especially the fact that Aristotle follows Plato in dividing arts into two broad kinds: those that produce images and imitations, and those that share a capacity with nature at, e.g., Pl. *Leg*. 10, 889d and Aristotle *ap*. Iamblichus, *Protrepticus* 9 (49,3–50,2 Pistelli). This likely corresponds roughly to the Democritean division of necessary and luxury arts familiar from Aristotle's *Metaphysics* A1.

and progressed: that art, as Stephen Halliwell puts it, "follows the pattern of nature",[9] and the artist learns from nature by imitating its processes in the same way a student imitates the movements of their teacher. Nature itself, on the other hand, is in some appropriate sense self-taught or self-ordering. Thus, the author of the Hippocratic *Epidemics* 6 claims "[people's] natures are doctors in cases of illness (νούσων φύσιες ἰητροί)" and that "nature discovers methods (ἔφοδοι) by itself", suggesting that methods used in medicine are derived from natural processes.[10] Democritus likewise is reported to have said, "we are pupils (μαθηταί) of the animals in the most important things: the spider for spinning and mending, the swallow for building, and the songsters, swan and nightingale, for singing, by way of imitation (κατὰ μίμησιν)".[11] After Aristotle, this way of thinking about art's imitation of nature continues. As we will see, it is used in this sense by Theophrastus, Posidonius, Lucretius, Seneca, and Galen—even works as distant as Harvey's *Exercitationes de Generatione Animalium*, Dante's *Inferno*, and Hobbes' *Leviathan*.[12] I will call it the 'epistemological reading' of the phrase "art imitates nature": that our skills derive from natural processes that are regular, ordered, and intelligible to us. I suggest it is this sense that Aristotle uses to motivate his views on inquiry and teleology in natural science.

The advantage of this reading is that it accommodates thinkers who, like Democritus and Lucretius, assert art imitates nature but deny teleology and purpose in nature, and who, like Posidonius and other Stoics, think nature is a divine artist. It also accounts for the similarities between Aristotle's and his contemporaries' use of the analogy between art and nature. They are similar because they begin from common premises, even though they draw different conclusions from them. It will be helpful at this point to say what I think these are: Aristotle shares the common belief that "art imitates nature" and thus that we have learned how to produce reliable results by following the pattern of nature; he also shares a belief that this implies that nature as the source of our

9 Halliwell (2002) 153. Halliwell himself seems to maintain both a 'teleological' and 'epistemological' reading of the phrase (e.g., 153 n. 5). The 'epistemological' reading is similar to the sense of the phrase Lebedev (2014) attributes to Heraclitus.

10 *Epidemiae* 6.5.1 (V.314 L. = 254 Smith). Cf. *De alimento* 39 (IX. 112 L. = 145,12 Joly). On these examples in context, see pages 140–141 below. Concerning the use of 'Hippocrates' and 'Hippocratic' see the Introduction (section 2) and Perilli's chapter in this volume.

11 Plutarch, *De sollertia animalium* 20 = *Moralia* 974A8–11 = Democritus fragment 68 B 154 DK.

12 For Harvey, see *Exercitationes de Generatione Animalium* Ex. 71, 380, and discussion in Lennox (2017) 191–193. For Dante, see *Inferno* XI.97–105. For Hobbes, see the first sentences of *Leviathan*.

activities must itself be intelligible and regular.[13] What is new, I claim, are his arguments that regularity in nature further implies the existence of ends. "Art imitates nature", in other words, works as a reputable or *endoxic* claim and, in using it, Aristotle is following his own advice in the *Rhetoric* for providing arguments that begin from premises that one's interlocutors will accept.[14]

To support this reading, I will look at how the idea that art imitates nature is used by early Greek medical authors to justify the reliability of their medical practice by defending an appropriate method of inquiry. I then turn to how Plato uses art, specifically what he calls the method of Hippocrates, as a model when motivating a scientific rhetoric in the *Phaedrus*. Finally, I apply the results of these studies to Aristotle and the three occurrences of the phrase "art imitates nature" in arguments related to natural teleology. I will begin, however, with characterizations of art in the fifth and fourth centuries BCE in order to narrow in on what Aristotle might have found useful in them for motivating his own approach to natural science.

1 Art as a Model for Inquiry

In the *Metaphysics*, Aristotle says that "every science seeks (ζητεῖ) certain principles and causes concerning each of the things known by it, e.g. medicine and gymnastics and the rest of the sciences, productive (τὰ ποιητικά) and mathematical (μαθηματικά)."[15] Similarly, at the beginning of the *Physics*, he says "in all disciplines (αἱ μέθοδοι) which have[16] principles, causes and elements, knowledge, especially scientific knowledge (τὸ εἰδέναι καὶ τὸ ἐπίστασθαι), follows from an acquaintance with them".[17] The start of the *Physics* is Aristotle's attempt to motivate an inquiry "to determine things concerning these principles (διορίσασθαι τὰ περὶ τὰς ἀρχάς)".[18] One thing he is particularly interested

13 Aristotle argues for this in, e.g., *Physica* 2.8, *De Partibus animalium* 1.1, *De generatione animalium* 2.1.

14 *Rhetorica* 1.1, 1355a17–18; cf. 1.2, 1357a7–13. On *endoxa* in this sense, and on issues concerning the use of this term in secondary scholarship, see Frede (2012) 196–197.

15 *Metaphysica* K7, 1063b35–1064b3.

16 Ross (1954) ad loc. suggests, following Simplicius, that the antecedent of ὧν is an implied but missing ταῦτα: τὰ ἔχοντα ἀρχάς, the things having principles, i.e., the objects of τὸ εἰδέναι καὶ τὸ ἐπίστασθαι. It is not clear to me why the antecedent should not be τὰς μεθόδους, since there are some disciplines that do not have principles, namely, the science of first principles. For more on Aristotle's use of the term μέθοδος, see excellent discussions of Lennox (2008), (2011), and (2021).

17 *Ph.* 1.1, 184a10–12.

18 *Ph.* 1.1, 184a14–16. On Aristotle's use of general γνώμη in motivating a particular science,

in motivating is the very possibility of natural science (ἡ περὶ φύσεως ἐπιστήμη), since this possibility was sometimes doubted in the Old Academy.[19] However, he is more specifically trying to motivate an inquiry into the principles of natural science, since, as he will go on to show in the rest of *Physics* 1, he does not think anyone has succeeded in finding them.[20] In the passage from the *Metaphysics*, he uses the examples of medicine and gymnastics as obvious cases of *sciences* (ἐπιστῆμαι) that seek the principles and causes of what they know, and it is worth asking why he thinks both the theoretical study of physics and the art of gymnastics are both engaged in the same kind of inquiry.

The development of the productive arts and theoretical sciences is useful here. Already by the fifth century, arts (τέχναι) were understood to be highly specialized forms of productive knowledge. Following Heinimann's work of early 1960s, Leonid Zhmud notes four common characteristics of τέχνη in this sense:[21] (1) it is meant to be useful; (2) it serves a specific purpose; (3) it is specialists' knowledge of the means necessary to obtain a specific end; and (4) it must be able to be transferred to others by teaching.[22] According to Heinimann and Zhmud, these characteristics describe a theory of science whose aim is productive, rather than theoretical, knowledge.[23] The boundaries between theoretical and practical knowledge at this time are fuzzy, and, in general, the theoretical sciences of classical Greece arose from reflection on τέχνη and used it as a model for their own research. Τέχνη may have originally referred to activ-

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and on the interpretive puzzles related to these remarks in particular, see Menn (2019) 20–22.

19 Menn (1995) 60–62. The status of the *Timaeus* is a tricky issue. Plato describes his account in the *Timaeus* as "likely story" (εἰκὼς μῦθος) and perhaps it follows from this that physics is not a science (ἐπιστήμη) in the strict sense. Then again, Timaeus (the character) offers causal explanations of the kind that Plato elsewhere associates with ἐπιστήμη, e.g., in the *Gorgias, Phaedrus* (on this, see section 4 below), *Meno* (e.g., *Men.* 97e5–98a8), and *Phaedo*. If Plato believes dialectic (and perhaps mathematics) are prior sciences or sciences more strictly speaking, it need not follow that he thinks physics cannot be a science. He may think physics' first principles need to be known to be true independently, and so until they are demonstrated to be true by a prior science, physics would remain a likely story. Aristotle apparently does not think that what Plato was after in the *Timaeus* is different from what he is after in the *Physics*, and he usually treats Plato's views in the *Timaeus* on par with the Ionians and Democritus in his physical and psychological writings. For discussion, see also Lennox (2001a) and Johansen (2004).

20 The relation between *Physics* 1 and the theory of demonstration in the *Analytics* is discussed in Bolton (1991).

21 On this, see Zhmud (2006) 45–81 and Heinimann (1961).

22 Zhmud (2006) 46 and Heinimann (1961) 105–106.

23 Zhmud (2006) 47 and 48 n. 14, who notes that τέχνη and ἐπιστήμη are, generally, not distinguished in Plato's dialogues.

ities like medicine or architecture, but there seems to have been some shift that would allow the words 'τέχνη' (art) and 'ἐπιστήμη' (knowledge) to be used almost interchangeably, and to allow Plato, for example, to present the character Socrates plausibly speaking of virtue as if it were a kind of τέχνη. In such cases, 'τέχνη' seems to mean something more than mere handicraft.[24]

This shift seems to have started in the late fifth and early fourth centuries, when aspects of τέχνη concerning inquiry, discovery and teaching began to be considered apart from their utilitarian or productive context.[25] It might be better to refer to these collectively as the methodological aspect of τέχνη, since it was the systematic programme of research (rather than a manner of production) that was adopted as the model by newly developing sciences. In the fifth century, to the old Ionian sciences of astronomy (ἀστρονομία from νόμος, 'law') and geometry (γεωμετρία from μέτρον, 'measure'),[26] were added the sciences of arithmetic (ἀριθμητική), logistics (λογιστική), and harmonics (ἁρμονική), and in the fourth century, mechanics (μηχανική) and optics (ὀπτική) followed.[27] These sciences are named as if they were τέχναι (e.g., ἡ ὀπτικὴ τέχνη, ἡ λογιστικὴ τέχνη), except they are understood not to be productive, like medicine (ἡ ἰατρικὴ τέχνη), but theoretical.

It is within this context that we must also trace the appearance of the science of physics, the name we continue to use today although with a more restricted domain. At the beginning of his theoretical investigation into the causes, principles, and elements of natural science, Aristotle calls the discipline "ἡ περὶ φύσεως ἐπιστήμη",[28] and he refers to it as ἐπιστήμη explicitly to indicate he has more in mind than simple ἱστορία (or research), a genre which, for Aristotle, presents facts whose causes need to be investigated (as in *History of Animals*), but which is the kind of investigation he thinks many of the Presocratic physicists undertook. Elsewhere, however, especially in the *Metaphysics*, he explicitly refers to it as "physics": ἡ φυσική (sc. τέχνη) or ἡ φυσικὴ ἐπιστήμη. I have found no sources before Aristotle where the term 'φυσική' means a body of knowledge or discipline. It is absent in this sense in earlier extant works of Greek language. Later records, like the catalogues of ancient works preserved by Diogenes Laertius, mention no works with the name 'φυσική' or 'physics'

24 Zhmud (2006) 46–47.

25 Zhmud (2006) 47 and literature cited in 47 n. 9.

26 Aristophanes, *Nubes* 201–203 explicitly mentions these as disciplines taught in the "Thinkery".

27 Zhmud (2006) 47.

28 *Ph.* 1.1, 184a15.

before Aristotle.[29] In fact, terms 'φυσικός, -ή, -όν' are basically absent before Aristotle as either adjective or substantive. I have found four occurrences. The earliest is cited by LSJ: Xenophon's *Memorabilia*, where Socrates asks if courage is "learned or natural" (διδακτὸν ἢ φυσικόν).[30] A TLG search returns no instance in any extant treatise by Plato. Among writings of early Greek philosophers, it is not found among the *verbatim* fragments of pre-Aristotelian thinkers in Diels-Kranz (although it occurs regularly in *testimonia*).[31] Some have contended it should be read in the Derveni papyrus. In the most recent edition, Laks-Most conservatively print "φυσικ[." and translate as the adjective "natural"; others, including Janko, read it as a noun, "physicist".[32] Neither is certain given the state of the evidence. The only other occurrences are in two early Greek medical works. It is found once in *Diseases of Women* 3 (also called *On Sterility*), when the author says a doctor should "try to be natural (φυσικός)",[33] where it seems to mean something like 'apply treatments relative to the body of the individual patient'; and once in *On Sevens* (*De hebdomadibus*), where we are told a situation is dangerous "when the season itself fights along with the disease, like summer with fever or winter with dropsy; for the natural (τὸ φυσικόν) completely prevails."[34] The word "φυσική", however, in the sense of a body of knowledge, is not attested anywhere before Aristotle. Its absence of course

29 At D.L 9.7.47, some of Democritus' works are collectively called "physical" (τὰ φυσικά), but it is not clear to me whether this refers to the objects of those works ('natural things') or the works themselves ('physical works'). Their actual titles use the earlier epithet "On Nature" (περὶ φύσεως). Empedocles' works on nature are similarly given the title τὰ φυσικά by later authors, already in Aristotle, e.g., Arist. *Mete*. 4.4, 382a1, with the same ambiguity.

30 Xenophon, *Memorabilia* 3.9.1 (222 Marchant). On the idea of 'natural ability', see below n. 59.

31 Even in the context of later *testimonia* or commentary, it is not clear 'φυσικός' is univocal, even as an adjective. See Most (1987) 6–9.

32 *Derv*. fr. F14 (380 Laks-Most = p. 115 Kouremenos et al.). Kouremenos et al. print "φυσ ...[" and suggest in their apparatus that "φυσικ[" (with κ) is more likely than "φυσιν[" (with ν). Alternatively, Janko (2008, 43) prints "φυσικ[ός". For discussion, see Heinemann (2021) 14 n. 9. Heinemann and I independently noted the fact that φυσική as the name for a science does not appear in any extant Greek texts earlier than the Aristotelian corpus, although we come to different conclusions about what this means. See Heinemann (2021) 14–15.

33 *De morbis mulierum* 3.230 (VIII.444 L. = 372 Potter).

34 *Hebd*. 50 (VIII.667 L.). Mansfeld, based on vocabulary and resemblance of doctrines to the Pneumatist school, dates this chapter of *De hebdomadibus* to the first century CE, quite different from the commonly cited date of around 430 and 370 BCE. See Mansfeld (1971) 227 and Craik (2014) 128. The Greek text is preserved in section VIII of the *Aphorisms* attributed to Hippocrates, a section that Mansfeld notes is only found in two manuscripts (1970, 4 n. 7). In most copies since the time of Galen, the *Aphorisms* ends with section VII.

cannot prove this sense is an Aristotelian invention, although it is possible. Regardless, it is a name whose formation is closely allied to names for productive sciences.

When Aristotle refers to natural philosophy as φυσική, i.e., 'physics', clearly he does not mean to imply that it is a productive science; however, it is also clear that he is thinking of natural philosophy on the model of τέχνη and that he is extending the theoretical aspect of τέχνη as he understands it to the study of the natural world.[35] Of course, Aristotle adopts or coins names for many sciences that are not obviously productive using this convention, notably practical science (πρακτική, knowledge of how to act) and first philosophy (knowledge of separate, immaterial objects, which he sometimes calls θεολογική or the highest form of θεωρητική, although he refers to all forms of reflective knowledge as θεωρητική[36]). I do not think the use of such words implies that Aristotle thinks all sciences are instances of τέχνη. My point, rather, is that he thinks ἐπιστήμη or science is something that developed from the kind of reflection that was done by those who developed the arts. This seems implicit in the cultural history he presents at the beginning of *Metaphysics* A: science progresses through stages, where at first necessary τέχναι arise, whose goals are means of survival, followed by τέχναι, for which the goal is pleasure, and finally the theoretical disciplines, whose goal is demonstrative knowledge.[37] While theoretical disciplines, unlike arts of survival and pleasure, are not themselves productive, Aristotle nevertheless identifies an aspect of τέχνη that he thinks is common to all three stages of scientific development: "every science seeks (ζητεῖ) certain principles and causes concerning each of the things known by it". He thus considers the specification of scientific inquiry (ζητήσις) as inquiry into the causes and principles of a subject matter (πραγματεία) to be something that practical and theoretical science share.

35 Cf. *Metaph.* Γ3, 1005b2; E1, 1025b19, 1026a12, 1026a19, and 1026a36; K7, 1064a31; *Part. an.* 1.1, 641b1; he also uses φυσική to describe processes that are natural, as opposed to artificial (τεχνική), again on the model of the arts. There are many instances in the early Academy of arts being used as a way of understanding nature. On this, see Lennox (2001a), Menn (2002), Coughlin (2013), Henry (2013), Gelber (2017), Fernandez and Mittelmann (2017), Barney (2021). Schiefsky (2007, 68) claims that analogies between art and nature were used regularly in Greek science as heuristic devices for learning about nature. I mainly agree, but there is a further question that concerns whether or not they were aware they were using the arts as heuristic devices and how they justified it.

36 Cf. *Metaph.* E1, 1025b19.

37 *Metaph.* A1, 980b26–981b24.

2 Theories of Art among Early Greek Medical Writers

The notion of art as a method of inquiry developed during the fifth century, in part among the sophists, in part among medical authors who were attempting to clarify the method that medical inquiry should follow.[38] These discussions arose in the context of debates about the roles of luck and art in medicine. Many physicians were engaged in a project of demonstrating to the public that medicine was an art (τέχνη) and that their successes were not the result of luck (τύχη) but came from their exercise of the art. The author of *Places in Man* (*De locis in homine*) for example says that "the man who knows medicine (ἰητρικὴν ἐπίσταται) least depends on luck (τύχη)" and "all medicine has advanced, and its finest established techniques seem to have very little need of luck".[39] Luck is "self-ruled" (αὐτοκρατής) but "ungovernable, and it is not its way to come in response to one's wish; knowledge (ἐπιστήμη) however is governable and brings success (εὐτυχής) when the one with knowledge wishes to use it".[40] Art and knowledge are different kinds of causes from luck and chance: what results from knowledge exhibits a regular connection between cause and effect, while none of the results of luck do.[41] The author of *Ancient Medicine* (*De vetere* or *prisca medicina*) gives a further argument in favour of medicine's status as an art claiming that if medicine were not an art, all doctors would be equally bad and "all the affairs of the sick would be governed by chance";[42] as it is, "some practitioners are bad, while others are much better", which we would not expect to find "if medicine did not exist at all and if nothing had been examined or discovered in it".[43] The author's point is not merely that some doctors are good and some doctors are bad, but that the doctors who are regularly able to produce good results do so in virtue of their art.

In the context of asserting that the doctor's art differentiated the results of medicine from those of luck, some medical writers began to ask what this art was. One of the clearest examples of this kind of discussion appears in *Ancient Medicine*. The author is trying to prove that medicine has discovered a prin-

38 I will not speak directly about the development of τέχνη among the sophists. See Zhmud (2006) Chapter 2; Schiefsky (2005) 36–37.

39 *De locis in homine* 46 (VI.342 L. = 84,18–21 Craik), tr. Craik, modified.

40 *Loc. Hom.* 46, (VI. 342 L. = 84,23–24 Craik), tr. Craik, modified.

41 Schiefsky (2005) 7.

42 *De vetere medicina* 1.2 (I.570 L. = 118,14–119,1 Jouanna), tr. Schiefsky.

43 *VM* 1.2 (I.570 L. = 118,10–12 Jouanna), tr. Schiefsky.

ciple and a method (καὶ ἀρχὴ καὶ ὁδὸς εὑρημένη)[44] not only for applying medical treatment, but for discovering new treatments. He claims the method of medicine is ancient and was discovered in the course of learning which foods were conducive to health and which were harmful.[45] He opposes this to the method proposed by new doctors who, assuming "empty hypotheses" (κενῆς αὐτέην ὑποθέσιος) like the principles of Empedocles' system, try to ground medicine in principles that are ultimately unverifiable (τὰ ἀφανέα τε καὶ ἀπορεόμενα).[46] The author and his opponents differ in what they take the starting point of medicine to be, but the existence of a debate suggests that they agreed that an appropriate starting point for medicine exists, and that determining what this is and what the appropriate method is that proceeds from it, is subject to rational scrutiny.

Whatever method the art of medicine ends up following, it must be the kind of method that allows the doctor to demonstrate that his results originate in art (τέχνη) and not in chance (τύχη). One way a doctor might do this would be to show that he knows why, i.e., that he knows the causes through which the treatment has certain therapeutic outcomes. In his study of *Ancient Medicine*, Mark Schiefsky has shown that the concept of nature (φύσις) was central to the author's strategy of justifying their methods through their knowledge of causes. The idea that natural phenomena had regular, intelligible, and hence discoverable causes meant that doctors could attribute successful therapeutic outcomes to knowledge of the causes through which nature regularly operates.[47] If a doctor knows nature, she knows its causes; and if she knows its causes, she can justify her practice by appealing to its regularity and intelligibility. It is not surprising, therefore, that the starting point of medicine for many early Greek medical writers was nature itself. Some doctors look to a more general conception of nature, like those who take on the hypotheses of Presocratics; others, like the authors of *Ancient Medicine*, *Nature of the Human Being*, and *Places in the Human Being* will start from human nature. Either way, starting with a general grasp of the way nature operates, doctors could justify their practice (why it was successful in one case, but unsuccessful in another) and also, since the principle is sufficiently general, apply that knowledge in unfa-

44 *VM* 2.1 (I.572 L. = 119,12–13 Jouanna).

45 *VM* 3.1–6 (I.574–578 L. = 120,16–123,8 Jouanna).

46 *VM* 1.3 (I.572 L. = 119,4–5 Jouanna), tr. Schiefsky. He seems to have in mind the kind of explanation we see in the early medical work, *De carnibus* (VIII.584–615 L. = 127–165 Potter). Schiefsky (2005) 19–21 gives other examples of this kind of theorizing.

47 Schiefsky (2005) 10.

miliar situations.[48] Since this knowledge rests not on individual cases but on general theories of nature, the method of reasoning from nature to treatment is also something that can be taught.

The medical art, however, is not simply a method for applying an existing body of knowledge about human nature; it must also be able to progress, to discover new treatments. In addition to claiming that the doctor can appeal to natural causes to justify a particular therapy, the author of *Ancient Medicine* sets out to prove that medicine "has discovered a principle and a method through which many excellent discoveries have been made".[49] The art of medicine is, therefore, in part also a method of inquiry.

As a method of inquiry (ζητήσις), τέχνη implies a kind of systematic research, whose aim is the discovery (εὕρησις) of new knowledge, skills, or products.[50] The notions of inquiry and discovery as sources of knowledge were also associated with two related pedagogical notions: learning and imitation (μάθησις and μίμησις). Discoveries become the objects of learning and imitation, and together they constitute the basis of teaching.[51] Among the sophists, especially, teaching was thought of as a form of imitation. In their textbooks or τέχναι, some sophists presented their students with a model speech (παράδειγμα), and their students were considered to be learning by literally imitating (μιμεῖται) these models, adding appropriate modifications to suit different situations.[52] Education as imitation, however, has earlier roots than the sophistical method of education. It also served as a model for explaining the origin of arts and acquisition of new techniques. If the only way to acquire new knowledge is through discovery or through learning and imitation, there must have been someone who first discovered the art who was then imitated by everyone else. Before the fifth century, people were usually presented as having first been taught the arts by gods or demi-gods, with different gods being assigned different arts. By the fifth and fourth centuries, these stories came to be replaced by new (but in many ways equally mythical) accounts of the πρῶτοι εὑρεταί—

48 Schiefsky (2005) 10–11.

49 *VM* 2.1 (1.572 L. = 119,12–14 Jouanna), tr. Schiefsky: καὶ ἀρχὴ καὶ ὁδὸς εὑρημένη καθ' ἣν καὶ τὰ εὑρημένα πολλά τε καὶ καλῶς ἔχοντα εὕρηται.

50 Zhmud (2006) 47.

51 The development of Greek education and culture (*paideia*) is complex. I am closely following two studies on this subject: Jaeger (1986) (first published in German as *Paideia: die Formung des griechischen Menschen*, 3 vols. Berlin: De Gruyter, 1933–1947) and more recently Zhmud (2006) looks at the historiographical tradition in antiquity, particularly the development of writing about the history of *technai* and science. Other studies include those in Bloomer (2015) and Salvo and Scheer (2021).

52 Jaeger (1986 vol. 1) 286–331.

the first discoverers of crafts or techniques.[53] The first discoverer is a necessary condition for any account that assumes knowledge is passed on by learning and imitation. Both Plato and Aristotle, in trying to trace back a specific discipline to its founder, are following a characteristically Greek tradition of accounting for the origins of knowledge and culture on the model of imitation.

Many of the early Greek medical writers, however, explained the discovery of crafts not only through imitation of a first discoverer or divine figure like Asclepius, but through the imitation of nature itself. The author of *Regimen* (*De victu* or *De diaeta*) almost makes a parody of the idea when he claims that all the human arts arose from imitating human nature:

> People do not know how to investigate the invisible from the visible; for, although they use arts that are similar (ὁμοίῃσιν) to human nature, they are not aware of it. For the mind (νοῦς) of the gods taught [them] to imitate (ἐδίδαξε μιμέεσθαι) what is their own, knowing what they are doing but without knowing what they are imitating (γινώσκοντας ἃ ποιέουσι, καὶ οὐ γινώσκοντας ἃ μιμέονται).[54] (*De victu* 1.11.1, VI.486 L. = 134,21–24 Joly-Byl)

The author goes on to give many examples of arts imitating bodily processes in this unconscious way: forging iron tools is like physical training (1.13); carpenters, by pushing and pulling saws, imitate the pushing and pulling of air in breathing (1.16). Everything from singing and cooking (1.18) to building (1.17) and basket-weaving (1.19) are all equally imitations of nature.[55] The author is claiming that by reflecting on the fact that these are imitations of natural processes, people will have a method of investigating invisible natural phenomena through more evident artistic ones, since we "know what we are doing even if we do not know what we are imitating". One begins, in other words, with things that are better known to us, and then seeks the causes of their regularity in what is better known by nature.

The connections the author finds between the arts and nature seem incredible. Still, it is worth asking what the author means when he describes these arts

53 Zhmud (2006) 34–44.

54 οἱ δὲ ἄνθρωποι ἐκ τῶν φανερῶν τὰ ἀφανέα σκέπτεσθαι οὐκ ἐπίστανται· τέχνῃσι γὰρ χρεώμενοι ὁμοίῃσιν ἀνθρωπίνῃ φύσει οὐ γινώσκουσι. θεῶν γὰρ νοῦς ἐδίδαξε μιμεῖσθαι τὰ ἑωυτῶν, γινώσκοντας ἅ ποιέουσι, καὶ οὐ γινώσκοντας ἃ μιμέονται.

55 *Vict*. 1.13–24 (VI.488–496 L. = 136,15–142,5 Joly-Byl). For discussion of these passages, see Bartoš (2015) 145–155. On the relationship of these chapters to the rest of Book 1, see Popa (2014), who argues that these chapters serve as a model in later chapters for explaining complex higher order dispositions to the material constituents of our bodies. See also Lebedev (2014) 27–42 on the connections to Heraclitus.

as unconscious or instinctual imitations of natural processes. One thing scholars have often thought the author means by imitation is ontological priority, much like the kind we find in Plato: as particulars are to forms in Plato's ontology, or to the numbers in Pythagoreanism, so the arts (or their products) are to nature (or its products).[56] Following Burkert, Hynek Bartoš has convincingly shown that a Platonising or Pythagoreanising sense of imitation (μίμησις) does not seem to be the relevant sense here. If it were, we would expect the author to claim that artistic processes depend on natural ones for what they are. Such a relationship would be one-way: arts could 'imitate' nature, but nature could not 'imitate' art in return. The author of *Regimen*, however, at times suggests the imitation-relation between artistic and nature is reciprocal and, for this reason, Bartoš argues that what the author has in mind is a non-hierarchical sense of imitation that might be better translated as resembling.[57] Without going into details here, the metaphysical assumption behind such reciprocity of resemblance is that the regularity in both artistic and natural processes are due to a common set of regular processes in their constituent materials, which artistic processes and the processes of the human body share.[58] I would add, however, that while the art and nature analogy may be reciprocal, it is meant also to be didactic: nature may seem invisible and so unknowable to us through simple observation, but its intelligible order can be understood by analogy with the order of art, which is clearly manifest to us. Bartoš's conclusions suggest as much, namely that the author of *Regimen* takes nature to be intelligible. He says, we "know what we are doing" even if we do not attend to the fact that our actions are instances of things that already happen in nature.

A similar claim is made in the early medical work, *The Art*. The author of this treatise, like the author of *Ancient Medicine*, is engaged in a defence of medicine against those who claim its results come about by chance; like the author of *Regimen*, this author is concerned to show that the art of medicine knows invisible or unclear things (ἄδηλα) through research.[59] This research, however,

56 For presentation and arguments against this view, see Bartoš (2014) 549–553 and Witt (2015) 113.

57 *Vict*. 1.18.3 (VI.492 L. = 138,22–24 Joly-Byl), rejecting the emendations of Joly, on which see Bartoš (2014) 542–549 and (2015) 129–132. I do not think, as Bartoš does, that this means we need to abandon the translation of imitation, so long as we understand it is copying or imitating processes that may ultimately have a common mechanism or explanation, something Bartoš himself seems to suggest at Bartoš (2014) 553. On this sense, see also the comments of Zhmud (2006) 66.

58 Bartoš (2014) 549–550, 553; and a fuller discussion in Bartoš (2015) 139–164. See also Joly-Byl (2003) 243–244.

59 *De arte* 11.1 (VI.19–20 L. = 237,4–20 Jouanna).

is possible in medicine as in all others arts because art itself is known from the moment it is taught to "derive from a certain form" (ἔκ τινος εἴδεος), where 'form' refers to manifestations of nature rather than of human contrivance.[60] For this author, the order of art derives from the order of nature.

The art and nature analogy in *Regimen* also suggests that the author believes the reliability of technical methods should be explained in terms of the regularity already present in natural processes.[61] The reliability of nature, on the other hand, is not in need of further explanation. Nature does not, like an artist, learn its techniques by imitating anything else (even if instructed to do so by the mind of the gods). Instead, "nature spontaneously knows these things (ἡ φύσις αὐτομάτη ταῦτα ἐπίσταται)".[62]

The autodidacticity of nature is not a unique idea to the author of *Regimen*. It is mentioned in several works transmitted in the Hippocratic Corpus. In *Epidemics* 6, for example, we find the claim:

> [People's] natures are doctors in cases of illness. Nature discovers the methods (ἔφοδοι) for itself, not from reasoning (ἐκ διανοίης)—for example, blinking, the tongue offering assistance, and the like. Being well-educated, ready, and without teaching, nature does what is needed.[63] (*Epid.* 6.5.1, v.314 L. = 254 Smith)

60 *Art.* 1.2 (VI.5 L. = 226,3–4 Jouanna).

61 The author grounds the regularity of nature itself in divine providence, claiming "the gods arranged the nature of all things" (*Vict.* 1.11.2, VI.486 L. = 136,2 Joly-Byl); however, he is primarily interested in showing that it is because nature is regular that our arts exhibit the degree of reliability and regularity that they do.

62 *Vict.* 1.15.2 (VI.490 L. = 136,28–138,1 Joly-Byl).

63 νούσων φύσιες ἰητροί. ἀνευρίσκει ἡ φύσις ἑωυτῇ τὰς ἐφόδους οὐκ ἐκ διανοίης, οἷον τὸ σκαρδαμύσσειν, ἡ γλῶσσα δὲ ὑπουργεῖ, καὶ ὅσα ἄλλα τοιαῦτα. εὐπαίδευτος ἡ φύσις ἐκοῦσα οὐ μαθοῦσα τὰ δέοντα ποιέει. Here I follow Smith's text and translation. The text is problematic, with some mss. followed by Littré transmitting ἀπαίδευτος and ἐοῦσα. Smith basically follows the text Galen seems to have read: see Galen, *De placitis Hippocratis et Platonis* 9.8.26 (V.810 K. = 586,22–23 De Lacy) and *In Hippocratis Epidemiarum Liber VI commentaria* 5.2 (XVIIB.283 and 286–287 K. = 259,12–13 and 261,8–14). For my purposes, the difference is not relevant. Whether nature is untrained (ἀπαίδευτος) or well-educated (εὐπαίδευτος), all editors (ancient and modern) agree the text asserts nature is not taught (οὐ μαθοῦσα) and still does what is necessary. In his commentary on the *Epidemics* 6 passage, Galen refers to Thucydides' (Thuc. 1.138) description of Themistocles as having "by his own intelligence (οἰκείᾳ ξυνέσει) without any past or present education (οὔτε προμαθὼν … οὔτε ἐπιμαθών)" an ability to decide on present and future matters in order to explain how one can be well-educated without having been taught. This is reminiscent of Xenophon's Socratic discussion of whether courage is either learned or natural (φυσικόν), mentioned above on page 133.

Like the author of *Regimen*, nature here seems to be restricted to the nature of the human body and the author uses examples of its activities (blinking and moving the tongue) to describe it as if it acted instinctively: it produces health without having to be taught how to do it.[64] The same view is expressed in the aphoristic work *Nutrition*: "the natures of all things are untaught" (φύσιες πάντων ἀδίδακτοι).[65] Unlike in *Epidemics* 6 and *Regimen*, there is little context given in *Nutrition* to understand precisely why the author thinks this, although even here it seems to offer some kind of answer to a question of how the human body in some sense knows what and when something is helpful and when it is harmful. A final example comes from a passage attributed by Diogenes Laertius to the comic poet Epicharmus, who, when explaining how a hen knows to sit on its eggs to incubate them, is reported to have said: "nature alone knows how it is with this wisdom, for it has learned from itself".[66] In all these cases, describing nature as 'self-taught' only makes sense if one assumes that, in more familiar cases, regular and ordered processes require instruction. One can assume what the first 'teacher' must ultimately have been by hypothesizing that the nature of living bodies follows regular and ordered processes without learning it from anything else and, in fact, that the regular processes we engage in were learned by following regular patterns in nature.

The hypothesis that nature is self-taught allows the author of *Regimen* to explain the reliability of τέχνη on the grounds that nature is a cause of regular effects. The hypothesis has been taken by some interpreters to be an extension of the idea of τέχνη onto nature itself, as though nature were a kind of artist.[67] I think a more important implication is the author's commitment to the intelligibility of nature, something he and other early Greek medical writers could appeal to in order to defend their practice against those who claimed their results were no more than luck. If the causes operative in cases of health or disease could be shown to be intelligible, then it made little difference whether or not they might ultimately be caused by the gods. So long as they could be reliably discerned and understood, they could provide an adequate foundation for medical techniques. The commitment to the intelligibility of nature is what allows the author of *Sacred Disease* (*De morbo sacro*) to claim the 'sacred' dis-

64 For further parallels, see Craik (2017) 207–210.

65 *Alim.* 39 (IX.112 L. = 145,12 Joly).

66 D.L. 3.16 (251,175–176 Dorandi = Pseudo-Epicharmia fr. 278 Kassel-Austin): τὸ δὲ σοφὸν ἁ φύσις τόδ' οἶδεν ὡς ἔχει μόνα· πεπαίδευται γὰρ αὐταύτας ὕπο. The attribution to Epicharmus is doubted by Kassel and Austin (2001) 162. I return to these texts below, in section 4.

67 Jaeger (1986 vol. 3) 27.

ease is no more or less sacred than any other. The author zealously attacks the charlatans (ἀλαζόνες) who he claims called the disease 'sacred' (ἱερή) because they had failed to discover any treatment and thus hid the fact that, in actuality, they did not know the cause of the disease.[68] Despite this, the author asserts that the disease has a nature (φύσις) and a cause (πρόφασις), but one that people have failed to grasp because of their inexperience (ἀπειρία).[69] With experience, however, he thinks the doctor can find reliable treatments because the doctor will be able to discover its cause (αἴτιος). This only serves to emphasize the fact that the medical art relied on the assumption that nature itself was a cause whose regularities were intelligible and open to rational inquiry. Moreover, claims that art is an imitation of nature and that nature is self-taught are claims implying that the reliability of productive methods in art presupposes that nature, as a cause, is a first cause of regular, intelligible effects.

3 Plato on Inquiry in Medicine and Rhetoric

Plato picks up these themes in the *Phaedrus*, where Socrates discusses what method the art of rhetoric should follow and proposes it should follow what he calls "the method of Hippocrates". Plato describes the method of Hippocrates as beginning with an inquiry into human nature to discern what human nature is and how human nature is affected by things external to it.[70] The method presupposes that these causes are both intelligible and general; once these causes are discovered, how to apply them to practice becomes something that can be taught.[71] Plato uses this discussion to suggest that a similar method could be used to develop a scientific rhetoric.

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68 *De morbo sacro* 1.4 (VI.354 L. = 3,18–4,5 Jouanna).

69 *Morb. Sacr.* 2.1 (VI.364 L. = 10,4–11 Jouanna). For discussion, see van der Eijk (2017) 218–221.

70 *Phaedrus*, 269e4.

71 *Phdr.* 270a1. Whether Plato may have been reading any of the extant works attributed to Hippocrates (and hence whether we have any direct evidence of the historical Hippocrates) is a source of endless debate and one which I will not enter here. The traditional view, maintained by Galen, is that Plato had read the work *Nature of the Human Being* (*De natura hominis*). See Jouanna (2002) 58–59; (2012) 39 n. 3 for literature. Émile Littré, the 19th c. editor of the Hippocratic Corpus, believed Plato was reading *Ancient Medicine* (*De vetere medicina*). Wesley Smith (2002) 44–60 believed Plato was reading *Regimen* (*De victu*). On the question of the Platonic evidence, Lloyd (1975) remains an important entry point into the issues. Jaeger suggests that Plato's characterization of "Hippocrates' method" is too general to determine direct antecedents in the extant Hippocratic corpus, but he follows Littré in claiming that the method seems similar to the one presented by

The discussion begins when Socrates wonders whether "the method (τρόπος) of medicine [is] in a way the same as the method of rhetoric".[72] He proposes that they are in a way the same, since in both cases "we need to determine the nature of something (δεῖ διελέσθαι φύσιν)—of the body in medicine, of the soul in rhetoric. Otherwise, all we will have will be a routine and empirical practice" (μὴ τριβῇ μόνον καὶ ἐμπειρίᾳ).[73] As we will see, Plato uses the terms "empirical" and "artless" to discredit rhetoric as an art in the *Gorgias*. There, however, his aim is to promote the art of justice rather than the art of rhetoric as the true political science on the grounds that rhetoric makes its objects appear good without in fact being good. Plato's concern in the *Phaedrus* is not to discredit rhetoric, but to motivate the possibility of a 'scientific' art of rhetoric. Thus, he applies to it the method of inquiry he attributes to "Asclepius' descendent"—a method of "thinking systematically about the nature of anything" (διανοεῖσθαι περὶ ὁτουοῦν φύσεως) to show what rhetoric would be like if it were truly an art.[74]

The method he has in mind, however, is not a method of productive rules, but a second-order investigation into the principles of medicine itself. And Plato thinks this method must be carried out if "we intend to become experts (τεχνικοί) and capable of transmitting our expertise".[75] Socrates says:

> Isn't this the way to think systematically (διανοεῖσθαι) about the nature of anything? First, we must consider whether the object regarding which we intend to become experts and capable of transmitting our expertise (αὐτοὶ τεχνικοὶ καὶ ἄλλον δυνατοὶ ποιεῖν) is simple or complex. Then, if it is simple, we must investigate its power: what things does it have what natural power of acting upon (τίνα πρὸς τί πέφυκεν εἰς τὸ δρᾶν ἔχον)? By what things does it have what natural disposition to be acted upon (τίνα εἰς τὸ παθεῖν ὑπὸ τοῦ)? If, on the other hand, it takes many forms, we must enumerate them all and, as we did in the simple case, investigate how each is naturally able to act upon what and how it has a natural disposition to be

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the author of *Ancient Medicine*. See Jaeger (1986 vol. 3) 22–23. Whoever Plato was reading, I think we can see that the method begins from the nature of the body, and both groups take it for granted that the nature of the body is (in some sense) 'reducible' to or explained in terms of what it is made from. Plato is also willing to group Anaxagoras in with Hippocrates, since he thinks Pericles was the greatest orator because he learned this kind of knowledge about nature from him.

72 *Phdr*. 270a1, tr. Nehamas and Woodruff, modified.

73 *Phdr*. 270b4–6, tr. Nehamas and Woodruff, modified.

74 *Phdr*. 270d1.

75 *Phdr*. 270d2.

> acted upon by what (τί ποιεῖν αὐτὸ πέφυκεν ἢ τῷ τί παθεῖν ὑπὸ τοῦ). (*Phdr.* 270c10–d7, tr. Nehamas and Woodruff, modified)

The kind of inquiry Plato describes—one which an art must engage in to justify its practical methods—is one that establishes the causal relations among its principles or elements. In the case of medicine, this may be how the body reacts to different treatments, or even how the hot acts on the moist.[76] In rhetoric, it might be the causal relations among different kinds of souls and different kinds of speeches.[77] Regardless of the subject matter, Plato's point is that those who want to be experts (τεχνικοί) in their art, who want to produce regular results and teach the art to others, must be able to discern the regular (here, efficient) causal relations among its objects and ground these relations in their natures.

In addition to the study of causal relations, Plato also thinks arts involve the study of their proper aims, and again he uses the art of medicine to motivate his position. Plato develops this position in the *Gorgias* in response to Gorgias' claim that what he calls rhetoric (as opposed to the scientific rhetoric Plato himself proposes in the *Phaedrus*) is a part of politics or political science (πολιτική).[78] In the dialogue, Socrates argues that if the sophists' rhetoric were part of politics, then it would be an art; but the sophists' rhetoric is no art, so it is no part of politics. To show why the sophists' rhetoric is not an art, he distinguishes between art itself and what only seems to be an art but is more appropriately called an empirical (ἐμπειρία) or routine (τριβή) practice.[79] Plato uses an example to illustrate what he means. Rhetoric, Socrates says, stands to politics the way the saucier's art (ὀψοποιική) stands to medicine, or the way the art of personal adornment (κομμωτική) stands to gymnastics.[80] The sau-

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76 For example, in *Vict.* 3 (VI.472 L. = 126,5–19 Joly-Byl) or *Carn.* 2–3 (VIII.584–588 L. = 132–136 Potter).

77 *Phdr.* 271d–e.

78 The account I present here cannot cover the complexity of the discussion in the *Gorgias* or its relation to the *Phaedrus*, on which see Moss (2007), esp. 247.

79 *Gorg.* 463a3–4.

80 Here, I translate ἡ ὀψοποιικὴ τέχνη (a bit torturously) as 'the saucier's art' and ὀψοποιός as 'saucier'. Zeyl translates them as 'pastry baking' and 'pastry baker' in the Hackett *Plato: Complete Works*, which has become influential among English-speaking scholars. The translation does well to emphasize the fact that Plato is thinking of foods primarily made for pleasure, not health; still, it misses some nuance of the culinary arts of the period. The ὀψοποιός is the person who prepares an ὄψον, a prepared dish, like a sauce, stew, or relish, eaten with bread. An ὄψον is contrasted with a τράγημα, usually dried fruits eaten as a dessert, or a πέμμα, a cake or pastry. All are culinary comforts. So, after Socrates describes his initial ideal city at the beginning of *Republic* 2—one of moderate desires where people eat acorns, for which reason Glaucon describes it as a "city of pigs"—ὄψα are the first things

cier's art, Plato claims, "has no account (οὐκ ἔχει λόγον οὐδέν) of the nature (τὴν φύσιν) according to which it applies the things it applies, so that it is unable to state the cause of each thing (τὴν αἰτίαν ἑκάστου μὴ ἔχειν εἰπεῖν), and I refuse to call anything that lacks such an account (ὃ ἂν ᾖ ἄλογον πρᾶγμα) an art".[81] The saucier's art is only apparently an art; in fact, Plato thinks, it is a knack for producing pleasant flavours and avoiding unpleasant ones, a practice that comes from the experience of what produced pleasure or pain in the past. The saucier does not know why a dish is pleasant or not, nor could they explain why to anyone. The doctor, on the other hand, practices an art because they can explain why what they produce is healthy by explaining how it affects the body. This is also something a doctor can teach to someone else. Therefore, according to Plato in the *Gorgias*, for something to be considered an art, it must resemble the kind of knowledge the doctor has about the nature of the body and why things act on it the way they do. An art is whatever can state the causes through which it does what it does, where those causes are grounded in an account of their nature and the nature of whatever it is they act on. A routine practice simply does not meet this condition.

However, Plato's point in making the distinction between the art of the saucier and medicine is not only to point out that a true art, like medicine, has knowledge of the causes according to which it operates. He also wants to suggest there is a difference among their respective ends. The aim of the art of medicine is not just to know about the body, but also about health. Medicine assumes the body has a best state (εὐεξία)[82] and its goal is to either bring this about or maintain it.[83] The art of the saucier, too, has a goal, but not one determined by considerations of the nature of the body; rather, it is based on what either appears good or bad to different people. Thus, it "pretends to know the foods that are best for the body" but, in fact, it only guesses, and "takes no thought at all of whatever is best".[84] To help understand Plato's point, we might imagine what a scientific saucier might look like, one who could explain why something tastes good or bad, instead of an artless kind of saucier who only knows by experience. The scientific saucier has inquired into human nature

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Glaucon complains are missing (Plato, *Respublica* 2, 372c3). Socrates relents and goes on to describe a luxurious city, where the citizens will receive comforts like "relishes, perfumes, incense, prostitutes, and pastries" (ὄψα δὴ καὶ μύρα καὶ θυμιάματα καὶ ἑταῖραι καὶ πέμματα, *Resp*. 2, 373a3–4). On this passage, see Rowe (2017) 57–58.

81 *Gorg*. 465a3–6, tr. Zeyl, modified.

82 *Gorg*. 464a3.

83 *Gorg*. 464c4.

84 *Gorg*. 464c5–e2, tr. Zeyl.

and into the nature of foods; they know about chemistry and why different flavours arise from different combinations of ingredients acting on receptors in the tongue and nose. If asked, it seems Plato would have to grant that this kind of practice is truly an art, since it knows the nature of the body and how certain foods affect it. But what art would it be? It is no longer merely a 'routine practice', so it is not the routine practice of the saucier. Rather, it would be the art of medicine, but perverted and vicious, since the practitioner knows that their sauces and relishes do not produce health but continue to produce and prescribe them anyway as part of their patient's regimen. Plato's point in the *Gorgias* is to make the normative aspect of productive knowledge explicit, and this is something that was not stated among the medical writers.[85] An art is a body of knowledge that discerns regular causal relations, and it grounds these in the nature of its objects of study; but it is also a normative kind of knowledge, which aims always to provide and care for the best state of its objects (ἀεὶ πρὸς τὸ βέλτιστον θεραπευουσῶν).[86]

4 Aristotle: The Technical Model Applied to Physics

Aristotle's understanding of science is, like Plato's, informed by the method of inquiry found in the arts, especially as discussed by early Greek medical writers. He describes the project of the *Metaphysics* for example as an inquiry into the kinds of causes and principles that wisdom itself will study.[87] He also distinguishes τέχνη from mere experience or routine practice on the grounds that the person of experience can neither teach their art nor make any systematic progress in it, since new discoveries can only come about accidentally.[88] These examples suggest that Aristotle is thinking about ἐπιστήμη on the model of τέχνη and continuing in the tradition of seeking the appropriate causes and natures from which the art takes its own starting point. But Aristotle is also, like

85 This is something of a simplification. Gorgias' position in the dialogue is that rhetoric is an art, and all arts can be used for good or ill, while Plato's position is that arts are always *per se* directed at some good and only accidentally towards illness, just as medicine is always directed *per se* towards health. One way to understand what Plato is saying is that rhetoric, as Gorgias understands it, cannot be an art because it cannot give an account, or cannot explain, which of two opposite effects it produces. On these issues, see Barney (2010).

86 *Gorg*. 464c4.

87 *Metaph*. A1, 982a4–6.

88 *Metaph*. A1, 980b26–981a12 and 981b14.

Plato in the *Phaedrus*, refining the method of inquiry adopted from the arts, in particular medicine, so that it is appropriate for each discipline.[89] Unlike other Academics who applied the same mathematical precision and methods to many disciplines, Aristotle thinks "it is the mark of an educated man to look for precision in each class of things just so far as the nature of the subject admits".[90] Part of Aristotle's project, therefore, whether in physics, ethics, or rhetoric, is to isolate the first principles at the appropriate level of generality so that others can continue the work of seeking how those principles are related to the phenomena under investigation and then work out the appropriate causal story or demonstrations. Once the appropriate first principles have been found and the method refined, "it would seem that any one is capable of carrying on and articulating what has once been well outlined, and that time is a good discoverer or partner in such a work; to which facts the advances of the arts are due; for any one can add what is lacking."[91]

Rarely, however, does Aristotle claim to be starting a new discipline; instead, he sees his own work as perfecting or completing the advances made by others.[92] This leads to the other characteristic of τέχνη that continued to be associated with ἐπιστήμη once the two notions began to come apart: ἐπιστήμη, like τέχνη, is teachable. Unlike people who have only experience, "in general it is a sign of the man who knows, that he can teach, and therefore we think art more truly knowledge than experience is; for artists can teach, and men of mere experience cannot".[93] Sometimes teaching took the form of imitating the products of an expert. Notably, the method of education used by the sophists

89 On biology as a kind of inquiry, see *Part. an.* 1.1, 645a21–23. On celestial physics as inquiry, see Arist. *Cael.* 2.1, 286a5. On the study of the soul as inquiry, see Arist. *An.* 1.2, 403b24. On physics in general as inquiry into sensible things, see *Ph.* 3.5, 204a 35.

90 *Ethica Nicomachea* 1.2, 1094b24. Lennox (2008, 163–171) makes a similar point.

91 *Eth. Nic.* 1.7, 1098a22–26. The same point is made at *Sophistical Refutations* 34 and in *Metaphysics* A and α. See the following note.

92 In *Sophistical Refutations* 34, he suggests that syllogistic is an entirely new discipline, and this obviously has extensive implications for how he conceives of both acquiring facts, giving definitions, and presenting demonstrations (*Sophistici elenchi* 34, 183a37–184a9). However, syllogistic seems to be the only discipline that he claims to have invented. Even in *Metaphysics*, he prefers to think of himself as one of a line of thinkers investigating σοφία and first principles. The doxography of rhetoric in *Soph. el.* 34, the doxography of σοφία in *Metaphysics* A, and the description of progress in attaining truth in *Metaph.* α1 may all serve their own purposes of presentation, but it is clear that Aristotle is one, if not the first, philosopher to emphasize his own place in these histories. This is noticed by Jaeger (1968, 3–7) and Zhmud (2006, chapter 4).

93 *Metaph.* A1, 981b8.

and teachers of eristic consisted in just this: giving model speeches to imitate and modify as needed for particular purposes.[94] Aristotle is especially critical of this model of education. In the *Sophistical Refutations*, he complains that "they (sc. the sophists) trained people by imparting to them not the art but its products" and that training that proceeds by giving its students models to copy is like "anyone professing that he would impart a form of knowledge to obviate any pain in the feet, were then not to teach a man the art of shoe-making or the sources whence he can acquire anything of the kind, but were to present him with several kinds of shoes of all sorts—for he has helped him to meet his need, but has not imparted an art to him".[95] But his criticism is not directed against imitation as such; rather, he is critical of the sophists because they claimed to be teaching students by having them imitate their products, when the students ought to have been imitating their method of producing them. As Aristotle suggests, the reason the sophists and the teachers of eristic did not teach their method was that they did not have one: "concerning deduction (συλλογίζεσθαι), we had absolutely nothing from the past to go on, but, inquiring with practice (τριβῇ ζητοῦντες), we worked for a very long time (sc. to arrive at a method)".[96] Aristotle thinks what should be imitated, instead, both in art and science, is the proper method of inquiry that leads to further discovery.[97]

Like Plato's attempt to motivate a scientific rhetoric in the *Phaedrus* and his own development of a scientific eristic in the *Sophistical Refutations*, one of Aristotle's tasks in the *Physics* is to motivate a scientific investigation into nature on the same model of τέχνη. In *Physics* 1.1, when he claims, "in all disciplines which have principles, causes and elements, knowledge, especially scientific knowledge (τὸ εἰδέναι καὶ τὸ ἐπίστασθαι), follows from an acquaintance with them",[98] he is proposing an inquiry into the starting points of explanation in physics. In Book 1, Aristotle arrives at three elements from which any science of motion or change must begin: matter, form, and privation. In Book 2, he turns to establishing the principles of *ordered* change, attempting to show

94 Jaeger (1986 vol. 2) 259–263.

95 *Soph. el.* 34, 183a20–22, tr. Pickard-Cambridge.

96 *Soph. el.* 34, 184b1–3.

97 *Soph. el.* 34, 184b6.

98 *Ph.* 1.1, 184a10–12 ἐπειδὴ τὸ εἰδέναι καὶ τὸ ἐπίστασθαι συμβαίνει περὶ πάσας τὰς μεθόδους, ὧν εἰσὶν ἀρχαὶ ἢ αἴτια ἢ στοιχεῖα, ἐκ τοῦ ταῦτα γνωρίζειν. Compare to the more 'productive' sounding introduction to *Eth. Nic.* 1.1, 1094a1–3: πᾶσα τέχνη καὶ πᾶσα μέθοδος, ὁμοίως δὲ πρᾶξίς τε καὶ προαίρεσις, ἀγαθοῦ τινὸς ἐφίεσθαι δοκεῖ· διὸ καλῶς ἀπεφήναντο τἀγαθόν, οὗ πάντ' ἐφίεται.

that two of these elements, matter and form, are the principles of natural motion and so are (at least two of) the ultimate causes physics is concerned with.[99]

To do this, he first distinguishes art from nature, using the contrast to articulate our preconceptions about what nature is. Nature, he says, is a kind of principle in something that causes it to behave the way it does and without which it cannot exist while remaining the same thing;[100] art, on the other hand, is a principle that causes something to behave the way it does, but which exists in something else. Wood, for example, is something internal to a ship that causes and explains why it floats on water, while the sailor is something external to the ship and causes and explains why it moves in the direction it does. Both the wood and the sailor, nature and art, are causes of the ship's behaviour, but only one is internal.[101]

He then goes on to claim that nature is said in at least two senses: as matter and as form. On the one hand, he says, the matter out of which something is made is said to be its nature, since the constituents—things like fire, air, water, and earth—are ultimately what something is, its οὐσία, and these elements determine what something does independently of any arrangements or affections imposed on them.[102] On the other hand, he says, nature is also said to be the shape and form, "for just as what is in accordance with art and what is artistic is said to be 'art', so too what is in accordance with nature and natural is called 'nature'".[103] Here Aristotle relies on an analogy to art to explain why certain arrangements or affections can indeed be considered to be a thing's nature: just as the behaviour of a coat or a boat is due not only to the materials, but also the way those materials are put together, so we should consider that the par-

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99 On the application of material and formal natures in biological explanation, see, e.g., Lennox (2001b), Leunissen (2010), and Henry (2019).

100 *Ph.* 2.1, 192b21–23: "nature being a certain kind of principle and cause of moving and resting in that to which it belongs primarily in itself and not accidentally" (οὔσης τῆς φύσεως ἀρχῆς τινὸς καὶ αἰτίας τοῦ κινεῖσθαι καὶ ἠρεμεῖν ἐν ᾧ ὑπάρχει πρώτως καθ' αὑτὸ καὶ μὴ κατὰ συμβεβηκός).

101 *Ph.* 2.1, 192b13–33. There may be cases where art is internal, too, like when a doctor cures herself; however, Aristotle thinks the cause is internal only accidentally, since the same person happens to be both doctor and patient. Strictly speaking, it is the doctor that explains the behaviour of the patient.

102 *Ph.* 2.1, 193a9–28.

103 *Ph.* 2.1, 193a31–33. ὥσπερ γὰρ τέχνη λέγεται τὸ κατὰ τέχνην καὶ τὸ τεχνικόν, οὕτω καὶ φύσις τὸ κατὰ φύσιν [λέγεται] καὶ τὸ φυσικόν. Following Diels and Ross, who omit the second instance of λέγεται. Aristotle will ultimately claim that form is more properly οὐσία than matter.

ticular arrangement of the matter of natural things also determines what they do; and just as the former is called 'art', so the latter is called 'nature': it is that in accordance with which a thing does what it does.[104]

An Aristotelian nature, therefore, shares certain conceptual similarities with the nature found among some of the early Greek medical writers. Both conceive of nature as a cause that internally determines a thing's behaviour and does so in virtue of being the kind of thing that it is. It is also clear that he thinks it is uncontroversial to conceive of nature on the model of the arts, as if nature were a kind of internalized art.[105] Such a proposal would also be familiar for many of the early Greek medical authors we have explored, who express a similar notion by claiming that nature is in some sense self-taught. Whether Aristotle's acquaintance with their works is direct or indirect, they share a family resemblance.

Aristotle recognizes, however, that proposing two senses of 'nature'—nature as form and nature as matter—is problematic if we wish to maintain there is a single science of nature:

> For, about this as well someone might raise an *aporia* that if there are two sorts of nature, which of them is the student of nature (φυσικός) concerned with? Perhaps with that which consists of both? But if about that which consists of both, then also each severally. Then, does it belong to the same or different [sciences] to grasp (γνωρίζειν) each of them? If we look to the early thinkers, it might seem that the study of nature is the study of matter, for Empedocles and Democritus touched only very superficially on form and essence. But if art imitates nature, and it belongs to the same science (ἡ αὐτὴ ἐπιστήμης) to know the form and to know the matter up to a point (e.g., of the doctor, health and also bile and phlegm, in which health inheres; likewise of the house-builder, both the form of a house and the matter—that it is bricks and beams; and so on in the

104 On this distinction, see Lennox (2008) 153–157 and (2021) 122–123.

105 Broadie (2007, 85–100, esp. 193–194) suggests Aristotle's views on art are determined by his views on nature, rather than the other way around. She concludes, "when nature is compared to craft, it is the first that prescribes what the second must mean in this alignment". Perhaps this is a conclusion Aristotle wants to defend, but it seems more plausible to me that art is that by means of which nature is understood. Art functions for Aristotle as what Lakoff and Johnson (1980, 3–6) call a metaphorical concept, i.e., that by means of which nature is conceived and understood, like what Kövecses calls a "structural metaphor", in which the source domain (in this case, 'art') supplies a rough-and-ready map of elements and relations with which to understand a target domain (in this case, 'nature'). See Kövecses (2010) 33–46, esp. 37–38.

> case of the other arts), then it belongs to physics (φυσική) to know both natures.[106] (*Ph.* 2.2, 194a15–194a27, tr. Charlton, modified.)

Aristotle is attempting to motivate the use of τέχνη as an appropriate model for understanding nature because it provides an answer to the question about the unity of natural science. If nature is like a τέχνη, then just as an art must know both the matter and the form it produces in the matter, so physics will also know both causes. The doctor, for example, knows both what health is and knows the material it is realized in. This model only works, however, if we can conceive of nature as manifesting this same epistemic structure as art. Aristotle justifies this move with the conditional statement "art imitates nature". But how are we to understand this assertion?

One way we might try to understand the claim, as Jaeger, Ross, Halliwell, and others have suggested, is to interpret it to mean that art and nature are analogous, teleological productive causes. If art imitates nature, then "the study of art must conform to the study of nature", because the goals of the arts are subordinated to or ontologically dependent on natural ends.[107] On this reading, the argument of *Physics* 2.2 proceeds in the following way:

1. Art (τέχνη) is like nature (φύσις) ("art imitates nature")
2. Art (τέχνη) knows both matter and form.

C. Therefore, the study of nature (φυσική) knows both matter and form.

There is, however, a problem with reading the argument in this way. As James Lennox points out, this reconstruction of the argument trades on an unrecognized equivocation.[108] 'Τέχνη' ambiguously refers to both a kind of cause and a body of knowledge, whereas φύσις, the internal cause explaining a thing's behaviour, is not the same as φυσική, namely theoretical knowledge of that cause. If the claim "art imitates nature" means that art and nature are analogous kinds of causes, nothing immediately follows from this concerning artistic and natural sciences. Given that the ambiguity of this reading leads to an invalid

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106 καὶ γὰρ δὴ καὶ περὶ τούτου ἀπορήσειεν ἄν τις, ἐπεὶ δύο αἱ φύσεις, περὶ ποτέρας τοῦ φυσικοῦ. ἢ περὶ τοῦ ἐξ ἀμφοῖν; ἀλλ' εἰ περὶ τοῦ ἐξ ἀμφοῖν, καὶ περὶ ἑκατέρας. πότερον οὖν τῆς αὐτῆς ἢ ἄλλης ἑκατέραν γνωρίζειν; εἰς μὲν γὰρ τοὺς ἀρχαίους ἀποβλέψαντι δόξειεν ἂν εἶναι τῆς ὕλης. ἐπὶ μικρὸν γάρ τι μέρος Ἐμπεδοκλῆς καὶ Δημόκριτος τοῦ εἴδους καὶ τοῦ τί ἦν εἶναι ἥψαντο· εἰ δὲ ἡ τέχνη μιμεῖται τὴν φύσιν, τῆς δὲ αὐτῆς ἐπιστήμης εἰδέναι τὸ εἶδος καὶ τὴν ὕλην μέχρι του (οἷον ἰατροῦ ὑγίειαν καὶ χολὴν καὶ φλέγμα, ἐν οἷς ἡ ὑγίεια, ὁμοίως δὲ καὶ οἰκοδόμου τό τε εἶδος τῆς οἰκίας καὶ τὴν ὕλην, ὅτι πλίνθοι καὶ ξύλα· ὡσαύτως δὲ καὶ ἐπὶ τῶν ἄλλων), καὶ τῆς φυσικῆς ἂν εἴη τὸ γνωρίζειν ἀμφοτέρας τὰς φύσεις.

107 Ross (1955) 508. Cf. Jaeger (1968) 74–75; Halliwell (2002) 153–154; Leunissen (2010) 218; Witt (2015) 113; and note 3 above.

108 Lennox (2008) 176–177.

argument, Lennox suggests what I think is a more plausible alternative: rather than using the assertion "art imitates nature" to prove to readers that physics will study both form and matter, perhaps Aristotle's aim is only to point them in the direction of the arts as a model for understanding what a unified science of matter and form would look like. On Lennox's reading, "art imitates nature" is not meant so much as a premise in the argument, but rather as a justification for why one might look to the arts, rather than another science, for guidance.[109] Since art imitates nature, and since in art the artist must have knowledge of matter and form, perhaps there is a way to understand the natural scientist studying both as well. What Aristotle thinks should ultimately persuade us of the truth of the hypothesis is the fact that nature is teleologically ordered and that certain forms require certain materials.

I would add to Lennox's reading that, however we understand Aristotle's argument at this point of *Physics* 2.2, he thinks his audience will find the claim "art imitates nature" plausible, even self-evident, and it seems unlikely they would immediately think it was plausible if it were a novel or paradoxical claim. There are, in fact, a few reasons to suppose that he thinks his audience already believes the claim. First, he never justifies or explains the claim anywhere in his extant writings. Second, it would be rhetorically ineffective to produce a conditional whose antecedent is vague or even innovative and not give evidence for it. Third, as we have seen, it is plausibly a claim Aristotle could use to express ideas about the relationship between art and nature present in many early Greek medical authors and philosophers we have encountered earlier (I will review the evidence shortly). Finally, while it is true the precise claim "art imitates nature" (ἡ τέχνη μιμεῖται τὴν φύσιν) does not appear in any earlier works extant, as we will see, other figures in the Lyceum contemporary with Aristotle also use the phrase and apply it to mean precisely what we have seen it mean among early Greek medical and philosophical writers.[110]

The claim "art imitates nature" is often assumed to be a distinctively Aristotelian claim. One way scholars understand the sense of imitation is as either teleological subordination or ontological dependency. One of the clearest statements of this type comes from Jaeger, who thinks "art imitates nature" is a compressed argument from analogy used to assert his belief in natural teleology: since art is teleological and since art takes nature as its paradigm,

109 Lennox (2008) 177.

110 I thank Vladimír Mikeš for encouraging me to address the fact that Aristotle's phrasing is novel, regardless of what he might mean.

therefore nature is teleological in an even higher degree than art.[111] On Jaeger's view, the claim ultimately means that arts exist because ends exist in nature. The art of medicine, for example, acts for the sake of bringing about the natural good state of the body; housebuilding might be thought to be subordinated to natural ends by ensuring survival through the protection of the body and possessions like food; sculpture is subordinated to nature by bringing about a superficial copy of a living being. It is true that Aristotle thinks some arts exist in order to contribute to already existing ends and no doubt many other thinkers in the classical period do as well. The belief that the arts imitate nature, however, was never used to express ontological dependence before. Instead, it expressed epistemic dependence: knowledge of reliable (i.e. repeatable) artistic methods depends on regular, intelligible processes in nature. One famous example is attributed to Democritus:

> We are pupils of the animals in the most important things: the spider for spinning and mending, the swallow for building, and the songsters, swan and nightingale, for singing, by way of imitation.[112] (Plut. *De soll. an*. 20 = *Mor*. 974A8–11 = 68B154 DK)

Democritus, of course, did not think that artistic goals were subordinated to natural goals or that nature is teleological.[113] For him the idea that the arts imitate nature is meant to explain how the arts were first discovered.[114] This claim is similar to what we find in *Regimen*, where the author claims that people "use arts that resemble human nature" because "the gods taught [people] to imitate (ἐδίδαξε μιμέεσθαι) what is their own",[115] while nature did not learn

111 Jaeger (1968, 74) asserts something along these lines: "It is a characteristically Aristotelian view that nature is purposive in a higher degree even than art, and that the purposiveness that rules in handiwork, whether art or craft, is nothing but an imitation of the purposiveness of nature. The same view of the relation between these two things is often briefly expressed in the second book of the *Physics*, which is one of Aristotle's earliest writings." Precisely what Jaeger means is not clear. In a footnote to this claim, he says, "all arts are merely man's attempt to compete with the organic and creative nature, and this competition necessarily takes place in another medium (that of artificial construction), in which it is never possible to speak of an end (telos) in the highest or organic sense", but I admit I find this equally obscure.

112 μαθητὰς ἐν τοῖς μεγίστοις γεγονότας ἡμᾶς· ἀράχνης ἐν ὑφαντικῇι καὶ ἀκεστικῇι, χελιδόνος ἐν οἰκοδομίαι, καὶ τῶν λιγυρῶν, κύκνου καὶ ἀηδόνος, ἐν ὠιδῆι κατὰ μίμησιν.

113 Sedley (2007, 154) claims for the atomists, "invariably, craftsmanship improves on a process or activity already present in nature".

114 Brancacci and Morel (2007) 191–194.

115 *Vict*. 1.11.1 (VI.486 L. = 134,21–24 Joly-Byl). See above page 138.

how to act from anything else, but "from herself knows these things (ἡ φύσις αὐτομάτη ταῦτα ἐπίσταται)".[116] It also echoes the author of *Epidemics*, who claims that "[the patients'] nature is the doctor that cures illness (νούσων φύσιες ἰητροί)".[117] In all of these instances, the claim that the arts imitate nature is bound up with the idea that nature somehow 'knows what to do' or that it is 'self-taught'.

If "art imitates nature" implies that nature is 'self-taught', this gives some insight into the ambiguity in the word "nature" in the argument from *Physics* 2.2. If we think that nature means exclusively a goal-directed productive cause, then it is not clear why he thinks the analogy between art and nature implies there should also be similarities between art, as a *form of* knowledge, and natural science. If, however, the phrase "art imitates nature" is taken to express an epistemic relation, the ambiguity seems less problematic. The ontological priority of nature does not entail the epistemic priority of nature (art can depend on nature without us knowing how nature works). But this is not what imitation was meant to express in authors before Aristotle. Instead, it was meant to express the epistemic priority of nature. Nature, metaphorically, 'knows' what it is doing: its order is intelligible, and this intelligible order can serve as the starting point for our own productive knowledge, and, as Aristotle thinks, our theoretical knowledge about how nature works.

This epistemic sense of "art imitates nature" is also the sense attested in authors after Aristotle. It is well known, for instance, from authors outside of Aristotle's school. Lucretius, for example, describes the natural origins of artistic methods in book 5 of *The Nature of Things*.[118] He speculates that the observation of lightning or of branches rubbing together in the wind and catching fire "may well have given fire to mortal men" and that "the sun instructed (*sol docuit*)" humans to cook when they saw how it warmed and softened things.[119] He similarly attributes the art of song to observation of birds singing and wind whistling; and agriculture techniques—not only sowing seeds, but complex procedures like grafting and tilling to improve flavour—to observing how plants grow.[120] One finds similar examples of arts being imitations of nat-

116 *Vict*. 1.15.2 (VI.490 L. = 136,28–138,1 Joly-Byl). See above page 140.

117 *Epid*. 6.5.1 (V.314 L. = 254 Smith). See above page 140.

118 Jaeger (1968, 75 n. 1) asserts that Lucretius follows Democritus by way of Epicurus, although it seems possible to me that these examples were popular.

119 Lucretius, *De Rerum Natura* 5, 1091–1109.

120 Lucr. *Nat. re*. 5, 1361–1416.

ural processes throughout the later tradition, including Posidonius,[121] Cicero,[122] and Galen.[123] In none of these examples is "art imitates nature" a teleological notion, but is instead a way to explain the origin of technical methods of production.

The same sense found among other philosophical schools is also the only sense we find in Peripatetic writers after Aristotle. In *Causes of Plants*, Theophrastus observes that "some [plants] work together (συνεργεῖν) to preserve and propagate others" and states that "the deciduous help the evergreen, since it happens that the earth is manured (as it were) by the decomposing leaves, and this is useful for good-feeding and for making the seeds sprout" (πρὸς τὴν βλάστησιν τῶν σπερμάτων χρήσιμον).[124] He then pairs this with an example from farming, where, he says, "plants [are] sown among the young vines when the growers wish to reduce their excess fluid".[125] The farmer learns to fertilize the soil by observing the effects of rotting leaves on seed growth, and he learns to sow plants among vines by observing how certain plants interact when growing together spontaneously, for, as he says, "we should assume these kinds of things happen among nature's spontaneous creations (ἐν τοῖς αὐτομάτοις τῆς φύσεως), as well, especially if art imitates nature (ἡ τέχνη μιμεῖται τὴν φύσιν)".[126] Theophrastus is not saying there is a teleological relationship among plants, such that, for example, deciduous trees lose their leaves for the sake of feeding evergreens. One plant can benefit the other, but not because it does what it does for the other's sake. Art, however, can imitate this pro-

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121 Seneca, *Epistulae Morales*, 90.22 (Fr. 284 Edelstein-Kidd): Seneca cites Posidonius' view that humans learned to mill wheat into flour by looking at teeth grinding:

> Next, [Posidonius] is not satisfied [attributing only] these arts [of weaving and farming to philosophy], but he sends the philosopher down to the bakery: he describes how he began to make bread by imitating nature.
>
> *Deinde non est contentus his artibus, sed in pistrinum sapientem summittit; Narrat enim quemadmodum rerum naturam imitatus panem coeperit facere.*

122 Cicero, *De legibus* 1.26:

> Countless arts have likewise been discovered by the teaching of nature; for reason, imitating art, skillfully obtains things necessary for life.
>
> *Artes uero innumerabiles repertae sunt, docente natura, quam imitata ratio res ad uitam necessarias sollerter consecuta est.*

123 Galen, *De naturalibus facultatibus* 7 (II.17–18 K. = 113,15–17 Helmreich):

> Now, this work is not possible for them, nor is there a way to be educated to imitate it, not for children or for anyone else; for it is a property of nature alone.
>
> νυνὶ δὲ τοῦτ' αὐτοῖς ἐνδεῖ τὸ ἔργον οὐδὲ καθ' ἕνα τρόπον εἰς μίμησιν ἐνδεχόμενον ἀχθῆναι μὴ ὅτι τοῖς παισὶν ἀλλ' οὐδ' ἄλλῳ τινὶ· μόνης γὰρ τῆς φύσεως ἴδιον ἐστιν.

124 Theophrastus, *De causis plantarum*, 2.18.1.

125 Theophr. *Caus. pl.* 2.18.1.

126 *Caus. pl.* 2.18.2.

cess, in the sense that farmers, having observed and understood the process, can repeat it in order to produce the same result. Theophrastus uses the same reasoning several times, including in his work *On Stones*, when he describes the invention of processes for creating artificial varieties of red ochre and cinnabar, claiming, "it is clear from these things that art imitates nature" (φανερὸν δ' ἐκ τούτων ὅτι μιμεῖται τὴν φύσιν ἡ τέχνη).[127] In addition to Theophrastus, the Peripatetic Chamaeleon of Pontus, another of Aristotle's students, also describes the invention of the arts in terms of imitation, even repeating Democritus' claim about the invention of music. At least he is reported by Athenaeus of Naucratis to have described "the discovery of music" (εὕρησις τῆς μουσικῆς) as having been grasped by the ancients "by means of imitation" (κατὰ μίμησιν λαβεῖν).[128] Among Aristotle's immediate students, therefore, our evidence suggests "art imitates nature" always had the same meaning we find elsewhere: that arts were discovered by observation of natural processes.

Finally, that reliable methods of production and their discovery are grounded in regular natural processes is also found in Aristotle. In the *Protrepticus*, Aristotle says that "in the manual arts (αἱ τέχναι δημιουργικαί) the best tools have been discovered from nature (εὕρηται ἀπὸ τῆς φύσεως), e.g., in construction, the plumb-line, the straight-edge and the compass: some are grasped from water, others from light and the rays of the sun, relative to which, when judging according to our perception what is sufficiently straight and smooth, we test".[129] And in his discussion of concoction in the *Meteorology*, he claims:

> Broiling is concoction by dry foreign heat. Hence if a man were to boil a thing but the change and concoction in it were due, not to the heat of the liquid but to that of the fire, the thing will have been broiled and not boiled when the process has been carried to completion: if the process has gone too far, we use the word "charred" to describe it. [...] Now broiling and boiling are artificial processes, but the same general kind of thing, as we said, also [occurs] by nature. The affections produced are similar though they lack a name, since art imitates nature. For instance, the concoction of food in the body is like boiling, for it takes place in a hot and moist medium and the agent is the heat of the body.[130] (*Mete*. 4.3, 381a24–381b9, tr. Webster, modified.)

127 Theophrastus, *De lapidibus* 60 (349 Wimmer = 28 Caley-Richards).

128 Athenaeus of Naucratis, *Deipnosophistae* 9.43 Kaibel = 9.389F–390A Casaubon = Chamaeleon fr. 24 Wehrli.

129 Arist. *ap*. Iambl. *Protr*. 10 (54,22–55,1 Pistelli). For discussion, see Hildebrandt (2022).

130 ὄπτησις δ' ἐστὶν πέψις ὑπὸ θερμότητος ξηρᾶς καὶ ἀλλοτρίας. διὰ τοῦτο κἂν ἕψων τις ποιῇ μετα-

If Aristotle thought "art imitates nature" meant the ends of art were subordinate to natural ones, his point would be that cooking and digestion have the same end, namely producing nutrition for the body. What he says, however, is that concoction in both natural and artificial contexts produces similar qualities in the matter (their effects are the same). The passage does not suggest that concoction of food in the body and cooking are both for the same end; it does suggest, however, that the processes in both cases are instrumental. Aristotle asserts this in a parallel passage from the *Meteorology*: "there is no difference among artificial and natural instruments (οὐδὲν διαφέρει ἐν ὀργάνοις τεχνικοῖς καὶ φυσικοῖς) should something come to be, since they all will exist because of the same cause."[131] "The same cause" is the heat acting on the moist, which is only instrumental to the production of the ends either of nature or of art. And this is what we would expect if a science of nature was being modelled on a science of art. The processes of concoction in both cases are conceived of as instrumental, even though they do not have the same ends.

As we have seen, the claim that humans imitate nature was used as part of a larger debate about the status of medicine as an art (τέχνη). Some early Greek medical writers invoked this idea in arguing against those who claimed their results were due to luck (τύχη). They conducted investigations into the first principles of medicine to prove that their art was a reliable cause of order in the body, and they did this by grounding medicine's ability to order the body in the intelligible order already present in nature. This order can be revealed by observation, but only because nature itself is already intelligible. Aristotle finds this model useful in the study of nature for the same reason the early Greek medical writers found it useful in their study of physiology and medicine: if the methods of art are successful, then it is because nature is ordered and that order must be immanent. Aristotle takes the further step by saying that, if nature is ordered, then the cause of that order cannot be the matter itself. Instead, it must be something that explains the order in matter the same way an art does.[132] Phys-

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βάλλειν καὶ πέττεσθαι, μὴ ὑπὸ τῆς τοῦ ὑγροῦ θερμότητος ἀλλ' ὑπὸ τῆς τοῦ πυρός, ὅταν τελεσθῇ, ὀπτὸν γίγνεται καὶ οὐχ ἑφθόν, καὶ τῇ ὑπερβολῇ προσκεκαῦσθαι λέγεται· […] ὄπτησις μὲν οὖν καὶ ἕψησις γίγνονται μὲν τέχνῃ, ἔστιν δ', ὥσπερ λέγομεν, τὰ εἴδη καθόλου ταὐτὰ καὶ φύσει· ὅμοια γὰρ τὰ γιγνόμενα πάθη, ἀλλ' ἀνώνυμα· μιμεῖται γὰρ ἡ τέχνη τὴν φύσιν, ἐπεὶ καὶ ἡ τῆς τροφῆς ἐν τῷ σώματι πέψις ὁμοία ἑψήσει ἐστίν· καὶ γὰρ ἐν ὑγρῷ καὶ θερμῷ ὑπὸ τῆς τοῦ σώματος θερμότητος γίγνεται.

131 *Mete.* 4.3, 381a9–12.

132 This is how Alexander seems to take it, cf. *In Aristotelis Metaphysica commentaria* (103,35–104,19 Hayduck, tr. Dooley, emphasis mine):

> For all natural things come to be according to a certain order and certain determinate numbers, and not by chance or spontaneity, but surely this does not mean that they

ics, therefore, can be a single science if, as Aristotle thinks, the formal nature is the source of order in the matter. Whatever Aristotle's reasons might be for conceiving of nature in this way, it is not because the arts act for the sake of natural ends that art imitates nature; rather, the reliability of artistic methods presupposes regularity in nature. The arts give Aristotle a model for explaining this order because they, too, are a source of order in matter. The model, however, assumes the source of order is something achieving its end through matter, both as substrate and as instruments, and so it is no surprise that in Aristotle's physics, nature manifests the same instrumental structure that we observe in the arts.

Aristotle argues that nature manifests this instrumental structure in *Physics* 2.8. There, he uses arguments like the ones given by the medical writers we have seen—which they used to show that the outcomes of their procedures were not due to chance—to show that regular natural outcomes cannot be due to chance either, but must occur because nature is a cause that acts for the sake of an end. He argues for this conclusion in what has come to be called the "rainfall example",[133] but it is in the passage immediately after this argument, where he concludes that nature exhibits an instrumental structure, that the analogy between art and nature plays an immediate role:

> Again, where there is an end, the successive things which go before are done (πράττεται) for it. As things are done (πράττεται), so they are by nature (πέφυκε), and as they are by nature, so they are done, if there is no impediment. Things are done for something. Therefore, they are by nature

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also come to be by reference to a model. For it is not by reflecting (ἐννοεῖν) that nature produces what it does (for it is an irrational power), but it is responsible for the fact that [generation] takes place in an orderly progression of movements, so that a first movement is followed in orderly sequence by a second, although not as the result of any reasoning process, and this second movement is followed in turn by a third, until the movements have progressed to the end for the sake of which they occurred. *It is this order that art imitates, for it puts things together in a rational way and* [*thus*] *produces its object.* [...] Again, it is possible to discover [this] regular order even in evil things and in those that come to be in a way contrary to nature, such as abscesses, wounds, boils, and periodic illnesses. But the generations of certain living things too are in fact orderly, but not by reference to an Idea, those e.g., of worms, gnats, and grubs.

133 *Ph.* 2.8, 198b17–199a8. There is some controversy concerning what the "rainfall example" implies about the scope of natural teleology, but it makes no difference for this paper. For discussion of the issues, see Furley (1985); Cooper (1987); Sedley (1991); Sauve Meyer (1992); Furley (1996); Johnson (2005); Judson (2005); Bodnár (2005); Sedley (2007); Scharle (2008). Good surveys of the literature can be found in Leunissen (2010) 22–49 and Gotthelf (2012). On Aristotelian teleology and its reception, see Sharples (2017).

> such as to be for something. Thus, if a house were one of the things which come to be due to nature, it would come to be just as it now does by the agency of art; and if things which are due to nature came to be not only due to nature but also due to art, they would come to be just as they are by nature. The one, then, is for the other. In general, art either completes that which nature is unable to bring to completion or imitates it (ὅλως δὲ ἡ τέχνη τὰ μὲν ἐπιτελεῖ ἃ ἡ φύσις ἀδυνατεῖ ἀπεργάσασθαι, τὰ δὲ μιμεῖται). If, then, that which is in accordance with art is for something, clearly so is that which is in accordance with nature. The relation of that which comes after to that which goes before is the same in both. (*Ph*. 2.8, 199a8–20, tr. Charlton)

The argument in this passage relies on the claim, "as things are done (πράττεται), so they are by nature (πέφυκε); and as by nature, so things are done, if nothing interferes".[134] And while Aristotle thinks action and nature are similar insofar as they have ends, the analogy between art and nature cannot be justified on these grounds, since the teleological character of nature is what he is trying to prove. Instead, Aristotle assumes that there is a similarity between artistic and natural processes: in both cases, the later stages come after earlier stages in a definite order. But why should he think, for instance, that if a house comes into being by nature, the process by which it comes into being will follow the same sequence of steps as it would by art? And why think if effects that come about by nature were also to be produced by art that they would come about in the same way as by nature? His answer is that "art sometimes completes what nature cannot bring to a finish, and sometimes imitates nature".[135]

The claim that "art completes nature" is compatible with the claim that ends in nature are prior to artistic ones: medicine exists *because* health exists; and agriculture exists *because* plants exist and sometimes require human aid for growth. However, it is not obviously compatible with the reciprocal case, "if a house, e.g., had been a thing made by nature, it would have been made in the same way as it is now by art".[136] If Aristotle believed "art imitates nature" implies the ontological priority of natural ends to artistic ones, the argument would be

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134 For discussion, see Charles (1984) and Granger (1993).

135 On the distinction between the claim "art imitates nature" and the division between mimetic arts and helper arts, see Halliwell (2002) 153–154. The division Aristotle alludes to here has antecedents in Plato's *Laws* 10 (Pl. *Leg*. 10, 889b1–e1), which may have prior antecedents in Democritus (or whoever Plato's target is in this passage).

136 *Ph*. 2.8, 199a13.

question-begging.[137] Aristotle has not said why he thinks if nature built houses it would build them the same way the art of house building does. Yet, a few lines after our passage, he gives the same argument again, saying:

> If the art of shipbuilding were present in wood, it would act in the same way as nature; so if the 'for something' is present in art, it is present in nature too. The point is clearest when someone doctors himself: nature is like (ἔοικεν) that. (*Ph.* 2.8, 199a28–31, tr. Charlton)

The argument seems as question-begging as the previous one. The simile or metaphor that nature is like art (reversed here from the more familiar "art is like nature") may help us to conceive of what he means, but it is not obviously convincing.

It is more sensible, however, if we assume the epistemological sense of "art imitates nature": if houses were made by nature, then the way nature makes houses would be the same way housebuilders make them, since housebuilders will have learned how to produce houses by observing how nature produces them. If Aristotle believed his audience was already committed to this epistemological claim, the argument is less puzzling; and, as we have seen, many early Greek medical writers, Democritus, Theophrastus, and others are reported to have made precisely this claim.[138] If, therefore, Aristotle's audience already believes that productive knowledge is learned from observing ordered natural processes, and if Aristotle thought he had already convincingly established that ordered natural processes require final causes, the argument seems reasonable. The epistemological claim that "art imitates nature" requires the existence of order in nature. If Aristotle makes the further claim that order requires final causes, he may have made his case.

Someone might object that Aristotle's next statement suggests he cannot have the epistemological sense in mind. Aristotle goes on to say, "if things made by nature were made not only by nature but also by art, they would come to be

137 As noted by Simplicius, *In Aristotelis physicorum libri* (1.375,1–5 Diels, tr. Fleet):
> I do not think that I grasp his point, since he [Aristotle] seems to me to be saying nothing more than that, in understanding that the products of nature are for some purpose, he concludes that the products of nature are for some purpose. For what do the words 'the previous stages happen for the sake of the end even in the products of nature' mean other than that?

138 Aristotle's examples in *Ph.* 2.8, 199a20–32 of swallows building nests, spiders making webs, and leaves protecting fruit show echoes of Democritus' examples. It is unclear whether these are commonplaces or whether Aristotle is picking them up from Democritus. On Aristotle's debt to Democritus in natural scientific inquiry, see the discussion in Menn (2015).

in the same way as by nature."[139] If art imitates nature means the arts learn their methods of production from nature, then why are there things we are not yet able to produce? But this suggestion reflects a much more optimistic view of our ability to learn than Aristotle would admit. He thinks the arts progress, and there are times at which human art does not yet know how to produce something it will know how to produce in the future. This does not suggest nature is not our teacher. It simply suggests we are slow learners. Before medicine existed, health may have seemed to be something that only nature could produce, or something that simply came about by luck or by chance. But the early Greek physicians observed that there was an order and regularity not only for health, but even for disease.[140] Medicine has discovered its methods by imitating this order—by inquiring into what health is and how and when it comes about naturally. Imitating this process meant learning how it worked, and doctors believed they were able to "complete what nature cannot bring to a finish," i.e., to bring about health, because they came to understand the causes that produced it.

Conclusion

I want to conclude with two brief remarks about what this study suggests regarding Aristotle's approach to method in natural science. First, it suggests one way Aristotle is responding to Plato. Aristotle wants to maintain that nature can be the subject of a science and so is, in virtue of itself, knowable. He also agrees with Plato that nature exhibits a teleological order. Plato, however, thinks that understanding this order requires understanding the model that the demiurge looked to in creating it. Aristotle agrees that we must look to the appropriate model, but thinks we do not need to posit a separately existing one to ground our understanding of the natural world. Instead, he believes that if "art imitates nature", then this is enough to show that nature is sufficiently intelligible in itself without needing to posit or consider external causes or sources of its intelligibility.

In addition, this study suggests that Aristotle and Plato are part of a broader tradition of appealing to an analogy between natural and artificial processes to motivate a particular method of inquiry. Plato used this analogy to motiv-

139 *Ph.* 2.8, 199a13–14.

140 On this, see van der Eijk (2017).

ate a scientific art of rhetoric, while Aristotle used it to motivate a science of nature. But it is the same method that certain early Greek medical writers used to motivate a scientific art of medicine. As the author of *The Sacred Disease* asserts, this method involves discovering the nature (φύσις) and causes (προφάσεις) of things through experience. Yet, the analogy also implies that we can use artistic processes to understand natural ones: "there is no difference in artificial and natural *instruments* (οὐδὲν διαφέρει ἐν ὀργάνοις τεχνικοῖς καὶ φυσικοῖς) whenever something comes to be, since all will exist because of the same cause".[141] The ends of art and nature may be different, but Aristotle thinks the instruments with which they produce their effects will be similar, since we acquired understanding of how to use those instruments in the first place by observing nature. It is not surprising, therefore, that Aristotle, like the author of *Regimen*, is willing to use artistic processes to inquire into a wide range of natural phenomena that are otherwise hidden to us.[142] A study of how Aristotle uses the analogy of art as a way of inquiring into nature, of "reverse-engineering" processes in nature that are hidden from observation, is the subject for further study. But Aristotle's insight into the relation between art and physics as sciences is that our knowledge of either one depends on the other.

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141 *Mete*. 4.3, 381a9–12.

142 For instance, his use of concoction or cooking as a metaphor to speak about a whole range of physical processes in biology. See Lloyd (1996) 83–103.

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CHAPTER 5

Aristotle and the Medical Tradition on Sleep and Food

Claire Bubb

Aristotle offers a particular explanation for the physiology of sleep, and this paper proposes that he developed it in dialogue with contemporary medical rather than philosophical thinking. While the evidence suggests that ideas about sleep among previous philosophers foregrounded heat and blood, Aristotle tightly implicates the process of digestion in his explanations for sleep and waking. This paper walks through Aristotle's position and its idiosyncrasy in comparison to what we know about its philosophical counterparts. It then turns to medical texts both in the Hippocratic Corpus and beyond to demonstrate that a wide range of medical authors from this period closely link the processes of sleep and digestion. Thus, while he develops the details of the relevant physiology more thoroughly and in his own way, the correlations that Aristotle draws between sleep and food are remarkably in harmony with—and likely directly reflective of—the pervasive medical thinking on the topic in the period.

1 Aristotle

Food is central to Aristotle's definition of sleep. He begins the *De somno* by explaining sleep's final cause: it is an incapacitation of the sensitive soul that preserves animal life by allowing rest from continual movement. Yet, he recognizes that there are several different types of incapacitation that are not the same as sleep: "for unconsciousness, a certain kind of suffocation, and fainting also produce this sort of incapacitation."[1] The efficient cause is therefore critical to his definition, and he is unambiguous that it is digestion. He says, "sleep is not just any incapacitation of the sensitive faculty, rather this affection comes

1 Aristotle, *De somno* 456b10–11 (καὶ γὰρ ἔκνοια καὶ πνιγμός τις καὶ λειποψυχία ποιεῖ τὴν τοιαύτην ἀδυναμίαν). All translations are my own.

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about from the exhalations attendant on food."[2] He explains that the concoction of food in the digestive organs produces an exhalation (ἀναθυμίασις)—a term that he defines in the *Meteorology* as existing on a continuum of wet to dry, from vapour at one extreme to smoke at the other.[3] We must thus envision a steamy, turbid substance, whose hot nature, he tells us, causes it to rise from the gut into the venous system and thence to the head.[4] In what follows, he proves himself conflicted about how, precisely, this exhalation manages to incapacitate the sensitive soul in the heart; however, he is consistent in his description of the process, if not of the mechanics of the decisive moment.[5] Luckily, the sequence of events is sufficient for my purposes here. First, the nutritive exhalation rises through the veins straight to the head. This trip to the head is critical to engendering sleepiness—he credits it with causing nodding and heavy eyelids.[6] After reaching the head, it reverses itself, either because it has encountered an obstacle in the shape of the skull or because it has cooled down thanks to the refrigerant character of the brain.[7] Either way, the mass of food exhalations, now somewhat purified and tamed by its sojourn in the head, descends on the heart, effectively immobilizing all its sensitive functions. Once this digestive process is complete—that is, once all of the nutriment has reached the heart, been fully concocted into blood, separated into the purer and less pure, and, finally, dispersed to its proper locations—sleep ceases, and the animal wakes up. Thus, the digestive process directs every aspect of sleep, from nodding off to awakening.

Now, this tight dependence of sleep on food is intrinsically flawed, and Aristotle is well aware of the fact. He acknowledges that it is perfectly possible for someone to fall asleep without having first eaten: he says that sleep occurs "most of all" after food, implicitly allowing for the circumstances when it does not.[8] However, his analysis of these other soporific moments serves only to reinforce his thesis. He names soporific drugs, fatigue, and certain diseases

2 *Somn.* 456b17–19 (οὐκ ἔστιν ὁ ὕπνος ἀδυναμία πᾶσα τοῦ αἰσθητικοῦ, ἀλλ' ἐκ τῆς περὶ τὴν τροφὴν ἀναθυμιάσεως γίγνεται τὸ πάθος τοῦτο).

3 *Somn.* 456b3–5; *Mete.* 359b28–34.

4 I have analysed Aristotle's conception of the digestive process in greater detail in Bubb (2020) 142–151.

5 On this question, see Wiesner (1978) 251–271, as well as Marelli (1979–1980) 132–136, Althoff (1992) 136–143, and Code (2015) 34–43.

6 *Somn.* 456b26, 32; he also entertains the possibility that eyelids close because they are chilled at 457b4.

7 *Somn.* 456b20–23 for the obstacle theory (cf. the variation at 457b22–25); 457b31–458a5 for the cooling theory, which he seems more to endorse.

8 *Somn.* 456b24, 33 (μάλιστα).

as alternative efficient causes, but, in each case, they produce sleep precisely because they mimic food's role in triggering the digestive process. Indeed, he says that the action of soporifics is "proof" of his thesis about food: they all cause the head to become heavy, having (presumably) set in motion an upward rush of vapours like that from digestion.[9] Certain types of fatigue, in turn, cause sleep because "fatigue is solvent, and the product [of this dissolution] *acts just like undigested food*."[10] Finally, some diseases can cause sleep if, that is, they are associated with a hot and moist residue, allowing them to set off a simulation of the digestive process.[11]

Furthermore, Aristotle offers anatomical differences as the driving reason why some types of people are naturally sleepier than others. In each case, structural characteristics that impede or facilitate the flow and ebb of digestive matter to and from the head through the veins are the decisive factor. Thus, infants sleep constantly since they are warm, moist creatures, whose disproportionately large heads accommodate an enormous traffic in exhalations.[12] In contrast, people with large veins, which are able to rapidly drain the head, do not need much sleep.[13] Melancholics, too, are minimal sleepers because they have naturally cool dispositions, which are not hot enough to produce sizable quantities of digestive exhalation in the first place; indeed, their disinclination to sleep is symptomatic of the fact that they are simply bad at digestion—no matter how much they eat, they do not gain weight.[14] Aristotle is thus confident in his conclusion, which he reiterates at the end of the treatise, that sleep is the direct result of the digestive journey of nutritive exhalations upwards to the head and then, inevitably, back down; sleep ends "whenever digestion is complete" and when the sleeper is "relieved of the weight of the food."[15] In short, for Aristotle, the digestive process actively drives the cycles of sleep and waking.

This is not a standard correlation in natural philosophy. The Aëtian *Placita* reports the following notable positions on the cause of sleep:

> Alcmaeon says that sleep comes about from the retreat of the blood into the blood-flowing veins, and that awakening is the diffusion of the blood, and death is its complete retreat. Empedocles says that sleep comes about

9 *Somn.* 456b28–32 (σημεῖον).
10 *Somn.* 456b34–457a1 (ὁ μὲν γὰρ κόπος συντηκτικόν, τὸ δὲ σύντηγμα γίγνεται *ὥσπερ τροφὴ ἄπεπτος*); my emphasis.
11 *Somn.* 457a1–2, 17–21.
12 *Somn.* 457a3–5.
13 *Somn.* 457a25–27.
14 *Somn.* 457a27–31.
15 *Somn.* 458a10 (ὅταν πεφθῇ), 24–25 (ἀπολυθέντα τοῦ ἐκ τῆς τροφῆς βάρους).

> from moderate cooling in the heat in the blood, but that from immoderate and complete cooling heralds death. Diogenes says that if the blood, being generally diffused, fills the veins and thrusts the air contained in them into the chest and the underlying belly, sleep comes about and the thorax becomes warmer; but if all the air leaves the veins, death occurs. Strato and the Stoics say that sleep comes about from the relaxation of the sensitive pneuma—not slackening, as in intoxication, but being borne up to the hegemonic part, or the brow—but when a complete relaxation of the sensitive pneuma comes about, then death occurs.[16]

Blood, heat, and pneuma dominate this conversation. Certainly, the first two of these elements are also active in digestion and are critical to Aristotle's model of sleep causation, but food itself does not seem to have played a noteworthy role, if any at all, in any of these theories. No one offering a parallel summary of Aristotle's opinion in this manner could fail to mention the role of food. Indeed, this same doxographer proves to be a responsible reporter in the next chapter, where he discusses the related question, "whether sleep and death belong to soul or body."[17] There, he characterizes Aristotle's position on sleep in familiar terms: "the cause of it is moisture evaporating from the trunk to the places around the head, arising from the food below."[18] He goes on to discuss the sleep-theories of Anaxoragas, Leucippus, and Empedocles, but, across both of these chapters, Aristotle's is the only name associated with food.

Outside of Aëtius, there is limited evidence for philosophical positions on sleep. Tertullian's succinct doxography on sleep in his *On the Soul*, which seems to stem from a similar source as Aëtius', does not mention food as a causative

16 Aetius, *Placita* v.24 (909d–f) (Ἀλκμαίων ἀναχωρήσει τοῦ αἵματος εἰς τὰς αἱμόρρους φλέβας ὕπνον γίνεσθαί φησι, τὴν δ' ἐξέγερσιν διάχυσιν, τὴν δὲ παντελῆ ἀναχώρησιν θάνατον. Ἐμπεδοκλῆς τὸν μὲν ὕπνον κατὰ ψύξιν ἐν τοῦ τῷ αἵματι θερμοῦ σύμμετρον γίνεσθαι, κατὰ δὲ ἀσύμμετρον καὶ παντελῆ ἐπαγγέλλειν θάνατον. Διογένης, εἰ ἐπὶ πᾶν τὸ αἷμα διαχεόμενον πληρώσει μὲν τὰς φλέβας τὸν δ' ἐν αὐταῖς περιεχόμενον ἀέρα ὥσει εἰς τὰ στέρνα καὶ τὴν ὑποκειμένην γαστέρα, ὕπνον γεγενῆσθαι καὶ θερμότερον ὑπάρχειν τὸν θώρακα· ἐὰν δ' ἅπαν τὸ ἀερῶδες ἐκ τῶν φλεβῶν ἐκλίπῃ, θάνατον συντυγχάνειν. Στράτων οἱ Στωικοὶ τὸν μὲν ὕπνον γίνεσθαι ἀνέσει τοῦ αἰσθητικοῦ πνεύματος οὐ κατ' ἀναχαλασμόν, καθάπερ ἐπὶ τῆς μέθης, φερομένου δ' ὡς ἐπὶ τὸ ἡγεμονικὸν ⟨ἢ⟩ μεσόφρυον· ὅταν δὲ παντελὴς γένηται ἡ ἄνεσις τοῦ αἰσθητικοῦ πνεύματος, τότε γεγενῆσθαι θάνατον); see also the discussion in Laks (2015) 30–40.

17 Aet., *Plac.* v.25 (909f–910b) (ὁποτέρου ἐστὶν ὕπνος καὶ θάνατος, ψυχῆς ἢ σώματος).

18 Aet., *Plac.* v.25 (909f) (αἴτιον δ' αὐτοῦ τὸ ἀναθυμιαθὲν ὑγρὸν ἀπὸ τοῦ θώρακος εἰς τοὺς περὶ τὴν κεφαλὴν τόπους ἐκ τῆς ὑποκειμένης τροφῆς); he also adds the reason "or the heat in the heart having grown cold" (ἢ τὸ ἐν τῇ καρδίᾳ περιψυχθὲν θερμόν), in anticipation of his subsequent explanation for death.

agent at all—not even, troublingly, in his summary of Aristotle's views.[19] Plato briefly discusses sleep causation in the *Timaeus*, where he explains that darkness itself induces sleep by cutting off the interaction between the light of the sun and the internal fire of the eyes.[20] Heraclitus also offers some scant material from which to cautiously reconstruct a theory of sleep.[21] Like most of his contemporaries, he focuses on the close ties between sleep and death. Because his theory of the soul's vitality is tied up with ideas of moisture, it seems plausible that his theories of sleep also centred on cycles of moistness. While blood is the obvious candidate for this moisture, J. Mansfeld has also posited an implicit reference here to digestion, including the moisture-inducing intake of food and drink.[22] With Heraclitus, then, it may be possible to begin to sketch the outlines of a bridge between the prominent role of blood in the theories described by Aëtius and Aristotle's emphasis on food intake. All told, though, it is safe to say that there is a marked difference between Aristotle's approach to sleep causation, with its tight and explicit dependence on the digestive process, and the approaches of his philosophical predecessors for whom any evidence remains. In light of this, it is particularly interesting that he decided to forgo his usual procedure and not engage with other philosophers' theories at the beginning of the *De somno*.[23] My suggestion is that he was instead engaging tacitly with a different circle, namely the medical one.[24]

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19 Tertullian, *De anima* 43.1–2.

20 Plato, *Timaeus* 45d–e.

21 See especially, Heraclitus, DK 22 B26, 88 and the discussions in Mansfeld (1967) and Laks (2015) 40–45.

22 Mansfeld (1967) 20–23. Suggestively, Heraclitus' theories appear to have been influential to the Hippocratic author of *De victu*, who, as we see below, articulates clear connections between food and sleep; see Bartoš (2015) 117–127.

23 He does, however, engage implicitly with this type of explanation for sleep at *Historia animalium* 3.19 521a15, where he endorses the idea that "in those who are asleep, there is less blood in the outward parts [of the body]" (τοῖς δὲ καθεύδουσιν ἐν τοῖς ἐκτὸς μέρεσιν ἔλαττον γίνεται τὸ αἷμα).

24 It has already been observed that Aristotle's engagement with medical ideas tends to be anonymous (see van der Eijk (2012), 1502 and the introduction to this volume) or, especially where he is adopting ideas, to be tacit; this latter is in keeping with his general policy, as neatly summed up by Byl (1980), 4: "selon un principe qui lui tient à cœur, Aristote ne cite généralement ses prédécesseurs que pour les réfuter." Indeed, his few citations of medical authorities by name (listed at van der Eijk 2012, 1502–1504) are decidedly critical in tone, in a way similar to his attitude towards those philosophical predecessors singled out by name in the type of *status quaestionis* so notably absent at the beginning of *De somno*. It thus seems quite possible that the absence of engagement with previous theories here is in itself indicative of a medically informed background. Tiberiu Popa points out to me that a similar dynamic seems to be at play in the fourth book of the *Meteorologica*.

2 The Hippocratic Corpus

Ancient medical authors routinely see a correlation between sleep and digestion, and I believe that Aristotle is drawing on this established tradition.[25] Before embarking on the medical evidence, however, we must digress briefly to put ourselves into the proper ancient mindset. To our modern three-square-meals-a-day sensibilities, the notion that food directly causes sleep is absurd. While large holiday meals might have the reputation of being soporific, most people consider breakfast to be exactly the opposite, and daytime snacks are meant to be pick-me-ups, not the reverse. In antiquity, however, patterns of food consumption were different. It was a standard practice to eat only one meal a day, in the evening before bed, though some people consumed a lunch at mid-day in addition. Various authors attest to this situation in the fifth and fourth centuries. The author of *Ancient Medicine* makes clear that these are the two standard options:

> It is the case that, for some [healthy people], it is expedient to eat one meal a day—and, because of this benefit, they arrange accordingly—; for others, to eat a lunch, for the same reason: because it is expedient for them … For most people it makes no difference whichever custom they practice, that is eating one meal or eating lunch too.[26]

Diocles also confirms this picture of one main meal at the end of the day, with an optional smaller lunch at midday; further, he indicates that napping after the midday meal is an unremarkable practice.[27] In this ancient food landscape, then, the idea that sleep and food-intake are directly linked begins to seem a more reasonable proposition.

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25 Marelli (1979–1980), too, picks up on the fact that Aristotle neglects to engage with previous theories, and he offers a broad look at theories of sleep among fifth century philosophers and doctors as compared to Aristotle; he briefly comments on some Hippocratic moments connecting sleep to food (p. 129–130), but, ultimately, he is more interested in the sources of Aristotle's apportioning an uncharacteristically prominent role to the head.

26 *De vetere medicina* 10 (I.590–592 L. = 129,17–130,5 Jouanna) (ἔστι γὰρ οἷσιν αὐτῶν συμφέρει μονοσιτεῖν —καὶ τοῦτο διὰ τὸ συμφέρον οὕτως αὐτοὶ συνετάξαντο—, ἄλλοισί τε ἀριστᾶν, διὰ τὴν αὐτὴν ἀνάγκην· οὕτω γὰρ αὐτοῖσι συμφέρει … τοῖσι μὲν γὰρ πλείστοισι τῶν ἀνθρώπων οὐδὲν διαφέρει, ὁπότερον ἂν ἐπιτηδεύσωσιν εἴτε μονοσιτεῖν εἴτε ἀριστᾶν, τούτῳ τῷ ἔθει χρῆσθαι); cf. *De victu acutorum A* 11 (4 L.), 28 (9 L.) (II.246–248, 280–284 L. = 40,10–19, 47,22–48,13 Joly), *De salubri diaeta* 4, 7 (VI.76, 82 L. = 210,12, 216,16 Jouanna), *Epidemiae* 7.3.3 (VII.372 L. = 52,9 Jouana/Grmek).

27 Diocles, *Fr.* 182, ln. 174–180.

The authors in the Hippocratic corpus are not as explicit as Aristotle that food intake is the efficient cause of sleep—none of them, after all, is writing a treatise dedicated to the topic—but many of them operate on the underlying assumption that sleep and digestion are intimately connected. The author of *Regimen in Acute Disease A* describes the effects that he believes to follow after deviating from one's customary meal patterns. He explains that both those who eat once a day and those who eat twice a day will suffer from any abrupt changes to their habits. If a man accustomed to a single meal decides to eat lunch, for example, it "immediately makes him weak, heavy in his whole body, feeble, and sluggish."[28] The solution to this stupor is to sleep: "it is necessary for him to sleep on it, just as he would sleep through the night after dinner."[29] Thus, the body's proper response to food is to sleep, unless one has accustomed one's stomach to receive food mid-day without a rest. Indeed, this author clearly conceives of sleep as critical to the digestive process. Later in the treatise, he explicitly says that "excessive wakefulness causes food and drink to be less digested," and, similarly, that a lack of sleep prevents the concoction of not just food but of all the bodily fluids, including urine and sweat.[30] The relationship, however, goes both ways. In the example above, he asserts that sleep is required for proper digestion. In the subsequent passage, he implies that the inverse is true as well: sketching out the opposite scenario to the one above—a man who usually eats lunch but skips it—he says that such a person will be equally as discomfited as his counterpart and will "sleep much worse than if he had taken lunch."[31] Thus, food begets sleep, just as sleep begets digestion.

The author of *On Ancient Medicine* understands things in a markedly similar way, including a passage strikingly similar to the one above; indeed, he emphasizes the soporific qualities of food even more sharply, saying that an unaccustomed lunch for a one-meal-a-day person results not only in general sluggishness, but also in "yawning and drowsiness."[32] The general scholarly consensus is that there is a direct line of influence or a common source connecting the authors of *On Ancient Medicine* and *Regimen in Acute Disease*—in no small part because of the tight correlation of these very passages—but a relationship

28 *Acut. A* 28 (9 L.) (II.284 L. = 48,8–10 Joly) (εὐθέως ἀῤῥώστους ποιεῖ, καὶ βαρέας ὅλον τὸ σῶμα, καὶ ἀσθενέας καὶ ὀκνηρούς).

29 *Acut. A* 29 (9 L.) (II.286 L. = 48,15–16 Joly) (ἐγκοιμηθῆναι γὰρ χρή, ὥσπερ νύκτα ἄγοντα μετὰ τὸ δεῖπνον); see also the parallel passage at *Acut. B.* 42 (18 L.) (II.478 L. = 87,21–88,1 Joly).

30 *Acut. A* 49 (13 L.) (II.330 L. = 57,16–18 Joly) (ἀγρυπνίη ἰσχυρὴ πόμα καὶ σιτίον ἀπεπτότερα ποιεῖ); *Acut. A* 42 (11 L.) (II.312–314 L. = 54,2–13 Joly).

31 *Acut. A* 30 (9 L.) (II.290 L. = 49,10 Joly) (δυσκοιτέουσι πολὺ μᾶλλον ἢ εἰ προηριστήκεσαν).

32 *VM* 10–11 (I.590–594 L. = 129,14–132,9 Jouanna); quotation from *VM* 10.3 (I.592 L. = 130,11–12 Jouanna) (χάσμης τε καὶ νυσταγμοῦ).

between sleep and food is visible across the corpus, even in texts without any notable affiliation to these ones.[33] For example, Aristotle's portrait of babies as sleep-obsessed gluttons, who are therefore excellent case studies for the soporific properties of food and the digestive powers of sleep, has parallels in the Hippocratic *Dentition*. The author of that short text agrees with the theory that food causes drowsiness, pointing out that "[children] who take in a lot of milk when they nurse are generally sleepy."[34] Furthermore, he endorses the complementary theory that sleep begets digestion, opining that "those [children] that sleep well and are well nourished may eat a lot, even [if only] inappropriate food is available."[35] Though the text is a bit difficult here, he is clearly indicating that good sleep correlates with powerful digestion. The author of *Aphorisms*, too, alludes to the same set of ideas. He mentions that "the bowels are by nature hottest in the winter and the spring and sleep is longest; therefore, in these seasons it is necessary to also give more food."[36] He then clarifies that heat is the driving factor behind the need for extra sustenance, but he clearly sees increased food and increased sleep as intuitively correlated. Indeed, his comment that "much sweat after sleep without some obvious cause shows that the body has an excess of food" indicates his belief that, in the natural course of events, sleep should suffice to process all ingested food and that signs of surfeit are therefore clearly visible after sleep, when all ingested matter would otherwise have been properly dealt with.[37] The author of *Epidemics 4* also sees a correlation, though his understanding of the details is more eclectic. He characterizes sleep as "food for the guts," an enigmatic statement that nevertheless conjures an image of digestion-promoting sleep.[38] He also says that "much

33 On the similarities and probable connection between *VM* and *Acut. A* and *B*, see Ducatillon (1977), 308–309, 324–340, Jouanna (1990) 63–71, Schiefsky (2005) 209, and Craik (2015) 6.

34 *De dentitione* 28 (VIII.548 L. = 224,21–22 Joly) (τὰ πουλὺ γάλα τῶν θηλαζόντων ἀναλαμβάνοντα, ὡς τὸ πουλὺ ὑπνώδεα).

35 *Dent.* 15 (VIII.546 L. = 223,11–12 Joly) (τὰ εὔυπνα καὶ εὔτροφα πολὺ ἀναλαμβάνειν παράκειται καὶ οὐχ ἱκανῶς διῳκημένον).

36 *Aphorismi* 1.15 (IV.466 L. = 104,1–3 Jones) (αἱ κοιλίαι χειμῶνος καὶ ἦρος θερμόταται φύσει, καὶ ὕπνοι μακρότατοι· ἐν ταύτῃσιν οὖν τῇσιν ὥρῃσι, καὶ τὰ προσάρματα πλείω δοτέον).

37 *Aph.* 4.41 (IV.516 L. = 144,1–3 Jones) (ἱδρὼς πουλὺς ἐξ ὕπνου ἄνευ τινὸς αἰτίης φανερῆς γινόμενος, τὸ σῶμα σημαίνει ὅτι πλείονι τροφῇ χρῆται).

38 *Epid.* 6.5.5 (V.316 L. = 242,15–17 Smith). The entire passage reads πόνος τοῖσιν ἄρθροισι καὶ σαρκὶ σῖτος, ὕπνος σπλάγχνοισιν, which could be translated either as "labour is food for the joints and the flesh, sleep [is food] for the guts" or, more aphoristically, as "labour for the joints and food for the flesh, sleep for the guts." I am inclined to read it in the former way, with Smith (1994), but the latter equally points to a tight connection between sleep and digestion, if somewhat less poetically.

sleep also reduces someone who has been extremely purged," indicating again that he considers sleep to trigger digestive activity.[39] His contention that "wakefulness induces appetite" may further suggest that prolonged vigil creates desire for food and the sleep that it will bring; however, it might equally point in the opposite direction and be interpreted to mean that food is processed during wakefulness and that its prolongment therefore increases the need to eat.[40] Indeed, his report that "in sleep blood retreats more to the interior" indicates that this author is taking on board a variety of ideas, including both prevalent medical views on sleep's connection to food and contemporary philosophical theories of sleep as outlined in Aëtius, suggesting that it is perhaps overly optimistic to expect him to deploy a consistently reconstructable physiology.[41] Regardless, all of these examples evidence a general correlation between sleep and digestion in operation across the medical thinking revealed in the Hippocratic corpus.

This correlation is also visible, though often a bit harder to parse, in these authors' discussions of treatments. *Regimen in Health* is most explicit. The author advises that individuals who vomit their food the day after eating it or who otherwise show signs of a plethora of undigested material will benefit from "sleeping for a longer time."[42] Similarly, the author of *Regimen in Acute Disease B*—who may or may not be identical to the author of the first half of the text—deploys sleep as a curative element in cases where digestion needs to be promoted.[43] The author of *Aphorisms* indicates that sleep directly impacts the rate at which food and drugs are digested: he suggests activity and wakefulness as a means of prolonging the efficacy of hellebore and sleep (and its ensuing destruction via digestion) as a means of ending its effects.[44] Indeed, some authors frame their advice for dietetic treatments in reference to their timing vis-à-vis sleep. The author of *Diseases 2*, for example, desires one patient to eat a large dose of raw garlic and strong wine "when he is about to go to bed," while the author of *Internal Affections* advises that another patient drink his

39 *Epid.* 6.5.15 (V.320 L. = 246,2–3 Smith) (ὑπέρινον ἰσχναίνει καὶ ὕπνος πολύς).

40 *Epid.* 6.4.18 (V.312 L. = 238,16 Smith) (ἀγρυπνίη βορόν).

41 *Epid.* 6.5.15 (V.320 L. = 244,22–23 Smith) (τὸ αἷμα ἐν ὕπνῳ ἔσω μᾶλλον φεύγει); cf. 6.4.12 (V.310 L. = 238,6–7 Smith).

42 *Salubr.* 7 (VI.84 L. = 218,8 Jouanna) (καθεύδειν μὲν πλείω χρόνον).

43 *Acut. B* 43 (18 L.) (II.480 L. = 88,9–20 Joly); *Acut. B* 42 (18 L.) (II.478 L. = 87,21–88,8 Joly) also briefly reprises the material from *Acut. A* on the detrimental effects of changing eating habits. For the authorship of *Acut. A* and *Acut. B*, see Jouanna (1990) 63 (and the bibliography there) and Craik (2015) 3–5.

44 *Aph.* 4.13–15 (IV.504–506 L. = 136,1–138,3 Jones).

fill rapidly after a large dinner, sleep for a short time, and then be woken and caused to vomit, evidently in the hopes of catching the digestive process in a different stage.[45]

Unsurprisingly, the author in the corpus with the most robust theory of a connection between sleep and digestion is that of *On Regimen*. He explicitly lays out the connection in the second book:

> periods of sleep while fasting strengthen and cool, if they are not long, for they empty the moisture in the body; if they are longer, they heat up and melt the flesh and dissolve the body and make it weak. In one who has eaten, periods of sleep warm and moisten, distributing the nutriment in the body. After morning walks, sleep is particularly drying. Wakefulness is harmful on full stomachs, since it does not allow the food to be dissolved; on an empty stomach, it renders thinning of a sort and is less harmful.[46]

The implications of this passage are both clear and consistent. Sleep facilitates digestion. Sleep after food "distribut[es] the nutriment in the body," while lack of sleep after food "does not allow the food to be dissolved." Indeed, sleep is an inherently digestive process, whether or not the belly is full of food, with the result that sleep on an empty stomach causes thinning: any spare moisture is dealt with first and then the body's own substance begins to be digested. Conversely, vigil while fasting leads to a different sort of weight loss in which new nutriment is simply never added.

The author of *On Regimen* applies this theory of sleep-dependent digestion across his more practical recommendations in the third book, which also reveal his belief in the inverse relationship, namely that food itself causes sleep. He advocates that most people should eat small lunches followed by short naps in the summer, but that, in the autumn, they should return to the winter norm

45 *De morbis* 2.27 (VII.44 L.) (ἐπὴν μέλλῃ καθεύδειν); *De internis affectionibus* 20 (VII.216 L. = 122,9–14 Potter).

46 *De victu* 2.60.1–2 (VI.572–574 L. = 182,21–26 Joly-Byl) (ὕπνοι δὲ νῆστιν μὲν ἰσχναίνουσι καὶ ψύχουσιν, ἢν μὴ μακροὶ ἔωσι, κενοῦντες τοῦ ὑπάρχοντος ὑγροῦ· ἢν δὲ μακροὶ ἔωσι μᾶλλον, ἐκθερμαίνοντες συντήκουσι τὴν σάρκα καὶ διαλύουσι τὸ σῶμα καὶ ἀσθενὲς ποιέουσι· βεβρωκότα δὲ θερμαίνοντες ὑγραίνουσι, τὴν τροφὴν ἐς τὸ σῶμα διαχέοντες· ἀπὸ δὲ τῶν ὀρθρίων περιπάτων ὕπνος μάλιστα ξηραίνει. ἀγρυπνίη δὲ ἐν μὲν τοῖσι σιτίοισι βλάπτει οὐκ ἐῶσα τὸ σιτίον τήκεσθαι· ἀσίτῳ δὲ ἰσχνασίην μέν τινα δίδωσι, βλάπτει δὲ ἧσσον). See also his consistent but more obscure comments at *Vict.* 4.86.2 (VI.640 L. = 218,8 Joly-Byl) on the activities of the soul during sleep, which seem to encompass nutritive functions (the soul "manages her own housekeeping" (διοικεῖ τὸν ἑωυτῆς οἶκον)); see the discussion in Bartoš (2015) 201–207.

of eating only in the evening and, accordingly, omit sleep during the day.[47] He explains that in men whose food consumption outstrips their exercise, the surfeit of food causes them to have "long and pleasant periods of sleep" and to sleep also during the day; he says that this sleep is triggered "by the moistening of the flesh" from food, though this eventually becomes so disproportionate that even sleep cannot manage it and "the periods of sleep are no longer pleasant."[48] Other sufferers from surfeit also find that they fall asleep immediately after dinner and that their sleep is distressed; interestingly, in these cases the head and the belly begin to struggle against each other, each wishing to deposit the surplus nutriment in the opposite place—in other words, we seem to have here a digestive process that links bowels to brain, similar to the one that Aristotle describes.[49] Still other patients suffer from plethora due to insufficient heat for digestion, which makes them "unable to digest their food *in the night*"; he encourages these cases to exercise before sleep, presumably in order to stoke up some heat before sleep begins to act on the food.[50] Again, in his discussion of patients whose flesh is too firm to properly absorb nutritive moistures, he indicates that it is "in the first period of sleep" that "the food is heated and dissolved" to allow for its absorption by the body.[51] In general, the length and timing of sleep is a tool in this author's arsenal to bring about a perfectly balanced relationship between body and food.[52] In every case, his deployment of sleep operates from the assumption that nutritive matter triggers sleep and/or that sleep forwards digestion. In sum, while the authors of the Hippocratic texts vary in the degree to which they endorse and engage with these ideas and while none of them links sleep to food quite as tightly as Aristotle does, there is a widespread understanding across the corpus that sleep facilitates digestion—that sleep and digestion are, in fact, corollary processes, just as Aristotle envisions them.

Moreover, *Places in Man*, though not engaging directly with sleep, offers some interesting parallels to Aristotle's physiology of digestion. Much like with the surfeited patients in *Regimen* whose head and bowels were locked in a

47 *Vict.* 3.68.11, 14 (VI.602, 604 L. = 198,29–30, 200,17–18 Joly-Byl).

48 *Vict.* 3.71.1–2 (VI.610 L. = 202,34–204,4 Joly-Byl) (ὕπνοι μακροὶ καὶ ἡδεῖς … ὁ δὲ ὕπνος γίνεται τῆς σαρκὸς ⟨ὑγρανθείσης⟩ … οὐκ ἔτι … ἡδεῖς οἱ ὕπνοι).

49 *Vict.* 3.73 (VI.612–614 L. = 204,27–206,13 Joly-Byl).

50 *Vict.* 3.75 (VI.616 L. = 206,32–33 Joly-Byl) (οὐ δύναται καταπέσσειν τὸν σῖτον *ἐν τῇ νυκτί*); my emphasis.

51 *Vict.* 3.78 (VI.622 L. = 210,3–4 Joly-Byl) (ὅταν τὰ σιτία διαθερμαίνηται καὶ διαχέηται ἀπὸ πρώτου ὕπνου).

52 See *Vict.* 1.35.12, 3.80.2, 82.3, 83.3 (VI.522, 626–628, 632, 634 L. = 156,14–15, 212,20–21, 214,27–28, 216,14 Joly-Byl).

power-struggle, the author of *Places in Man* sees the head as a natural destination for the moistures attendant on digestion. However, like his colleague from *Regimen*, he views the trip to the head as a noxious rather than natural turn of events. He explains:

> for whenever the belly does not achieve an appropriate purging and food enters into it, the body floods with the moisture of the ingested food. This moisture, blocked out of the belly, goes into the head all at once; and when it arrives in the head, not being used up by the vessels of the head, it flows at random, both round about the head and into the brain, through the delicate bone … And if it goes back into the belly, it transmits illness to the belly; and if it happens to land elsewhere, it transmits illness elsewhere …[53]

Thus, in this author's understanding, a trip to the head is *not* characteristic of proper digestion: quite the contrary. Nevertheless, he and the author of *Regimen* both indicate that there is a tradition of linking head to belly in medical thought.

4 Medical Authors Outside the Hippocratic Corpus

The Anonymous of London papyrus confirms that this correlation between belly and head in medical thought goes beyond the texts canonized as Hippocratic. Its doxography of disease aetiology includes several authors who affirmed a similar upward peregrination of digestive substances. Euryphon of Cnidos is reported to believe that residues produced from improper digestion "rising to the places around the head cause diseases"; Alcamenes, that the residues of digestion rush up to the head and then cause various diseases "having received bolstering from the head and having been sent to the whole body."[54] While these two physicians, in keeping with their two counter-

53 *De locis in homine* 1.2–3 (VI.276 L. = 38,16–39,5 Joly) (ἡ γὰρ κοιλίη ὁπόταν ὑπεκχώρησιν μὴ ποιῇ τὴν μετρίην, καὶ ἐσίῃ ἐς αὐτὴν, ἄρδει τῇ ὑγρότητι τὸ σῶμα τῇ ἀπὸ τῶν σιτίων τῶν προσφερομένων· αὕτη δὲ ἡ ὑγρότης ἀπὸ τῆς κοιλίης ἀποφρασσομένη ἐς τὴν κεφαλὴν ὠδοιπόρησεν ἀθρόη· καὶ ἐς τὴν κεφαλὴν ἐπὴν ἀφίκηται, οὐ χωρευμένη ὑπὸ τῶν τευχέων τῶν ἐν τῇ κεφαλῇ, ῥεῖ ᾗ ἂν τύχῃ, καὶ πέριξ τῆς κεφαλῆς, καὶ ἐς τὸν ἐγκέφαλον διὰ λεπτοῦ τοῦ ὀστέου … καὶ ἢν μὲν ἐς τὴν κοιλίην πάλιν ἀφίκηται, τῇ κοιλίῃ νοῦσον ἐποίησεν· ἢν δ' ἄλλῃ πῃ τύχῃ, ἄλλῃ νοῦσον ποιεῖ …).

54 Anonymous of London, IV.31–40 (ἀνενεχθέντα ὡς τοὺς κ(ατὰ) τὴν κεφαλὴν τόπους ἀποτελεῖ τὰ[ς νόσ]ους); VIII.6–10 (ἐπιχορηγούμενα πρὸς τῆ[ς κε]φαλῆς καὶ ἐπιπεμπόμενα τῶι ὅλῳ σώματι).

parts from the Hippocratic corpus, present the head's involvement as largely or entirely sinister, Timotheus of Metapontum apparently held a more nuanced view. Anonymous of London credits him with the following position:

> whenever the head is healthy and clean, similarly clean nutriment is delivered from it to the whole body and the creature is thus healthy; but, whenever it is not healthy, it brings disease by blocking up the passageways. For, he says, whenever these are blocked up, the reverting residue remains in the places around the head for a time because it lacks an exit and, having remained there, it changes into salty and acrid moisture and then, having remained a still longer time and [then] effectuated a rupture, it is borne into some place and, depending on the differences of the places, brings different diseases.[55]

Timotheus envisages the trip to the head as a normal step in the digestive process; in a healthy person, he tells us, "nutriment is delivered from [the head] to the whole body." In other words, he indicates that, as for Aristotle, a trip from belly to head is an essential part of the normal processing of ingested food. Further, the head's ability to transmit this nutriment is dependent on the capacity of the passages that descend from it, in a situation evocative of Aristotle's enumeration of the effects of different types of veins on their owners' ability to sleep and to digest. With Timotheus, then, the second striking aspect of Aristotle's nutritive theory of sleep—that it is triggered not just by food, but specifically by the food's digestive peregrination to and from the head—also has sound medical precedence.[56]

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55 Anon. Lond., VIII.11–28 (ὅταν μ(ὲν) γ(ὰρ) ἡ κεφαλὴ ὑγιὴς ᾖ καὶ [κα]θαρὰ, καθαρὰ καὶ ἡ τροφὴ ἀπ' αὐτῆς π(ροσ)τίθεται τῶι ὅλωι σώματι καὶ ο(ὕτως) ὑγιαίνει τὸ ζῶιον· ὅταν δὲ μὴ ὑγιὴς ᾖ, νόσους ἐπιφέρει τῶι τὰς διεξόδους ἀποφράσσεσθαι· ὅταν γάρ, φ(ησιν), αὗται ἀποφρα[γ]ῶσιν, ἀνατρέχον τὸ περίσσωμα ὡς τοὺς κ(ατὰ) τὴν κεφαλὴν τόπους τ[έω]ς τῶι μὴ ἔχειν διέξοδον ἐμμένει, ἐμμεῖναν δὲ μεταβάλλει εἰς ἁλμυρὸν καὶ δριμὺ ὑγρόν καὶ εἶτα πλείω ἐμμεῖναν χρόνον καὶ ῥῆξιν ἐργασάμενον φέρεται εἰς ὁτιοῦν μέρος καὶ παρὰ [τ]ὰς [το]ύ τον διαφορὰς διαφόρους [τὰς] νόσους ἐπιφέρει).

56 Indeed, Sophia Connell pointed out to me that the upward rise of food-vapours from the belly to the head is a distinctively anthropocentric theory—in a cow, for example, the head is lateral to the belly, not above it, making an evaporation-based explanatory model more difficult to apply. Thus, it seems all the more likely that Aristotle is indeed engaging here with a *medical* model of digestion, which would naturally concern itself only with human physiology. Moreover, Aristotle is perfectly aware of the idea that the head's involvement in digestion can be medically problematic: he curtails his discussion of the head's role in digestion as parallel to the evaporation and condensation of rain at *De partibus animalium* 2.7 653a4–10 by saying that it is a topic more suitable to a study "on the origins of diseases" (ἐν ταῖς τῶν νόσων ἀρχαῖς); cf. just above at *Part. an.* 2.7 653a1–2 and *Somn.* 458a2–3, where

In addition to this extra-Hippocratic evidence for theories of digestion that parallel those in Aristotle's *De somno*, the assumptions about sleep and food that I have so far demonstrated to be prevalent in the Hippocratic corpus are also visible beyond that group of texts. The physician Diocles offers a glimpse into the broader medical thinking of Aristotle's own time. While his dates have been the subject of some controversy, general consensus at this point is that he was more or less contemporary with Aristotle and that there was likely some intellectual flow between them, though it is not possible to be certain of the direction (or directions) of influence.[57] Diocles was very likely familiar with our Hippocratic texts, but he represents a distinct set of views that were not later amalgamated into the Hippocratic corpus: Pliny refers to him as "second in time and in reputation" to Hippocrates.[58] An extensive extract of his work preserved in Oribasius covers his views on regimen.[59] The passage opens with nothing else than the connection between sleep and digestion:

> The beginning of the business of healthiness is the transition out of sleep into wakefulness. In general, the circumstances for waking are good when the food has already moved from the upper stomach to the lower bowels. For a young man or one in the prime of life, these good circumstances obtain a little before sunrise—about twenty minutes or, in summer, ten—for an older man, less than this in both summer and winter.[60]

Though he does not go quite as far as Aristotle and assert a causative link between the completion of digestion and awakening, Diocles clearly conceives of waking up as synchronous with a distinct shift in the digestive process in a healthy person. As the passage goes on, he indicates that post-prandial walking is beneficial for digestion; this is because the gentle exercise "consolidates and mixes" the ingested meal and results in "less disturbed sleep."[61] Here, we

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he explains that the head's role in digestion results in the consolidation and siphoning off of phlegmy residues.

57 See von Staden (1989) 44–46, van der Eijk (2000–2001) vol. 2, xxxi–xxxviii, and Nutton (2013) 122.

58 Pliny, *NH* XXVI.6.10 (= Diocles, Fr. 3) (*secundus aetate famaque*).

59 Diocles, Fr. 182.

60 Diocles, Fr. 182,3–8 (ἀρχὴ μέν ἐστι τῆς τῶν ὑγιεινῶν πραγματείας ἡ ἐκ τῶν ὕπνων εἰς τὸ ἐγρηγορέναι μετάβασις· ἐγείρεσθαι δ' ὡς ἐπὶ τὸ πολὺ καλῶς ἔχει μεθεστηκότων ἤδη τῶν σιτίων ἐκ τῆς ἄνω γαστρὸς ἐπὶ τὴν κάτω κοιλίαν. καλῶς δ' ἔχει τὸν νέον καὶ ἀκμάζοντα μικρὸν πρὸ ἡλίου ὅσον διελθεῖν στάδια δέκα, θέρους δ' ὅσον πέντε, τὸν δὲ πρεσβύτερον ἐλάσσω τούτων καὶ θέρους καὶ χειμῶνος); I have followed the interpretation in van der Eijk (2000–2001) in reckoning the time intervals.

61 Diocles, Fr. 182,47–53 (ὁμαλίζουσί τε καὶ μιγνύουσι … ὕπνους ἀταρακτοτέρους).

see some standard medical wisdom: the state of food in the belly at night-time directly impacts the quality of sleep. Later on, unsurprisingly, we find the other side of the coin: he implies that sleep is required to properly digest a mid-day lunch, saying "after lunch, one should go to sleep, before delaying too long."[62] This advice is more nuanced with regards to the evening meal; those who "do not digest their food easily should … go to sleep immediately," while everyone else can venture to take a gentle stroll before retiring.[63] In keeping, he advises the flatulent—who also fall into the class of poor digesters—to sleep late: in both cases, those in need of longer time to digest are directed to sleep longer.[64] Thus, in this single passage from Diocles, we find both of the recurrent themes on sleep and food that we saw in the Hippocratic corpus: namely, that sleep promotes digestion and, conversely, that appropriate food begets good sleep.[65] Furthermore, Diocles finds it intuitive that awakening is correlated with a shift in the digestive process, an idea consistent with both of the above and familiar from Aristotle, but one that we have not yet seen directly articulated in the medical tradition.

Conclusion

In sum, we can trace a persistent connection between sleep and digestion in medical thinking of the fifth and fourth centuries. Physicians of this time period operate—both explicitly and tacitly—on the assumption that sleep and food are linked. This connection goes both ways: food promotes sleep and sleep, in turn, promotes digestion. In addition, Diocles indicates that awakening, too, correlates with the digestive cycle. Finally, there is an active current of thought that connects digestion with a movement of material from the bowels to the head. This movement is typically characterized as to some degree deviant and noxious, but not exclusively: there is at least one voice that discusses it as a standard and wholesome aspect of digestion. In short, all the basic elements of Aristotle's theory of sleep as a digestive process—elements which notably lack any secure precedent among ancient philosophers—are present and accounted for in the medical thinking available in his day. I believe that it is there that

62 Diocles, Fr. 182,96–97 (μετὰ δὲ τὸ ἄριστον μὴ πολὺν διατρίψαντα χρόνον καταδαρθεῖν).

63 Diocles, Fr. 182,145–148 (μὴ ῥᾳδίως τὰ σιτία πέττοντας).

64 Diocles explains the digestive failures of the flatulent at Fr. 109,23–35.

65 Mnesitheus, a rough contemporary of Diocles, also seems to view sleep as materially impacting digestion; at Bertier (1972) fr. 45,14–15, he cautions those who have over-indulged in alcohol to be sure to vomit before going to sleep.

Aristotle, no stranger to medical literature, found them and drew them into the detailed and distinctive theory he presents in *De somno*.[66]

In support of this thesis, I think that it will be instructive to close with a brief retrospective look at the situation from the perspective of the first and second centuries CE. The close association between food and sleep remains deeply embedded in the medical thinking of that time. Celsus takes the link between sleep and digestion to be self-evident. He advises those of a naturally weak disposition—townsfolk and scholars—to keep a careful eye on the state of their bellies and plan their sleep accordingly:

> From among these, those who have digested well may safely get up in the early morning; those who have insufficiently digested should repose and, if it was necessary for them to get up early, they should go back to sleep; those who did not digest at all should remain in every way at rest and commit themselves neither to exertion nor to exercise nor to business.[67]

Galen discusses sleep and food in ways similar to the authors of the Hippocratic Corpus. He explains, for example, that peasants are able to eat terrible things like donkey meat, which he himself would find indigestible, because

> sleep is much deeper in those who do a lot of hard labour, and this contributes to their digestion to a greater degree, for which reason they are less harmed by inferior foods; but if you compelled them to stay awake for several nights in a row, they would immediately fall ill.[68]

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66 Indeed, Bartoš (2015) 241–289 offers an extensive argument that Aristotle was directly influenced by *De victu*, one of the texts most outspoken about a food-sleep connection, while Bartoš (2021) expands this argument to include *De carnibus* as another example of Hippocratic influence on Aristotle's theories of nutrition and digestion. See Oser-Grote (2004) and van der Eijk (2012), as well as the introduction and other contributions in this volume, for recent discussions of Aristotle's broader relationship with the Hippocratic Corpus.

67 Celsus, *De medicina* I.2.2 (*Ex his igitur qui bene concoxit, mane tuto surget; qui parum, quiescere debet, et si mane surgendi necessitas fuit, redormire; qui non concoxit, ex toto conquiescere ac neque labori se neque exercitationi neque negotiis credere*).

68 Galen, *De alimentorum facultatibus* I.2 (VI.487 K. = 29 Wilkins) (τοῖς πολλὰ ταλαιπωροῦσιν ὕπνοι βαθύτεροι γίγνονται καὶ τοῦτ' αὐτοῖς μειζόνως πρὸς τὰς πέψεις συντελεῖ, διὰ τοῦθ' ἧττον ὑπὸ τῶν μοχθηρῶν ἐδεσμάτων βλάπτονται· εἰ δ' ἀναγκάσαις αὐτοὺς ἀγρυπνῆσαι πλείοσιν ἐφεξῆς νυξίν, αὐτίκα νοσοῦσιν); cf. *De sanitate tuenda* IV.4.16–18, VI.4.3 (VI.247, 401 K. = 109, 176 Koch).

He also sees an intimate connection between the gut and the head, indicating that any noxious vapours that escape from the bowels have immediate and direct access upwards, sometimes causing headaches, mental confusion, and vision problems.[69] Even colleagues of a different sectarian persuasion felt the same: Caelius Aurelianus, channelling second-century Methodist beliefs, points out, for example, that in some patients with chronic headaches, "[the head] is weighed down by the motion of the faeces and the exhalations that rise from it."[70] It is not surprising, then, to hear Galen make causal links between sleep and digestion in his discussion of sleep in *On the Causes of Symptoms*. He says that "food is digested best during sleep" and goes on to explain:

> just as people sleep more promptly and more deeply after exercise, they also do so after having consumed food, and the moister this is in nature, the more they sleep … For all these sorts of things seem to fill the head with moisture, which, indeed, it needs since it becomes so worn out and dried up in the course of its many functions. But that the head being filled up causes sleep has been sufficiently proven by Aristotle and there is no need for me to digress on the matter now. For anyone who has read his book *On Sleep and Waking* will learn this clearly: that sleep comes to animals when the head is filled up.[71]

He goes on to criticize the cardiocentric aspects attendant on the theory, but he presents Aristotle's general approach as a perfectly integrated part of medical understanding.[72] As, indeed, I have proposed that it was from its inception.

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69 Gal., *De symptomatum causis* I.2.7, I.7.7 (VII.97, 137 K.), *De locis affectis* I.2 (VIII.20–23 K. = 248–253 Gärtner).

70 Caelius Aurelianus, *Tardarum passionum* I.1.14 (436 Bendz) (*stercorum … quorum motu ac expirationis ascensu amplius gravabatur*).

71 Gal., *Caus. Sympt.* I.8.2 (VII.140 K.) (πέττεσθαι τὴν τροφὴν ὑπνούντων κάλλιστα); I.8.2–3 (VII.141–142 K.) (ὥσπερ δὲ ἐπὶ τοῖς γυμνασίοις ἑτοιμότερόν τε καὶ βαθύτερον ὑπνοῦσιν, οὕτω καὶ τροφὴν προσενεγκάμενοι, καὶ ὅσῳ περ ἂν ὑγροτέρα τὴν φύσιν ὑπάρχῃ, τοσούτῳ μᾶλλον ὑπνοῦσιν … ἅπαντα γὰρ τὰ τοιαῦτα φαίνεται πληροῦντα τὸν ἐγκέφαλον ὑγρότητος, ἧς ἄρα δεῖται κεκμηκώς τε καὶ κατεξηρασμένος ὡσαύτως ἐν ταῖς πολλαῖς ἐνεργείαις. ἀλλὰ γὰρ ὅτι ἡ μὲν κεφαλὴ πληρουμένη τὸν ὕπνον ἐπιφέρει, δέδεικται πρὸς Ἀριστοτέλους αὐτάρκως, καὶ οὐδὲν δεῖ νῦν ἡμᾶς ἐπεξιέναι τῷ λόγῳ. τὸ γάρ τοι περὶ ὕπνου καὶ ἐγρηγόρσεως ἀναγνούς τις αὐτοῦ βιβλίον, αὐτό τε τοῦτο σαφῶς ἐκμαθήσεται, τὸ πληρουμένης τῆς κεφαλῆς ἐπιγίγνεσθαι τοῖς ζώοις τοὺς ὕπνους).

72 The pseudo-Galenic *Medical Definitions* also offers an unabashedly Aristotelian answer to the already quite Aristotelian question, "what is the efficient cause of sleep?" (τίς ποιητικὴ αἰτία τοῦ ὕπνου;) at *Def. Med.* XIX.381–382 K.

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CHAPTER 6

The Hippocratic Background to Aristotle's Gynaecology

Sophia Connell

Introduction

This paper details overlaps between the ancient medical works on women's health and Aristotle's *De generatione animalium* and *Historia animalium* Book 7. With respect to *Hist. an.* 7, Balme dismissed any medical influence on the grounds that Aristotle "makes statements that conflict with Hippocratic views".[1] However, this fact does not preclude serious engagement with these authorities. After all, it would hardly be considered a good reason to dismiss Aristotle's debt to, for example, Plato. While Balme's attitude toward Hippocratic influence has been popular in the past, the medical background to Aristotle's biology is now receiving increasing philosophical attention.[2] Despite this, with certain exceptions,[3] the way in which Aristotle's biology interacts with ancient gynaecology has not been systematically investigated. This paper takes steps towards finding Hippocratic and other medical influences in the field of Aristotelian gynaecology. Directing one's attention in this manner reveals certain tensions within Aristotle's biological project as well as his attempts to resolve them.

1 Balme (1987) 16.

2 E.g. Bartoš (2016) and papers in Bartoš and King (2020) and Lo Presti and Korobili (2021).

3 Most notably the work of Dean-Jones. As she puts it: "although Aristotle was writing later than the period of the composition of the Hippocratic treatises, and although he was not primarily concerned with pathology and therapy, many of his concerns were the same and he considered the Hippocratics part of the rational tradition with which he could have a meaningful dialogue." Dean-Jones (1996) 19–20. While Dean-Jones pays careful attention to parallels and similarities, her main concentration is on how the Hippocratic and Aristotelian Corpora are "in opposition on many points." Dean-Jones (1996) 20. Oser-Grote (2004) focuses almost exclusively on anatomy and only references one of the parallels discussed here (see Section III on fertility tests). Poschenrieder (1887) does not discuss any of the parallels in detail, although he does list some of them at pp. 34–37. While Byl (1980) takes care to set out many of the passages that I discuss, his commentary is scant (91–92). Hammann (2022) finds connections between Aristotle and the Hippocratics on more general themes, helpfully

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Aristotle moves in two directions. First of all, as specified in his general scientific methodology detailed in the *Analytica posteriora, Historia animalium* 1 and *De partibus animalium* 1, he provides views and evidence about *all* animals that share an attribute.[4] His explanations of particular kinds often include reference to the broader characteristics they share with other animals. However, certain animals have peculiar characteristics (*ta idia*; *Part. an*. 1.1, 639b5) not shared with other groups. Humans have more of these than any other kind.[5] But we also find that Aristotle comes up with his own theory of reproduction and sex difference in dialectic with doctors (*Gen. An*. 1.17–22), who concentrate on human beings, and particularly women, and from here applies this knowledge to the rest of the natural living world.[6] Thus, there is tension in reproductive science—humans are both paradigm and exceptional. While that pattern is apparent more generally,[7] within gynaecological discussions it is even more pronounced. Where Aristotle uses the human as paradigm in his zoology, this appears to be a hang-over from Platonic ideas of us as separate from and above other living nature. In contrast, the use of the female human as paradigm in reproductive theory comes from an engagement with ancient gynaecology, which views women as more infirm than other female animals. While Aristotle contests the details of this viewpoint, he is broadly in agreement with it.

The paper will begin with an overview of Aristotle's philosophical zoology and the contrasting procedures of medical writers. The paper will then detail a series of engagements with Hippocratic and other scientific gynaecology. In coming up with a general theory of sex difference and reproduction as well as the female role, Aristotle focuses on medical debates which concern only humans and which he extends to all animals. The paper then explains how he also treats women as unique in the animal kingdom. The last section finds contrasts and similarities with medical experts in Aristotle's view of women's pathological condition. While certain characteristics of women are open to

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emphasising points of similarity. He concludes that "The Hippocratic texts serves Aristotle as starting points for his own thoughts". The paper does not cover gynaecology.

4 All locomotive animals have sex difference (*Gen. an*. 1.1, 715a18–716a2). All sublunary living beings reproduce (*Gen. an*. 1.23, 732a30).

5 These include: hands (*Part. an*. 4.10, 687a5), upright posture, buttocks (*Hist an*. 2.1, 499a31, *Part. an*. 4.10, 689b5), thinnest of skin (*Gen. an*. 5.2, 781b19–22), soft lips and tongue (*Part. an*. 2.16, 659b30–34), greying and balding (*Gen.an*. 5.2), the most naked bodies and the smallest nails (*Gen. an*. 5.2, 745b16–18). For further references and discussion, see Lloyd (1983)30.

6 At the very end of the discussion, the general reproductive theory is applied to all animals (*Gen. an*. 1.21, 730a24–32) and then to all living things (1.23).

7 We start with the human both because it is "more familiar" (*Hist. an*. 1.6, 491a19–21; *Part. an*. 2.10, 656a3–6) and "more complete" (*Gen. an*. 2.4, 737b25). On problems for this procedure, see Lloyd (1983) 26–43; Kress, forthcoming.

reasonably straightforward Aristotelian explanations, others are more problematic and seem to indicate the strong influence of a medical framework.

1 Aristotle versus Hippocratic Methodology

Clearly Aristotelian biology and ancient medicine have different methodologies and aims. Since scholars of the *De generatione animalium* often seek continuity with the philosophical zoological methodology set out in the *Analytica Posteriora* and *De partibus animalium* Book 1,[8] the prominence of medical information and analysis in *Gen. an.* 1.17–22 presents a challenge. Aristotle's general methodological recommendations emphasise finding what is most common to the object under investigation[9] before proceeding to distinguish differences that relate to functions and finally what is peculiar (*idia*) to each kind.[10] The data provided in the *Hist. an* follows this pattern, often moving through from blooded quadrupeds to birds, fish, cephalopods, crustacea and finally insects (*Hist. an.* 2.1–4.7),[11] while detailing any peculiar attributes requires further explanation. The move from broader shared characteristics to narrower, more peculiar ones, and thus also from certain general characterisations of types of animal to more specific groups, is apparent right away in *De generatione animalium*, when Aristotle details the generative organs in various animals. A similar pattern is evident as he moves from blooded animals through to insects, although given it is an explanatory work on generation, the modes of reproduction such as live-bearing or egg-laying are also detailed. The general procedure is so much like that in *De partibus animalium*[12] that some scholars think this section of the *Gen. an.* rightly belongs in that work.[13] *Gen. an.* 1.17–22, on the other hand, is a series of close debates with medical authorities and is mainly focused on the human. *Gen. an.* 1.18 includes dialectic with

8 *Part. an.* 1.1 is often taken to be a philosophical prolegomenon to biological research. See Lennox (2010) 58, 76.

9 *Post. an.* 2.14, Lennox (1987) 98.

10 Lennox (1987) 100; *Hist. an.* 4.1, 523a31–32; *Part. an.* 1.1, 639a5, 639a36–b14). On *atoma eidei* see Henry (2021) and forthcoming.

11 Although, as Epstein notes, the order is reversed in *Hist. an.* 5–7 from shellfish up to people (2019, 52).

12 Gotthelf and Falcon (2018) 28; Balme (1992) 127; Gotthelf (2012) 91–92.

13 As Lefebvre explains, if *Gen. an.* is supposed to be about the coming to be of animals, then it should be about embryogenesis (the focus of *Gen. an.* 2) and not the generative parts of fully formed animals. Thus, *Gen. an.* Book 1 on generative parts looks like a 'free-floating' section of the *Part. an.* within the *Gen. an.* Lefebvre (2018) 45.

Empedocles and Anaxagoras, but these also appear to be medically orientated. At times, Aristotle talks of "animal" or "female" and "male", but then immediately makes clear that he is thinking primary about people (*Gen. an.* 1.19, 727b9–33, 1.20, 727b33–728a25, 728b21–32). One part of the discussion centres around inheritance of hands, a body part only humans can have (*Gen. an.* 1.18, 722a18–26, 722b32; 1.19, 726b15–23).[14] The general theory of reproduction rests heavily on matters concerning human beings and women's health in particular.

While some recent work on the *De generatione animalium* includes attempts to acknowledge various effects and influences of Hippocratic and other medical thought, philosophical research on the text has not yet fully benefited from this.[15] It is general practice not to mention any Hippocratic work or medical writing when discussing *Gen. an.* 1.17–21 but instead characterise the opposing position as 'pangenesis', a Darwinian term obviously not used by Aristotle himself.[16] Even so, it cannot be glossed over that the break from the *Part. an.* procedure to *Gen. an.* 1.17–23 presents difficulties for the thesis that Aristotelian biology follows the recommendations and procedures of *Part. an.* 1.1. Gotthelf and Falcon talk of the "special problems posed by *Gen. an.* 1", while Lefebvre urges us not to "underestimate how problematic" this section is.[17] The content also contrasts with other parts of the work. *Gen. an.* 3 follows the general procedure recommended in *Part. an.* 1.1 by running through the various methods of generation in egg layers. This pattern is less streamlined than in the *Part. an.*, with asides about wind eggs, the function of milt, parthenogenesis and refuting false myths. Nevertheless, the procedure is similar enough, ending with more detailed explanations of peculiarities in the case of bees and testacea (*Gen. an.* 3.10–11). And at the outset of *Gen. an.* 4.1, Aristotle pleasingly states that he has simultaneously studied that which is common to all animals and that which is particular to each group (765b6–8). However, this is not what we find in *Gen. an.* 1.17–22. Lefebvre's solution is to suggest that *Gen. an.* 1.17–22 is simply a fur-

14 While there are also other elements, such as the attempt to provide a definition of semen (*Gen. an.*1.18, 724a14–25; Bolton 1987), these do not constitute the bulk of the discussion.

15 *The Critical Guide to Aristotle's Generation of Animals*, published in 2018, contains only a single reference to the Hippocratic works in a footnote to Leunissen's paper. Leunissen (2018) 68 n. 22. The most recent translation with commentary of the *Gen. an* does not mention any medical works (Reeve 2019).

16 Balme's 1972 Clarendon commentary discusses the dialectic in *Gen. an.* 1.17–22 but does not refer to this as medical. Balme (1972) 69. From an earlier era, Peck's 1942 edition is careful to mention the Hippocratics in the context of the "great men" who preceded Aristotle and gave him material to "extend". Peck (1942) x.

17 Gothelf and Falcon (2018) 21; Lefebvre (2018) 45.

ther analysis of a generative part, i.e. *sperma*, and thus a continuation of *Gen. an.* 1.3–16,[18] and yet of course the procedure of moving from common characteristics to peculiar ones is absent. Thus, it seems that Aristotle's dependence on medical knowledge and his engagement in a medical debate is in tension with zoological methodology.

While many feel it important to show that *De generatione animalium* Book 1, and the treatise as a whole, is a unity[19] or even a single argument,[20] the focus on this as philosophical exoneration for the work can distract the reader from its medical engagement. In contrast, acknowledging this engagement can be help us to understand the structure and content of *De generatione animalium*. Book 1, chapters 17–22 is almost entirely focused on human beings and uses references to other animals in a way that is uncharacteristic of the rest of the biological works and more in line with medical authorities. Within medical contexts, reference is made to non-human animals when required to support certain theses about human physiology.[21] For Diocles of Carytus (born 375 BC), the fact that animals without blood can reproduce indicates that seed is not of the essence of blood.[22] In the Hippocratic works, the animals mentioned tend to be domesticated, presumably due to familiarity and accessibility. Thus in *On Fleshes* (*Carn.*) 8, menstrual blood is compared to the blood of sacrificial animals and at *On the Nature of the Child* (*Nat. Puer.*) 31, the author argues that twins are caused by different pouches of the uterus drawing in separate parcels of seed by referencing what "we ourselves have seen" (αὐτοὶ ὁρέομεν) in dogs and pigs (VII.540.12 L. = 83,12 Joly). And finally, in one of the most striking ancient experiments in the history of science, the author of *Nat. Puer.* recommends taking chicken eggs laid on the same day and opening them on successive days.[23]

> And you will discover that the further development of the foetus right through to the end is just as I have revealed in my account, if anyone

18 Lefebvre (2018) 49.

19 Lefebvre (2018).

20 Gotthelf and Falcon (2018).

21 Certain works in the Hippocratic Corpus make some general points about all animals (*Vict.* 1.3, VI.472.12–14 L. = 126,5–6 Byl, *Nat. Hom.* 3, VI.36–38 = 170,8–172,12 Jouanna). But even here, the focus is on the human; as the author of *On Regimen* explains: "I shall say nothing about the other animals, confining my attention to human beings." (*Vict* 1.7, VI 480.7–8 L. = 130,18 Byl).

22 Van der Eijk (2001) 78.

23 In another example, the medical authority who authored *Hist. an.* 10 talks of an experiment with grasshoppers that is meant to prove something about women's contributions to generation (*Hist. an.* 10.6, 637b16–20). See Connell (2023) 74.

> wishes to take account of the protocol which I am now about to expound. For a person wanted to set twenty or more eggs under two or more hens to be hatched, and each day beginning from the second day until the last day on which an egg will be hatched remove one egg and break it open, he will discover on examination that everything is according to my account, as far as one can compare the growth of a bird to that of a human being. (*Nat. Puer.* 29, VII.530.3–15 L. = 77,19–78,4 Joly)[24]

Aristotle famously details the same experiment,[25] documenting this in both the *Gen. an.* and *Hist. an.* (*Gen. an.* 3.2, *Hist. an.* 6.3, 561a4–62a21) and based his account of embryological development in part on these observations (*Gen. an.* 2.6). The assumed parallels between chick and human for the Hippocratic author led him to conclude that human foetuses also run out of food, break their membranes and struggle to get out of the uterus. While it is not entirely clear whether Aristotle holds to that view, and he disagrees about which part of the egg is nutriment,[26] he uses eggs, as with the medical author, not to learn about birds but to learn about human beings and extrapolate from there to all animals. *Gen. an.* 1.17–22 contains a series of references to other animals that serve only to prove or reinforce the position on human generation. These are not further characterisations of attributes in kinds or explanations of peculiar attributes but are instead "proofs" or "signs" (σημεῖον). For example, what happens in multiparous animals is a proof for the human case (1.20, 729a4–12). And what occurs in birds and fish is the "greatest proof" (μέγιστον σημεῖον) of maternal and paternal influences (1.21, 729b33–730a25), until this point the discussion focused on evidence from men and women in a medical context.[27] The discussion of resemblances, different bodily fluids and their powers, male exhaustion after intercourse, timing of conception, the weakness of women's bodies, breast development, vaginal discharges, multiple births and sexual pleasure all indicate a strong medical background to this section of the *De generatione animalium*. Some of the data for this and other later sections of *Gen. an.* Books 4 and 5 on human generation coincide with the last part

24 Please see end of chapter for a list of translations used.

25 In the history of science, Aristotle is very often said to be the originator of this experiment, but the text of *Nat. Puer.* is older. See for example Wolpert (2004).

26 For the Hippocratic author, it is the white, while for Aristotle, it is the yolk (*Gen. an.* 3.1, 751b2–9).

27 In another case, Aristotle seeks to prove that the fluid women emit in intercourse is not seminal by the fact of its absence in oviparous animals (*Gen. an.* 1.20, 728a34–728b3). See also evidence from insects (1.18, 723b3–8, 19–32, 1.21, 729b22), wind eggs (1.21, 730a24–33), cephalopods and crustacea (1.19, 727b2–6) and even grape vines (1.18, 725b34–726a3).

of *Hist. an.* on generation, i.e., the peculiarities of humans,[28] which emphasise medical issues: the balance of bodily fluids, infertility, breast development (*Hist. an.* 7.1), menstrual regularity, vaginal secretions, uterine prolapse (7.2), conception, lochial discharge, differential development of male and female in utero (7.3), subjective feelings of conception and pregnancy, variable gestational periods, superfetation (7.4), differences in fertility with different partners, inherited deformity and resemblance (7.6), labour and afterbirth (7.9), and human lactation (7.5, 11). There is a difference (*diaphora*) between humans and the rest of animals with respect to these features (*Hist. an.* 7.4, 584b26–27).

2 De generatione animalium *1.17–23 and Medical Dialectic*

While there is evidence of women's own involvement, both theoretically and practically, in gynaecology and obstetrics,[29] by the time of Aristotle, male physicians had encroached significantly and were producing extensive written works on women's health, including two of the oldest and longest in the Hippocratic Corpus, *On the Diseases of Women* (*Mul.*) *1* and *2*.[30] Other works that either focus on or include gynaecology, obstetrics and reproductive theory in the Hippocratic corpus are: *On the Nature of Man* (*Nat. Hom.*), *On Regimen* (*Vict.*), *On the Eight-Month Child* (*Oct.*), *On Generation* (*Genit.*), *On the Nature of the Child, On the Nature of the Bones* (*Os.*), *On Fleshes* (*Carn.*), *On Nutriment* (*Alim.*), *On Barrenness* (*Steril.*), *On Girls* (*Virg.*), *On Superfetation* (*Superf.*) and *On the Nature of Women* (*Nat. Mul.*).[31] We also know of a treatise by Diocles entitled: '(On) Matters Related to Women'.[32]

While many scholars emphasise the differences between Aristotle's theories and those of medical writers, supported by the fact that Aristotle disputes various medical authorities, the similarities between the two outlooks must also be noted, not least because Aristotle gains a great deal of information about women's bodies from medical sources.[33] He takes on board accounts of menstruation, gestation periods, subjective experiences of conception and pregnancy, and other data. He accepts that women are weaker and wetter than

28 As Epstein notes: "Der Hinweis auf die eigentümliche Natur (ἡ φύσις ἡ οἰκεία, 581a11) des Menschen sticht hervor." Epstein (2019) 53.

29 Connell (2023).

30 Dean-Jones (1996) 26; Dean-Jones (2018).

31 For the most comprehensive treatment of these texts and their relation to Aristotle, see Dean-Jones 1996.

32 van der Eijk (2000) xxxiii.

33 Leunissen (2024).

men; there is also a shared view that women's health and fertility depends on the right economy of fluids. It is extremely unlikely that Aristotle gathered all of this information independently.[34] In any case, he would have had no reason to do so when it was already available from authorities he trusted.[35] Much of the overlap I will be setting out is very specific to medical theory and there is no evidence of it being 'commonplace'.[36] It is very difficult to determine whether Aristotle read any of the texts that have come down to us or other similar works or whether he conversed directly with medical experts. It is not necessary to settle these questions when the Hippocratic corpus and other medical writings provide overlap and continuity with whatever sources he had.[37]

In attempting to understand and theorise about sex difference and reproduction, it is hardly surprising that Aristotle turns to some of the most sophisticated scientific work on this subject within the medical arena of the time.[38] Since many emphasise the disagreements between Aristotle and medical theory, we will begin with the sort of medical theory that Aristotle opposes. In *On Generation*, it is stated that women need to feel pleasure in order for conception to occur.

> Now in women, I assert that as their vagina is rubbed and their uterus moved during intercourse, a kind of tickling sensation befalls these parts and gives rise to pleasure and warmth in the rest of their body. And women, too, ejaculate from their body, sometimes into their uterus—the uterus then becomes moist—and sometimes externally, if the uterus gapes open more than it should. (*Genit.* 4,VII.474.14–18 L. = 46,21–47,1 Joly)

34 Dean-Jones speculates that he questioned his female relatives and slaves. Dean-Jones (1996) 36.

35 See Bartoš (2021a) 50–51 on Aristotle's approving statements about the quality of medical knowledge.

36 It was Fredrich (1899, 9 n. 4) in his cursory dismissal of Poschenrieder (1987) who first proposed the idea that any overlaps between the Hippocratic works and Aristotle were due to their both accepting commonplace views rather than any direct influence (Bartoš 2021a, 48).

37 See similar rationale at Connell (2016) 96–97.

38 Even the fact that the seed is the nutriment in its final form, which Aristotle contrasts with various unknown opponents, is not new but appears in the Hippocratic works (e.g. *Alim.* 36 (IX.110.15 L. = 82,24 Heiberg); see Louguet, forthcoming. On the medical background to Aristotle's nutrition theory, see Bartoš 2021b.

For this author, sexual intercourse produces seed in women's bodies, which they contribute at sexual climax. If this does not happen, then conception is not possible.[39]

Aristotle posits that the female animal's contribution to generation, her seed, is in fact menstrual blood (*Gen. an.* 1.19, 727a26–30). He offers the following proof that the female does not contribute anything generative at sexual climax.

> Here is a sign that the female does not discharge the same sort of seed as the male, and that it [i.e. the generated thing] is not generated by a mixture of both, as some say: many times the female conceives when pleasure did not happen for her in sex. And it happens just as much on the contrary side: the male and female keep pace but do not generate unless a sufficient and proportionate blend of so-called menses is present. (*Gen. an.* 1.19, 727b6–11)[40]

While Aristotle disagrees that female orgasm is necessary for generation and argues that women do not release seed at climax, his own theory of the female contribution to generation draws heavily on medical sources.[41] *On Nature of the Child* explains how the contribution of menses is crucial to embryonic growth.

> The seed [i.e. initial conceptus] is increased by the mother's blood passing down to her uterus; for when a woman is pregnant, her menses no longer flow. (*Nat. Puer.* 14, VII.492.8–10 L. = 56,13–15 Joly)

As the author explains, the offspring forms its bodily parts from the menstrual blood, beginning with flesh (*Nat. Puer.* 13–14, VII.492–494 L. = 56,13–58,23 Joly).

Aristotle accepts further ideas concerning female bodies from medical authorities. For example, he notes the following tests for fertility:

> Women are tested by pessaries, whether the smells penetrate upward from below to the breath exhaled, and by rubbing colours into the eyes, whether these colour the saliva in the mouth. For if these do not hap-

39 Diocles may also have thought of female seed in this manner, although the fragments are inconclusive (van der Eijk 2001, 86).

40 My translation of *Gen. an.*

41 Dean-Jones (1996) 60. "Aristotle's theory of menstruation includes elements present in both *Mul.*'s theory that women could not convert nourishment as men could and *Genit.*'s

> pen, that makes it clear that the passages of the body through which the residues are excreted have become indistinct and have grown together. (*Gen. an.* 2.7, 747a8–14).

These have direct parallels in the Hippocratic writings:

> Test: wrap a little oil of bitter almonds in a piece of wool, insert it [into the vagina], and see whether the patient emits the smell through her mouth. (*Mul.* 1.78, VIII.178.15–15 L. = XI.186.25–26 Loeb)[42]

> If you wish to test whether a woman is capable of having a child, anoint her eyes with red stone: if the agent penetrates [to the mouth], she is; if not, not. (*Nat. Mul.* 99, VII.416.1–3 = 83,15–17 Bourbon)

Dean-Jones questions the authenticity of the Aristotle passage on the grounds that these tests presuppose theories of generation, which he rejects.[43] However, the tests occur in works that do not specify what theory lies behind their supposed effectiveness and seem to be about the general openness of passages for the free flow of bodily fluids. Some medical works on women's health are preoccupied with menstruation—and bringing it about regularly. If the passages of the women's body are not open enough, this bloody residue gets trapped and causes them difficulties that can lead to infertility (*Mul.* 2.170, VIII.350.11–20 L. = XI.388.14–25 Loeb).

> If a woman's menses cease to flow at all ⟨...⟩ then too she will fail to conceive, since her vessels, being filled with blood, cannot take up the seed, and also old blood must of necessity be present in her uterus which will prevent the seed from being nourished. (*Steril.* 1.21, VIII.412.11–15 L. = 73,3–8 Bourbon)

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theory that parallel physical developments in male and female produced semen in the former and menses in the later."

42 There is a parallel passage at *Steril.* 2 (VIII.414.20–21 L. = 74,21–22 Bourbon). Similar tests are mentioned reasonably frequently in the Hippocratic corpus. In some cases, it is recommended that the woman sit over something strong smelling, like garlic, and if the smell can be detected on her breath, she is fertile or pregnant (*Mul.* 2.157, VIII.322.8–14 L. = XI.358.17–21 Loeb; *Nat. Mul.* 96, VII.412.19–414.3 L. = 81,15–82,4 Bourbon, *Aph.* 5.59, IV.554.3–6 L. = IV.174.1–4 Loeb), See Dean-Jones (1996) 73 n. 104; Totelin (2009) 103, 181. This test also seems to have been endorsed by Diocles (Fr.172, van der Eijk 2000, 276.9–13).

43 Dean-Jones (2017) 476–477. She is particularly concerned with the implied seed-brain connection in the second test.

According to these Hippocratic authors, sexual intercourse, birth and lochial discharge open up the vessels of the body, leading to a healthier female system.

> I assert that a woman who has not borne children becomes ill from her menses more seriously and sooner than one who has borne children. For when a woman has given birth, her small vessels allow a freer flow for her menses, since the lochial cleaning makes them fluent. (*Mul.* 1.1, VIII.10.2–4 L.= IX.8.1–5 Loeb)

These tests accord with the need for a woman's body to have the right amount of menstrual fluid in the right condition available for generation, a view which aligns perfectly with the Aristotelian hypothesis about female seed.

The first test with the pessaries also indicates the general health of the reproductive system. Aristotle explains how it works: "the spermatic excretions are from the diaphragm, for the principle of the animal's nature is there, so that changes in the generative organs penetrate to the chest, and the smells from the chest are made perceptible through the breath" (*Gen. an.* 2.8, 747a19–22). The area around the diaphragm indicates fertility, i.e. the area around the heart, this being the origin or principle of the living being (*Gen. an.* 2.4, 738b5–20) where both male and female seed originates (4.8, 776b26–27). Damage in this area means incomplete or faulty development of the generative organs (see note on eunuchs at 2.7, 746b21–25).[44] Thus, the ease with which smells manifest in the breath indicates the general health of the heart and reproductive organs.

The second test, which concentrates on the transfer of pigments from eyes to mouth, also indicates the general fluidity of the body.[45] For Aristotle, the head is fluid and cold, particularly the brain, to which the eyes are connected by passages (*Hist. an.* 1.16, 495a11–19).[46] Those naturally prone to intercourse

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44 One reason for infertility is congenital damage (*Gen. an.* 2.7, 746b22–24), paralleled to *Aph.* and *Aer.* by Byl (1980) 18.

45 The connection between the eyes and semen/fertility is old, very well attested and was most famously held by Plato. Oser-Grote connects Aristotle's statement here to the doctrine of Syennesis, although she notes that Aristotle does not mention crossed veins that connect eyes to genitals (Oser-Grote 2004, 115). The connection to Syennesis, who Aristotle names in *Hist. an.* 3.3, is through the Hippocratic *On Bones* (*Os.*). The connection between the eyes and fertility is also found in a fragment of Diocles (fr. 182.11, van der Eijk 2000, 310–311).

46 In embryological development, the eyes are large at first but the last to be completed due to their being cold and fluid like the brain (*Gen. an.* 2.6, 743b33–744a14). Poschenrieder

go bald because the head is the coldest and most fluid part of the body and so experiences the effects of the cooling and drying caused by frequent spermatic excretion (*Gen. an.* 5.3, 783b26–784a4).[47] When a body is in a dried-out state, the eyes will be a good indication of this condition, since they are the most fluid part of the head (747a16). Whatever fluid is left over in the eyes is not flowing and abundant enough to make its way to the mouth in the pigment test. That body, then, lacks the relevant fluidity to be productive of the extra nutriment required for a viable spermatic contribution.

In accepting these tests for fertility, Aristotle draws out some of the implications in the medical writings on women's health concerning the openness and fluidity of their bodies. He also indicates adherence to the related idea that sexual desire depends on the openness of vessels.[48] The following passage from *Mul.* 1 explains why it is that women who become accustomed to sex desire it more.

> If she does not conceive at once, but everything seems to be as it should, there is nothing to prevent her from having intercourse with her husband on the other days, for habitual practice will increase her desire, her small vessels will open up, and if what comes from her husband flows together in line with what comes from her, she will become pregnant more quickly. (*Mul.* 1.17, VIII.56.18–22 L = XI.58.24–60.4 Loeb)

While not agreeing with the parallel seed view apparent in the passage, Aristotle accepts that there are such physiological and psychological effects of regular sexual activity.

> For the females who are sexually active while quite young become more intemperate, and so do the males if they are unguarded either in one direction or in both. For the channels become dilated and make an easy passage for fluids in this part of the body; and at the same time their old memory of the accompanying pleasure creates desire for the intercourse that then took place. (*Hist. an.* 7.1, 581b16–22)

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finds parallels between this view of Aristotle's and the Hippocratic *On Bones* (Poschenrieder 1887, 11–12).

47 The *Problemata* 4.2, 876a36–b22 raises the question of why the buttocks and eyes of those who have frequent sexual intercourse have fallen in and speculates that it is due to both being robbed of moisture.

48 The ways for the passage of both seed and menses in girls are opened at the same time according to *Nat. Puer.* 20 (VII.508.6–7 L. = 65,11–17 Joly).

The openness of passages leads to greater sexual desire. This works for both men and women, but given that Aristotle thinks that women do not have a parallel seed, why would he subscribe to this medically inspired view? This seems due to his observation that women emit a non-seminal fluid in sex.

> Certain people think that the female contributes semen in intercourse because some women have pleasure equivalent to that of men and emit fluid at the same time. However, this fluid is not spermatic but is peculiar to the place of each [woman]. (*Gen. an.* 1.20, 727b34–728a1)

Aristotle notes that this also occurs in certain non-human animals:

> About pairing-time mares huddle together more than they have done previously … A fluid also flows out of their sexual organs, similar to semen, but much thinner than the male's. (*Hist. an.* 6.18, 572a22–27)

Presumably, he indicates here natural vaginal lubricant, secreted by two sets of glands near the urethra;[49] in his view, the body's openness makes this flow more freely.

The idea that once fluids flow freely, they also increase is a general medical principle. The author of *Nat. Puer.* parallels the process of milk production to that of semen production:

> … as the breasts are sucked, the small vessels to them become more fluent …. For also if a man has frequent sexual intercourse, as his small vessels become more fluent they induce more intercourse. (*Nat. Puer.* 21, VII.514.1–5 L. = 68,14–18 Joly)

But Aristotle doesn't only agree that the sexual fluids in women are the cause of desire but also that their seed is too. He posits that women experience excessive sexual desire when menstrual residues are "collected together" and that this can be "cured" through these being used up in pregnancy.

> For menses are unconcocted seed, as was said earlier. For this reason, those women who are weak-willed when it comes to this sort of sexual intercourse, when they have borne several children, stop being sexually excited. For the spermatic residue having been expelled, it no longer produces the desire for that sort of sex. (*Gen. an.* 4.5, 774a2–6)

49 These are the Bartholin's and Skene's glands.

There are clearly various theories in play[50]—the one that is used to control female sexuality, so important in the patriarchal human context, sees the body as open and full of the fluids that drive sexual desire.[51] On the other hand, for those theorists who prefer very early marriage, and the social advantages of this practice, the idea of a build-up of menses is more useful—girls are driven mad by not being pregnant from the very start of menarche (*Virg.*, VIII.466–468 L. = 181–191 Bourbon).

3 Women in the Zoological Sphere as Unusual

Historia animalium Book 7 is almost entirely occupied with data about the peculiarities of human generation. Some of the key ways in which women differ from other animals documented in *Hist. an.* 7 and the *Gen. an.* are the following: regular external menstruation, year-round mating, variable gestational periods, superfetation, presence of mola uteri, differential development of male and female foetuses, illness in pregnancy and difficulty in giving birth. According to the zoological methodology we are expecting, peculiarities cannot be explained in terms of a broader kind, but will refer to the material constitution and the way of life of the particular kind. These explanations ought also to reference functions. An example is the case of the toes of the wryneck:

> In other birds, then, the position of the toes is thus [three fore, one aft] but the wryneck has only two in the front and two behind; a cause of this is that its body is less inclined in the forward direction than the body of other birds (*Part. an.* 4.12, 695a22–25).[52]

Explanations of this kind of the peculiarities of women's biology are not much in evidence in the *Gen. an.*, although it is sometimes possible to construct them. They require "delving further into [wo]man's nature".[53] Meanwhile, the influence of medical methodology remains strong.

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50 In this section of the *Gen. an.*, Aristotle also gives another reason for sexual desire in females—the descent of the uterus (*Gen. an.* 4.5, 773b10–774a14).

51 "Furthermore, it contributes to temperance to give women in marriage when they are older, for they are thought to be more licentious if they engaged in intercourse when they were young girls" (*Pol.* 7.16, 1335a21–24).

52 Illustration and translation from Lennox (1987) 113.

53 Lennox (1987) 112.

3.1 *Variable Gestation*

Aristotle says that only humans have variable gestational periods.

> Other animals have a single [gestational] period, but with humans there are several: children are born at seven months and ten months and at intermediate times, and indeed eight months' babies live, though less often than the others. (*Gen. an.* 4.4, 772b8–11)[54]

> Now the other animals bring birth to completion in a single way, for there is one time fixed for the birth in all cases; but for man alone among animals there are many times: there are seven-month, eight-month, nine-month births, and the majority at ten months; some women even reach the eleventh month. (*Hist. an.* 7.4, 584a36–584b1)

While these statements occur where they are supposed to, amongst unusual features, the information here is taken from ideas that we find in a number of medical works.[55]

The Hippocratic *On the Eight Month's Child* notes approvingly the views of women on the subject.

> Although there may be some who wish to assert something different, in fact women who possess judgement and who furnish the most convincing arguments on this subject always say explicitly that they give birth in the seventh month, the eighth month, the ninth month, the tenth month, and the eleventh month, and that of these children, those born in the eighth month do not survive, whereas the others do. (*Oct.* 4, VII.442.1–4 L. = 167,6–11 Joly)[56]

Aristotle accepts the medical view that human gestation is of variable length and that the eighth month is the most dangerous time.[57] Adhering to this requires explanation, since, in his zoology, there are fixed gestational periods

54 See also *Gen. an.* 4.8, 776a23–24.

55 E.g., *Alim.* 57; *Oct.*, *Carn.* Diocles fr. 45a–b (van der Eijk 2000, 92–96; and discussion in van der Eijk 2001, 103).

56 Loeb IX.78, l.21–80, l.6.

57 Along with Diocles, Aristotle does not think that death is inevitable in such cases (Diocles fr. 48b–c in van der Eijk 2000, 98–99) Aristotle fragment 258 found in Oribasius (Raeder 1933: VI 2,2).

(*Gen. an.* 4.8, 776a20–21).[58] Although Aristotle says "the reason may be discerned from what has been said" (*Gen. an.* 4.4, 772b11–12), the previous discussion mentions only that human beings can produce one or many offspring at one time (772b2–5). Before investigating further how this connects to Aristotle's ideas of the peculiarities of human females, we need to consider the medical explanations and their influence. For these writers, certain numbers are all-important when keeping track of health-related time periods that mark significant changes. For example, at the age of seven months, a baby gets teeth (*Oct.* 9, VII.448.10–11 L. = 171,15–16 Joly),[59] and at the age of seven years, old teeth fall out and new ones come in (*Carn.* 13, VIII.598–602 L. = 195,15–24 Joly).

The measurement of 'seasons' of life by periods of seven years traditionally had a socio-political rather than a medical use: men are suited to different activities at different ages. The first part of a fragment from Solon gives us a sense of this:

> A child, while still immature, grows a fence of teeth and loses them for the first time in seven years. When the god completes another seven years, he shows the signs of coming puberty. In the third his body is still growing, his chin becomes downy, and the skin changes it hue. In the fourth, everyone is far the best in strength, whereby men show their signs of physical excellence. In the fifth it is the time for a man to be mindful of marriage … (West frag. 27)[60]

This idea that development for humans is marked by periods of seven years is included in Aristotle's educational recommendations.

> There are two ages corresponding to which education should be divided—there must be a break after the period from seven to puberty, and again after that from puberty to twenty-one. For those who divide the ages by periods of seven years are generally speaking not wrong and it is proper to follow the division of nature. (*Pol.* 7.11, 1336b37–1337a2)

Aristotle called this "the division of nature", indicating the possibility of a more systematic explanation for such occurrences. This is what medical writ-

58 And documented in *Hist. an.* 5 and 6. See also *Nat. Puer.* 29 (VII 530–532 L. = 77,14–78,9 Joly).

59 Loeb IX, 88, l.15–16.

60 Translation from Kamen (2007).

ings construct, taking sevens not only annually, but also in terms of cycles of moon and sun, i.e., by weeks and days.[61] These rhythms of time enter their understanding of the workings of the natural world, and prominently include the cycles apparent in women's lives that women themselves are most often responsible for documenting—menstruation, pregnancy and the development of the foetus. Later testimony suggests that Diocles also adhered to the view that development proceeded in seven-day intervals. The foetus was "completely articulated" after five of these (fr. 45a).[62]

Certain medical authors also believe that things happen by forties. Human pregnancy, being two hundred and eighty days in duration at its maximum, significantly contains seven forty-day periods. Aristotle notes the importance of forty and especially the idea that foetuses change every forty days (*Hist. an.* 7.3, 583b10–13). And in this he follows medical science, which notes that in the first period, the foetus is articulated (*Oct.* 9, VII.446.19–448.2 L. = 170,11–174,3 Joly); Cf. *Carn.* 19, VIII.608.22–610.4 L. = 200,25–203,7 Joly). This explains why foetuses born at eight months' gestation generally die. In the transition from the sixth to the seventh of these periods, the foetus is at a precarious stage before it can get used to the new situation of its growth. If that big change is combined with the change of birth, then foetuses tend to die.

> About the eight months' birth I contend that two distresses following immediately one upon the other are impossible for children to withstand, and that for this reason eight month's children do not survive. (*Oct.* 10, VII.452.4–8 L. = 174,4–6 Joly)[63]

Seven months' children are less at risk because they are born in "182 and a fraction days", which is not a multiple of forty (*Oct.* 1, VII.436.1–4 L. = 164,1–9 Joly). This means that no significant change in their development has recently occurred to render them vulnerable.

Variable gestational periods and the health of foetuses at each stage might seem a good candidate for the shared 'commonplace' hypothesis. After all, there is archaic precedent, as noted, of measuring natural processes in terms of sevens and tens.[64] But, in the hands of medical writers, there is partial rational-

61 For the idea of ages of life, see especially *Hum.* 16, *Vict.* 1.2, 32–33, *Aph.* 3.24–31. *Hebd.* 5.

62 Van der Eijk (2000) 92–93.

63 Loeb x, 92 l.25–94 l.2.

64 Rosher (1907); Dean-Jones (1996) 209. See Hippocratic *Sevens* (*Hebd.*) West (1971) for the text.

isation of older numerological beliefs rather than mindless adherence.[65] More in the realm of numerology than rational medicine, *On Sevens*, is emphatic about the significance of seven not only in counting time but in parts of the body and soul.[66] The causes and patterns occur both in humans and the cosmos at large. The fragment of Solon states that causation is divine, a feature echoed in Pythagorean texts from Philolaus (B 20) to Pseudo-Iamblichus.[67] It is difficult to discern if the number seven itself was thought of as a principle of nature, like a cause, or if it was supposed that a divine intelligence used this measure to order the world. Instead, it might be that the world is ordered in terms of sevens and recognising this helps us to better understand the inner workings of the body. Medical scientists were attempting to rationalise this information to aid health outcomes, as in the case of the theory of 'critical days'.[68]

While Aristotle does not think that numbers can be causes (*Metaph.*), he was happy to accept that bodies are affected by time periods. For one thing, he recommends consulting medical experts in *Politics* (7.16, 1335a40) when considering procreation. The insights about life stages are thus connected to theories of embryological development that would potentially aid the formation of policies around conception, pregnancy and abortion. Aristotle's own explanation of the fact that living beings are affected by time periods involves the movement of the heavenly bodies:

> The times of gestation and formation and of lifespan aim, according to nature, at being measured by 'periods'. By a 'period' I mean day and night and month and year and the times which are measured by these … the limits of these processes, both as regards their beginning and their end, are controlled by the movements of these heavenly bodies. (*Gen. an.* 4.10, 777b17–31)

It is not just that the heavenly bodies mark the passage of time, they also change the environments in which living things attempt to survive and reproduce, the most obvious being the heat and coolness of different seasons. The passage fails to explain why development might proceed by forty-day periods that do not accord with any astronomical change. The commitment to forty-day peri-

65 At our most charitable we might see this as a precursor to recent advances in the fascinating field of chronobiology (Dunlap et. al. 2003).

66 West (1971). It was thought that there were seven planets. See e.g. Plato *Ti.* 36d.

67 Van der Eijk (2001) 99.

68 *Progn.* 20, *Epid.* 1.26, *Carn.* 19, *Hebd.* 26, *Oct.* 9, Rosher (1907).

ods suggests that on this point, Aristotle was willing to forgo general principles in order to follow medical authorities in these matters.

However, his concentration on seven-day periods can be connected to the cycle of the sphere of the heavens on which the moon resides.[69] In terms of the connection between human menstruation and the cycle of the moon, Aristotle sides with those medical authorities who think that "the month has a peculiar power over the [female] body (ἔχοντος τοῦ μηνὸς ἰδίην δύναμιν ἐν τοῖσι σώμασιν)" (*Oct.* 9, VII.448.5–7 L. = 171,11 Joly). That Aristotle is concerned with the medical model is apparent in that he treats these periods of time as particularly pertinent for humankind rather than in zoology more generally.[70] Sevens and forties play a lesser role in his account of the time periods in which other animals develop, age and die. Going back to our chicken egg, its development goes by threes (*Hist. an.* 6.3, 561a4–8) and tens (561a24, b27) and will vary in different sizes of birds (561a4–8) and in different seasons (*hôra*) (*Gen. an.* 3.2, 753a18–21). Indeed, talk of how many days between stages of development is completely abandoned in Aristotle's account of the causes of embryological development in the *De generatione animalium*, presumably because the account will have to apply to all live-bearing animals, whose gestational periods vary widely (as documented in *Hist. an.* 5).

Aristotle was attracted to the idea that humans are more attuned to cosmic cycles and harmonies than other animals, which is also found in medical texts (*Carn., Hebd.*).[71] The idea seems similar to the thought that humans' upright orientation is in line with the dimensions of the cosmos while other animals' orientation is not (*Hist. an.* 1.15, 494a26–b1, *Prog. an.* 5, 706b8–10,

69 The phases of the moon take 29 ½ days, but this can be roughly rounded down to 4×7 = 28. After explaining the effect of wind on the generative fluids of men and women, Aristotle remarks: "In addition the menses occur naturally more as the moon wanes for the same reason. For this time of the month is colder and more fluid because of the diminishing and decay of the moon. For on the one hand the sun makes summer and winter in a whole year; on the other hand, the moon [makes this] in a month" (*Gen. an.* 4.2, 767a1–7).

70 *Hist. an.* 7 on the generative peculiarities of humans heavily emphasises sevens and forties (e.g. 7.1, 581a14, 582a16–18, 28–30; 7.3, 583a31, 583b4, 13; 7.5, 585b3). As the author of *Fleshes* puts it: "The period of life of a human is seven days" (*Carn.* 19, VIII.608.22 L. = 200,25 Joly). One exception is that milk appears in dogs seven days before their birth (*Hist. an.* 6.20, 574b6). Dogs are, however, domesticated animals most often living with humans; this affects their life cycles, bringing them closer to human patterns of growth according to Aristotle (see Section V ii.).

71 In his analysis of a puzzling passage in *De Caelo* 2.12, Christof Rapp argues the complex movements/changes inherent in being human makes us more akin to the planets than the other heavenly spheres (Rapp 2020).

Part. an. 2.10, 656a7–13, 4.10, 686a27–b2).[72] While that has Platonic origins, the time periods of embryological development, gestation, lactation, menstruation, etc. have a longer history in the theories of physicians and medical naturalists.

3.2 *Explaining Women's Peculiarities*

Aristotle's discussion of multiparous births in humans fits with his zoological methodology, appearing at the end of a section in which he gives an account of multiparity in animals.

> These [i.e. human twins] seem rather to be monsters, because their formation is contrary to the for-the-most-part and what is usual. (*Gen. an.* 4.4, 772a36–37)[73]

The related phenomenon of superfetation[74] occurs when a woman conceives a second child while already pregnant with a first. Although the topic is introduced in terms of all animals—some superfetate and others do not (*Gen. an.* 4.5, 773a33–34)[75]—it ends with only two species: humans and horses.

> Likewise because the human being is naturally a producer of more than one offspring, and there is something left over with respect to the size of the uterus and [the amount] of the residue (however not enough so as to nourish the later one), amongst the animals only women and mares allow intercourse while pregnant. (*Gen. an.* 4.5, 773b22–25)

It may seem odd that humankind is said here to be naturally prone to multiparity when twins were deemed a monstrosity in the earlier passage. This must be because humankind "dualises" or "plays a double game" (ἐπαμφοτερίζει) between monoparity and multiparity (*Gen. an.* 4.4, 772b1).

> The human kind plays a double game in all the groups. For it is productive of one offspring and of few and of many, but most of all it is naturally productive of one. On the one hand, producing many offspring is due to

72 For the latest work on this topic, see Corcilius (2021); Rapp, Forthcoming.

73 In this passage, Aristotle disagrees with *Vict.* 1.30 (VI 504–506 L. = 146,17–28 Byl) that twinning is natural. See Connell (2016) 357–358.

74 A topic that interests medical theorists (*Superf.* 1, VIII.476 L. = 276,1–277,2 Bourbon).

75 This seems to be said rather loosely in the sense that *in a way* all multiparous animals superfetate (*Gen. an.* 4.5, 773b6–7).

> the fluidity and heat of the body (for the nature of seed is fluid and hot), on the other hand, because of its size, it is productive of few and productive of one. Because of this also [the human being] is the only one of the animals where it happens that the times of gestation are irregular. (4.4, 772a37–772b7)

While Aristotle did not provide any clear explanation of the variability of gestational periods earlier on, here he hints that it too has to do with the heat and fluidity of the human constitution.

Human beings are hotter and more fluid than other animals, the material basis for superior vital capacities, including cognition (*Gen. an.* 2.1, 732b31–32). Humans have the purest heat and best blend in their hearts (*Gen. an.* 2.4, 744a26–29). Since this is the case, they produce the most generative residue (for their size) of any animal. Thus, women produce the most menstrual discharge.

> There is more evacuation in women than in any other animal … the reason is the constitution of the body being fluid and warm, for in such a body there comes to be the most residue. (*Gen. an.* 1.20, 728b14–18.)[76]

Twinning, superfetation and mola uteri are all explained by reference to abundant menstruation.[77] Women superfetate because they are also a type of multiparous animal (falling into more than one grouping) and "the production of many offspring is due to the fluidity of the body and to heat" (*Gen. an* 4.4, 772b4–5). These material features also explain how women can complete the nourishment in the second embryo (*Gen. an.* 4.5, 773b7–9).

The mola is directly connected by Aristotle to excessive menstruation and represents the most pathological of the conditions so far detailed:

> It has happened already in some woman, having had intercourse with a man and thinking to have conceived, at first that her bulk increased with respect to the belly and everything proceeded as was correct, but when it

76 See also *Gen. an.* 1.19, 727a22–23, 1.20, 728b14–15, 2.4, 738b4–5, 4.6, 775b6, 4.8.776b26–27. Cf. *Hist. an.* 3.19, 521a26–27, 6.18, 572b29–31; 7.1, 582b28–30.

77 Peck thinks that mola are explained by women being "colder than any other animal" (Peck 1942, 459 n.b). This cannot be right. Women are only colder than male human beings and are warmer than all other animals, since human beings (*anthropoi*) are the hottest and most fluid of all animals. Aristotle is perhaps using "heat" and "cold" too ubiquitously; heat explains both human and male superiority, which means that women are awkwardly both hotter (than all other animals) and colder (than all men).

> was the right time to deliver, she neither gave birth nor did the bulk lessen, but instead three or four years passed until she suffered from dysentery and being in a dangerous way, gave birth to a [bit of] flesh which was a so-called 'mole' (μύλην). (*Gen. an.* 4.7, 775b27–33)

This is the only one of the phenomena peculiar to female humans that Aristotle presents as a puzzle. "This is a puzzle: why this does not happen in the other animals" (*Gen. an.* 4.7, 776a8–9). The reason he gives that "only women amongst the animals suffer in the womb [literally: are hysterical]; and they have a greater share by way of menses and are not able to concoct this" (*Gen an.* 4.7, 776a9–12).

3.3 *Differential Growth in Embryos and the Defects of Women*

Aristotle accepted the medical theory that male and female embryos in humans develop at different rates.

> Any female that is aborted within the three months appears unarticulated as a rule; any that has reached the fourth month has become divided and achieves the rest of the articulation in quick stages. For a time, then, the female is slower than the male to attain the complete formation of its parts and tends more than the males to be born at ten months. (*Hist. an.* 7.3, 583b21–24)

It is possible that Aristotle considers the supposed evidence from miscarriages and abortion to be authoritative. Here is the author of *Nature of the Child* again:

> Many women have aborted a male foetus a little before 30 days, and it showed no articulation, whereas foetuses aborted after, or just at, 30 days showed articulation. And similarly in the case of the female foetus: when the abortion takes place at 42 days the limbs show articulation …. The reason is that the female congeals and becomes articulated later, since female seed [i.e. seed that makes a female embryo] is weaker and moister than male. This is the reason why a female must necessarily congeal later than a male. (*Nat. Puer.* 7, VII.504–506 L. = 63,17–64,4 Joly)

Aristotle seems to cite almost identical 'evidence' noting that a male embryo aborted at forty days has been seen to have "all its parts, especially the genitalia, and the eyes very big just as in the other animals". But a female that is aborted at three months is "unarticulated" (*Hist. an.* 7.3, 583b18–21). Very similar views are available in the Hippocratic corpus (e.g. *Nat. Puer.* 18, 21, VII.500–

506, 510–512 L. = 60,19–64,7; 67,1–68,18 Joly).[78] This supposed fact does not tend to enter into his description of other animals. In detailing the development of the embryo in chicken eggs, for example, there is no indication that this shows that male embryos develop more quickly than female ones (*Hist. an.* 6.3, 561a4–562a21). Indeed, that would invalidate the results of the experiment, since there is no way of ensuring that all the eggs were one sex or the other.

In *De generatione animalium*, where Aristotle decides the differential growth of male and female embryos only occurs in human beings, his first attempt to explain why touches on a seeming connection between gestational periods and longevity.

> The period of gestation is of a definite length for each of the animals, and normally the periods are proportionate to the animals' span of life; after all, we should expect those which have a longer life-span to take longer over their formation than others. (*Gen. an.* 4.10, 777a33–35)

Clearly Aristotle will have to dispense with this idea in order to make sense of male and female differences because human females are, he thinks, shorter lived and so this is a counterexample to any general connection between longer inter-uterine development and slow decline to old age.[79] It turns out that this connection is not a scientific principle.

> This is not the cause of it, but it is what happens for-the-most-part. For the larger and more perfect of the blooded animals also live a longer time, though not all large ones are longer lived. For of all animals, human lives the longest, except for the elephant, so far as we have reliable experience. But the group human is smaller-bodied than the group pack-animals and many other groups. The cause of any animal being long-lived is the mixture being nearly the same as the surrounding air, and due to some other natural features, about which we will speak later. The size of those generated determines the time of the gestation. For it is not easy in a short time for large structures to reach their completion, whether an animal or almost any other thing. (*Gen. an.* 4.8, 776a34–777b12)

78 Loeb. X, 50.14–28. Also *Epid.* 2.6.17 (V.136.8–9 L.), *Mul.* 1.71 (VIII.148–150 L. = Loeb X 156.12–14), *Steril.* 21 (VIII.446.17–19 L. = 96,3–5 Bourbon). For a similar view, see Diocles fr. 47, van der Eijk (2000) 97.

79 A problem also noted by Dean-Jones (1996), 210 n. 224.

Larger animals tend to be more "perfected", which is what causes them to live longer, in that their blend is more stable. And it is their size which causes their longer gestation.

In the case of the differential growth of male and female embryos, though, size cannot help to explain the phenomenon either. Female human beings take longer to form in uteri but are not larger than male human beings. Thus, Aristotle requires an added, and quite sexist, explanation. Prefacing this account with the idea that this only happens in human beings (*Gen. an.* 4.6, 775a11–14)[80] and in no other animal, he proceeds:

> While still within the uterus, the female is differentiated for a longer time than the male, after birth takes place, everything reaches completion sooner, such as puberty, prime of life and old age, in females than in males. For females are weaker and colder and we must take it that female nature is as if a deformity. While inside, then, it is differentiated slowly due to coldness (for differentiation is by concoction (πέψις), since heat concocts, and the hotter thing concocts well). When outside due to weakness it reaches quickly toward the prime and old age. Everything inferior reaches its end (τὸ τέλος) more quickly. (*Gen. an.* 4.6, 775a11–21)

Aristotle has committed himself to the added idea that women age more quickly than men, which is again found in medical writings (*Oct.* 9, VIII.450.6–8 L. = 172,16–24 Joly).[81] The reasoning here is shaky and seems an extended attempt to find some natural cause for a series of presumptions asserted in medical literature.

Aristotle's reasoning depends on a double meaning of *telos*—as perfection or completion and as death or destruction. The idea is that strength, that is, being warm, brings about completion in the uterus. But the same factor, warmth, makes the resultant animal able to resist the deteriorating effects of the external environment, which ultimately leads to its "end" in the sense of death. Weak products deteriorate more quickly. The idea that a blend or bal-

80 Scholars disagree about the text; however, both Peck and Lulofs agree that there is an indication of human uniqueness.

81 "In males everything becomes quite distinguishable, while in females at this stage their tissues seem only to have outgrowths (ἀποφύσιας μοῦνον) … and differentiate more slowly … Inversely, after they have left their mother, daughters mature more quickly than boys, become sensible (φρονέουσι) more quickly, and age more quickly" (trans. Potter). See Dean-Jones (1996) 103.

ance must be maintained for health and vigour is a common medical trope. And the thought that old age is a state of being dry, accepted by Aristotle (*Long*. 5, 466a17–23), applies to older women in various ancient gynaecological works (*Nat. Mul.* 1, VII.312.6–7 L. = 1,8–9 Bourbon; *Mul.* 2.111, VIII.238.2–240.1 L.).[82] Also, in his general work on longevity, Aristotle explains that the expelling of excess residues ages an animal.

> That which is to resist destruction must not be productive of waste matter … Hence animals that are salacious and have much seed age quickly; for the seed is a waste product, and also by its emission causes dryness ….female are longer lived than males, if the males are salacious; so also the male sparrow lives a shorter time than the female. Further this is true of all males that work hard, and grow old more rapidly because of their toil; for toil produces dryness, and old age is dry. But by nature, as a general rule, the male lives longer than the female; the reason being that the male is a warmer animal. (*Long*. 5, 466b5–16)[83]

Aristotle notes that males who emit a large amount of semen age more quickly. Since women's menstrual blood is their seed and a residue they emit each month, one must also view this to be very aging for them based on the same reasoning. Female human beings, according to Aristotle, are more ill, weaker and age more quickly than other female animals due to this excessive loss of seed.

Aristotle needs to keep separate a general zoological theory of reproduction and sex difference, based on human females, but applicable to all animals, from the peculiarities of women, which do not occur in any other animal. When it comes to setting out what he takes to be the weaknesses of the female sex, these boundaries become blurred. In many places in the zoology, he assumes that females are weaker or smaller or less spirited than males, based on the model of women.[84] The difficulty is that this is quite unsustainable both because

82 Loeb XI 268.12–13; Dean-Jones (1996) 105.

83 Translation Hett.

84 In the footed, blooded, viviparous kinds, for the most part males are larger and longer-lived than females (*Hist. an.* 4.11, 538a22–25). However, for all other animals, it is the other way around. Many female animals are larger than their male counterparts (*Part. an.* 4.8, 684a21–22, *Gen. an.* 1.16, 721a18–20, *Hist. an.* 4.11, 538a25–30) and, e.g., female fish are longer lived than males (538a30–b2). If females are always colder than males, it is hard to understand how they could sometimes be larger, since heat "promotes" growth (*Part. an.* 2.7, 653a31–32, *Part. an.* 3.6, 669b3).

of observations of capable female non-human animals and because these assessments apply to human women due to their peculiar attributes, especially external monthly bleeding. In general, the themes of female weakness, slowness and incapacity are strongest when Aristotle is detailing gestation and birth in human beings. In other animals, this is much less apparent and his theories make more sense when not trying to apply these conclusions too broadly. One can see a huge influence, then, from certain aspects of medical theory on his view of female animals.[85]

4 Aristotle's Agreements and Disagreements with Medical Authorities

4.1 *Pregnancy and Health*

On the medical model, women are thought to require monthly purging of blood in order to remain healthy. The common Hippocratic recommendations for men include exercise along with changes in eating habits, purging and other ways to "balance" the battling fluids in the body. Given the seclusion of elite women, some speculate that it was not possible to prescribe exercise to them.[86] Whether this is actually the case is disputed, but it is clear from the texts we have that the treatment of women concentrated on diet, drugs and procedures to bring about menstruation or pregnancy, the rationale being these would rid the female body of excess bloody residues which cause them to be ill. The fertile female is almost seen as pathological, a body that is in its best condition when pregnant.

> [B]ecause a woman's flesh is softer, when her body fills up with blood, unless the blood is then discharged from her body, the filling and warming of her tissues that ensue will provoke pain: for a woman has hotter blood, and for this reason she herself is hotter than a man; if, however, most of the blood that was added is subsequently discharged, no pain will arise from it. A man, having solider flesh than a woman, will never overfill with so much blood that, unless some of it is discharged each month, he feels pain, and besides he takes in only as much as is necessary for the nourishment of his body, and his body—lacking softness as it does—is never overstretched or heated by fullness as a woman's is. A great amount

85 Leunissen, forthcoming, explains other similar anthropomorphising tendencies in the *Hist. an.*

86 Dean-Jones (2018) 254.

> of this is also due in a man to his exerting himself physically more than a woman, which consumes a part of the exhalation. (*Mul.* 1.1, VIII.12.17–14.7 L.)[87]

Even though Aristotle thinks that women have colder rather than hotter blood than men (*Part. an.* 2.2, 4), he agrees that they are in a pathological state most of the time. The generative residues of men are "of a good bulk" (εὔογκον) rather than being excessive. The reason that women have such abundant residues is due to their weakness and inability to cook up their nutriment.

> The seed is a residue, in the hotter of the blooded animals, i.e. the males, it is a good bulk (εὔογκον) in terms of amount, for this reason the receiving parts for the male residue are passages (πόροι). In females, on the other hand, due to being unconcocted, the bloody stuff is plentiful (for it is not thoroughly worked up), so that there must be some part acting as a receptacle, and this is unlike the other [male parts] and is large. (*Gen. an.* 4.1, 766b19–24)

Aristotle, however, would seem to disagree with the idea available in some Hippocratic texts that pregnancy has a therapeutic effect on women:

> When a woman is pregnant, she is not troubled by the failure of her menses to pass, since her blood is not stirred up as it separates off in a mass each month; rather blood passes into her uterus gently a little at a time without trouble (ἄνευ πόνου) each day. (*Nat. Puer.* 14, VII.492,21–494,2 L. = 57,5–9 Joly)[88]

Aristotle thinks of pregnancy in humans as another site of pathology:

> After conception women feel weighed down over their whole body, and experience darkness in front of the eyes and pains in the head. Some develop these feelings sooner, even at about ten days, others more slowly, according to whether they tend more or less to form residues. Further, nausea and vomiting seize most women, especially women of that nature, when the menses have ceased flowing and have not yet been diverted to the breasts. Now some women suffer more at the beginning, some later

87 Loeb XI.12.3–17.

88 Loeb X.38.12–15. See also *Nat. Puer.* 4.

> when the foetus has put on more growth; many also experience frequent stanguries towards the end. (*Hist. an.* 7.4, 584a2–13)

Aristotle documents other types of animal that are either in a better condition or "ill" during pregnancy (*Hist. an.* 8.30, 607b1–27).[89] The relative health of these animals in their pregnant state would seem to be due to nature. When it comes to human females, one might think that Aristotle's reasoning is similar, that women tend to pathology while pregnant due to a natural bodily condition. However, he does not straightforwardly accept that their pathological situation is natural; instead, it has a socio-cultural dimension.

4.2 *Women as Social and Domesticated Animals*

The peculiarities of human generation call out for Aristotelian-style explanations. What is it about human physiology and way of life that bring these about? Might they actually be incidental consequences of the human way of existing rather than serving any purpose? The heat and fluidity of humans means abundant generative residues; this combined with thin sensitive flesh, necessary for higher cognition, results in greying, balding and other weaknesses of skin and hair (*Gen. an.* 5.2–5). The weaknesses that plague women, such as mola uteri and sickness in pregnancy, might also be due to a combination of unfortunate material consequences of the human's bodily constitution.[90]

Although pregnancy can affect other animals adversely, Aristotle thinks that only human beings suffer severe pain in labour.

> Now in the other animals births are not painful, but they are evidently troubled to a more moderate extent by labour; but in women the pains occur with more strength, especially in sedentary women and those who are weak in the chest and unable to hold their breath. (*Hist. an.* 7.9, 586b34–587a4)

Aristotle thinks that women that are more sedentary have a harder time in pregnancy and labour. Thus, women are different from other animals because of this artificial restriction to their physical activities and this is due to culture rather than nature.

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89 Curiously, at *Hist. an.* 6.17, 570b43–44 Aristotle declares that all fish suffer in pregnancy. Given the context, it could be something that is reported but need not be ultimately accepted by him.

90 On this sort of explanation, see Connell (2016) 352–369.

> There is a difference with respect to gestation between humans and other animals. For they [other animals] flourish more in their bodily condition most of the time, whereas many women are ill when pregnant. However, one reason for this is their way of life (διὰ τὸν βίον). For being sedentary, they accumulate a lot of residue, since in nations where the women have a hardworking way of life, pregnancy isn't as obvious, and they give birth easily (as well as those used to hard work everywhere). For hard work uses up the residues, but sedentary women have a lot of residues due to lack of work and because the menses do not occur during pregnancy. Labour pain is very hard [for them]. Hard work exercises the breath (τὸ πνεῦμα) so that being able to hold it determines whether giving birth is easy or difficult. (*Gen. an.* 4.6, 775a27–775b2)

Aristotle does not seem to think that regular menstruation and pregnancy solve the health problems of female humans as some medical authorities maintain. He does consider, however, that exercise improves their condition, particularly in relation to pregnancy and labour. "Pregnant people ought to look after their bodies, and not avoid exercise or adopt a restrictive diet" (*Pol.* 7.16, 1335b13–14). The thought that lifestyle plays a part is also available in the medical tradition where women's constitution is sometimes attributed to their regimen (τὴν δίαιταν) (*Vict.* 1.34, VI.512.13–19, 17–18 L. = 150,23–28 Byl; *Oct.* 9, VIII.450.10 L. = 172,24 Joly).[91]

Aristotle's views on women's reproductive health may owe something to another line of medical investigation. In the work *Airs, Waters, Places*, the diet and locations that affect peoples in different nations is documented, and how easy pregnancy and labour are for the women is of particular interest (*Aer.* 3; 4; 7).[92] This is a much more comprehensive account of what Aristotle hints at when he says that in "certain nations" women do better; in Egypt, for example, women have the easiest time in birth (*Hist. an.* 7.4, 584b8–10). In addition to location and diet, these differences have a social dimension; for Aristotle these are arguably embedded in the natural. Aristotle is emphatic that women cannot act like Plato's female dogs and do the same tasks as their male counterparts because "animals have no household management (οἰκονομίας) to do" (*Pol.* 2.5, 1264b6). The *oikos* is a necessary part of the *polis*, which is required for the fulfilment of a human way of life (*Pol.* 1.3, 1253b2–3; 8–18.).[93] In this situation,

91 Dean-Jones (1996) 58.

92 II.14–22, 26–32 L. = Heiberg 57–78; Loeb I.74.16–17; I.78.14–18, I.84.30–32.

93 This explanation fits to Aristotelian biological methodology insofar as the human way of life contributes to the peculiarities in their parts and activities (Lennox 1987).

women are well-fed, sedentary and thus full of fluids, resulting in difficult pregnancies and births.[94] Curiously, some peculiarities of human generation are extended to domesticated animals by Aristotle, indicating the effect of acculturation on animal nature.

The domesticated Laconian hound shares that seemingly uniquely human peculiarity: variable gestational periods, since theirs can last sixty days, seventy-two days or three months (*Hist. an.* 6.20, 574a20–27). And in tamed horses, differential embryonic growth occurs. Noting that mares begin breeding at five years old while horses are six, Aristotle writes:

> So the females reach their complete development before the males, though while in the uterus the males are ahead of the females, as in human beings. (*Hist. an.* 6.22, 576b2–4)

Aristotle hints at an explanation for why domesticated animals share human beings' unusual reproductive characteristics in a passage on year-round mating:

> Human beings pair and breed at any and every season and so also do many domesticated animals owing to the shelter and the plentiful food they get by their association with humans (τῶν συνανθρωπευομένων ζῴων πολλὰ διὰ τὴν ἀλέαν καὶ εὐτροφίαν). (*Hist. an.* 5.8, 542a26)[95]

It seems that they too, once adapted to be part of the *oikos* and *polis* (*Pol.* 1.3, 1253b23–30; 1254b11–12), take on peculiar reproductive attributes.

A fuller explanation might run as follows: domestication means being well fed, which then results in a body full of fluids. The main cause of the generative peculiarities of women is excessive fluid combined with their human heat, presumably exacerbated by overfeeding. These material conditions fail to directly explain the two most prominent features that do not appear in other animals: variable gestational periods and the differentiation of male and female embryos. These are part of the medical tradition that Aristotle accepts, but he would also seem to have some reasons in terms of his own explanatory

94 Perhaps this is also why Diocles thought that women who are very "moist and warm" have the most difficulty in labour (fr. 171, van der Eijk 2000, 274–275).

95 Women and mares are said to be the most lustful (λαγνίστατον, *Hist. an.* 6.22, 575b30–31), probably a reference to year-round mating. Epstein notes recent scientific research that confirms Aristotle's findings here about horses and in a related passage at *Problemata* 10.47 (Epstein 2019, 276).

account to connect these as well to acculturation. Well-fed and tame animals that are friendlier (*Hist. an.* 9.1, 608b30)[96] are thereby also more liable to mate all year round.[97] This is no doubt why they mate while already pregnant, as occurs in horses (*Gen. an.* 4.5, 773b26–27). This could cause them to develop variable gestational periods, when the body attempts to cope with nourishing offspring conceived at different times.[98] And perhaps the sedentary and slow nature of mature females eventually extends its effect to their female foetuses. *Oct.* 9 states that female foetuses develop slowly due to a theory of like to like, from woman to foetus (VIII.450.6–8 L. = 172,19–20 Joly). Admittedly, the latter is a medical speculation that has no explicit articulation in the works of Aristotle,[99] but might give us some way of making sense of his adherence to these views.

In conclusion, understanding Aristotle's engagement with ancient medicine is crucial to making sense of his views of reproduction and sex difference in *De generatione animalium* and *Historia animalium* Book 7. The tension between a focus on women and bringing other animals under the theory of human females and seeing humans as unusual is explained by the different discussions we find. Overall, Aristotle accepts but also adapts the evidence and reasoning of the medical tradition, overlaying these with his own zoological methodology. In general, he guards against transferring what is peculiar in women to all other female animals, although at times he cannot seem to help waxing lyrical about the weakness of 'female' nature. The female animals that are most like women are those within the *oikos* and *polis*, a situation of overfeeding productive of friendliness and fecundity that results in a kind of pathology of female reproduction that Aristotle takes to be widespread in our kind.

96 See also the gentleness of a well-fed lion at *Hist. an.* 9.44.

97 Aristotle explains that hybrid births occur when different animals are well fed and thus friendlier and more likely to mate with each other (*Hist. an.* 8.29, 606b20–24, *Gen. an.* 2.7. 746b10–12).

98 There is a hint that this lies behind the phenomena, as the only reason he gives for variable gestational periods is humans' dualization between being mono and multiparous (*Gen. an.* 4.4, 772b1–8). However, this is not a very satisfactory explanation for the ubiquity of variable gestational periods in women given the rarity of superfetation.

99 Aristotle rejects Democritus' idea that a foetus' parts are moulding after that of its mother (*Gen. an.* 2.4, 740a36).

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CHAPTER 7

Aristotle's Indebtedness to Early Greek Medical Texts on Wind-Pregnancies

Mariska Leunissen

Introduction

In establishing the facts concerning conception and pregnancy in his biological works, Aristotle relies a great deal on the evidence for these topics provided by early Greek medical texts preserved in the Hippocratic Corpus. For instance, Aristotle's discussion of the male and female contributions to reproduction and of the role of female pleasure in his *Generation of Animals* (*Gen. an.*) reveal a deep familiarity with the medical theories expressed in the Hippocratic *On Generation* (*Genit.*) and *On the Nature of the Child* (*Nat. Puer.*).[1] And while he rejects the pangenesis account of reproduction, he generally accepts the evidence presented by the medical authors as trustworthy and as in need of explanation.[2] Aristotle's dispute with the medical thinkers in this context, then, is a dispute about what counts as the *best explanation* of the evidence, while the "facts" themselves—whether derived from their own (alleged) direct observations or from (alleged) first person reports from women—are treated as authoritative. In this paper, my goal is to show Aristotle's indebtedness to these medical thinkers in developing his views about a related, yet less well-studied gynecological phenomenon, namely that of so-called wind-pregnancies—that is, of false or true pregnancies that are claimed to be caused by winds entering a female's uterus—and of winds affecting the fertility of women and the sex of their offspring more generally.

My argument proceeds in four parts. First, in section 1, I will discuss Aristotle's acceptance and endorsement of the remarkable claim in the *History of Animals* (*Hist. an.*) that winds entering and inflating the uterus are responsible for false pregnancy symptoms in women. This claim, which does not fit eas-

1 On Aristotle's familiarity with these specific medical treatises, see also Koribili (in this volume).

2 On this example, see my Leunissen (2024). On Aristotle's familiarity with the medical texts on reproduction traditionally attributed to Hippocrates, see Bartoš (2021); Connell (in this volume); Dean-Jones (1994) 19–20; and van der Eijk (1999).

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ily with Aristotle's own account of conception, appears to be derived directly from *Nat. Puer.*, and Aristotle uses it to exonerate women from having made a mistake in the calculation of the duration of their pregnancy. In section 2, I will argue that while Aristotle records some of his own evidence concerning the existence of such "wind-pregnancies" in animals such as horses and birds in his *Hist. an.*, his reliance on the evidence concerning winds entering *women*'s uteri from *Nat. Puer.* is best understood as part of a much larger series of Aristotelian adaptations of medical views, specifically those recorded in *On Airs, Waters and Places* (*Aer.*), about the effects of winds on women's pregnancies. I work out this argument in sections 3–4, where I show how Aristotle's account in *Gen. an.* 4.2 on how winds (and waters and places) affect women's pregnancies uses *Aer.* as its main source of "facts".[3]

In sum, Aristotle did not conduct his biological research in a vacuum. And therefore—or so I will argue—we can only make sense of his claims about winds that enter uteri and affect pregnancies in various ways by taking their wide-ranging medical background and influence into consideration as well.

1 "Winds" as Causes for False Pregnancy Symptoms

In his discussion of reproduction and childbirth in humans, Aristotle argues that, unlike in other animals in which the gestational period has a fixed limit, in humans the duration of pregnancy can range anywhere from seven to eleven months (*Hist. an.* 7.4, 584a33–584b1). He claims about these babies that the ones born before the seventh month never survive, that the ones born in the seventh and ninth month survive and thrive, but that those born in the eighth month—at least those born in Greece—for the most part die and rarely survive. This assumption about eighth-month babies not surviving is so strong, he claims, that when a baby born in the eighth month *does* survive, women believe that they must have conceived their baby earlier "but that this had escaped their notice" (*Hist. an.*7.4, 584b1–14) and hence that the baby must have been a nine-month one. Regarding babies born in the eleventh month, Aristotle presents the following argument (*Hist. an.* 7.4, 584b18–25):

> In the same way *it is thought* to have escaped their notice (δοκεῖ λανθάνειν) also when children appear to be born later than the eleventh month; for

3 Ultimately, the influence of *On Airs, Waters and Places* on Aristotle's biological views about how winds affect pregnancies also permeates into his *Politics* (*Pol.*); I discuss this in Leunissen (in progress).

> in their case too, the beginning of the conception escaped the women's notice (λανθάνει τὰς γυναῖκας). For often when winds occurred earlier in [or: in front of] their uterus (πολλάκις γὰρ πνευματικῶν γενομένων ἔμπροσθεν τῶν ὑστερῶν), and then later they have intercourse and conceive, they believe that the former [i.e., having the uterus fill with winds] was the beginning of the conception, since it caused them similar signs (δι' ἣν ἐχρήσαντο τοῖς σημείοις ὁμοίοις).[4]

Two things are worth noting here about Aristotle's comments about the beliefs of women concerning the duration of their pregnancies. First, in both cases, Aristotle affirms the general reliability of women in possessing knowledge of when they conceived and of how long they carried their pregnancies. In the case of surviving babies born in the eighth month, women *believe* they must have been mistaken about the timing of the conception, but Aristotle suggests that in fact they are not: for babies born in the eighth month in Greece do on occasion survive. In the case of babies allegedly born in the eleventh month, Aristotle argues that women are indeed mistaken about the timing of the conception, but instead of blaming them for this mistake, he suggests that the miscalculation was caused by them experiencing symptoms that are like those caused by true conception (and presumably early pregnancy)[5] due to winds—or perhaps more accurately "airy materials"—having entered and inflated their uterus; these latter symptoms then masked the symptoms of the true conception that happened later, thus causing them to escape their notice.

Secondly, Aristotle's preservation of the epistemic authority of women regarding the duration of their pregnancies by claiming that their uterus filled with windy or airy materials appears to come at a cost for Aristotle's own theory of reproduction, for it is not clear what exactly these materials could be according to Aristotle, or what mechanism could explain their presence in the uterus. Presumably, Aristotle's vague description of the materials as *pneumatic* intentionally precludes their straightforward identification with innate *pneuma*. For Aristotle, the latter refers to a special and refined type of hot air that is enclosed within seed and that contains soul heat, thereby making seed fertile (*Gen. an.* 2.2, 736a1–2; 2.3, 736b30–737a17; and 3.11, 762a19–24), and that is also used "as a tool" in the articulation process of the embryo (*Gen. an.* 5.8, 789b5–11) and in the production of the motion of limbs (*MA* 10).[6] It would be unusual for *innate*

4 All translations are my own.

5 On signs of conception and early pregnancy available to women, see *Hist. an.* 7.3, 583a14–15; 583a34–583b2; and *Hist. an.* 7.4, 584a3–9.

6 Connell (2016) 181–183, 215–220 and Freudenthal (1995) 106–148.

pneuma to be able to enter and fill the uterus on its own without being enclosed in spermatic fluids or other blood-products.[7] However, Aristotle does sometimes suggest that sexual pleasure is conjoined with the release of *pneuma*, which is presumably "regular" air that is released through the heating of fluids resulting from the rubbing motions (*Gen. an.* 2.6, 742a15). For instance, in *Hist. an.* 7.7, 586a15–17, Aristotle claims that the emission of male seed is preceded by *pneuma* and that the force of this *pneuma* (βίας πνευματικῆς) in fact propels it forward, and in *Part. an.* 4.10, 689a29–32, he explains that the male penis is both sinuous and cartilaginous "so it is able both to contract and be erect, and be receptive of air (πνεύματός ἐστι δεκτικόν)."[8] Similarly, Aristotle also sometimes talks about *pneuma* produced by the female orgasm opening up the mouth of the uterus and drawing out the menses.[9] It is possible, then, absent any explicit account in Aristotle about the nature and origin of these materials, that they refer to the kind of airy or windy materials released during the female orgasm, which, instead of being released through the mouth of the uterus to allow the male seed to enter, somehow get "trapped" inside.

Interestingly, as it turns out, all these claims about the variability of the human gestational period, about the survival-chances of babies born during different gestational months, and about winds entering the uterus and producing misleading signs of conception are derived directly from the Hippocratic text *On the Nature of the Child* (*Nat. Puer.* 30, VII.532–534 L. = 79,4–25 Joly):

> But any [women] who believe (ἔδοξαν) that the period [of gestation] is more than ten months—for I have heard this said many times—have been misled (διεβλήθησαν) in the way I am about to explain: whenever the uterus takes breath into itself out of the cavity, which blows wind into it, and when it swells up—for this happens—women believe that they conceived then (ὁκόταν αἱ μῆτραι πνεῦμα λάβωσιν ἐς σφᾶς αὐτὰς ἀπὸ τῆς κοιλίης

7 Blood is pneumatized in the heart by being concocted there (*Resp.* 20, 479b31–32) and remains inherently so, without *pneuma* turning into vapour: see Freudenthal (1995) 121–123 on Aristotle's use of boiling milk—which retains its bubbles throughout the liquid—as a model for how blood remains consistently pneumatized. *External* winds can be present inside of bodies independently: see, e.g., Aristotle's report about fish that produce sounds (but not voice) through the wind (πνεῦμα) that is present in their bodies and that rattles their gills in *Hist. an.* 4.9, 535b22–23.

8 Cf. *Probl.* 30.1, 953b25–954a4, where the author argues that wine is an aphrodisiac because it contains air (πνευματώδης), and air produces sexual desire and erections and causes male ejaculations.

9 *Gen. an.* 2.4, 739a26–35 and *Gen. an.* 3.1, 750b34–751a2; cf. *Gen. an.* 1.18, 723b32–724a3, *Gen. an.* 1.20, 728a9–14, and *Gen. an.* 2.4, 737b27–738a6.

> φῦσαν παρεχούσης καὶ ἐξαρθῶσι, γίνεται γὰρ τοῦτο, δοκέουσι δὴ αἱ γυναῖκες πρὸς σφέας ἔχειν τότε) … Then sometimes the menses break out spontaneously … and the wind exits (καὶ ἡ φῦσα ἐξῆλθε) … But women who are inexperienced with these arguments and these facts, count (λογίζονται δ' αἱ γυναῖκες αἱ ἄπειροι τούτων τῶν λόγων καὶ τῶν πρηγμάτων) their pregnancy from that moment, namely when their menses stopped flowing out from them and their uterus became raised (ᾐρμέναι).[10]

In this Hippocratic text, breath or *pneuma* plays an integral role in the initial formation of the embryo and in its subsequent articulation,[11] and its source is most likely internal to the body itself, that is, the digestive process leads to fumes or breaths or winds—*phusai*—that are trapped inside the body and can lead to diseases if their passages are impeded.[12] In this account, it is the inexperience of women with the theories just presented and with the relevant facts of pregnancy (i.e., that sometimes the uterus fills with breath and that this breath then raises the uterus, falsely suggesting to women that they have conceived) that cause women to believe—mistakenly—that their pregnancies lasted more than ten months.

Aristotle's version is simpler, but otherwise presents as a straightforward gloss of the medical text quoted above. There's vagueness both in the meaning of ἔμπροσθεν in *Hist. an.* 7.4, 584b22 (are the windy materials present *earlier*, before true conception takes place, as is suggested by the contrast with the intercourse and conception that happen later in Aristotle's text, or are they located *in front of* the uterus, in the vaginal cavity, as is suggested by the medical text?) and in what matter is meant by the "airy materials that come to be."

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10 On women's alleged knowledge of conception, see also Dean-Jones (1995), 45–47 and Leunissen (2024).

11 See, e.g., *Nat. Puer.* 14 (VII.492 L. = 56,19–20 Joly): "together with breath (Ἅμα δὲ τῇ πνοῇ), blood is pulled [into the womb] through the membrane"; *Nat. Puer.* 17 (VII.496 L. = 59,9–10 Joly): "and the flesh grows and is articulated through breath (ὑπὸ τοῦ πνεύματος)"; and *Nat. Puer.* 19 (VII.506 L. = 64,8–11 Joly): "when the fetus becomes articulated … and these things also happen due to breath (ὑπὸ τοῦ πνεύματος)."

12 See, e.g., *Nat. Mul.* 10 (VII.324 L. = 13,4–5 Bourbon): "if the uterus swells up by being inflated, winds enter in it (Ἢν αἱ μῆτραι φλεγμήνασαι πρησθῶσι, φῦσα ἐγγίνεται)." Anonymus Londinensis (first or second century A.D.) includes a description of the causes of disease according to Hippocrates attributed to Aristotle: in it, the author argues that according to Hippocrates, all diseases are caused by breaths or winds (*phusai*) trapped inside the body, resulting from residues and vapours produced by the digestive process, and that Hippocrates identified breath (*pneuma*) as the "most necessary and the supreme component in us, since health is the result of its free, and disease of its impeded passage." On this passage, see Jouanna (1999) 59–60; cf. also van der Eijk (2012) 1505–1508.

However, I believe that it is this vagueness that allows Aristotle to take over the explanation for why some women mistakenly, but with good reason, believe themselves to have been pregnant for eleven months, but without having to work out all the physiological details of the medical text within his own theory. For instance, Aristotle elsewhere argues that inhalation is caused by organs, such as lungs, expanding such that outside air rushes in (*Resp*. 21, 480a25–480b12), while here the rushing in of airy materials is taken to be the cause of the expansion of the uterus. And again, while Aristotle argues elsewhere that the uterus draws in *male seed* through heat (*Gen. an*. 2.4, 739b9–20), there is no causal mechanism readily available in his writings through which it could draw in wind or air. However, if the "pneumatic stuff" in Aristotle's explanation is to be read as a quick gloss on the *phusai* of the medical texts, then that suggests that perhaps Aristotle too thinks of these as simply the *fumes* that are already available in the body—and so in or near the uterine cavity—as a byproduct of ongoing digestive processes.[13] On the other hand, it is also worth pointing out that compared to the medical source text, Aristotle's version also seems more generous to women: the "pneumatic stuff" (whatever its source or nature) and true conception inflate and raise the uterus, thereby producing the same symptoms, and it is not clear that *on Aristotle's account* more experience or "knowledge of the facts" would allow women to differentiate between true and false pregnancy symptoms as is argued in the medical text.

In short, then, it appears that Aristotle is willing to incorporate this theory about "winds inflating uteri" derived from his medical sources in order to preserve the epistemic authority of women concerning the moment of conception. However, the apparent ease with which Aristotle assimilates this rather curious account from his medical rivals within his own theory of reproduction and pregnancy in humans requires further explanation. In what follows, I will first, in section 2, contextualize Aristotle's acceptance of the claim that winds can enter uteri with evidence from his own collection of biological facts in his *Hist. an*., which demonstrate Aristotle's familiarity with widespread beliefs in wind-pregnancies and wind-eggs among animals, according to which winds were not just able to enter uteri but could also cause conceptions of some sort and sometimes even viable pregnancies. However, as I will argue next in sections 3–4, in order to make sense of Aristotle's acceptance of the view that winds or windy stuffs cause false pregnancy symptoms in *human* females, we

13 I would like to thank Brooke Holmes for this suggestion. Note that Aristotle discusses the presence of such "windy exhalations" in the body due to the nutritive process in the context of explaining the phenomenon of sleep: see, e.g., *Somn*. 3, 456b33–34: πολλὴ γὰρ ἡ ἀπὸ τῶν σιτίων ἀναθυμίασις and *Somn*. 3, 457a12: τὸ πνεῦμα.

need to look at his more widespread practice of assimilating gynaecological views derived from medical texts into his own biology, and in particular at his assimilation of the views concerning how winds affect the pregnancies and fertility of women as recorded in the medical *Aer*.[14]

2 Wind-Eggs and Wind-Pregnancies in Aristotle's *History of Animals*

Aristotle's *History of Animals* contains a collection and preliminary organization of various biological facts pertaining to the four main differentiae of animals, i.e., their modes of life (such as being a water-dweller, or being a flyer), their activities (such as feeding and reproducing), their characters (such as being courageous or crafty), and their bodily parts (*Hist. an.* 1.1, 487a10–13). Ways of life and activities as they pertain to reproduction and sexual intercourse in non-human animals are collected in books 5–6, and it is in this latter context that Aristotle brings up various cases of wind-pregnancies.

The first example of an animal that experiences wind-pregnancies that Aristotle brings up is the partridge (*Hist. an.* 5.5, 541a26–31):

> Partridges, when the females stand down-wind (κατ' ἄνεμον στῶσιν) from the males, they become pregnant. And often also when they hear his voice when they happen to be in heat, and when she is being flown over, on account of the male breathing down on her (ἐκ τοῦ καταπνεῦσαι). Both the female and the male have their mouth open (χάσκει) and they stick their tongue out during copulation.

The passage (which is marked as a probable interpolation)[15] occurs in the context of Aristotle's refutation of the view that female fish are impregnated by swallowing the milt: Aristotle confirms that fish indeed frequently swallow milt (this is confirmed by observation), but he denies that this is the cause of pregnancy (true copulation among fish is difficult to observe). The case of the partridge, then, which presumably has its origin in folklore, provides some background for why people might have believed the claim that fish are impreg-

14 *Pneuma* and cognates such as *phusa* and *aêr*, of course, play an important role in several Hippocratic texts—see e.g. *On Winds, Regimen* 2.38, *On the Nature of Man* 9, *Aphorisms* 3.5, and *On the Sacred Disease* 4 and 16—but for Aristotle's views about how winds affect women's pregnancy and fertility, I believe that *On Airs, Waters and Places* was the most influential.

15 Peck ([Aristotle]1970) 110.

nated by swallowing milt: for partridges are believed to be impregnated by swallowing, or taking in through their mouth, wind or breath that originates from the male. Aristotle repeats the claim that female partridges are impregnated by standing down-wind from the male when discussing copulation in birds, but there he suggests that it is the male's *smell*, and thus wind or air inhaled through the female's nose—that causes this type of conception (*Hist. an.* 6.2, 560b13–16):

> For when she [i.e., the partridge] stands down-wind (κατὰ πνεῦμα) from the male, she conceives and becomes immediately useless for hunting purposes. For the partridge appears to have a very acute sense of smell (ὄσφρησιν).

The partridge case also reflects the common (and correct) belief that female birds can produce eggs without having mated with a male. These eggs, which are often inferior in size and shape, and which do not develop into chicks, are known in Greek culture as "wind-eggs."[16] Aristotle flags these wind-eggs as a topic in need of a more accurate discussion at the beginning of book 5 (*Hist. an.* 5.1, 539a31–b2) and discusses them at length when dealing with copulation in birds in *Hist. an.* 6. Let me quote the section that is most relevant for our purposes (*Hist. an.* 6.2, 559b20–560a8):

> Those who claim that wind-eggs (τὰ ὑπηνέμια) are left-overs from copulations that happened earlier do not speak the truth. For it has been observed sufficiently already that chickens of the common hen and goose have laid wind-eggs without having been subjected to copulation. Compared to eggs that are fertile, wind-eggs are smaller in size and less palatable and moister, but larger in number. When they are put under the bird the liquid does not set, but the yellow and the white remain as they are. Wind-eggs occur among many [birds], such as the common hen, the partridge, the pigeon, the peahen, the goose, and vulpanser. (…) [Wind-eggs] that are called by some *kynosoura* and *uria* happen more often during summer. Wind-eggs are called 'Zephyrus-eggs' by some, because at springtime *female birds appear to receive winds* (φαίνονται δεχόμεναι πνεύματα αἱ ὄρνιθες) …

In this passage, Aristotle records the popular belief that wind-eggs are produced by winds and specifically by Zephyrus, which female birds appear to

16 Cf. Aristophanes, *Birds* 695 and Plato, *Theaetetus* 151e.

inhale during spring. Aristotle's own explanation of how wind-eggs occur is complicated and controversial,[17] but for our purposes it is sufficient to point out two things. First, Aristotle takes the phenomenon of wind-eggs seriously: he believes that wind-eggs provide evidence for the capacity of *all* female animals to reproduce on their own, albeit to a limited degree, and goes to great lengths to explain how this is possible.[18] Secondly, though he ultimately rejects the idea that wind-eggs are caused by winds, he nevertheless attributes generative power to surrounding winds and air in the case of other animals,[19] and believes that the presence of *pneuma* in the environment is an important part of the explanation of spontaneous generation.[20]

The second example of animals that Aristotle describes as experiencing wind-pregnancies involves mares (*Hist. an.* 6.18, 572a8–22):

> Of all female animals, the horse possesses the greatest impulse towards having sex, followed by the cow. And mares go a-horsing (ἱππομανοῦσιν). (…) And people say that they also get impregnated by the wind (ἐξανεμοῦσθαι) around this precise time. For this reason, in Crete, they do not remove the stallion from the mares. When they are affected by this, they run away from the other horses. (…) At that time, they expel something. People call this also "hippomanes," just as they call that which is on top of a newborn foal. It is like the sow-virus,[21] and the women producing potions seek after this most of all.

Based on Aristotle's report of what people say, mares can be impregnated by the winds around the time they go into heat, and this "pregnancy" then results in the "birth" of a rare and much sought-after substance, the so-called "hippomanes."[22] This report also appears to have its origin in folklore, and

17 On this topic, see especially Gotthelf (2012), Kress (2020), Stavrianeas (2008), and Zwier (2018).

18 See *Gen. an.* 1.21, 730a4–7; *Gen. an.* 2.3, 737a30–34; *Gen. an.* 2.5, 741a16–32; *Gen. an.* 3.1, 749a34–b7 and 750b1–751a26. In brief, Aristotle thinks that wind-eggs are produced only in those female birds that produce lots of residues (that is, in birds that do not fly much or at all), and that smelling the male in the case of partridges induces the females to lay eggs but does not cause their conception.

19 See, e.g., *Hist. an.* 5.19, 552a10–11: "with all grubs and all animals that break out from the grub state, generation is due primarily to the sun or to wind (ἡ ἀρχὴ γίνεται τῆς γενέσεως ὑφ' ἡλίου ἢ ὑπὸ πνεύματος)"; cf. also *Hist. an.* 5.19, 552a7–8 and 552a28–29 on wind as a source of motion.

20 See *Gen. an.* 3.11, 762a8–24.

21 On this sow-virus, see *Hist. an.* 6.18, 573b1–2.

22 On the hippomanes, see also *Hist. an.* 6.18, 572a25–28, *Hist. an.* 6.22, 577a7–13 and *Hist. an.* 8.24, 605a2–7.

references to wind-pregnancies in horses in Homer suggest that in popular belief these wind-pregnancies could perhaps also result in true pregnancies and the birth of foals.[23]

There are no other cases of wind-pregnancies in animals in the remainder of the *Hist. an.*, though *Hist. an.* 6.19 reports that in sheep and goats the direction of the winds during intercourse influences the sex of the offspring (I will return to this passage below in section 3). And though both the cases of birds and mares provide support for the general belief in the existence of wind-pregnancies, neither provides the right kind of parallel from which Aristotle could have constructed the account of winds causing false pregnancy symptoms in women independently from his medical source-text: birds inhale winds or breath through *their mouth*, and the pathology of mares in heat and their birthing of "hippomanes" seem a far stretch from what happens in women when winds inflate their uterus.

There is one more example of wind-pregnancies—this time as experienced by women—discussed in Aristotle's *Hist. an.* 10.3, 636a9–28 that is worth discussing, though the text is most likely spurious and not authored by Aristotle himself.[24] *Hist. an.* 10, which is sometimes referred to as *On Sterility*, focuses on diagnoses of infertility in women and is explicitly therapeutic in nature. It was most likely written by a medical author and preserved by Aristotle as part of his collection of *endoxa* in his *Hist. an.*, in the same way that he also included long "quotes" from the medical authors Syennesis, Diogenes, and Polybus in *Hist. an.* 3.2–3. Interestingly, this text also provides an explicit explanation for the presence of winds in the uterus, and it does so in a way that at a first glance seems congenial to the explanation provided in *Nat. Puer.* 30 (VII.532 L. = 79,6–9 Joly): for according to *Hist. an.* 10.3, 635b4–9, there are "fumes" (b4: φύσας) present in the uterus that develop there by nature in the same way that they do in the stomach, and women need to expel these in order to successfully carry a pregnancy.[25] However, this text also explicitly rejects the idea that *what are called* wind-pregnancies have anything to do with winds or air or such fumes inflating the uterus (*Hist. an.* 10.3, 636a9–26). Instead, so this text argues, the

23 Hom. *Il.* XVI.148–151 and XX.221–225. On ancient beliefs about the powers of winds, see Lloyd (2007); about wind-pregnancies in ancient folklore, see Zirkle (1936).

24 My account of *Hist. an.* 10 is roughly based on the interpretation of this text defended by Dean-Jones (2011).

25 Note also that, according to this text, the uterus draws in seed deposited by the male in the vaginal canal "by means of wind, just like the nostrils" (*Hist. an.* 10.2, 634a34–35: ἐντεῦθεν σπῶσι τῷ πνεύματι, οἷον αἱ ῥῖνες; see also *Hist. an.* 10.3, 636a4–8) and claims that this kind of external wind is always present in the uterus, as it is in other parts of the body (*Hist. an.* 10.5, 637a15–36).

affection is due to the *dryness of the uterus*, which shrinks down the male seed to such an extent that its expulsion goes unnoticed by the women involved; but while the seed is still present, the women experience pregnancy symptoms, such as a raised uterus (*Hist. an.* 10.3, 636a9–10: εἰσὶ δέ τινες αἳ πάσχουσί τι τοιοῦτον ὃ καλοῦσιν ἐξανεμοῦσθαι; 636a12: διὸ καὶ καλεῖται ἐξανεμοῦσθαι). This text stresses that this affection, though attributed to the supernatural, is in fact something that can be treated naturally (*Hist. an.* 10.3, 636a24–26), presumably through moistening the uterus, and thereby in effect rejects the existence of *wind*-pregnancies altogether.

In sum, while all three cases reported by Aristotle provide support for the widespread belief in wind-pregnancies, none of them appear to rival the account of false pregnancy symptoms caused by "winds" as presented in *Nat. Puer.* 30 for their influence on Aristotle's rendition of the phenomenon as he describes it in *Hist. an.* 7.4. In order to further demonstrate the broader influence of medical authorities traditionally associated with Hippocrates on Aristotle's gynaecology and especially on the role of winds therein, I will devote section 3 to the examination of texts in Aristotle's *Gen. an.* 4.2 pertaining to winds (and places and waters) affecting the sex of the offspring during embryogenesis; then, in section 4, I will argue that the "facts" as Aristotle incorporates them in *Gen. an.* 4.2 are derived most likely from the medical *On Airs, Waters and Places*.

3 Winds and Their Effects on Pregnancy in Aristotle's *Generation of Animals* 4.2

Aristotle's discussion of the effects of winds on women's pregnancies in *Gen. an.* 4.2 is part of a broader investigation into the causal processes responsible for sex-differentiation during embryogenesis, which is recorded in *Gen. an.* 4.1–3. In outline, Aristotle conceptualizes embryogenesis as a form of matter—the female menses—being concocted and thereby being "refined" and "informed" to an appropriate degree by the form-transmitting motions that the male seed imparts. Male and female *sperma* are both useful residues of concocted blood, but that of the male is hotter, better concocted, and more condensed than that of the female, which is colder and less concocted.[26] The form-transmitting motions from the male are derived from his capacities for the development and maintenance of his body as it exists in actuality, and they therefore corres-

26 This account of embryogenesis is a simplification of Leunissen (2017) 87–88.

pond to his form. These motions, then, "set" the female menses and produce the foetal heart, after which the developing embryo takes over its own further development. The female menses, in their turn, are residues of the nutriment that was supposed to nourish her own body, but that are now used to produce another creature like herself. Reproduction is successful and "most natural" when the male principle "dominates" and shapes the female menses into its own likeness: the offspring will be a physically complete male resembling his father, with a perfect level of natural heat. However, if the male imparts too much heat, the menses will "burn up" and there will be no offspring, and, if his motions are too cold and/or if the female menses are too copious or too moist, the shaping will be imperfect, and the offspring will be female or "some other monstrosity."

In *Gen. an.* 4.2, Aristotle presents five factors that he believes can affect the process of embryogenesis such that the offspring becomes female instead of male and that provide evidence for his theory of sex-differentiation—or so he argues (*Gen. an.* 4.2, 766b28: "the facts provide evidence for what has been said"). Let me discuss each of these factors in turn before attending to their medical background in *Aer.*

The first factor that Aristotle mentions is the *age* of the parents (*Gen. an.* 4.2, 766b29–34). Aristotle defines aging as animals slowly cooling down and drying up: their blood and bodies start out too hot and moist, but reach perfection during adulthood, and then become colder and drier until death occurs, which is the complete extinction of internal heat.[27] For reproduction, this means that both the young and the old are unable to concoct their seed perfectly, and hence are more likely to produce female offspring (θηλυτόκα μᾶλλον); the same happens in those whose bodies are too moist or "womanly"—the concoction will be less perfect and more likely to result in female offspring (θηλυγόνα μᾶλλον).[28] In both cases, it is ultimately the *internal* lack of natural heat that is responsible for the birth of females; the next four factors, however, involve *environmental* properties. The latter, I submit, all trace back to medical views.

Among the environmental factors, Aristotle mentions *winds*, and specifically the *direction* from which they blow, as affecting the sex of the offspring (*Gen. an.* 4.2, 766b34–767a1):

27 On aging, see Freudenthal (1995) 155–156 and Leunissen (2017) 36–39.

28 See also *Hist. an.* 7.1, 582a16–19 with 582a29–32 (on young parents producing imperfect offspring and on thin—or diluted—seed being more productive of females) and *Gen. an.* 4.3, 767b10–13.

> And the northern winds are more productive of males than the southern winds (τὸ βορείοις ἀρρενοτοκεῖν μᾶλλον ἢ νοτίοις): for bodies are moister during southern winds (ὑγρότερα γὰρ τὰ σώματα νοτίοις), such that they are also more productive of residue. And more residue is more difficult to concoct: this is why in men the seed and in women the menstrual discharge is moister.

Under the influence of southern winds, bodies become moister, thus increasing residues and making concoction during embryogenesis less effective, which results in the birth of fewer males.[29] By implication, northern winds presumably have a drying effect on bodies, which aids the process of concoction, resulting in more male offspring. Aristotle links this claim about the increase in menstrual discharge under the influence of southern winds to an explanation for why menses also happen predominantly during the waning of the moon, but then quickly returns to the topic of winds while adding a third factor, *position* (*Gen. an.* 4.2, 767a8–13):

> Shepherds say, too, that it makes a difference for the production of females and the production of males (πρὸς θηλυγονίαν καὶ ἀρρενογονίαν) not only if mating occurs *during northern or southern winds* (βορείοις ἢ νοτίοις), but also if while mating the animals *look south or north*. So small a thing sometimes shifts the balance and becomes a cause of cold or heat, and these ⟨become a cause⟩ of generation.

Shepherds, so Aristotle claims, confirm his earlier statement about the effects of southern and northern winds, and they add that even facing south or north during copulation has the same effect: both the directions of winds and of the position taken up while mating produce internal changes in the level of natural heat and thus affect the sex of the offspring that is generated.

Aristotle explains how this works in the passage that follows and that identifies the two remaining environmental factors that impact sex-differentiation (*Gen. an.* 4.2, 767a28–35):

> Region (χώρα) differs from region in these respects, and water (ὕδωρ) from water, due to the same causes: for food and especially the condition of the body become of a certain quality due to the mixture of the surrounding air (διά τε τὴν κρᾶσιν τοῦ περιεστῶτος ἀέρος) and of the things that enter

29 Cf. also *Pr.* 14.5, 909a32–35 on southern winds being more productive of females.

> inside, and especially due to liquid food. For that is brought in most, and that is present in everything as nourishment, even in dry foods. For this reason, also hard and cold waters produce sterility in some and the production of females in others (διὸ καὶ τὰ ἀτέραμνα ὕδατα καὶ ψυχρὰ τὰ μὲν ἀτεκνίαν ποιεῖ τὰ δὲ θηλυτοκίαν).

The third and fourth environmental factors are thus regions and waters, and they affect sex-differentiation in the following way: first, the individual material qualities of the region change the elemental mixture of the surrounding air (through material-efficient causation), producing differences of the more and the less. This mixture of the surrounding air in its turn then changes the material qualities of the bodies of living beings in it, but also of the dry and especially of the liquid foods they consume. Once consumed, these foods then also produce differences of the more and the less in the elemental mixture of the blood of living beings.[30] The material properties of water, since it is in *everything* consumed, are especially important in this respect, and Aristotle claims that "hard and cold" waters have especially detrimental effects on women's pregnancies, leading to infertility or the production of females.

The account that Aristotle provides here of the four environmental factors—and especially of the way in which they produce differences of the more and the less in the internal heat of living beings, and thereby lead to an increase in male or female offspring—is fully consistent with his broader understanding of the environment's effects on the bodies of living beings as presented elsewhere in his natural treatises. That is, Aristotle believes that each environment (τὸ περιέχον) possesses its own mixture (κρᾶσις) of hot and cold, dry and moist, and that this mixture is in constant interaction with the material natures of the living beings it surrounds.[31] When this interaction between the environmental and bodily elements produces a proportionate blend (and hence a stable balance between the contrary material potentials), animals will be healthy and long-lived, and this balance is achieved most easily when animals live in their own

30 Cf. *Part. an.* 2.4, 651a12–17: "It is reasonable that of many features the cause is the nature of the blood, both with respect to character among animals and with respect to perception: for it is the matter of the entire body. For nourishment is matter, and blood is the last stage of nourishment. It therefore makes a great difference whether it is hot or cold, thin or thick, turbid or pure."

31 *Long.* 3, 465b25–29: "the environment acts with or against [living beings]: and because of this, things that change become more or less enduring than their nature [warrants]"; cf. also *Ph.* 8.3, 246b5–6; 8.2, 253a7–21; and *Gen. an.* 4.10, 777b6–8. On the environment, see further Thompson ([Aristotle]1910) ad 589b and Freudenthal (1995) 13; on the notion of *krasis*, see Tracy (1969) 163–174.

proper location.[32] However, even within the confines of these proper locations, differences of the more and the less in environmental factors produce temporary or chronic changes in the animal's material nature, which sometimes lead to the destruction, putrefaction, or disease of the animal,[33] or sometimes merely to changes in their outward affections, such as in hair-structure, as Aristotle suggests here (*Gen. an.* 5.3, 782b33–783a1):

> And for this reason, the Scythians on the Black Sea and the Thracians are straight-haired, for both they themselves and the surrounding air are moist (καὶ γὰρ αὐτοὶ ὑγροὶ καὶ ὁ περιέχων αὐτοὺς ἀὴρ ὑγρός), whereas the Ethiopians and those living in hot countries are curly-haired, for their brains and the surrounding air are dry (ξηροὶ γὰρ οἱ ἐγκέφαλοι καὶ ὁ ἀὴρ ὁ περιέχων).

In the same chapter, Aristotle also identifies north-facing directionality and being in a windy location as external material-efficient causes for plants becoming harder and earthier, presumably as a result of these winds having a drying and chilling effect on their surrounding air respectively, which in their turn cause a hardening and thickening—in a manner that is parallel to how open air life or the material properties of their location hardens the hair in animals living in cold climates (*Gen. an.* 5.3, 783a12–33):

> Sheep living in cold climates (ἐν τοῖς ψυχροῖς) suffer the opposite from humans: for the hair of Scythians is soft, but the hair of Sarmatian sheep is hard. And the cause (αἴτιον) of this is the same as with regard to all wild animals. *For the cold hardens them through thickening* (*πηγνύουσα*), *on account of the drying*: for as the heat is pressed out, the moisture evaporates, and the hair and skin become earthy and hard. The cause of this is in wild animals their outdoor life (ἡ θυραυλία), but in others the quality of the location (ὁ τόπος τοιοῦτος) they are in. A sign of this is also what happens to sea-urchins … [Their spines] are hard and have turned into stone because of the cold and the coagulation. In the same way it also happens that plants become harder and earthier and more petrified *in north-facing locations more than those facing south* (τὰ ἐν τοῖς προσβόρροις τῶν πρὸς νότον) and *locations that are exposed to winds* more than in sheltered ones; for they all get more chilled and their liquid evaporates.

32 See *Resp.* 13, 477a27–31, *Resp.* 14, 477b14–478a1.

33 *Gen. an.* 4.10, 777b28–30; cf. *Mete.* 4.1, 378b27–379a14.

In other words, the view that environmental factors—which also include local climate and seasonal changes—produce changes or differentiations of the more and the less in the features, parts, characters, and behaviours of animals is well-established in the Aristotelian corpus.[34]

Moreover, the distinction that Aristotle presents between northern and southern winds here in *Gen. an.* 4.2—but also in the passage from *Gen. an.* 5.3 above—fits with his general account of winds in the *Meteorology*. There, Aristotle defines winds as a kind of exhalation in which the dry dominates the moist. These exhalations are caused by the sun approaching the earth: the heat of the sun *both* draws up moisture from the earth and causes moist exhalations (these turn into rain upon cooling) *and* causes dry exhalations by the heating and drying of the earth itself. These latter exhalations are smoky and form the "source and nature of all winds" (*Mete.* 2.4, 359b27–360a17; 360a12–13: τῶν πνευμάτων ἀρχὴ καὶ φύσις πάντων). Because the sun runs its course from east to west, clouds collect in the regions to the north and the south. When the sun approaches the earth, this causes moist exhalations, and when it recedes, it causes rain. Then it is reasonable, so Aristotle claims, that where there is the most rain, there must also be the largest amount and most important kinds of dry and smoky exhalations, "just as green wood gives the most smoke." This movement of the sun, then, explains why most winds are either from the north or from the south (*Mete.* 2.4, 361a4–22; cf. *Pol.* 4.3, 1290a13–14). The southern winds are the warmest of winds, as they blow from dry and hot regions, whereas the northern winds—which blow from moist regions—are cold. In Greece, the latter are said to bring nice weather (*Mete.* 2.3, 358a27–358b3; cf. *Mete.* 1.10, 347a36–b11), which is perhaps also why Aristotle in *Gen. an.* 4.2 associates them with the production of more males. And given this meteorological background, it thus seems that the drying effect of northern winds on bodies must result from their coldness, while the moistening effect of southern winds, as mentioned in *Gen. an.* 4.2, must result from their heat.

As for the *source* of Aristotle's claims about northern and southern winds affecting the sex of the offspring, his reference here in *Gen. an.* 4.2 as well as in the (methodologically prior) statement of the same facts in *Hist. an.* 6.19[35]

34 See e.g., *Hist. an.* 5.11, 543b18–31; *Hist. an.* 8.12–17; *Hist. an.* 8.18–20; *Hist. an.* 8.28, 605b22: "animals differ also in accordance with their locales (κατὰ τοὺς τόπους)"; *Hist. an.* 8.28, 606b17–19; *Hist. an.* 8.29, 607a9–13; *Gen. an.* 3.11, 761b13–15; *Gen. an.* 5.2, 781a33–34; and *Gen. an.* 5.6, 786a30–34. For a systematic discussion of the impact of the environment on animals, see Popa (in this volume).

35 *Hist. an.* 6.19, 573b32–574a4: "Some of these ⟨sheep and goats⟩ become productive of females, others productive of males, due to the waters (διά τε τὰ ὕδατα)—for some are pro-

to sheep and shepherds suggests that this is common lore among those tending to and breeding domesticated animals.[36] In fact, Aristotle's original statement of the facts of the impact of waters, winds, and position in the *Hist. an.* occurs amid detailed recordings of phenomena related to mating and conception among domesticated animals (*Hist. an.* 6.18–25). As his sources for this information, he mentions elephant-keepers in India (*Hist. an.* 6.18, 571b32–572a5), women producing potions (*Hist. an.* 6.18, 572a20–29 and *Hist. an.* 6.22, 577a7–13), keepers of cows (*Hist. an.* 6.18, 572a32–33 and *Hist. an.* 6.21, 575a26 and 575b2), goat-keepers and shepherds (*Hist. an.* 6.18, 573a1–2; *Hist. an.* 6.19, 573b26–27 and 574a14), expert breeders of dogs (*Hist. an.* 6.20, 574b14–18), Scythian horse-riders (*Hist. an.* 6.22, 576a20–21), and people who breed asses (*Hist. an.* 6.23, 577b13–15). None of these sources suggest a medical background to Aristotle's identification of wind as an environmental factor impacting the sex of the offspring. However, Aristotle presents his arguments about the four environmental factors affecting sex-differentiation in *Gen. an.* 4.2 as general claims about what happens in *all* female animals, and especially in those that are *human* (cf. the reference to "womanly" bodies in 766b32 and the account of the monthly cycle of menses in 767a1–8, which only explains the timing of menses in *women*), while the reference to shepherds' sayings is merely brought in as supporting evidence. The most important source for Aristotle on his views about the environmental effects on pregnancies in *women*, I aim to show below, was the medical treatise *Aer.*

4 The Medical *Airs, Waters and Places* as Aristotle's Source Text for *Generation of Animals* 4.2

Aristotle's account of the environmental factors that affect the sex of the offspring in *Gen. an.* 4.2 shares at least two important commonalities with the

ductive of females, some of males—and due to the matings (διὰ τὰς ὀχείας) in the same way, and those that mate during northern winds give more birth to males, and those that mate during southern wind more to females (βορείοις μὲν ὀχευόμενα ἀρρενοτοκεῖ μᾶλλον, νοτίοις δὲ θηλυτοκεῖ). Those that give birth to females also change and give birth to males: for it is necessary for them to look to the north while mating (δεῖ δ' ὁρᾶν ὀχευόμενα πρὸς βορέαν)."

36 See also *Hist. an.* 5.9, 542b28–29 with *Hist. an.* 5.19, 551a2–4 on bees that are able to breed also in the winter during southern winds; *Hist. an.* 8.10, 596a27–29 on water from the north being better for the fattening of sheep in the fall than water from the south; *Hist. an.* 8.19, 602a22–25 on longer fish thriving more during northern winds; and *Hist. an.* 8.13, 597b9–13 on quails thriving and producing offspring during northern winds, but struggling during "moist and heavy" southern winds.

medical views transmitted to us in *Aer.* I believe these commonalities are strongly suggestive of the influence of the latter on the former.

The first of these pertains to the *types* of environmental factors singled out and the *general* causal schema adopted by Aristotle, as the direction of the winds—together with the position of the animals during intercourse—and the regions and waters mentioned in *Gen. an.* 4.2 closely resemble four of the six factors mentioned by the medical author of *Aer.* This latter author argues in *Aer.* 1 (II.12 L. = 24,1–26,4 Diller) that "whoever wishes to inquire correctly into the science of medicine" must think deeply about (1) the seasons of the year (τὰς ὥρας τοῦ ἔτεος) and "what it is that each can produce"; next (2) "about the hot and the cold winds (τὰ πνεύματα τὰ θερμά τε καὶ τὰ ψυχρά), especially the ones that are common to all humans, and next also the ones that are local to each particular region (τὰ ἐν ἑκάστῃ χώρῃ ἐπιχώρια ἐόντα)"; (3) the capacities of the waters (τῶν ὑδάτων … τὰς δυνάμιας); (4) the position (τὴν θέσιν αὐτῆς) of the city one is visiting, i.e., "how it is positioned both with regard to the winds (πρὸς τὰ πνεύματα) and with regard to the risings of the sun," because a city positioned towards the northern wind does not have the same capacity (δύναται) as the one that is positioned towards the southern wind (ἥτις πρὸς βορέην κεῖται καὶ ἥτις πρὸς νότον); (5) the soil (τὴν γῆν), "whether it is bare and dry or leafy and moist and whether it is in a hollow and stifling with heat or elevated and cold (εἴτε ἔγκοιλός ἐστι καὶ πνιγηρὴ εἴτε μετέωρος καὶ ψυχρή)"; and, finally, (6) the way of life of the people (τὴν δίαιταν τῶν ἀνθρώπων). Of these six factors, the medical author identifies winds and waters[37] as the most important factors that impact human health,[38] and these are also the only two factors he discusses as having an impact on the pregnancies of women (I will return to the relevant passages below). Seasons are discussed comparatively briefly,[39] while location and way of life feature mostly in the second part of the treatise, where the author presents his ethnographical accounts. It is no coincidence, then, that Aristotle focuses on winds—conjoined with position—and waters—conjoined with the idea of regional differences—in *Gen. an.* 4.2. In addition, Aristotle's identific-

37 When authors discuss the impact of liquid diet on health and diseases elsewhere in the Hippocratic corpus, the reference is mostly to *wine* (or sometimes milk), while the importance attributed to *water* seems to be a unique feature of *Aer.*: see Jouanna (2012) esp. 155–158.

38 *Aer.* 3–6 is devoted to winds and *Aer.* 7–9 to waters; on their importance, see (*Aer.* 7, II.26 L. = 34,16–19 Diller): "About winds (περὶ μὲν πνευμάτων)—the ones that are healthy and unhealthy—things are this way. About the remaining waters (περὶ δὲ τῶν λοιπῶν ὑδάτων) I would like to talk now … For it contributes a great deal to health (πλεῖστον γὰρ μέρος ξυμβάλλεται ἐς τὴν ὑγιείην)."

39 In *Aer.* 10–11.

ation of *krasis* as a key causal concept for how environmental factors impact sex-differentiation also seems to be directly derived from *Aer.*, which identifies "the mixture of the seasons" (ἡ κρῆσις τῶν ὡρέων) as the main cause for the differences in beauty, size, and character traits of humans and animals living in Europe and Asia (with customs and habits only playing a secondary role in this treatise).[40]

Secondly, and more specifically, there are a couple of striking similarities in how both texts treat the impacts of winds and waters on women and their pregnancies. For instance, even though the medical text differentiates *four* winds, while Aristotle only considers *two* of these, both agree on the gynaecological significance of northern and southern winds. Moreover, in *Aer.*, southern and northern winds are also prioritized and receive a lengthier discussion than eastern and western winds (discussed in *Aer.* 3–4 respectively *Aer.* 5–6), with more details of their effects on women. Thus, in *Aer.* 3 (II.14–18 L. = 26,23–28,10 Diller), the medical text describes southern winds as hot, and people exposed to these hot winds while being protected against northern winds as moist and phlegmy, and their waters as plentiful. Women exposed to southern winds are unhealthy, subjected to excessive fluxes, and "many are childless through disease (πολλὰς ἀτόκους ὑπὸ νούσου), not by nature, and miscarry frequently (ἐκτιτρώσκεσθαι τε πυκνά)." By contrast, in *Aer.* 4 (II.22 L. = 30,22–32,3 Diller), the medical text describes northern winds as cold, and people exposed to these cold winds while protected against southern winds as sinewy and lean, and their waters as hard and cold. Women exposed to northern winds become infertile (στρυφναὶ) due to the waters being hard, indigestible, and cold (διὰ τὰ ὕδατα ἐόντα σκληρά τε καὶ ἀτέραμνα καὶ ψυχρά); their menses become scant and unhealthy; and childbirth is difficult for them (though they rarely miscarry); after birth, they cannot nurse their children because their milk dries up; and they often suffer from emaciation after delivery. The medical text has comparatively little to say in *Aer.* 5 about the gynaecological effects of eastern winds, which are moderate in heat, and which produce clear waters and healthy people, and "quick pregnancies and easy deliveries" in women (II.24 L. = 32,19 Diller). The text also says nothing about the effects of western winds, which bring lots of rain and make people unhealthy. In the chapters that follow, the medical author continues this prioritization of the effects of southern and northern winds (see especially *Aer.* 7, II.30 L. =

40 Jouanna (2012) 168. Cf. also Bartoš (2015), 38–39, who argues that *Aer.* is the oldest Hippocratic treatise to introduce the concept of mixture and to suggest that there is a close relationship between the mixture of seasons and the constitutions of human bodies.

38,15–17 Diller and 9, 11.38 L. = 44,13–14 Diller) and blames them for bad effects on women's pregnancies (see *Aer.* 10, 11.44–46 L. = 48,13–19 Diller).

Aristotle adopts this very same causal schema according to which southern winds are hot and produce excess moisture in bodies, and according to which northern winds are cold and produce excess dryness in bodies. He similarly seems to adopt waters as a factor that mediates between the effects of the winds—or the environment at large—and the bodies of people. However, since Aristotle "only" recognizes two types of main winds, the valence he places on the effects of southern and northern winds is different: in *Aer.*, both southern and northern winds have detrimental effects on women's bodies, with excessive moisture due to southern winds leading to frequent miscarriages and with excessive dryness due to northern winds leading to barrenness (and lactation insufficiency after having giving birth), while in Aristotle, only the excessive moisture due to southern winds is bad because it leads to more female offspring. The drying effect of northern winds is reinterpreted as beneficial in Aristotle's schema, as it contributes to concoction and thus leads to more male offspring.[41] As an aside, it might be worth mentioning that even though Aristotle does not attribute a major role to eastern winds, he elsewhere identifies cities facing east as the healthiest,[42] and he associates moderation in heat and a well-mixture of the environment with all the positive attributes assigned to eastern winds and intermediate regions in *Aer.*[43]

A similar pattern can be discerned regarding the effect of hard and cold waters on women's pregnancies: while the medical text associates these with northern winds (*Aer.* 4, 11.30 L. = 28,24–30,3 Diller) and identifies them as a cause of infertility due to excessive dryness, Aristotle refrains from specifying their causal connection to either type of wind. Instead, he seems to associate hard and cold waters implicitly with southern winds, as both are causes of infertility (but in this case due to excessive moistness) and the production of female offspring. However, even this association of excess moisture with infertility and with "the production of females" seems to have its source in *Aer.* and specifically in its account of the Scythians in *Aer.* 19–22. In these chapters, the Scythian

41 In this way, the characterization of southern winds as producing detrimental effects and northern winds as being the healthiest is closer to that employed in *Morb. Sacr.* 16.

42 See *Pol.* 7.11, 1330a34–41: "… As for [the city's] position (τὴν θέσιν), for it to be in accordance with our wish, we must look at four things: the first is health (πρὸς ὑγίειαν) as something that is necessary, for those that slope towards the east (πρὸς ἕω) and that are blown upon by winds coming from the east are the healthiest (ὑγιεινότεραι) …"

43 Cf. *Aer.* 12 (11.52–54 L. = 54,12–13 Diller): τὸ δὲ αἴτιον τουτέων ἡ κρῆσις τῶν ὡρέων; *Aer.* 12 (11.54 L. = 54,13 Diller): ἐν μέσῳ, and *Aer.* 24 (11.90 L. = 80,8–9) Diller: οὐκ εὔκρητα with *Pol.* 7.7, 1327b29: ὥσπερ μεσεύει κατὰ τοὺς τόπους and 1327b35: εὖ κέκραται.

territory is described as being *constantly* exposed to northern winds and therefore being in a constant state of winter (*Aer.* 19, 11.70–72 L. = 66,21–68,9 Diller). This constant frigid state makes the Scythians not dry (as one would perhaps expect based on *Aer.* 4), but excessively fat, moist, and flabby, and their bellies are never able to dry up (*Aer.* 19, 11.72 L. = 68,15–19 Diller). In addition, this excessively moist constitution is said to produce infertility among Scythians: in men, the moisture and softness of their abdomen takes away their desire for sex (plus the constant horse-riding makes them weak as well), while in the women, the excess fatness and moisture of their flesh prevents the male seed from entering their uterus (*Aer.* 21, 11.74–76 L. = 70,20–72,9 Diller). For the men, the condition is so bad that some of them become eunuchs and "do women's works and live the lives of women and speak in a similar way" (*Aer.* 22, 11.76 L. = 72,10–12 Diller): even in this medical context, excess moisture is "productive of females", and Aristotle seems to have adopted this causal association between excess moisture and being effeminate as well as the stereotype of the Scythians as being effeminate.[44]

The medical author only once discusses the effects of waters on pregnancies as they occur independently of winds (*Aer.* 7, 11.26–28 L. = 34,19–36,23 Diller): "marshy, standing, and stagnant waters" cause swellings and white phlegm in women, and "they conceive with difficulty and give birth with difficulty." In addition, "women appear to be pregnant, yet when the time for the delivery arrives, the fullness of the belly disappears: this happens whenever the uterus swells with moisture (ὁκόταν ὑδροπιήσωσιν αἱ ὑστέραι)." Aristotle does not include these marshy waters in his account in *Gen. an.* 4.2. However, note that the effects of the uterus swelling with moisture due to these waters is very similar to what happens to a uterus filling up with winds, as described both in the text of *Nat. Puer.* and by Aristotle in *Hist. an.* 7.4: women who suffer from these affections experience a raised uterus and false pregnancy symptoms.

A third consideration worth mentioning is that Aristotle does in fact treat the full range of factors brought up in the introductory chapter by the medical author of *Aer.*, but not all within *Gen. an.* 4.2. Two other passages are especially relevant. In the first of these, Aristotle provides a double causal explanation for why *Greek* women suffer most during pregnancy and childbirth by invoking both their excessive moistness and their *sedentary way of life*, the latter of which picks up the sixth factor mentioned by the author of *Aer.* (*Gen. an.* 4.6, 775a28–b16):

44 Cf. *Eth. Nic.* 7.7, 1150b1–16.

> There is also a difference between human beings and other animals regarding pregnancies. Other animals are most of the time in better physical condition, whereas most women suffer discomfort surrounding pregnancy.
>
> Now the cause of this is to some extent attributable to their manner of life (διὰ τὸν βίον), for they are sedentary (ἑδραῖαι γὰρ οὖσαι),[45] and this means that they are full of residue. This is borne out by the fact that among those ethnic groups in which the way of life of women is one of hard work (ἐν οἷς ἔθνεσι πονητικὸς ὁ τῶν γυναικῶν βίος), pregnancy is not as obvious and they give birth with ease, and the same holds of women everywhere who are used to physical toil. For the effort of working (ὁ πόνος) uses up the residues, whereas sedentary women (ταῖς δ' ἑδραίαις) have a great deal of such matter in their bodies owing to the absence of effort, as well as to the cessation of the menstrual discharges during pregnancy, and they find the pains of delivery severe. Hard work, on the other hand, gives the breath exercise (ὁ δὲ πόνος γυμνάζει τὸ πνεῦμα), so that they can hold it; and it is this which determines whether delivery is easy or difficult.
>
> All these things, then, as we have said, are in their way factors producing the difference in gestation as between women and the other animals; but the chief one is that … in women [the menstrual discharge] is greater in volume than in any other animal; and the result of this is that when it is not being discharged owing to pregnancy it causes them trouble. … In the other animals, because there is little of it and because the amount is commensurate with the growth of the embryos, and because the residues that obstruct the nourishment get used up, the animals are in a better physical condition (εὐημερεῖ τοῖς σώμασι).

In this complex explanation, Aristotle once again seems to draw from the account of the Scythian women provided in *Aer.* 18–21. For there the sedentary way of life is quoted as an additional cause of their infertility, from which they already suffer due to their excess moisture: the medical text argues that their habits of riding along in the wagons (*Aer.*18, 11.68 L. = 66,4 Diller), not swaddling their babies, and sitting around (*Aer.* 20, 11.74 L. = 70,14 Diller: διὰ τὴν

45 On this claim that sedentary women suffer most in childbirth, see also *Hist. an.* 7.9, 586b35–587a5: "Now in the other animals, births are not painful, but they are evidently troubled in a more moderate degree by labor; but in women the pains occur with more strength, especially in those who are sedentary (μάλιστα ταῖς ἑδραίαις) and those who are weak in the chest and who are unable to hold their breath. Labor is in fact more difficult if they let their breath go just when they are trying to exert force with the breath."

ἕδρην) make their bodies "fat and lazy, with cold and soft bellies" (*Aer.* 21, II.76 L. = 72,5–6 Diller: αὐταί τε ἀταλαίπωροι καὶ πίεραι, καὶ αἱ κοιλίαι ψυχραὶ καὶ μαλακαί). Even more strikingly, the medical text provides as a "great proof" for this explanation of infertility among Scythian women the case of slave-girls (*Aer.* 21, II.76 L. = 72,7–9 Diller), who conceive immediately after getting together with a man "on account of their hard labor and the leanness of their flesh (διὰ τὴν ταλαιπωρίην καὶ ἰσχνότητα τῆς σαρκός)." Aristotle substitutes the slave-girls—presumably abducted or bought by the Scythians from other regions—with a more generic description of ethnic groups in which the life of women is characterized by hard labour. The point is the same, though: a sedentary life increases an already existing excess of moisture in (Greek/Scythian) women, while hard work expends it and provides better "training" for childbirth.

For Aristotle's appeal to the first factor in *Aer.*, namely the role of the seasons and their impact on pregnancy and sex-differentiation, we need to turn to the eugenic program outlined in his *Politics* (*Pol.* 7.16, 1335a35–b2):

> About when sexual coupling should occur, we have spoken; about the season (περὶ τὴν ὥραν), one should use the times which many people use, since they now correctly set aside the winter for the production of this kind of living together as husband and wife. Also, it is necessary that they themselves study with a view to the production of children (δεῖ … αὐτοὺς … θεωρεῖν πρὸς τὴν τεκνοποιίαν) both the sayings from the physicians as well as those from the natural scientists: for the physicians speak sufficiently about the right times for bodies, and the natural scientists [speak sufficiently] about the winds, favoring northern winds more than southern ones (οἵ τε γὰρ ἰατροὶ τοὺς καιροὺς τῶν σωμάτων ἱκανῶς λέγουσι, καὶ περὶ τῶν πνευμάτων οἱ φυσικοί, τὰ βόρεια τῶν νοτίων ἐπαινοῦντες μᾶλλον).

In this passage, Aristotle identifies the winter as the appropriate season to conceive children,[46] but immediately follows this by suggesting that prospective parents should study themselves the writings of the physicians and the natural philosophers on this topic, attributing to the latter the claim that northern winds are better for producing children than southern winds, presumably because the former lead to more *male* offspring. Aristotle's differentiation here between physicians and natural philosophers complicates a reading of this as a

46 Cf. perhaps *Aer.* 10 (II.44 L. = 48,13–18 Diller) on the bad outcomes associated with pregnancies conceived during winters that are "southernly" and during springs that are "northernly."

straightforward reference to Hippocrates himself, whom he had just named as an example of a great physician (*Pol.* 7.4, 1326a15–16). However, as I hope to have shown, in his construction of the facts concerning the influence of environmental factors—and even ways of life—on women's pregnancies, (in)fertility, and troubles during childbirth in his *Gen. an.*, and subsequently in the eugenic program of *Pol.* 7.16, Aristotle's reliance on *Aer.* is pervasive, and his nod to Hippocrates perhaps acknowledges that influence.

Conclusion

In this paper, I have discussed two separate but related gynaecological phenomena concerning winds and pregnancies in Aristotle, and I have attempted to trace back these rather remarkable accounts to what I take to be their sources in the ancient medical corpus: Aristotle's views in *Hist. an.* 7.4 about how "pneumatic stuff" inflates the uterus and causes false pregnancy symptoms in women appear to originate in a similar account in *Nat. Puer.* 30, and his views in *Gen. an.* 4.2 about how winds (and waters and places) affect the sex of the offspring (and women's pregnancies and fertility more broadly) appear to originate in sections of *Aer.* discussing similar topics. Moreover, for the purposes of this paper, I have argued that Aristotle's extensive adaptation in his *Gen. an.* of gynaecological views from *Aer.* concerning winds and their effects on pregnancies provides some of the background against which Aristotle perhaps himself assessed the plausibility of other gynaecological claims made by medical authors, such as about winds inflating the uterus and causing false pregnancy-symptoms, and that this helps to explain the readiness with which Aristotle assimilated the account from *Nat. Puer.* into his own statement of the facts in *Hist. an.* 7.4. Taken together, these discussions also show the importance of the early medical texts on Aristotle's development of his own gynaecology more generally: despite his affirmation of the epistemological authority of women concerning the timing of conception, his main source of knowledge of the facts concerning *gunaikeia* appear to be the medical experts writing about these issues, not women themselves.

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CHAPTER 8

The Power of the Example: When Aristotle Read the Hippocratic *On the Nature of the Child* ...

Giouli Korobili

Introduction

The present chapter deals with two texts clearly differing in nature and purpose, Aristotle's *On Youth and Old Age, on Life and Death, on Respiration* (hereafter *On Youth*) and the Hippocratic *On Generation / On the Nature of the Child* (hereafter *Genit.* / *Nat. Pueri*).[1] These two pieces, when read together, constitute valuable sources of information for a tacit dialogue between medicine and natural philosophy in antiquity, each providing us with a representative example of the exchange of knowledge between kindred yet theoretically demarcated fields of what might be called 'ancient science'. Specifically, I will first show that the Hippocratic author, in the parts of the text where his natural philosophical interests are most prominent, seems to intentionally employ a number of examples originating not in the medical field but rather in the field of natural philosophy; and secondly that for this reason, among others, his text appears to have attracted the attention of Aristotle, who draws heavily on it for his own selection of examples in *On Youth*.

The two texts have much in common in respect to their main topics of discussion. *On Youth* is devoted to an examination of the concepts of life, death and respiration, and the stages of life. Aristotle's main goal in this treatise is to present a coherent account of all the necessary factors ensuring life. These factors are (1) the presence of the soul in the middle part of the body, (2) the presence of vital heat in the middle part of the body as an active principle, (3) the need for nutrition and for harmonisation with the physical environment, and (4) the need for cooling. The association of these factors with the concept of life is by no means Aristotle's innovation; yet the way they are interwoven, structured, and presented with the aim of clarifying the conditions

1 I follow Giorgianni (2006, 27) in using the abbreviation *Genit.* / *Nat. Pueri* for the work and in accepting it as a single treatise written by one author. I consider *On Youth and Old Age, on Life and Death* and *On Respiration* as constituting a single treatise: see Korobili (2022).

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under which a living body remains alive and healthy vividly exemplifies for the first time in extant Greek literature a psychophysiological theory of life.

The Hippocratic *On the Nature of the Child* comprises twenty chapters and is in all likelihood the second part of a larger medical work that begins with *On Generation*. The author presents his views about reproduction and embryology. The first eleven chapters, that is, the part called *Genit.*, deal with the nature of the seed, while the topic of discussion in chapters 12–31 is the nature of the embryo—how and by what means it develops into a living thing ready to be born. The exposition proceeds by delineating the developmental stages of the embryo from conception to parturition and, just like Aristotle, the Hippocratic author elaborates on the crucial role that material factors like breath / air, blood, and heat play in the successive phases of bodily development. A fascinating part of *Genit.* / *Nat. Pueri* deals with the analogy between embryo and plant (chapters 22–27, known as 'The Botanical Excursus') and this part bears important similarities with the initial chapters of *On Youth*, as we will see further below.[2] Both authors agree that, in a discussion revolving around the topic of life, one should take into account all kinds of living beings; hence, plants play a significant role in their works.

Moreover, the two texts display certain interesting similarities in the authorial techniques used to render the content more easily comprehensible to the reader.[3] In the course of their account, the two authors enrich their arguments not only by incorporating everyday knowledge along with views held by other thinkers, but also by resorting to summaries, digressions, analogical explanations, and illustrative examples. They both include several tacit indications of the kind of inquiry they conduct as well as direct self-referential statements on methodological issues.[4] As inquirers, they both emphasise the importance of employing data gained through observation not only at the very beginning of

2 Analogies between seed and embryo are frequent in Aristotle; see e.g. *De Generatione Animalium* (*Gen. an.*) 2.4, 739b33–740a4 and Connell (2016) 139–141, 147–149. For the pre-Socratic origins of this idea, see Lonie (1981) 237–239.

3 See Lonie (1981) 72–86, Giorgianni (2006) 6–11 and Korobili (2022) 187–211. Clarity and comprehension are highly valued, as can be inferred from the use of summary parts in both texts. According to Fausti (2010) 302, a search for clarity and precision characterises the "obvious didactic purpose" of the author. Aristotle twice summarises the important introductory chapters 1–6 of his treatise later on, namely in chapters 14 and 23. In a more direct way, the Hippocratic author claims that summaries serve to make things clearer (VII.504 L. = 188,18 Giorgianni). For more passages, see Fausti (2010) 316–317.

4 In the epilogue of *On Youth*, apart from a number of methodological remarks, we also find a kind of implicit guidance as to how the natural philosopher can select the subjects that should be dealt with in a treatise like *On Youth*; see Korobili (2022) 173–181.

an investigation but also at a later stage to verify certain accounts or views.[5] One particular type of observational data, experiment, is highly valued by the authors, as it clearly demonstrates how the validity of a certain hypothesis can be tested with a considerable degree of confidence. An experiment found in both texts, illustrating the development of chick embryos, will be discussed below.

After a combined analysis of the structure of *On Youth*, the content of its epilogue, and the methodological approach followed within it, it becomes clear that it belongs to the scientific genre of (or perhaps less anachronistically to the 'type of writing' called) *pragmateia*.[6] Whether *Genit.* / *Nat. Pueri* is also to be read as a *pragmateia* is still an open question. Philip van der Eijk refers to *Genit.* / *Nat. Pueri* as a treatise, although he admits that it does not correspond to the commonly accepted criteria for a *pragmateia* because, among other things, it reveals the authorial presence and seems less polished and less argumentative than other medical works.[7] Leaving this aspect aside, I am interested instead in

5 See *On Youth* 2, 468a22–23; 4, 469a23–28; *Genit.* / *Nat. Pueri* VII.486 L. = 166,11–12 Giorgianni; VII.504 L. = 190,15 Giorgianni; VII.534 L. = 220,12 Giorgianni. Autopsy is also highly esteemed and endorsed by both writers. Interestingly, the Hippocratic author incorporates into his account personal experiences such as the one we read in chapter 13, which he later identifies as *diagnosis* (Giorgianni 2006, 11 and n. 59). Not surprisingly, Aristotle's account is more laconic in this respect than that of the Hippocratic author. Yet it is still possible to identify the authorial persona, veiled behind the use of self/group-referential first-person plural verbs, an example of what M. Asper calls the "rhetoric of objectivity" (2019, 13).

6 Although there is no exact equivalence between our term 'treatise' and the ancient concept of *pragmateia*, and although we still need a comprehensive diachronic study of the concept, some specific features of *pragmateia* can be identified: "To give a strict definition of the treatise may not be easy, but we can certainly list some features commonly attributed to it and that distinguish it from other, perhaps equally elusive forms of writing (such as the 'essay'). In modern usage, we associate the treatise with systematicity, rigorous and sober reasoning about a well-defined subject or question, with the inquiry proceeding through rational argument from premises to conclusions, sometimes presented in the form of a series of theses with demonstrations. A treatise is usually impersonal and dispassionate in tone or mode of address; the presence of the author in the text (the authorial *ego*) tends to be minimal, as the argument is supposed to speak for itself; and the audience likewise tends to be, on a textual level, invisible or anonymous—at any rate no allowances are made for the non-expert. Consequently, and contrary to texts that are intended for beginners or lay people, a treatise can be characterized by ruthlessly specialized and complicated discussion of the subject matter, by exhaustive coverage and by a relentlessly high degree of technical detail and precision. When we look for examples from the ancient world illustrating these characteristics, we often associate the term 'treatise' with Aristotle's *pragmateiai*, well known—if not notorious—for their dry, sober, impersonal style of writing and uncompromising presentation." van der Eijk (2013) 146.

7 van der Eijk (2013) 147.

trying to understand whether *Genit.* / *Nat. Pueri* was read and treated as a treatise *by Aristotle*. In other words, without necessarily interrogating our modern standards for evaluating 'an ancient treatise', I set out to explore whether the attractiveness of this text in Aristotle's eyes had also to do with the medical author's style of writing. This is certainly a difficult undertaking and presupposes the examination of another, equally critical question: whether Aristotle had actually ever read *Genit.* / *Nat. Pueri*! It is my contention that Aristotle knew the content of *Genit.* / *Nat. Pueri* in a form close to what has come down to us today. In what follows, I will present three kinds of evidence to support this view: in Section 1, I will explain in what respect the two texts resemble each other as far as their main topic of discussion is concerned; in Section 2, I will pay special attention to the life-ensuring factors highlighted in both texts; while in Section 3, I will proceed comparatively, analysing selected passages found in the texts. Despite the similarities in thematic exposition as well as in methodological orientation, the purpose and, accordingly, the target audiences of these two texts are different.[8] How then can we explain the similarities? Could it be that both authors draw on a common reservoir of knowledge? Answering these questions in the concluding section of the chapter will enable me to offer some suggestions as to whether Aristotle could have treated *Genit.* / *Nat. Pueri* as an ancient treatise.

1 Similarities at the Broader Level of Thematic Agendas

Broadly speaking, both texts deal with the concepts 'life' and 'living thing'. The Hippocratic author addresses the topic in more practical terms, describing those functions that ensure life by considering both embryos and plants as living things. While his focus is undoubtedly on the initial stages of life, he nonetheless reverts very frequently to views centring on the developed 'human' (ἄνθρωπος). He thus turns a seemingly strictly embryological text into a work examining the major principles of life and health embedded within a physiological context. Aristotle, on the other hand, in a more philosophical manner, goes so far as to offer some sort of definition of life (24, 479a30) and death (4, 469b18–20), drawing a clear distinction between a plant (a thing that merely

8 Who are their target audiences? According to Giorgianni (2006, 6), *Genit.* / *Nat. Pueri* is a sophisticated, literary text intended for an educated audience with technical knowledge. *On Youth* on the other hand does not exclusively address an advanced audience (Korobili 2022, 3).

lives) and a thing that should be called an animal (which functions in a more complex way). Aristotle's aim in writing *On Youth* was to complement *De Anima* (as he himself states at the beginning of the former) by presenting his views on how physiology supports his theoretical working hypothesis that the soul is situated in the middle of the living body. Hence, the numerous medically-coloured accounts we find in this text serve to prove that (and how) the living body is a well-organised system in which both soul and body, as a unity, strive towards ensuring life and health.

While topics such as life, death, health, and generation had already been discussed before the oldest of the two texts, *Genit.* / *Nat. Pueri*, was written, what is remarkable in these two texts is that their authors organise their material and exposition in a relatively sophisticated way: we not only come across the tendency to underline the importance of particular life-securing factors, but can also discern the attempt to establish the view that there are certain specific requirements for life, growth, sustenance, and health. These prerequisites can be summarised as follows: nutrition, heat, breath ('exhalation / inhalation' / reception of air from outside), the localisation of the life-principle and the influence of the external environment. *Genit.* / *Nat. Pueri* is probably the first extant text in which all these prerequisites are deployed in order to constitute the broader conceptual framework upon which life-principles rest. Such a conceptual framework, as both Aristotle and the medical author show, can be applied to different forms of life (humans, animals, and plants) and to a variety of life-stages (adults, children, and embryos). Additionally, it enhances the overall sense of organisation of the data used, thus pointing towards an effective methodological approach underlying a careful and consistent style of writing.

Starting with the Hippocratic text, all the above factors are introduced as actively influential during the conception of the embryo—i.e., the earliest form of life. The relevant exposition occurs at perhaps the most crucial part of the text, namely towards the middle of the work,[9] at the very beginning of the discussion of the nature of the embryo:

> If the seed which comes from both parents remains in the womb of the woman, it is first of all thoroughly mixed together—for the woman of course does not remain still—and gathers into one mass which condenses *as the result of heat. Next, it acquires breath, since it is in a warm environment*. When it is filled with breath, the breath makes a passage for

9 Taken as a unified work—see n. 1.

> itself *in the middle of the seed* and escapes. Once this passage of escape for the warm breath has been formed, *the seed inspires from the mother a second quantity of breath, which is cool*. It continues to do this throughout the whole period: the warmth of its environment heats it, and it acquires cold breath from the mother's breathing. In fact everything that is heated acquires breath: the breath breaks a passage for its escape to the outside, and through this break the object which is being heated draws a second lot of cold breath, *by which it is fed*. (VII.486 L. = 164,7–166,5 Giorgianni).[10]

In this passage, I have italicised the requirements the medical author introduces in order for new life to begin. Through a quite dynamic image, (internal) *heat* is said here to act as a formative agent on the mixed seed and at the same time to affect the uterine *environment* (i.e., an environment external to it). As a consequence, the seed once formed draws *cold breath* which, upon escaping the seed, makes a vital passage in the middle of the seed, thus ensuring the latter's maintenance by retaining the heat's *source of nutrition*. Now compare these views with those found in the first six chapters of *On Youth*, from which I will provide some representative passages. The first one raises the importance of nutrition, which is regulated by several bodily parts:

> However, in order to preserve their nature, plants are indeed able [to continue to live when separated], while these animals are unable, as they do not have the organs to preserve themselves, and some are in need of the organ by which the food will be assumed and some are in need of the organ into which the food will be received, while others are in need of both of these and other organs too. (2, 468b5–9)

Here Aristotle does not specifically talk about the nutritive behaviour of internal heat;[11] rather, he examines nutrition in relation to animals whose bodies have undergone division. Yet this discussion prompts him indirectly to touch upon the topic of generation, when he alludes to the inability of these animals to regenerate organs they have lost. Bodily parts are formed only once after

10 Translations of *Genit.* / *Nat. Pueri* are taken from Lonie (1981). For the text, I follow Giorgianni (2006). Translations of Aristotle's works, apart from *On Youth* 1–6, follow the translations edited by Barnes (1984). The text of *On Youth* is based on Siwek's (1963) standard edition, except 6, 470a27ff. (=T4 below, cited already in p. 255), in which I accept Ross's (1955) reading.

11 See, however, pages 260–261 below.

conception, and those that fulfil vital processes (such as nutrition) are irreplaceable. Maintaining the organism's natural heat for retaining life is stressed in the following passage:

> Now, all parts and the whole body of animals have some connate natural heat; this is the reason why, when alive, they appear warm, but, when dead and deprived of life, they appear the opposite. (4, 469b6–9)

Shortly after, we find a passage that stands out as a sort of definition of death and, by extension, a concise description of what is indispensable for securing life:

> It is, therefore, of necessity that life and the maintenance of this heat exist simultaneously, and that what is called death be its destruction. (4, 469b18–20)

What is primarily responsible for the regulation of the natural heat of the body is the unhindered functioning of the organism's cooling mechanism, perhaps more than anywhere else in the source of heat, i.e., in the heart:

> It is obvious, therefore, that if indeed the heat is to be preserved (and this is necessary, if indeed the thing is to live), then some cooling of the heat in the principle [of life] must take place. (5, 470a5–7)

Plants, being stationary, may be affected by extreme environmental conditions, inasmuch as their natural heat is exposed, and thus in danger, when the weather is extremely hot or cold. Animals on the other hand can more easily adjust to their natural environment:

> And if the environment exceeds in coldness due to the season, when there are severe frosts, the force of the heat diminishes; but if there are heat-spells and the moisture drawn from the ground cannot produce a cooling effect, the heat is brought to an end by exhaustion … Now, of animals, since some live in the water and others spend their life in the air, it is from and through these media that they procure their cooling, the former by means of water, the latter by means of air. (6, 470a27–b4)[12]

12 More details on the importance of natural animal habitats are provided in Korobili (forthcoming).

These factors are repeated in summary form in *On Youth* 14, where cooling is left out of discussion (although referred to from chapter 15 onwards). Let us examine them in more detail.

2 Similarities between Specific Life-Securing Factors

2.1 *Heat*

Although in both texts the heat of the environment and the natural (i.e., internal or connate) heat are sharply distinguished, heat in general is conceived of as a constructive agent. In *Genit.* / *Nat. Pueri*, heat is responsible at an initial stage for condensing the spermatic residue.[13] As it causes the seed to inflate, the seed takes on a spherical shape (στρογγύλη), forming on its surface a membrane similar to the membrane formed on the surface of bread.[14] At a later stage of development, the bones of the embryo are said to "grow hard as a result of the coagulating action of heat".[15] In pregnant women, the fatty substance of nourishment, which produces breast milk, is warmed and becomes sweetened by the heat in the womb before being squeezed into the breasts.[16] Coming very close to Aristotelian terminology, the Hippocratic author claims that "the egg is made warm by the sitting of the hen, and its content is set in motion (κινέεται) by the same cause".[17]

As is well-known, Aristotle believed that the heat in the male seed is responsible for forming the female spermatic residue. In *Gen. an.*, he employs the example of rennet and milk (rennet contains vital heat and so brings the material into one mass and fixes it, eventually creating a solid membrane around it, *Gen. an.* 2.4, 739b20–33), an example resembling that of the baked bread offered by the Hippocratic author. Aristotle subsequently focuses on the formation of bones and sinews which, he says, are formed "as the fluid solidifies":

> The sinews and bones are formed by the internal heat as the moisture dries, and hence the bones are insoluble by fire like pottery, for like if they have been as it were baked in an oven by the heat in the process of development. (*Gen. an.* 2.6, 743a18–20)

13 VII.486 L. = 164,7–11 Giorgianni; cf. VII.470 L. = 146,3–15 Giorgianni.
14 VII.488 L. = 168,9–20 Giorgianni.
15 VII.498 L. = 180,16–17 Giorgianni.
16 VII.512 L. = 198,22–26 Giorgianni.
17 VII.536 L. = 222,15–16 Giorgianni.

The two authors are also in agreement with respect to the formation of breast milk. For Aristotle, breast milk results from the menstrual discharge in the breasts (and not in the womb as in *Genit.* / *Nat. Pueri*), which means that it is among the products of the action of nutrition (*Hist. an.* 7.3, 583a26–33). It is a warm and sweet product composed of a consistent substance and a watery serum (*Hist. an.* 3.20, 521b26–32). Although all this information is omitted in *On Youth*, most likely because it is not directly relevant to the subject matter, still, heat is introduced in chapters 4–6 as the principal factor on which life and soul depend in terms of both the growth / formation of parts and in terms of the maintenance of the living body.[18] In the sense of a dual principle, heat is employed by Aristotle here as being in constant need of nourishment and cooling, while at the same time standing in constant opposition to coldness.

2.2 *Breath*

Although *Genit.* / *Nat. Pueri* does not offer an account of cooling, as does *On Youth*, it does place special emphasis on breath as the crucial factor in regulating the amount of heat and blood in the foetus.[19] Breath is present from the very beginning in the spermatic mixture, and is understood as a result of the action of heat, i.e., as a sort of gaseous by-product of the heating of the mixture.[20] This process causes an inflation of the spermatic substance and, due to the pressure, the breath at some point makes a passage for itself in the solid membrane of the substance. Through this passage, warm breath is *exhaled* while cold breath is *inhaled*[21]—the terms used are ἐκπνοὴν ποιέεται and εἰσπνέει.[22] Interestingly, the author believes that once the mouth and nostrils have been formed, the embryo is able to respire (i.e., take air into and out of the body) normally and

18 Cf. Aristotle's summary statement at 14, 474a25–28: "We have already stated that life and the presence of soul involve a certain heat. Not even the digesting process to which is due the nutrition of animals occurs apart from soul and warmth, for it is fire that in all cases does the work."

19 VII.486 L. = 166,1–5 Giorgianni; VII.492–494 L. = 174,20–176,11 Giorgianni.

20 VII.486 L. = 164,7–166,2 Giorgianni.

21 Once this passage has been formed, the embryo avails itself of its mother, who acts as an additional source of cooling. Cf. VII.488 L. = 168,5–9 Giorgianni: "However there is a second source of breath for the seed: this is the breathing of the mother; for when the mother breathes in cold air from the outside, the seed gets the benefit of it: the seed is made warm by the warmth of its environment, and so it both contains and emits breath."

22 VII.488 L. = 166,23 Giorgianni; VII.486 L. = 164,15 Giorgianni. More frequently though, the author uses the terms ἴσχει ("aquire") or ἕλκει ("draw") and ἀφίησι ("emit"), and also phrases such as ἔξω ἔρχεται ("escape", VII.488 L. = 166,24 Giorgianni), πνοὴν ἔχει καὶ εἴσω καὶ ἔξω (VII.492 L. = 174,1–2 Giorgianni), πνέει (VII.492 L. = 174,18 Giorgianni) etc.

exclusively thanks to these parts.[23] This happens at some point before the 42nd day of the pregnancy for females and the 30th day for males, a temporal point of crucial importance for yet another reason, namely because the articulation of the body (effected by breath) starts to take place:

> By now the foetus is formed (καὶ γέγονεν ἤδη παιδίον). This stage[24] is reached, for the female foetus, in 42 days at maximum, and for the male, in 30 days at maximum. This is the period for articulation (διαρθροῦσθαι) in most cases, give or take a little. And the lochial discharge too after birth is usually completed within 42 days, if the child is a girl. At least this is the longest period which completes it (ἡ χρονιωτάτη καὶ τελείη), but it would still be safe even if it took only 25 days. If the child is a boy, the discharge takes 30 days—again the longest period which completes it (ἡ χρονιωτάτη καὶ τελείη), but there is no danger even if it takes only 20 days. (VII.498–500 L. = 184,7–19 Giorgianni; trans. slightly modified)

The passage starts by stating that by this time a child (παιδίον) has already formed. This use of the term παιδίον to denote the foetus (the embryo before the third month of gestation), although not rare in the Hippocratic corpus, remains infrequent in earlier and contemporary Greek literature, in which παιδίον usually refers to children after birth up to the age of seven years.[25] We may thus assume that—apart from several other purposes—this lexical choice, which points towards the future, could well serve the author's need to offer his non-expert reader a familiar image of the as yet unarticulated foetus. In other words, it helps the reader to visualise the 'unseen', to familiarise herself with the gradual development of the foetus' outline.[26]

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23 VII.498 L. = 182,8–9 Giorgianni.

24 This stage is viewed by the author as the first period of gestation, during which the embryo needs the least amount of blood flow to increase, compared with the rest of gestation, during which it has more need for blood (VII.500 L. = 186,3–10 Giorgianni). This view is compatible with his belief that the process of articulation (obviously a demanding process) starts at this point.

25 Hanson (2003) 188–190.

26 The author likes to indulge in such lexical tricks; earlier the foetus under formation was called "what is to become a living thing" (τὸ μέλλον ζῷον ἔσεσθαι, VII.492 L. = 174,11 Giorgianni). The author in all probability refers to the stages during the first critical weeks of pregnancy and the transformation of the generative materials into a living thing (cf. the use of the verb ζωοῦται, VII.540 L. = 226,17 Giorgianni). Instead of using a verbal form (e.g. ζῆν), which would have a direct meaning, he prefers to use an expression "appropriate to comparative biology where human procreation is not differentiated from that of other animals" (Craik 2015, 116), which enables the reader to visualise the entity under forma-

The period of articulation is compared in terms of duration with the period of lochial discharge. It is within this context that we find the author's views about the importance of the foetus' complete formation: it is implied that to be formed earlier than the longest period, although safe (ἀκίνδυνος), is not the best scenario, even though the foetus will survive. On the other hand, when the foetus takes the longest possible time to be formed, its articulation achieves its completion (τελείη)—the extreme being presented as the ideal medium. The formative capacity of breath / respiration seems to have a special status in this embryological doctrine: the author uses the root διαρθρ- (διάρθρωσις, διαρθρόω) at least 10 times in *Genit.* / *Nat. Pueri*, while it is rarely found in other works of the Hippocratic collection.[27] Here are a few examples:

> Now the formation of (διαρθροῦται) each of these parts occurs through respiration (πνοῆς)—that is to say, they become filled with air and separate, according to their various affinities. (VII.498 L. = 182,13–15 Giorgianni)

> Once the embryo's limbs are articulated (διαρθρωθῇ) and shaped, as it grows its bones become both harder and hollow, this too being effected by breath. (VII.506 L. = 192,1–4 Giorgianni)

In the same vein, Aristotle employs the concept of articulation in *On Youth* 2 in connection to (anatomically) complete animals:

> Since, then, there are three sections into which all complete (τέλεια) animals are divided, namely one by which they receive the food, one by which they emit the residue, and the third intermediate between these—in the largest animals this section is the chest but in other animals it is the analogous part—these [i.e., the three sections] are more clearly articulated (διήρθρωται) in some animals than in others. (2, 468a13–17)

Anatomically complete animals necessarily possess three bodily sections qualified to carry out the process of nutrition. Based on the comparison made later in the same chapter, these animals have the highest chance of survival, as opposed to animals that undergo division of their bodies and are then unable to replace or 'regenerate' the organs they have lost. Neither breath nor respira-

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tion within the womb. At the same time, this choice makes us wonder whether Aristotle's discussion of *On Youth* 1 (focusing on the clarification of what is a living thing and what is an animal) has been influenced by such lexical manoeuvres.

27 The root διαρθρ- is attested once in *De Morbis* 4, in *Epistulae*, and in *De Aere, Aequis et Locis*, and surprisingly only once in *De Articulis*.

tion, however, are in any way related to the process of articulation in Aristotle's mind.[28] One of Aristotle's main reasons for writing *On Youth* is to arrive at the truth about the purpose of respiration (ἀναπνοή). In his view, respiration occurs only in animals that possess lungs. Lungless animals utilise other forms of cooling. While he agrees with the author of *Genit.* / *Nat. Pueri* that in inhalation cold air is drawn into the body and in exhalation hot air is expelled (the Stagirite actually criticises some of his predecessors for having confused these two processes, see *On Youth* 11), he strongly disagrees with the claim that breath is received in order to nourish vital heat:

> But we must not entertain the notion that it is for purposes of nutrition that respiration is designed, and believe that the internal fire is fed by the breath; respiration, as it were, adding fuel to the fire, while the feeding of the flame results in the outward passage of the breath. To combat this doctrine I shall repeat what I said in opposition to the previous theories. This, or something analogous to it, should occur in the other animals also, for all possess vital heat. Further, how are we to describe this fictitious process of the generation of heat from the breath? Observation shows rather (μᾶλλον … ὁρῶμεν) that it is a product of the food. A consequence also of this theory is that the nutriment would enter and the refuse be discharged by the same channel, but this does not appear to occur (τοῦτο … οὐχ ὁρῶμεν γινόμενον) in the other instances. (*On Youth* 12, 473a3–14)

This view is defended by the author of *Genit.* / *Nat. Pueri* in a passage that seems to have been Aristotle's direct target:

> The same process occurs with wood, or with leaves, or with food and drink, when they are heated vigorously. You can see what happens from the case of burning wood—any kind of wood will behave in the same way, but green wood in particular. It will expel air where it has been cut, and when this air gets outside, it eddies around the cut. This is a matter of common observation (τοῦτο γινόμενον ὁρέομεν), and the inference is obvious: the air in the wood, since it is hot, draws to itself cold air to feed upon, at the same time as it expels air. If this were not the case, then neither would the air eddy as it is expelled. For everything which is heated is fed by a proportionate quantity of cold. Now when the moisture in the wood

28 For a detailed discussion of this chapter, see Korobili (2022) 37–57.

> is heated, it becomes air which then passes outside. As this air is expelled, the heat in the wood draws in cold air to replace it and to nourish itself. (VII.486 L. = 166,5–19 Giorgianni)

As far as I am aware, this is the only passage where this idea is expressed in terms so similar to those we find in Aristotle's text. It is probable, however, that the view was not held by the author of *Genit.* / *Nat. Pueri* alone.[29] The author uses the example of wood to emphasise that everything that is subjected to intense heat behaves in a similar way. When, on the other hand, Aristotle speaks of fire being supplied with combustible material (ὑπέκκαυμα ὑποβάλλεσθαι, 473a5–6), the image that immediately comes to mind is of wood being added to the hearth. At the same time, we find the Hippocratic author insisting that his opinion is patently obvious to anyone and a matter of common observation. By way of response, Aristotle challenges this view ("Observation shows *rather* …", μᾶλλον … ὁρῶμεν, 473a11–12) and concludes by rejecting, for the second time within a few lines, the Hippocratic author's line of reasoning: τοῦτο … οὐχ ὁρῶμεν γινόμενον (473a14). In Aristotle's eyes, this is due to the erroneous methodological approach endorsed by the Hippocratic author, which is in fact no better than fiction (473a11).[30]

2.3 *The Middle Part*

An interesting concept shared by both thinkers relates to the important role of the middle part in the formation and development of a living thing. In *On Youth* 1–4, we find Aristotle's justification of the middle bodily part as the place from which life and growth begins. Specifically, in chapter 1, the middle part of the body is put forward as a possible starting point for inquiry and is defined by reference to the spatial dimensions that are closely related to sensation and nutrition. In chapter 2, as we have seen in the previous section, it is further qualified in connection with the physiology and bodily articulation of complete (τέλεια) animals. Empirical evidence is adduced to support the view that the principle of the nutritive soul is situated in the middle of the three main bodily sections (head, thorax, legs). In chapter 3, Aristotle concludes that plants' generation (in both natural reproduction and transplantation) starts from their middle part. Based on these findings, he proceeds to make inferences about animal generation and cardiocentrism and implicitly refers to the well-known experiment on chick eggs, an experiment mentioned also by the Hippocratic

29 Bartoš (2020) 29–30.

30 On this point, see further Korobili (2022) 167–168, esp. n. 31.

author (chapter 29). Chapter 4 provides support "according to reason" (κατὰ τὸν λόγον) for the proposition that the psychic parts are situated in the optimal location, the middle of the body: in terms of proximity, the middle is close to those parts of the body that are involved in processing and receiving blood. In terms of location, the middle provides a secure environment for protecting the source of heat. At the same time, its position in relation to the other parts ensures the connection of those parts to the psychic source and the source of heat, as well as their dependence on these two sources.

In *Genit.* / *Nat. Pueri*, the crucial role that the author reserves for the middle point of the seed is that of the functional passageway through which the seed receives cooling while at the same time keeping its heat constantly nourished. Once the seed in the uterus acquires breath due to its being in a warm environment, breath escapes through the middle of the seed. From this point, a connection is established between the seed and its mother that enables the former to constantly acquire fresh and cold breath (recall here that for the Hippocratic author breath has a formative capacity).[31] Towards the end of chapter 12, the author refers again to the middle part. Interestingly, up to this point, he has explained and illustrated essential embryological concepts to which he often resorts in his exposition, but has treated the concept of the middle part as a self-evident given. That is, he feels the need to justify, for instance, his view that whatever is warmed expels warm air and draws in cold air even though he is convinced of its general truth, whereas he feels no need to reject, for example, the obvious counterproposal that air moves back and forth in the seed along some *random* point (and not specifically the middle part of it). Then, at the end of chapter 12, he launches into a description of the seed before the formation of the umbilicus:

> Around the seed which is warmed and comes completely into contact with the air, a membrane is formed at the exterior (περιτείνεται), and furthermore, a passageway to the middle (μέσον) of the seed forms through the membrane, so that breath can pass in and out. At that part of the membrane a narrow piece is missing, and there is very little of the seed present there, whereas the rest of the seed is spherical (στρογγύλη) inside its membrane. (VII.488 L. = 168,14–20 Giorgianni)

This passage places particular emphasis on the spherical shape of the seed under formation, and it does so by attempting to show that both the substance

31 VII.486 L. = 164,13–166,1 Giorgianni.

enclosed in the external membrane and the membrane protecting the substance are round in form, while it is from their (common) middle point that breath exerts its formative power. At a later stage, the umbilicus begins to form as a fleshy part of the embryo stretching from the centre of the seed towards the membrane.[32] In chapter 29, the statement about the middle point is repeated but here too no justification is given for ascribing such importance to this part of the body.

2.4 *Nutrition*

For Aristotle, nutrition is the function fundamentally responsible for the maintenance of a living being, while the nutritive soul is the elemental part of the soul and possessed by all living beings. The nutritive soul activates not only the process of nutrition, but also the processes of heating and cooling, and is in general assigned responsibility for the growth and development of the organism. In *On Youth*, such topics are at the centre of Aristotle's interest, together with the investigation of the relevant anatomical parts. In fact, already in chapter 2, Aristotle goes on to define complete (τέλεια) animals as animals exhibiting a clear articulation into three sections related to the process of nutrition (2, 468a13–17 cited in Section 2.2 above). On the other hand, dismembered or divided animals cannot survive because they are incapable of re-generating these parts once they have lost them. Nutrition is examined from two points of view: as a necessary condition for maintenance and as a necessary condition for growth. At the same time, Aristotle employs the language of nutrition in explaining decay and in describing perishing as a state in which heat cannot be adequately nourished (*On Youth* 5).

These two points of view in the investigation of nutrition can also be found in *Genit.* / *Nat. Pueri*. In chapter 27 the author refers to the concept of maintenance guaranteed by nutrition by drawing a comparison between plants and embryos:

> But to return now to the main argument which was my reason for introducing these matters. I maintain, then, that all plants which grow in the ground live off the moisture which comes from the ground, and that the character of the plant depends on the character of this moisture. Now it is in just the same way that the child in the womb lives from its mother, and it is on the condition of health of the mother that the condition of health of the child depends. But in fact, if you review what I have said,

32 VII.490–492 L. = 172,3–13 Giorgianni; VII.492 L. = 174,11–19 Giorgianni.

> you will find that from beginning to end the process of growth in plants and in humans is exactly the same.[33]

Some aspects of direct interaction between a healthy condition and the proper nourishment to be received by the embryo are discussed in *Genit.* / *Nat. Pueri* 9:

> Another thing which sometimes happens is that children are undersized and sickly, although both parents are large-bodied and strong. If this occurs subsequently to the birth of several children who are healthy like their parents, then it is clear that the child contracted its sickliness in the womb; the womb was more open than normal, and some of the child's nutriment from the mother escaped, hence the weakness of the child—and of course all living things fall sick to a degree in proportion to their normal strength. If on the other hand all the children born to a particular mother are weakly, the cause is the constriction of the womb. For if the space in which the embryo is nurtured is not adequate, obviously it will be undersized, since it will have insufficient space to grow in. Whereas if (a) it has plenty of space and (b) contracts no sickness, then it is reasonable to expect that a large offspring will be born to large parents. (VII.482 L. = 160,6–19 Giorgianni)

These two passages make clear that both the quality and the quantity of nourishment are an object of serious consideration when examining a child's (or a plant's) state of health. Normally, strong and large-bodied parents give birth to strong and large-bodied children—a statement revealing the significance of heredity for the author's account of growth and development. However, if

33 VII.528 L. = 214,15–24 Giorgianni. See also earlier: "Nutrition and growth depend on what arrives from the mother into her womb; and the health or disease of the child is relative to that of the mother. In just the same way, plants growing in the earth receive their nutriment from the earth and the condition of the plant depends on the condition of the earth in which it grows" (VII.514 L. = 200,12–17 Giorgianni). Now compare these passages with *On Youth* 1, 468a9–12: "For roots in plants are analogous to what is called the mouth in animals, by means of which the former receive the food from the ground, the latter [receive the food] by their own efforts." Aristotle is making valuable use of the Hippocratic author's view that the process of growth in plants and humans is the same, yet he leaves aside any reference to the character of plants. Still, frequent references to this idea are found scattered in his *Hist. an.* (see e.g. 5.11, 543b23–31 and cf. 5.16).

parents with physical characteristics such as those mentioned above give birth to undersized children, then the reason should be sought in a kind of deformity of the womb. Narrow or wide wombs may hinder the proper nourishment of the embryo and hence affect its development.

3 Additional Shared Examples

In this section, I will look at a few more examples of intriguing similarity between the Aristotelian and Hippocratic texts. Although proving direct influence is indeed a difficult and speculative task, in this section I hope to show that certain commonalities between these texts cannot be put down to mere coincidence. The first example comes from agriculture: both authors—the Hippocratic one *in extenso*—chose to employ an account of artificial plant reproduction in order to explain growth:

T1a (*Genit.* / *Nat. Pueri* VII, 514–518 L. = 200,17–204,12 Giorgianni):

> Now when a seed is planted in the earth, it is filled with moisture from it (the earth contains many different varieties of moisture, which is why it can nurture plants). Once the seed is filled with moisture, it becomes inflated and swells. Now there is a virtue or power in the seed: when the lightest part of this virtue is condensed and compressed by breath and the moisture in the seed, it turns into green shoots and breaks the seed open. This is what happens at first: the shoots sprout upwards, but once they have sprouted, then the moisture in the seed is no longer sufficient for their nutrition. So the seed and its shoots break open in a downward direction: the seed is forced to release downward that part of its virtue which has been left behind owing to its weight. Once the plant has taken firm root below and begins to derive its nutriment from the earth, then the whole seed is absorbed by the plant and disappears, excepting the husk, which is the most solid part of the seed. Eventually this too rots in the earth and disappears. After a time, some of the shoots send out branches. […] When trees are grown from slips, on the other hand, what happens is this: the sapling has a fracture *at its lower end* (where it was broken off from the parent tree), *the end which is placed in the earth*. This end sends out roots in the following way: when the plant is in the earth, and draws up moisture from the earth, it swells and becomes full of breath, though this is not yet the case with *the part projecting above the earth*. But *in the lower part*, the breath and moisture cause the heaviest portion of the plant's virtue to condense and to break forth *in a downward direction*; from it, there

> grow delicate roots. Once the plant has taken root *below*, it draws moisture from the root and imparts it to *the portion above the ground*. And so in its turn *the upper portion* too swells and acquires breath; and such of the virtue of the plant as is light condenses and grows out in the form of shoots: thereafter it grows both *upwards and downwards*. So the process of sprouting in the case of plants grown from seeds is just the opposite to the process in plants grown from slips: the shoots grow upward from the seed before the roots grow downward,[34] whereas the tree takes root first, and only later puts out leaves.

See also T1a' (*Genit.* / *Nat. Pueri* VII.528 L. = 214,3–11 Giorgianni):

> First of all the graft produces buds, for initially it still contains nutriment from the tree, from which it was removed (ἀφ' οὗ ἀπηνέχθη), and only subsequently from the tree in which it was engrafted (ἐν ᾧ ἐνετέθη). Then, when it buds, it puts forth slender roots into the tree, and feeds initially on the moisture actually in the tree on which it is engrafted. Then through course of time it extends its roots directly into the earth, through the tree on which it was engrafted; thereafter it uses the moisture which it draws up from the ground, and that is how it is nurtured—from the ground.

T1b (*On Youth* 3, 468b16–28):

> Moreover, [what is true] of animals is also clear in the case of plants; in plants this is clear to those who investigate both generation from seeds and grafting (ἐμφυτείας) and propagation by slips or cuttings (ἀποφυτείας). For in all plants generation from seeds results from the middle (for, since all seeds are bivalve (διθύρων), it is the place wherein (ᾗ) the two valves grow together (συμπέφυκεν) that is also the middle of each of the parts; both stem and root of plants emerge from that place (ἐντεῦθεν), and the starting point (ἀρχὴ) becomes their intermediary (μέσον)), and in both grafting and propagation by slips or cuttings, generation takes place, in most cases, about the eyes. For the eye is a sort of starting point of the branch, and at the same time it is its middle part; therefore people either remove this, or graft something into this, in order that either a branch

34 Contrary to this view, Aristotle states in *Gen. an.* 2.6, 741b34–37 that seeds send forth roots before shoots.

> or roots may be generated from it, in the belief that the origin of growth springs from the middle between stem and root.

Apart from the emphasis given to the vital process of nutrition discussed in the previous section, these texts refer to the two types of plant reproduction (natural and artificial) to illustrate how growth originates in the middle of the body and how crucial the surrounding environment is for nourishing the growing being. The Hippocratic author explains in much greater detail the formation and development of the seed as a kind of augmentation in size, which takes place by means of its drawing in of moist material. This process is understood as nutritional; indeed, the author states that the earth provides the seed with different sorts of nutritional ingredients for it to grow properly. Hence, the seed is visualised as a living thing that expresses the need for taking in food. Moreover, the whole process is explained as conforming to the developmental stages of the seed: when the seed receives insufficient nourishment from the ground, it adapts itself to circumstance and so sends out roots and turns into a plant. In both texts, the seed is viewed as the origin and centre of growth and development, and at the same time as the vital *topos* from which stems and roots will emerge in opposite directions.[35] Embedded in a sort of holistic approach, this example is intended by both authors to explain growth in all kinds of life.

On the other hand, in the second part of T1a, we find the Hippocratic author striving to determine with precision the double direction in which plant growth proceeds and searching for various expressions denoting the 'above' and 'below' in a tree with the surface of the earth as a reference point (the relevant phrases are italicised). One cannot help but ask whether this account is among those Aristotle criticises in *On Youth* 1, 467b32–468a12:

T2:

> [...] if the body of all living things is divided by reference to the up and the down (for all living things have an 'upper' and 'lower', and so, then, do plants as well), it is clear that [all living things] can have their nutrit-

35 The two authors do not miss the opportunity to emphasise that in plant life the crucial opposition between 'one' and 'many' is exemplified in terms of 'one source of origin'—'multiple outcomes': *Genit.* / *Nat. Pueri* VII.516 L. = 202,16–19 Giorgianni: "The reason for the *abundance of fruit, despite its small origin*, is that every plant draws from the earth more virtue than did the seed from which it originated, and this virtue erupts *not simply in one place, but in many*." (emphasis added); *On Youth* 2, 468a30–31: "[...] many trees come-to-be from a single source".

> ive principle in the middle of these regions. For we call upper that part in the region of which food enters, looking to it and not to the surrounding universe, while we call lower that part to the region of which living things emit the primary residue. This [arrangement] in plants stands in opposition to that in animals. On the one hand, among the animals, human beings, on account of their upright posture, possess in the greatest degree this arrangement, namely to have the upper part in accordance with the upper part of the universe, while the other animals have it in an intermediate position. For plants on the other hand, due to the fact that they are immobile and receive food from the ground, it is necessary always to have this part below. For roots in plants are analogous to what is called the mouth in animals, by means of which the former receive the food from the ground, the latter [receive the food] by their own efforts.

Aristotle's insistence on clarifying 'up' and 'down' in relation to living bodies implicitly critiques previous inconsistent attempts. Although he uses the first person plural ("we call upper"; "we call lower"), as though expressing shared human experience, this is actually one of those occasions in which the plural is employed in a self- or group- referential sense to demarcate Aristotle's and his students' views from competing ones.[36] What distinguishes his understanding of 'upper' and 'lower' from rival definitions is the perspective from which these directions are explained. For Aristotle, the upper part of plants and that of animals are not in the same direction with each other. Similarly, the upper part of plants is not in accordance with the upper part of the universe as others might be falsely led to believe.

Apart from the example of natural reproduction of plants and transplantation, the two authors use another common example, that of chick eggs, to explain how growth begins from the centre:

T3a (*Genit.* / *Nat. Pueri* VII.530 L. = 216,4–23 Giorgianni):

> Now I come to the observation which I promised to describe a little earlier—one which will make the matter as clear as is humanly possible to anyone who wishes to know that *the seed is contained in a membrane which has an umbilicus in the centre, and that the seed initially draws breath into itself and expires it, and that membranes extend from the umbil-*

36 Other such examples include 1, 467b20–25, 3, 468b29–30, and 4, 469a28–32. See in detail Korobili (2022) 196–199.

> *icus*. Furthermore (if you accept the evidence which I am about to give) you will find that the growth of the infant is from beginning to end exactly as I have described it in my discourse. If you take twenty or more eggs, and place them to hatch under two or more fowls, and on each day, starting from the second right up until the day on which the egg is hatched, you take one egg, break it open, and examine it, you will find that everything is as I have described—making allowance of course for the degree to which one can compare the growth of a chicken with that of a human being. You will find for instance that there are membranes extending from the umbilicus—in fact, that in every point all the phenomena I have described in the human child are to be found in a chicken's egg also. Yet if a man had not actually seen it, he would find it hard to believe that there is an umbilicus in a chicken's egg.

T3b (*On Youth* 3, 468b28–30):

> Likewise in blooded animals, the heart is generated first; this is clear from what we have concluded by observation in those cases in which it was possible to see while animals were still coming into being.[37]

In these passages, the two authors propound the same view that life and growth start from the middle part of the body. The Hippocratic author presents his experiment in detail, whereas such minutiae are outside Aristotle's scope here, as the latter instead confines himself to alluding to this example; that he himself experimented with chick eggs can be inferred from the lengthy account of *Hist. an*. 6.3, 561a5–b29, where he presents the stages of transformation in a three-day egg (and until the chick is born after the twentieth day), including a plethora of anatomical details.

Common examples used by the two authors do not end here. The following one aims at explaining plant maintenance:

T4a (*Genit.* / *Nat. Pueri* VII, 518 L. = 204,29–31 Giorgianni):

> [...] the earth below its surface is warm in winter, and cool in summer.

37 Cf. *De Partibus Animalium* 3.4, 665a33–b2: "For, in sanguineous animals, both heart and liver are visible enough when the body is only just formed, and while it is still extremely small. For these parts are to be seen in the egg sometimes as early as the third day, being then no bigger than a point; and are visible also in aborted embryos, while still excessively minute."

T4a' (*Genit.* / *Nat. Pueri* VII, 526 L. = 212,6–11 Giorgianni):

> Now if a tree is to be sound, it must not receive two lots of heat simultaneously, nor two lots of cold: if it receives heat above the ground, it must receive cold below the ground, and vice versa.

T4b (*On Youth* 6, 470a27–32):

> And if the environment exceeds in coldness due to the season, when there are severe frosts, the force of the heat diminishes; but if there are heat-spells and the moisture drawn from the ground cannot produce a cooling effect, the heat is brought to an end by exhaustion, and around these times of year trees are said to be blighted and star-struck.[38]

The principle of thermal inversion, or, according to these passages, the notion that when the atmosphere is cold, the underground earth is hot (or less cold) and *vice versa*, entails the balance required for plants to live. This mechanism of environmental adaptation enables plants to keep their most vital part—the upper part, where their roots / source of nourishment is to be found—intact under extreme weather conditions.[39] Further, thermal inversion as a principle expresses an underlying belief in the universal and collaborative harmony between living things and their surroundings. Both Aristotle and the Hippocratic author subscribe to this view.

The last example relates to the view shared by both authors that air in a cavity, when kept in motion, retains its coldness.

T5a (*Genit.* / *Nat. Pueri* VII.524 L. = 210,8–18 Giorgianni):

> In the same way too, drawing water from a well keeps the air in motion like a puff of wind, and causes it to chill the water; whereas if the water is not drawn during the summer but is left standing, because of its density it does not admit the air from the earth to the same extent, nor does it emit it into the earth. Instead, when it is allowed to remain stagnant in the well and is not moved about, it is warmed by the sun and the air superficially at first, then the heat is transmitted down through successive layers. This is why well-water which is not drawn in the summer is warmer than that which is drawn.

38 Cf. *Meteorologica* 1.12, 348b2–5: "Now we see that warm and cold react upon one another. Hence in warm weather the lower parts of the earth are cold and in a frost they are warm."

39 For roots as the 'mouth' of plants, see T2 above.

T5a' (*Genit.* / *Nat. Pueri* VII.526 L. = 212,11–17 Giorgianni):

> The roots distribute to the tree whatever they attract, while the tree distributes whatever it attracts to the roots: there is thus a dispensation of heat and cold. Just as when a man takes into his stomach those foods which cause heat when they are digested, he requires a compensatory cooling from drink, so too in the case of a tree the lower parts must compensate the upper, and vice versa.

T5b (*On Youth* 6, 470a22–27):

> And indeed the food brings about cooling when it enters, just as it also does in human beings when they first consume it, while fasting causes heat and produces thirst; for the air, being motionless, always becomes heated, but, moving as the food enters, it is cooled, until digestion is complete.

Both authors employ the same example of digestion to account for the temperature of air in motion. In both cases, the context focuses on plant maintenance. Yet there is an important difference in emphasis: while the Hippocratic author talks about heat produced by the transformed nutriment (digestion, as a process of change, produces heat), Aristotle emphasises the cooling effect of the whole process. Aristotle does not, of course, deny that heat is essentially a product of the digestive process, but this is not the point on which he wishes to focus here. We can therefore see how the Hippocratic view is transformed and adapted in *On Youth* to serve Aristotle's current purposes.

Concluding Remarks: The Power of the Example

Throughout *On Youth*, and especially in its epilogue, we come across various indications of what it is that helps produce an accomplished natural philosopher and an accomplished physician, what serves as an effective means to do research and write works suitable for its dissemination, and also in what sense these experts are allowed to endorse interdisciplinary approaches.[40] Such observations are by no means surprising, given the strategic position of *On*

40 See in detail Korobili (2022) 173–181.

Youth, a text with which Aristotle concludes his inquiry into living things and a collection of brief essays on what is common to body and soul. In *On Youth*, Aristotle not only allows for a fruitful dialogue between natural philosophy and medicine, but also claims (more or less directly) expertise in 'providing advice' on matters pertaining to both fields. In the same epilogue, Aristotle repeatedly uses the term *pragmateia* and cognate forms and implies that *On Youth* (as a text but also as a medium to communicate past research) is a *pragmateia*. Therefore, a close examination of this text may conclude that, in order to undertake research and transfer it into written form—a *pragmateia*, after the pattern of *On Youth*—any competent natural philosopher must pay attention to the following three factors in his inquiry: (a) content, (b) methodology and (c) interdisciplinary engagement.

(a) plainly involves the selection and discussion of those topics or research questions that pertain most properly to the scientific treatment of the subject under investigation. (b) relates to Aristotle's proposed methodological approach for conducting research, which can be reconstructed mainly but not exclusively from the critique of his predecessors, but also to his preferred writing techniques as deployed in *On Youth*. Finally, (c) allows for an interdisciplinary inquiry to be conducted (and transferred into written form) provided that the expert exercises caution when crossing the boundaries between kindred scientific fields. For a more concrete account of what (a), (b) and (c) imply, one has to study *On Youth* and explain the presence or absence of certain topics and methodological features found in that work. What the present analysis has shown, however, is that there is much in common between the Hippocratic *Genit. / Nat. Pueri* and *On Youth* in terms of all three factors specified above. In other words, in terms of its content, methodology and interdisciplinary approach, *Genit. / Nat. Pueri* must have appealed to Aristotle when composing *On Youth*. I have attempted to demonstrate that Aristotle was familiar with the content of the Hippocratic work and, when writing *On Youth*, found several of its examples to be useful and effective communication devices for his own readers. Furthermore, through an examination of selected passages, I have shown that the methodological approach of combining empirical data with abstract reasoning is endorsed by both authors, while their writing style and authorial strategy resemble one another in various respects.

The Hippocratic author commits himself to examining a medical topic, the nature of seed and embryo, by investigating already the earliest stage of the process of life-formation and looking at the cause of embryonic development and divergence. In a didactic manner, he turns his audience's attention to the need for synchronisation of the 'know-what' and 'know-why' factors of

his research with actual methodological practices prioritising the combination of empirical observation and reasoning as a prerequisite for grasping the true nature of things. Medical and natural philosophical questions are closely interwoven, being oriented in an implicit but clear way to a sophisticated target audience ready to explore embryology and the beginning of life through the prism of interdisciplinarity. The author prefers to address his audience directly, yet this personal tone, rather than being distracting, aims at rhetorically enhancing his arguments presented, especially those statements bringing to light the author's empirical observations. A textual outcome incorporating all the above-mentioned characteristics, such as *Genit. / Nat. Pueri*, could well be read, I propose, as a first attempt towards the establishment of the treatise-form of writing, and could have formed an attractive example for Aristotle while writing works like *On Youth*. Although it is difficult to say with any certainty whether Aristotle would have called *Genit. / Nat. Pueri* a *pragmateia*, we can still conclude that many of the stylistic features that pertain to Aristotle's *pragmateiai* can be identified in *Genit. / Nat. Pueri*. The comparative analysis above has shown that Aristotle was aware of the content of *Genit. / Nat. Pueri* and made valuable use of it as a fruitful example for his *On Youth*. Similarities tracked on the contextual level, especially the use of particular examples, such as the example of chick eggs, could testify to the direct influence of the Hippocratic text upon *On Youth*. On the other hand, similarities in methodology, such as the combination of empirical observation with reasoning and the knitting together of medical and natural philosophical ideas, do not necessarily point towards a loan from the Hippocratic text. Yet given the fact that such methodological choices are less frequent among the pre-Aristotelian medical texts and most common among the fragments of some pre-Socratic philosophers, we could assume that their presence within *Genit. / Nat. Pueri* had contributed positively to the production of a much-attractive textual source with which Aristotle attempted to open up a tacit philosophical dialogue.

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CHAPTER 9

Environmental Causation in Aristotle and in *Airs, Waters, Places*

Tiberiu Popa

Introduction

How is a natural kind generated? In modern biology, the standard response would appeal to evolutionary mechanisms. But Aristotle would find the question misguided, at least in most cases. He does, however, show a keen interest in answering another question, the answer to which depends in part on a peculiar notion of adaptation: what accounts for a biological kind being the kind that it is and that it has always been?[1] The answer relies primarily on interrelated concepts like essence (*to ti ēn einai*), defining account (*logos*), form (*eidos*), sets of specific capacities (*dynameis*) and functions (*erga*), and final cause (*to hou heneka*). That in itself is quite a metaphysical feat, and it has rightly been the subject of considerable discussion.

Closely linked with this, however, are Aristotle's detailed comments about the material constitution of organisms and about their interaction with their habitat—that is, what we might term environmental causation. A more comprehensive study of (quasi)adaptation would need to examine the kinds of examples where Aristotle notes adaptive features, but eschews outlines of causal mechanisms or even hints of mechanisms.[2] My paper, on the other hand, is centered on texts that go beyond simply listing characteristics which properly fit some environment or capturing the essential natures of various living beings.[3] Aristotle devotes much attention to causal mechanisms, some

1 On the notion of eternal species, see Lennox (2001b) and Henry (2006 and 2016), who investigate this topic from different perspectives.

2 To take a well-known example, consider the elephant's trunk, discussed in *Part. an.* 2.16. For a classic and influential analysis of the argumentative structure of this chapter (and related passages), see Gotthelf (2012b).

3 Gelber (2015, 269) offers an interesting attempt—partly based on earlier studies, notably Lennox (2010a and 2010b)—to reconstruct what she calls Aristotle's general answer to the question of fit (that is, between organisms and their habitats): "What I will propose (…) is a way of understanding Aristotle's views about the essences of living substances, i.e. the 'what-it-is-to-be' for living creatures, that explains why he would not ask any questions of

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rudimentary (e.g., the composition of organisms is determined to a significant extent by the 'chemistry' of the environment), some fairly sophisticated (e.g., a certain habitat and its specific climate can explain, for instance, the scarcity of water, which in turn accounts for diminished aggression among species sharing the same resources, a condition necessary for yet another phenomenon, interbreeding). His causal explanations cover both a wide range of determinants (climate, location, exposure to winds, composition of marine and other habitats, and much more) and of aspects which are subject to their influence (physical structure, 'biochemical' mixtures, longevity, as well as mental, temperamental and moral inclinations). In short, Aristotle's interest in such inquiries and explicit mechanisms is pervasive. Considered together, all of these accounts constitute a substantial set of explanations[4] supplementing, but never of course supplanting, Aristotle's effort to capture the essential characteristics of many kinds of animals in terms of functional accounts.

In this chapter, I argue that that it is likely that explanatory mechanisms[5] of this sort are significantly indebted to early medical theories.[6] Aristotle is

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fit. In short, my proposal will be that habitat is partially constitutive of the vital capacities that comprise a kind's essence." She rejects universal explanations based either on cosmic teleology or on the notion that habitats have "an efficient-causal role in shaping the character of the organisms living in them." I agree with Gelber in the rejection of the latter only to the extent to which environmental conditions do not seem to account for, say, the long legs of marsh-dwelling birds (her example, 2015, 276) or many other such features over which the corresponding functions have explanatory priority. While efficient causation alone cannot successfully explain all or even most defining characteristics of animals, I argue that Aristotle appeals to efficient causation quite consistently in a wide range of contexts, in ways that seem to echo earlier sources. On the concept of habitat in Aristotle, see also Morel (forthcoming), who distinguishes between the immediate or surrounding environment of an organism and a more comprehensive meaning of 'environment' (*periechon*).

4 This applies, among other works, to *Hist.an.*, despite the fact that this work, by and large, does not emphasize 'the why' (*to dioti*, in the language of *Hist. an.* 1 and of *Posterior Analytics* 1.13).

5 Causal connections are often explicit both in Aristotle and in the author of *Aer.* and are accompanied by words like 'cause' (*aitia*, *prophasis*) or by conjunctions, expressions, and particles that indicate such links ('for', *gar*; 'therefore', *dioti* etc.). As we shall see, however, there are also implicit explanations, where the cause and the expected or observed outcome are juxtaposed, but there is no direct elaboration on how a certain factor or cluster of factors is supposed to generate the corresponding outcome.

6 Awareness of Aristotle's general indebtedness to the early medical authors has been growing steadily in recent years; in addition to the other chapters in this volume, see, e.g., Pellegrin (1996), van der Eijk (2012, 2021), Johnson (2012), and Bartoš (2015, 2021). For possible links between medical writings and the Peripatetic *Problemata*, see Thumiger's chapter in this volume as well as Jouanna (1996b), Ulacco (2011), Oikonomopoulou (2015), and Thomas (2015).

notoriously tight-lipped when it comes to referencing specific medical treatises; this, however, should not prevent us from highlighting features shared with those works and probable influences. I am concerned here with works traditionally included in the Hippocratic Corpus, especially with *Airs, Waters, Places* (hereafter *Aer.*), probably written during the closing decades of the fifth century,[7] and where environmental causation plays a central and multifaceted explanatory role. While my comparison is by no means exhaustive, it aims to delineate the main aspects in which some of Aristotle's material-efficient explanations appear to follow the approach and occasionally the structure, formulation or details of the accounts offered in *Aer.* Significant similarities can be established, I believe, with a reasonable degree of confidence, with respect to how the environment can affect (1) the composition of organisms, (2) their morphology (including size), as well as (3) the temperament and character of human beings and of non-human animals. These aspects will be discussed in that order, although all three will also be addressed within each section. This reflects the fact that both Aristotle and the author of *Aer.* tend to fuse inextricably their respective observations about 'chemical' constitution, external and internal structures, and temperamental or moral propensities, although one or the other of these attributes can receive special attention, depending on the context.

In my analysis of passages from *Aer.* and from Aristotle's biological works, I identify the key elements of their methodological approaches, their guiding objectives and the principles that govern their inferences and demonstrations. Throughout this comparative study, I try to avoid the temptation of establishing incontrovertible and direct filiation, settling instead for probable influence. While I believe that Aristotle was acquainted with the main causal explanations offered in *Aer.* (and elsewhere, e.g., in *Vict.* 2) and at least with some of its passages, it cannot be established with certainty that he was familiar with the whole text of *Aer.*, rather than a synopsis or summary of it or with a collection of passages. While this inherent uncertainty must qualify any attempt to prove that Aristotle was partly influenced, directly or not, by *Aer.* (and by other early medical works), I trust it does not diminish the significance of the likely medical echoes in the sections of his zoological works where he explores the impact of environmental determinants, from distinct types of water to climate and landforms.

7 Jouanna (1996a) 82, (1999) 375, and Craik (2015) 11.

1 Composition

In his *Resp*., in the context of a discussion about breathing as a key factor in cooling the body and maintaining a vital thermic equilibrium,[8] Aristotle presents and then refutes the theory, defended about a century earlier by Empedocles, that the hottest animals seek to alleviate their condition by living (permanently) in water. Essentially, he demonstrates (*Resp*. 14) that Empedocles confuses an accidental state with (essential) nature. Aristotle does accept that excess of some state or condition (*hexis*) can be moderated if an animal seeks relief in places or during seasons of a type contrary to its state.[9] He may also have had in mind certain seasonal migrations, and possibly of terrestrial animals that try to find some respite from the relentless summer heat, by taking a plunge in a river for example. But—and this is the key point in our passage—while an animal may try to find relief in a place that is contrary to its bodily constitution and may even do so periodically, its nature itself is preserved[10] chiefly in suitable places (ἡ δὲ φύσις ἐν τοῖς οἰκείοις σώζεται μάλιστα τόποις *Resp*. 14, 477b16). This sharp distinction between natures and transient states, between *physeis* and *hexeis* or *diatheseis*, forms the brunt of his critique of Empedocles' view. In short, "The material natures [of organisms] happen to be of the same kind as the place in which they are found, those living in water being moist,[11] those living on earth being dry, and those living in air being

8 On the philosophical implications of Aristotle's discussion of cooling through respiration and otherwise, see Lennox (2020).

9 Aristotle appears here to be taking a page from early medicine, where good health is seen partly as the result of a proper equilibrium or *symmetria* between the dispositions that characterize a body (moist, hot, etc., and humours that reflect those characteristics) and the *dynameis* of the places and types of weather or climate to which the body is exposed. The therapeutic and prophylactic techniques discussed in works like *Vict*. and assumed in *Aer*., among others, rely significantly on the avoidance of such imbalances or the restoration of equilibrium between one's bodily constitution and the physical factors dominating a particular environment. *Epid*. 1 and 3 too could conceivably illustrate this point. The *katastaseis* outlined by the author, with their juxtaposition of dominant weather events and corresponding dispositions for sundry ailments and cases, amount arguably to complex, if implicit, inferences about the causes of those diseases. (For a relatively rare theoretical elaboration on this, see *Epid*. 1.23.) Perhaps this is also valid for *Aphorisms* 3, a somewhat later text.

10 In Aristotle's own treatment of material properties, the persistence of a thing's nature is often taken to hinge on the preservation of its proper heat within a particular range, which, of course, he never attempts to demarcate in precise quantitative fashion. On this see Freudenthal (1995) *passim*, and Popa (2020).

11 A more nuanced demarcation of aquatic and land animals in *Hist. an*. 7(8).2 relies on two criteria: whether they take in water or air for the purpose of cooling, and where they find

hot."[12] (*Resp*. 14, 477b31–478a1) The right place (*topos*) can attenuate an excessive or extreme state; this relief "should be sought in places proper to each type of material constitution (ἐν τοῖς οἰκείοις τόποις ἑκάστης ὕλης) and according to the changes of the general seasons.[13] For it is possible for the states [of organisms] to be contrary to the places [proper to them], but it's impossible for the matter [of the animals to be contrary to their proper places]."

So much is clear, then, about the correspondence between bodily composition and surroundings. Intuitively, all that may look sensible. What is not fully spelled out here, however, beyond this appeal to natures, is the reason behind this correspondence. In cases of spontaneous generation, the material nature of an animal can to some extent be explained by reference to its original constituents,[14] but that is not what is emphasized here. The main[15] explanation for the correspondence between physical constitution and environment likely has to do with the type of nourishment used by plants and animals. Examples can be found elsewhere. In *Hist. an*. 7(8).24, 605a9–17, for instance, the horse is said to have an affinity for water[16] and so does the hippopotamus (whose nature "is so constituted", *houtō sunestēken*), which suggests that the content of water[17] in the general composition of their bodies is relatively high. At *Hist. an*. 8(9).37, 621b3–6, we read that all fishes, migratory and nonmigratory ones alike, feed either in places where they grow (*phyōsi*) or in similar places, because the food proper (*oikeia*) to each of them is to be found in just such environments. The generic formulation of the principle underlying these and many other examples comes at the end of *Hist. an*. 7(8).1. After reminding his read-

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their food. E.g., an animal that takes in air and gives birth on land but finds its nourishment and spends much time in water is not an aquatic animal proper. Cf. *Hist. an*. 1.1, 487a14–b7.

12 The last category comprises land animals; their heat (which, again, needs to be kept within a certain range of tolerable levels by taking in air) is a mark of their perfection, relative to other living beings.

13 Literally: "according to the changes of the common season", κατὰ τὰς μεταβολάς τῆς κοινῆς ὥρας.

14 See, for instance, *Mete*. 4.1, 379b7–9: "[A]nimals are engendered in decaying materials, because the heat separated off, being natural, compounds the things that were separated out with it." (trans. Gill, Lennox, Popa).

15 Probably not the only one: see, in the section on morphology, the passage from *Gen. an*. 5.3, 782b32–783a1, where the moisture in the surrounding air is partly responsible for the composition of hair.

16 They like baths and they also drink a great deal of water: καὶ ὅλως ἐστι φιλολούτρον τὸ ζῷον καὶ ἐτι φίλυδρον 605a13.

17 Water, we should assume, exists potentially or *dynamei* in the constitution of these and other animals; for Aristotle's theory of uniform mixture, in which the original ingredients exist only potentially, but are in principle separable, see *Gen. corr*. 1.10, 2.7.

ers that the two activities which are fundamental to animals' lives are finding nourishment and producing offspring, Aristotle states that animals prefer foods (*trophai*) which correspond to the matter from which they are constituted (*kata tēn hylēn ex hoias synestēkasin*), because in each case growth is made possible by the same material nature. This 'law' of homogeneity rests on an even more general principle, articulated there by Aristotle: what is in accordance with nature is enjoyable, and all animals follow their natural pleasure.

The clearest causal explanation for the composition of human bodies is probably to be found in *Gen. an.* 4.2. Aristotle's main goal there is to identify the immediate as well as the more remote causes for sex differentiation. The main account turns on the predominance in an organism of moisture or dryness, and of heat or cold. The residue created by the accumulation of cold moisture can be harder to concoct (*dyspeptoteron*, *Gen. an.* 4.2, 766b37), and a moist constitution in the parents is likelier to lead to the conception of female offspring.[18] In addition to the physical constitution of the parents, Aristotle points out contributing factors such as the northerly winds, conducive to the generation of male offspring, and the southerly winds, which carry a greater amount of moisture, and can lead to the generation of female offspring (*Gen. an.* 4.2, 766b35–37).[19] Furthermore, following reports from shepherds, Aristotle surmises that the mere exposure of the parents to the north or the south during intercourse can determine whether they will beget male or female offspring. The chapter concludes with a reminder about the more general influence of the environment on the 'biochemistry' of organisms:

> Also, one region (*chōra*) differs from another in these respects, and one type of water from another on account of these same causes, for the quality of the nourishment especially and of someone's bodily condition depends on the blend of the surrounding air (διὰ τε τὴν κρᾶσιν τοῦ περιεστῶτος ἀέρος) and of the foods which the body takes up, and especially on the nourishment supplied by the water, since this is what we take most of, water being present as nourishment in everything, even in solid substances. (*Gen. an.* 4.2, 767a28–34; trans. Peck, slightly modified)

The nature of the land, then, as well as of the water, of the air and of the winds (as potential conveyors of moisture) can influence the composition of

18 The distinction between degrees of masculinity and femininity in both parents is somewhat reminiscent, perhaps not coincidentally, of the typology outlined in *Vict.* 1.28.

19 For a detailed analysis of this and related passages, from a different perspective, see Leunissen's chapter in this volume.

an organism, the main causal mechanism being ultimately the (direct or indirect) intake of water. That composition in turn becomes a proximate cause of generating male or female offspring. Aristotle's remarkable material-efficient explanation is quite complex and carefully links together various environmental factors among them, while also connecting them with nutrition.

While all this may appear simply attributable to Aristotle's own observation and intuition (garnished with reports by shepherds and others), passages such as these are likely also informed by the vast and detailed studies carried out by earlier physicians-*physiologoi* on nutrition or more generally on various regimens, and on the transformative effect of the environment (including climate as well as less stable weather patterns) on human constitution. The emphasis on the (mis)match between the composition of an organism and its habitat is definitely shared by a number of early medical writings (*Vict*. 1, for example)[20] and by some of the passages from Aristotle that I have mentioned above, even if the medical authors tend to be understandably more interested in factors that imperil the healthy balance of various bodily compositions.[21] The idea that the environment is partly responsible (along with way of life, etc.) for the 'chemical' composition and (im)balance of our bodies is amply illustrated also in *Aer*., for example, and, to a lesser extent, in *Sacred Disease*.[22]

According to *Aer*. 3 (II.14–18 L. = 26,22–28,23 Diller), people living in lands that are exposed to southerly winds (which are warmer and presumably carry a considerable amount of moisture) will have a moister constitution, including moist heads that are full of phlegm, and a rather flabby appearance (τὰ εἴδεα … ἀτονώτερα); their diseases will be due largely to excess of moisture. Those living in regions swept by northerly winds (*Aer*. 4, II.18–22 L. = 28,24–32,5 Diller) and where water is hard and cold tend to have a drier constitution; they are said to be sturdy and lean (εὐτόνους καὶ σκελιφρούς), and their characters are more fierce than mild (τὰ τε ἤθεα ἀγριώτερα ἢ ἡμερώτερα). In regions exposed to easterly winds (*Aer*. 5, II.22–24 L. = 32,6–24 Diller), which are spared extremes of heat and cold, and where the water is clear, sweet-smelling and soft, the inhabitants have a healthy complexion and diseases tend not to be frequent or severe (the implication being that the blend of their bodies tends to be better bal-

20 On this, see, e.g., Bartoš (2015) and Popa (2014).

21 See Bartoš's chapter on *krasis*, *summetria* and related concepts, in this volume, and also Johnson's chapter. Among the many relevant passages in the Hippocratic Corpus, see, e.g., *Vict*. 1.2.

22 With regard to *Sacred Disease*, see, for instance, the connection between the southerly winds and the excess of phlegm liable to block blood vessels, e.g., in chapters 14 and 16, with a remedy proposed in 21.

anced); they also display better temperament and intelligence. A similar set of causal connections can be found in the section on types of waters: for example, stagnant waters account for dry and hot viscera and a scrawny appearance (*Aer.* 7, II.26–32 L. = 34,16–40,6 Diller). Some of the examples and descriptions in the second major part of *Aer.* echo the first part: those who live near the Phasis river and in the surrounding marshy lands, where there are heavy rains and where the winds carry a great deal of moisture, are tall but flabby, so much so that one cannot discern their joints and their veins (*Aer.* 15, II.60–62 L. = 60,1–22 Diller).

Vict. 2.37 offers equally explicit accounts of how crucial properties of the human constitution are determined by habitat:

> The southern region is hotter and drier (θερμοτερὴ καὶ ξηροτερή) than the one lying in the north, and that is because it is the closest to the sun. The races of people (*ta ethnea*) and plants in those lands are necessarily drier and hotter and stronger than in opposite regions. Such is the Libyan race compared with the Pontic one … (*Vict.* 2.37,2–8, VI.528 L. = 158,3–7 Joly-Byl)

This reads like a compressed version of some of the passages in *Aer.* 12–24, without the elaboration on differences between characters, among other things. A few additional details, however, are provided to clarify the mechanism at work here, and the use of the transitive verbs in the next few lines in *Vict.* 2.37 (VI.528 L. = 158,10–16 Joly-Byl) is quite telling:

> Stagnant waters and marshes moisten and heat (ὑγραίνει καὶ θερμαίνει) … Valleys[23] devoid of water dry and heat (ξηραίνει καὶ θερμαίνει). They heat because they are hollow and circumscribed, and they dry both because of the dryness of the food and because the air that is breathed, being dry, draws the moisture (ἕλκει … τὸ ὑγρόν) from the bodies to use as nutrition for itself …

It is as if the active factors in the environment are taken to mold our nature, while we are reduced, at least with respect to our physical composition and the

23 Valleys (literally 'hollow spaces', *ta koila*), receive considerable attention in *Aer.* 1 as well (2.12 L. = 24,17–26,2 Diller: "the soil can be 'bare and dry or wooded and watered, hollow (*egkoilos*) and hot or high and cold'"; cf. 24, II.86 = 78,17 Diller) and, later, in Aristotle (e.g., *Gen. an.* 5.3, 783a33).

corresponding dispositions for health and disease (unless we follow a proper regimen), to a rather passive role in which we are largely subject to the effects of our habitat. This active / passive distribution of roles seems to have been adopted by Aristotle himself in a number of passages about quasi-adaptation or suitability to the environment (such as the end of *Gen. an.* 4.2 discussed above; see also, e.g., *Resp.* 14, 477b18–24).

Returning to Aristotle, then, the proposition that animals and plants should thrive mainly in places which match their material natures sounds reasonable enough, but this could well run the risk of circularity in a world where adaptation[24] is *not* conceived as a dynamic interaction between a variable population and gradually changing environments: an animal lives in some place rather than another because that place offers a certain type of nutrition, and the animal needs that kind of nutrition due to the composition of its body; but that composition (simply put, the particular ratio between the moist and the dry in a particular type of organism) is due to the fact that the animal lives in some place rather than another … By appealing solely to the concept of nature (it is in the nature of such and such animal to live in meadows or at the bottom of the sea), one is trapped within this circularity, especially in the 'static' world[25] that emerges from Aristotle's science and metaphysics (eternal forms, etc.).[26] Such an appeal to natures may be irreducible in its metaphysical simplicity, but may also cause more perplexity than illumination.

The sort of material factors discussed in this paper, on the other hand, quite frequently seem to point, however unsystematically, to *complementary*—as opposed to exclusive—modes of explaining certain features, such as the composition of organisms and its dependence on the environment. Aristotle may well be indebted to a number of early medical sources (or to texts based on

24 Environmental causation is not coextensive with adaptation, even though most of the passages dealing with the former also emphasize the latter. To give this distinction greater clarity, it may be helpful to think about the limits of teleology in Aristotle. In his view, not everything in nature or, more specifically, in the realm of life is goal-oriented. The limits of natural teleology in his biology have been discussed in a number of important studies—Lennox (2001a), Johnson (2006), Leunissen (2010), Gotthelf (2012a)—and the topic cannot be explored at more length here. The point I would like to make here is simply that several types of physical characteristics caused by external conditions are neutral with respect to adaptation: they do not contribute to more effectively coping with surrounding factors, to the organism's longevity under normal conditions, to reproduction, or to securing food.

25 There is perhaps a sense in which even modern schematic representations in biology can be regarded as 'static', as noted by Leroi (2010) 276.

26 See *Gen. an.* 2.1 and *De an.* 2.4. The classic study on the fixity of species is Lennox (2001b).

them) in his effort to clarify this relation. In both Aristotle and some of the early medical authors, nutrition turns out to be an essential causal link between the constitution of organisms and their habitat, and the quantity and quality of the moisture available in the environment is a central element of their causal explanations.

The shape and size of organisms, as well as the characteristics of their tissues, are the subject of investigations that often invoke the quality of the water in specific habitats, and more generally, the material nature of the environment and the roles played by cold and heat in it. I will first try to elucidate this aspect in the first part (1) of the next section, on morphology, before tackling two related topics: (2) the geographical distribution of dominant morphological features and of corresponding environmental causes, and (3) the explanatory strategies employed by Aristotle, and before him by the author of *Aer.*, in determining the causes of the typical sizes of animals.

2 Morphology

2.1 *'Chemical' and Thermal Conditions*

One of the most complex aspects of Aristotle's conception of the relation between living beings and their environment has to do with the overall structure of organisms—their size, the shapes of their various parts, the density of certain tissues etc., in short, roughly what we might call morphology. The impact of the environment on external appearance is abundantly illustrated by Aristotle's biology, but there are also a number of examples that focus on the characteristics of internal tissues. He distinguishes, for instance, between types of flesh (*sarkes*) in various fish (*Hist. an.* 7(8).13, 598a7–8). The flesh of fish that live deep in the sea is somewhat moist and flabby (ὑγραὶ εἰσι καὶ κεχυμέναι), in contrast with those that live close to the shore and whose flesh is denser (συνέστασι μᾶλλον). The explanation for this more compact flesh is that the regions near the shore have a beneficial balance (κεκραμένοι … καλῶς … οἱ τόποι). The language used there seems to reflect that of earlier texts (including medical) where proper or balanced mixtures (in the constitutions of bodies) are considered crucial for a healthy condition,[27] and where an excess of moisture is said to produce flabbiness (*Aer.* 3, 11.16 L. = 28,6 Diller; 15, 11.60 L. = 60,10–11 Diller; 24, 11.90 L. = 80,4 Diller). The beginning of this chapter, *Hist. an.* 7(8).13, 597b31–598a5, clarifies the causal chain: the sun shines on the plants growing

27 On this, see Bartoš's chapter in this volume.

in the water by the shore "as if in gardens"; this in turn contributes to an ample supply of food for the fish, and the result is a higher density or compactness in the flesh of those fish.

Such notes on the density of various tissues are supplemented elsewhere by comments on the external, observable shapes of animals. In a section dealing with the reproduction of bloodless animals, he notes quite memorably that *testacea* (or "the shard-skinned ones", *ta ostrakoderma*) are in respect to moisture like plants in respect to earth: "the shellfish are, as it were, plants living in water" (*Gen. an.* 7.11, 761a32). The more general point here is that different environments are best suited to different forms of life. Even though some plants grow in the sea, most grow "on the earth" (*en tēi gēi*);[28] conversely, although a few forms of *testacea* live "on the earth" (including some snails), most live in the sea. This is the immediate context that gives rise to an excursus about the relation between the shapes of animals and the elements prevalent in their environments.

Living beings that grow in water (*Gen. an.* 3.11, 761a32–b23) exhibit a greater variety of shapes (are more *polymorpha*) than those living on land or in the soil, because what is moist is more malleable or plastic (*euplastoteran*)[29] than earth. Moreover, sea water moisture of sea water is actually *not* much less 'bodily' (*sōmatōdes*) or substantial than earth.[30] Aristotle then refines his distinction by stressing that "the more and the less and nearer and farther make a significant and surprising difference".[31] Peck declares this phrase virtually meaningless,[32] but the examples supplied by Aristotle indicate fairly clearly that variations in the "substantial" nature of the water causally explain the presence or absence of different types of organisms in those aquatic environments. Fresh water, while

28 Cf. *Resp.* 14, discussed above.

29 Plasticity is a material disposition defined in *Mete.* 4.9, 386a26–29 as a subtype of a more general capacity, *thlaston*: being capable of taking an indentation or an impression. If something is *thlaston*, if the indentation or impression also persists, and if it is relatively easy to shape (for instance by hand), then it can be called *plaston*, "moldable". Judging by the adjacent passages in *Mete.* 4.9, about things that are fragile and things that are squeezable, the underlying structure responsible for plasticity is a certain network of *poroi* or invisible channels crossing what is *plaston* in a particular pattern.

30 Being *sōmatōdes* amounts here to having a share of moisture, of *pneuma* and of earth, and thus combines conditions which are normally necessary for the survival of aquatic forms of life, of land animals (*pneuma*, which can have a special meaning, crucial to Aristotle's account of generation—see, e.g., *Gen. an.* 2.3, 736b30737–a8—seems to be treated here as a synonym for 'air'), and of plants respectively.

31 Τὸ δὲ μᾶλλον καὶ ἧττον καὶ ἐγγύτερον καὶ πορρώτερον πολλὴν ποιεῖ καὶ θαυμαστὴν διαφοράν (*Gen. an.* 3.11, 761b15–16).

32 Peck (1942) 351 n. e.

sweet and nourishing, is less substantial and is also cold. Therefore (*dioper*), bloodless animals, which are not naturally hot, are not generated (*ou ginetai*) in lakes or in water that, while brackish, is close to being fresh—with some exceptions: some of the *testacea* ("shard-skinned", hard-shelled), cephalopods ("the soft ones"), and crustacea ("the soft-shelled ones"). Sea water, on the other hand, has more body (it is more *sōmatōdes*) than fresh water and is naturally hot, and so for that reason is the best habitat for a greater variety of animals.

Aristotle often[33] draws a direct causal connection between the environment and the 'chemical' composition of organisms.[34] It is hardly surprising, then, that in his view the nature of organisms living in the sea is very moist, which in turn explains their relatively high plasticity, and their immense variety of shapes, compared to those that grow in the earth (which are more earthy by nature, and thus less moldable, less varied—mainly plants) and also, among aquatic animals, compared to those that live in waters which are not particularly 'substantial' and hot.[35] Heat is an important element here both because it is a fundamental condition for life in general[36] and because, according to this passage from *Gen. an.* 3.11, it increases the plasticity of sea animals in contrast with cold.[37] This combination of 'chemical' and mechanical conditions (for example, plasticity) as well as thermal ones—invoked in addition to teleological accounts—makes for a curious picture of adaptation, in which plants and animals seemingly play a mostly passive role, with their environments assuming the role of a complex efficient cause which imposes shapes and determines composition.

These and similar passages share with early medical authors the general notion that habitat (including a wide range of types of water) and climate

33 E.g., *Resp.* 14, *Gen. an.* 3.11.

34 Variation in the constitution of animals should also be ascribed to differences with regard to way of life (*bios*). *Bios* itself is of course a very rich concept, analyzable into many complementary aspects, at least some of which (e.g., being a predator or not) can presumably further explain the composition of a certain type of organism. For a careful reexamination of the concept of *bios*, see Lennox (2010a), (2010b).

35 For the various meanings of 'hot' and 'cold', see *Part. an.* 2.2, 648a37–649b8.

36 On this, see *Long.* 5.

37 Cold and aqueous form a natural pair (e.g., in less 'substantial' liquids such as the water of lakes, compared to sea water), in so far as watery liquids can freeze more easily, a point that is elaborated in *Mete.* IV and is put to work in interesting ways elsewhere in explaining 'biochemical' and corresponding temperamental features (fear is associated with cold, and deer, which are relatively fearful creatures, hardly have any earthy fibers in their blood, which is thus more liable to freeze, according to *Part. an.* 2.4, 650b28–33, cf. *Mete.* 4.7).

can be largely responsible for the size and shapes of organisms.[38] Those living in regions where waters have a high mineral content are vigorous and lean (εὐτόνους καὶ σκελιφρούς, *Aer.* 4, 11.18 L. = 30,4 Diller) and have hard bellies.[39] People who live in regions with a relatively mild climate and drink water that is sweet, soft, and delightful have a good complexion, healthy appearance (εἴδεα … ἀνθηρά, *Aer.* 5, 11.24 L. = 32,17 Diller), and clear voices. Those living in west-facing localities and who drink turbid waters (*Aer.* 6, 11.24–26 L. = 32,25–34,15 Diller) are pale and have hoarse voices. Places with marshy, turbid waters are generally inhabited by people who are unusually thin, their shoulder blades and collar bones sticking out. Composition and morphology go hand in hand in such passages, just as they do in Aristotle. They rely on relatively unsophisticated, but admirably consistent, analogies. In addition, the idea that there are various different types of water—in respect to how it is formed and its purity or mineral content, among other things—is essential in this network of environmental causes and their impact on physical constitutions. Aristotle does not follow these 'recipes' in detail, and the scope of his biological investigations is more nuanced and comprehensive, but the overall causal principle at work in his accounts of environmental causation does approximate the explanations offered by early medical sources for numerous morphological features.

2.2 *Geographical Distribution*

Those generic explanations are supplemented in the second main section of *Aer.* with descriptive and normative comparisons between vast geographical regions. In *Aer.* 23 (11.82–86 L. = 76,5–78,8 Diller), climate is said to determine the appearance (κατὰ τὰς μορφάς) of sundry ethnic groups. The causal mechanism behind these distinctive characteristics is the changes undergone by the semen, whose congealing (τῇ συμπήξει) is affected by numerous deteriorations (αἱ φθοραὶ πλειόνες), especially in regions with sharp differences between seasons, which also affects various non-human animals (oxen are hornless in the lands of the Scythians because of the cold, *Aer.* 18, 11.68 L. = 66,9–10 Diller). Much of Europe experiences significant contrasts between seasons,[40] droughts

38 Lifestyle and customs too, of course, can contribute significantly to the shaping of bodies (*Aer.* 14, for example, includes a striking example), whether such traits are heritable or not.

39 For an interesting comparison between the comments on hard water, especially regarding infertility, in *Aer.* 4, 11.58–60 L. and Aristotle's observations in *Gen. an.* 4.2, see Byl (1980) 81.

40 On the distinctions made by the Hippocratic authors between seasons and on some of the innovations they introduced, especially with respect to the autumn, see Jouanna (2021).

alternating with heavy rains, intense cold with searing heat, and this meteorological variety is presumably the reason for a greater variety of sizes and shapes (κατὰ τὸ μέγεθος καὶ κατὰ τὰς μορφάς *Aer.* 23, II.82 L. = 76,6–7 Diller), as well as temperaments and stamina,[41] in contrast with the Scythians, for example. Morphological diversity is also induced by landforms (and related causes). According to the final chapter of *Aer.*, mountainous, rugged, and watered places, where the differences between seasons are particularly striking, account for the large physique, bravery, and ferocity of their inhabitants. Those living in valleys (κοιλὰ χωρία*Aer.* 24, II.86 L. = 78,17 Diller) are relatively short, have an unimposing physique, are fleshy and dark-haired, and lack courage or endurance. People living on high, windy plateaus are tall, but comparatively mild-natured. If a region has dry and bare soil and the differences between seasons are quite pronounced, their inhabitants display a hard physique (*eidea … sklēra*, *Aer.* 24, II.88 L. = 80,9 Diller) and are vigorous, have a fair complexion and a bold and independent spirit.

In addition to differences between types of landforms, climate and weather patterns, the quality of the soil and the availability of water are also major determinants in the appearance of various European populations. Both the physique and the behavior of the inhabitants are determined by (*akoloutheunta*, II.90 L. = 80,16 Diller) the nature of the soil or the land. Fertile and well-watered lands are populated by (and somehow produce) fleshy people whose joints are ill-defined (*anarthroi*, II.90 L. = 82,4 Diller) and who are deficient in intelligence and courage. Lands that are barren, devoid of water, and exposed to intense changes between seasons are populated by people who are well-built (*eutonous*, II.92 L. = 82,9 Diller), lean, and hairy, and are exceptionally energetic, intelligent, and courageous.

As with Aristotle later on, the author of *Aer.* does not adopt a simple reductionist approach, but allows for multiple and often interrelated factors to form complex networks of principal and auxiliary causes. Composition and morphology (along with temperament and way of life) are often treated together as inseparable aspects, although one or the other may receive special emphasis, depending on the topic at hand.

Aristotle's treatment of what we would call morphology may at first glance seem more akin to the spirit of the first eleven chapters of *Aer.*, with their distinct interest in correlation between the amount and quality of moisture and other elements of the environment, on the one hand, and the dominant fea-

41 See also *Aer.* 24 (II.86 L. = 78,11 Diller): "(with regard to) sizes and shapes and (levels of) courage", τὰ μεγέθεα καὶ τὰς μορφὰς καὶ τὰς ἀνδρείας

tures of (mainly human) organisms on the other. At least occasionally, however, Aristotle will make rather elaborate comparisons between kinds of animals and between peoples from different regions, with their respective climates, in a manner quite reminiscent of chapters 12–24 of the same *Aer*; *Gen. an.* 5 comes to mind as one such example.

Most of the distinctive features studied in *Gen. an.* 5 are emphatically non-teleological;[42] their coming to be and their being are not for the sake of something (*heneka tou*, *Gen. an.* 5.1, 778a32). Ch. 3 is concerned mostly with the material / efficient causes[43] for the thickness of hair, for the curly or straight nature of hair, and also for baldness. The number of causally explanatory principles in this chapter is staggering and there are remarkably numerous echoes from the *Mete.*, both its first three books (e.g., the smoky exhalation is mentioned at *Gen. an.* 5.3, 782b20)[44] and from *Mete.* 4 (e.g., *poroi* or minuscule channels which cross solid bodies, *Mete.* 4.9; thermal and mechanical processes)—texts where teleology is marginal at best.[45] The first sections of *Gen. an.* 5.3 focus on 'biochemistry' (including the ratio between the moist and the dry in the skin and in hair, and the fatty or greasy content that can inhibit drying)[46] and on morphological details: for example, if the pores in the skin are relatively large and the skin has a pronounced earthy composition, the hair will be thick. Later in the chapter, however, Aristotle gradually turns his attention to the extent to which *external* conditions are responsible for certain differentiae. Internal, chemical processes remain central to his explanations (curly hair is shaped by two contrary tendencies: heat moves upward, earthy matter downward), but he explicitly argues that this is only one possible cause[47] and that another one involves the drying of the prevalent earthy content of hair by the heat in the environment[48] (ὑπὸ τοῦ περιέχοντος 5.3, 782b26; ὑπὸ τῆς τοῦ περιέ-

42 The nature and limits of natural teleology in Aristotle's biology have been discussed in a number of seminal studies, including Lennox (2001a), Johnson (2006), Leunissen (2010), and Gotthelf (2012a).

43 References to material necessity (e.g., *anagkaion*, *Gen. an.* 783a4) are thus quite appropriate in this context.

44 The two types of exhalations (*anathymiaseis*)—dry or smoky and moist or vapor-like—are used in *Mete.* 1–3 to explain a wide variety of phenomena, from comets to earthquakes and to the formation of minerals.

45 With the notable exception of the very last chapter, *Mete.* 4.12 (for a detailed examination, see Gill (2014)) and of a handful of passages mostly in *Mete.* 4.

46 Qualitative differences in the moisture contained by the skin are a contributory cause (*synaition*, *Gen. an.* 5.3, 782a27) for the characteristics of hair.

47 … ἐνδέχεται μὲν οὖν οὕτω λαβεῖν τὴν αἰτίαν …

48 The term (*to*) *periechon* does not have a consistent or precise semantic sphere. As Morel (forthcoming) notes in the conclusion to his study, "(…) Aristotle's attitude towards

χοντος θερμότητετος 782b29). To further bolster this explanation, he asks us to consider the opposite case:

> Animals that contain a great deal of moisture have straight hair, because in their hair the moisture advances by flowing, not by dripping. That is why Scythians by the Black Sea and the Thracians have straight hair: both their constitution and the surrounding air (ὁ περιέχων ἀήρ) are moist. On the other hand, Ethiopians and people who live in hot regions have curly hair, because both their brain[49] and the surrounding air (ὁ ἀήρ ὁ περιέχων) are dry. (*Gen. an.* 5.3, 782b32–783a1; trans. A.L. Peck, slightly modified)

Such examples recall the sort of illustrations offered by *Aer.*, especially in chapters 12–24, not only in virtue of specific references to distant and utterly different lands, but also because of the pride of place taken by the causal connections between climate, on the one hand, and the peculiarities of the people living in those regions, on the other.

A similar set of environmental causes is invoked by Aristotle in his attempts to explain why some kinds of animals or races / breeds have thick hair and others thin, why some have hard hair and others soft. Here is another passage from *Gen. an.* 5.3, which illustrates this facet of his inquiry, while also claiming that different species living in the same or in comparable conditions can be affected variously by the environment:

> In cold regions sheep and human beings are affected differently from each other: for (*gar*) the Scythians have soft hair, but Sarmatian sheep have hard hair. The cause of this (τούτου δ'αἴτιον) is the same as it is in all wild animals. For (*gar*) the cold hardens them by solidifying and drying them,

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the surrounding environment is at the same time unsatisfactory and more subtle than it is commonly recognized. It is unsatisfactory insofar as it does not offer any systematic account of this notion, despite the fact that this lies at the core of his zoology, and because the most accurate term, περιέχον, is ambiguous. It is not always easy to discern whether it means the surrounding environment in the narrow sense, i.e. what surrounds the material boundaries of the body, or in the broad sense, including climate, region and the population of the living area of the animal or plant. Similarly, it is far from clear in what way the organism interacts with its immediate environment." He continues by pointing out that "Aristotle locates in the immediate environment the material conditions to which the vegetative-nutritive soul responds integrating their impact in the global *praxis* of the living being."

49 The brain's function is to cool down the body by offsetting the heat produced around the region of the heart. It is not, as, e.g., in *Sacred Disease* 19–20 or in Plato's *Ti.*, the seat of or at least connected with intelligence, perception and related capacities.

> for the moisture evaporates when the heat is expelled, and the hair as well as the skin become earthy and hard. The cause (*aition*) for some wild animals is that they live in the open air, while for others it is the fact that the place is of this sort (τόπος τοιοῦτος ὤν). (*Gen. an.* 5.3, 783a13–20; trans. A.L. Peck)

The outline of the 'thermodynamic'[50] process described here comes directly from *Mete.* 4, where the loss of moisture is often said (e.g., in Ch. 7) to accompany the suppression of internal or natural heat by external heat or cold, the result being usually the loss of a thing's very nature or *physis*, i.e., its proper cluster of capacities.

Again, echoes from *Aer.* 12–24 may be detected in Aristotle (whether he was familiar with that text itself or a summary of it), both with respect to his geographical references and in so far as determinants like moisture (itself dependent on climate or, as in the previous passage, on the proximity of the sea) are essential to physical features such as the nature of the hair. The impression of similarity with *Aer.* is further strengthened in the passage which immediately follows the section about the Scythians and the Sarmatian sheep, and where Aristotle mobilizes similar physical processes to explain why sea urchins have long and hard spines. The cold leads to the evaporation of internal moisture through the expulsion of the organism's natural heat, which causes hardening; insufficient concoction (*pepsis*), due to cold, causes the accumulation of residues and the growth of the spines.[51] To bring the main elements of this causal explanation into sharp relief, Aristotle makes an analogy with plants. Geographical situation (*topos*, 783a19) becomes crucial in this analogy (e.g., growing in valleys or hollows, *en koilois*, 783a33; cf. *Aer.* 24, II.12 L. = 26,1 Diller, II.86 L. = 78,17 Diller, and *Vict.* 37, VI.518 L. = 158,13–14 Joly-Byl), as do the winds. He speaks of the plants' exposure to northerly winds, which can increase the cold and accelerate the evaporation of internal moisture (plants are harder, earthier, almost petrified, if exposed to the northerly winds); southerly winds presumably have the opposite effect. All this, again, seems to borrow both from the early medical authors, directly or indirectly, and from Aristotle's own treatment of material interactions in *Mete.* 4 Indeed, it may not be accidental that several passages which appear to be indebted to works like *Aer.* are clustered together, and so I find it plausible that Aristotle may have drawn upon that

50 I borrow the term from Lennox (2014).

51 No function is attributed to the spines here, in keeping with the general emphasis on material necessity, rather than on natural teleology in *Gen. an.* 5.3. However, the role of the spines in the sea urchins' locomotion is mentioned in passing at *Part. an.* 4.5, 681a9.

source (or some intermediary text based on *Aer.*) throughout this section. Both Aristotle and the medical author seek to reveal the connections between relatively stable[52] environmental conditions and specific physical qualities of populations exposed to those conditions, and both of them appeal consistently to thermal and 'chemical' properties (for instance, preponderance of moisture of a certain kind in organisms or in their habitats).

2.3 *Size* (*and Longevity*)

Let me conclude this section on morphology by addressing a particular and quite prominent aspect of morphology in both Aristotle's biology and in *Aer.*: conditions responsible for the *size* of animals (usually varieties within a certain form, *eidos*, or kind, *genos*, of animals)[53] in various climates and regions. On a few occasions, Aristotle appears more guarded in his approach than his predecessors and acknowledges that animals' size variations cannot be traced uniformly and universally to climate. In *Hist. an.* 7(8), 28, for example, he notes that:

52 Many of the physical characteristics examined and explained in *Aer.* and in Aristotle's biology are regarded as essential or defining: the specific composition and morphology of organisms of a certain kind living in a particular region. Aristotle is also interested in the acquisition of accidental and transient qualities, especially in contexts focusing on morbidity. While his observations are far less detailed than what we find in early medical works, they are still interesting, not least because they seem to echo those earlier treatises. The pathology of birds and fish, for example, is a topic central to chapters 18–20 of his *Hist. an.* 7(8). Rainy years can compromise the health of birds, just as dry years can threaten the health of fish. The discussion in these texts is not so much about climates as it is about variations within climates, i.e., weather patterns that dominate a certain period of time (roughly what the author of *Epid.* 1 and 3 would call a 'constitution', *katastasis*). Aristotle deals in this context both with the symptoms of those diseases and with their etiology. Some threats resulting from weather patterns are common to all fish, but, in Ch. 19 and 20, he refines his explanatory accounts to indicate why certain kinds or forms of fish are more vulnerable to—or are more greatly benefited by—certain conditions rather than others. Rainy years are beneficial for many shellfish, but not for the murex (or purpura, *tais porphyrais*, *Hist. an.* 7(8).20, 603a13). During rainy years, the fish tend to migrate to the Black Sea in the summer: rain swells the numerous rivers flowing into the Black Sea and the sea water becomes sweeter, which then attracts those fish (20, 603a25 ff.). Other environmental conditions, like winds and situation, are carefully taken into account as well. Exposure to certain winds can contribute to the good health of fish, e.g., northerly winds have a more positive influence on long fish than southerly winds, especially in the summer (602a23–25). Different places, *topoi* (602a16), benefit different kinds of fish; for example, weedy places provide ample supplies of food. This all reads potentially like the repurposing of critical elements of texts like *Vict.* 2.37–38 and *Aer.* 1–11 and the application of those causal explanations to the health and seasonal morbidity of birds and fish.

53 On such subtler distinctions, not just with respect to size, see Jouanna (1996a) 62.

> In Egypt, whereas the other animals are larger than in Greece, such as the cattle and the sheep, some are smaller, for example wolves and asses and hares and foxes and ravens and hawks, and some are about the same, for example crows and goats. The cause is attributed to (*aitiōntai*) the food, in that it is unstinted for some but scanty for others such as the wolves and the hawks, and so is the provision for carnivores since the small birds are scanty, and for hares and all that do not eat flesh because neither nuts nor fruit have a long season. (*Hist. an.* 7(8).28, 606a21–b3; trans. D. Balme, slightly modified)

He thus carefully conveys a certain hesitation in attributing the cause of this diversity to food supply, but, given the examples justifying this explanation, and the absence of any objection, we may assume that he is basically inclined to accept this causal connection. Sparse population (e.g., of relatively small prey) can translate into scanty food for predators, and how much fruit certain plants will yield can play a comparable role for other animals. Ultimately, the various links in this complex causal matrix appear to point to climate, but the way in which it affects various forms of life cannot be reduced to a simple, linear account.

Aristotle, however, sounds much like the author of *Aer.* when he confidently identifies a direct causal link between the size of animals, taken quite generally, and their respective habitats. The passage quoted above continues as follows:

> In many places the climate too is a cause (ἡ κρᾶσις αἰτία), for example in Illyria and Thrace and Epirus the donkeys are small, while in Scythia and the Celtic country they do not occur at all. For these animals winter badly. In Arabia the lizards are over a cubit long, and there are many mice bigger than the field mice, having forelegs a span long and hind legs as long as up to the first joint of the fingers. In Libya the snakes develop a monstrous size, so it is said … (*Hist. an.* 7(8).28, 606b3–10; trans. D. Balme)

There is a somewhat folkloric ring about these lines, which is only intensified in what follows (large snakes devouring cattle and chasing galleys); but again, it is not clear whether Aristotle rejects any—or even most—of this. Be that as it may, the gist of this passage and of comparable passages is quite clear: warmer lands are generally inhabited by larger animals. What this passage lacks is an explanatory mechanism in terms of thermal and '(bio)chemical' processes. Fortunately, we find a convenient elucidation in another treatise, in *Long.* 5, 466b17–28:

> The same kinds of animals (*ta d'auta*) are longer lived in hot countries than in cold, for the same reason as that which makes them larger. The size of animals which have a cold nature makes this obvious; so snakes, lizards, and reptiles with horny scales are large in hot countries, and so are *testacea* in the Red Sea; for the warm moisture causes growth as well as life. But in cold countries the moisture in animals is more watery; consequently it congeals easily, so that in the northern climes animals with little or no blood either do not occur at all (neither terrestrial animals on land, nor water creatures in the sea), or if they do occur they are smaller and shorter lived; for the frost robs them of growth (ἀφαιρεῖται γὰρ ὁ πάγος τὴν αὔξησιν). (Trans. Hett.)

Crucially, the *quality* of the moisture contributes to size and longevity.[54] We have already come across a passage (*Gen. an.* 3.11, 761a32–b23) where the diversity of fish was attributed to the difference between sea water and less 'substantial' waters (the sweeter among brackish waters, e.g., the water of some lakes). The distinction here is between warm and cold moisture, and between aqueous[55] and fatty moisture.[56] One of the reasons why human beings tend to live longer than larger creatures is that our bodies contain a hotter type of moisture (*Long.* 5, 466a33–b2). Fatty or greasy moisture too ensures longer life in some animals, all things being equal, because it prevents easy drying and cooling (again, "the living creature is by nature moist and warm"). The argument is that fat contains air,[57] the nature of air is closer to that of fire (compared to the other simple bodies or so-called elements), and fire does not decay.[58] Aristotle's statements on the correlation between warm climate and the size of adult organisms, then, are supported by his physiological accounts developed in other contexts.

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54 The quality of the moisture (the driest water, the densest water, the purest water, etc.), among other things, plays a central explanatory role in the typology of human types (according to degrees of intelligence, temperament, vulnerability to various diseases) articulated in *Vict.* 1.32 and 35. Moisture is also an important factor in determining the contrasts between constitutions corresponding to different ages (*Vict.* 1.33) and between sexes (34). These accounts, however, differ in their details from Aristotle's.

55 The lifespan of some plants far exceeds anything that can be found among animals because their moisture is not watery; being viscous, it is less liable to dry up easily. (*Long.* 4, 466a9–10, 5.467a7–10).

56 On watery vs. greasy moisture, see *Gen. an.* 5.3, 782b5, 14–18.

57 See *Mete.* 4.7: the reason why olive oil floats on water is because it contains air. For a different argument, see *Gen. an.* 2.2, 735b13–17.

58 Cf. *Mete.* 4.1, 379a14–16.

Clearly, he is not content *merely* to draw on earlier treatises like *Aer.*, and develops his own causal accounts of the size and longevity of animals, as he does in *Long.*, just as in *Gen. an.* 5.3 he deploys with great effect his own theory about material interactions articulated in *Mete.* This, however, is not to say that his approach to explaining the size of (varieties of) animals is not largely similar to and possibly indebted to the correlations made by the author of *Aer.* Here are a few examples from *Aer.* 12: "(…) everything grows much more beautiful and larger in Asia …" (πολὺ γὰρ καλλίονα καὶ μέζονα πάντα γίνεται ἐν τῇ Ἀσίῃ … *Aer.* 12, 11.52 L. = 54,10–12 Diller); "The crops there tend to be abundant, the ones from seed as well as those that the soil itself provides …" (*Aer.* 12, 11.54 L. = 56,1–5 Diller); "people are well-nourished, of most beautiful appearance and very tall: καὶ μεγέθει μεγίστουςAer. 12, 2.54 L. = 56,6–7 Diller)." By contrast, in his later discussion about the Scythians, the author of *Aer.* observes that the animals living in the Rhipeaean mountains do not grow large so that they can find shelter underground (… οἵα τε ἐστιν ὑπὸ τὴν γὴν σκεπάζεσθαι); winter inhibits (*kōlyei*) their growth, as does the absence of warmth and shelter above the ground (*Aer.* 19, 11.72 L. = 68,7–9 Diller). He also repeatedly notes the variety to be found among Europeans (e.g., *Aer.* 23, 11.82–86 L. = 76,5–78,8 Diller) in stature and shape (κατὰ τὸ μέγεθος καὶ κατὰ τὰς μορφάς), attributing this to Europe's greater degree of climatic diversity and more pronounced contrasts between seasons than can be found elsewhere. Relatedly, as mentioned above, *Aer.* 23 points out that the changes undergone by the semen, whose congealing (*tēi sympēxei*) is affected by numerous deteriorations (αἱ φθοραί πλειόνες) in such regions, is the proximate cause—dependent on habitat—of the distinct appearance (*tas morphas*) of European peoples.

The ultimate cause, however, for morphological differences remains climate and the hot-cold and dry-moist continua, both for the author of *Aer.* and for Aristotle. This is evident in many of the passages analyzed in this section and is equally relevant to their approaches to how dominant types of temperament (with their moral connotations) are imposed by the environment.

3 Temperament

Aristotle's investigation into the interplay between animals' natures and their environment extends beyond physical attributes. As we have already seen in several passages, the types of causes responsible for distinct temperamental propensities range from various landforms to climate and to the necessity for cooperation among species. Here is an example dealing with a place not far from his native Stagira:

> Places (*topoi*) [i.e. *different* places] also produce differing characters (*ēthē*), for example mountainous and rugged places (τόποι … ὀρεινοὶ καὶ τραχεῖς) produce characters different from those in level and soft places: even in their appearance they are wilder and fiercer (καὶ γὰρ τὰς ὄψεις ἀγριώτερα καὶ ἀλκιμώτερα), like the pigs on Mount Athos; for even their sows are too much for the lowland boars to face. (*Hist. an.* 7(8).29, 607a9–13; trans. D.M. Balme, modified)

Whether or not this is an autoptic account (perhaps reinforced by reports from shepherds or hunters, etc.) is hard to tell, but Aristotle may very well rely here on analogies between uneven terrain and fierce temperament that go back at least as far as the last few decades of the fifth century, when *Aer.* must have been written. The word *topos* may at first seem banal, but it was used virtually as a technical term in early medical works to signal one of the most impactful determinants of good health or of different prevalent illnesses, of physical constitution, appearance, and character. The semantic sphere of *topos* is extensive, both in Aristotle's use of this word and in the medical authors. To take only some of the more prominent uses: landforms (here and in *Gen. an.* 5.3); exposure to sunrise or sunset, to this or that wind—and thus to dry or moist, cold or warm air (again, cf. *Gen. an.* 5.3, discussed above); general geographical situation (warm climes vs cold or temperate ones); land vs aquatic environment; access to various sources of water with significantly different mineral contents and properties; access to food in scant or ample supply (*Hist. an.* 7(8), 13); typical habitat for a certain *eidos* or *genos* of animals.

The implicit analogy employed here is between a mountainous and especially wild region and the wild, fierce character of the beasts that live there. There is no elaboration on exactly how that habitat impresses its character on the animals' looks and behaviours, but it is probable, again, that several medical accounts loom in the background of such passages. For the author of *Aer.* at least, landforms and climate or weather patterns are closely related in their combined effect on the morphology and dispositions of animals, including humans. Relative uniformity throughout the year and pleasant conditions are responsible for the imposing size and the beauty of animals and plants (πολὺ γὰρ καλλίονα καὶ μείζονα … *Aer.* 12, 11.52 L. = 54,10–11 Diller) as well as for the mild nature of the inhabitants (*Aer.* 12, 11.52 L. = 54,11–12). On the other hand:

> Where the seasons experience the greatest and the most frequent changes, the land too is very wild and very uneven; you will find there many wooded mountains, plains and meadows. But where the seasons do not alter much, the land is very even. So it is too with the people, if you

> will examine the matter. Some physiques resemble wooded, well-watered mountains, others light, dry land, others marshy meadows, others a plain of bare, parched earth.[59] For the seasons which modify a physical frame differ; if the differences be great, the more too are the differences in the shapes. (*Aer.* 13, II.58 L. = 56,19–58,16 Diller; trans. Jones, slightly modified)

Later, in Ch. 16 of *Aer.*, the author adds that one of the main reasons (*aitiai*, *prophasias*) for the gentler character (*ēthē*) of the inhabitants of Asia and the more warlike Europeans is that the seasons are comparatively uniform in Asia, whereas the seasons in European lands involve major changes (μεγάλας μεταβολάς). Those changes cause shocks to the mind (ἐκπλήξεις τῆς γνώμης *Aer.* 16, II.64 L. = 62,6–7 Diller), which shape the character of the Europeans.[60] This idea is further accentuated in *Aer.* 19 (II.72 L. = 68,14–17 Diller), where the absence of sudden, violent changes is taken to explain the lack of mental and physical endurance and the moist, fleshy bodies of the Scythians, and in Ch. 23, where considerable variations between the seasons are thought to be responsible for wild, unsociable and spirited natures. The causal mechanism described in Ch. 16 is echoed in Ch. 23: frequent shocks inflicted on the mind (αἱ γὰρ ἐκπλήξεις πυκναί γινόμεναι τῆς γνώμης … *Aer.* 23, II.84 L. = 76,19–20 Diller) by the changes from one season to another stimulate and toughen people's characters.[61]

Presumably, sharp differences between seasons are especially noticeable at high altitudes. A mountainous and rough region (χώρην ὀρεινήν … καὶ τρηχείαν …) contributes to the large stature of people living there, and to their endurance and courage, and their fierce and wild character.[62] Significantly,

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59 In the same vein, at the very end of his *Histories* (9.122), Herodotus has Cyrus issue this warning: soft lands breed soft men; it is uncommon for exquisite fruit and warlike men to grow from the same soil.

60 As mentioned before, this seems to be accompanied by another type of (proximate) cause in *Aer.* 23, where the differences among European peoples is explained by the numerous affections or corruptions (*phthorai*, 23, II.84 L. = 76,15 Diller) in the congealing of the semen, affections induced by frequent changes in weather.

61 It is tempting to suppose that the author of *Aer.* may have relied implicitly on analogies with technological methods, e.g., of rendering iron harder through repeated and sudden exposure to intense heat and to cold. For a reference to the production of steel (*ta stomōmata*) based on such a method, see *Mete.* 4.6, 383a32–b2.

62 … ἐνταῦθα εἰκὸς εἴδεα μεγάλα εἶναι καὶ πρὸς τὰ ταλαιπῶρον, καὶ τὸ ἀνδρεῖον εὖ πεφυκότα, καὶ τὸ ἄγριον καὶ τὸ θηριώδες αἱ τοιαῦται φυσίες οὐχ ἥκιστα ἔχουσιν (*Aer.* 24, II.86 L. = 78,15–17 Diller). Major changes from one season to another can also produce a character that is wild, unsociable, and spirited (τό τε ἄγριον καὶ τὸ ἀμεικτόν καὶ τὸ θυμοειδές … *Aer.* 23, II.84 L. = 76,18 Diller).

Aristotle's contrast between animals living in mountainous regions and those living in valleys, and his choice of characteristics and even words and expressions in his account of the boars on mount Athos (*Hist. an.* 7(8).29.607a9–13) are so similar to this passage in *Aer.* 24 that mere coincidence seems unlikely:

– *Aer.* 24 (11.86 L. = 78,13 Diller): "A mountainous and rough region … (χώρην ὀρεινήν … καὶ τρηχείαν …)";
– *Hist. an.* 7(8).29 (607a9–10): "… mountainous and rough places (τόποι … ὀρεινοὶ καὶ τραχεῖς)";
– *Aer.* 24 (11.86 L. = 78,16–17 Diller): "… display a keenly wild and fierce character (… καὶ τὸ ἄγριον καὶ το θηριώδες αἱ τοιαῦται φυσίες οὐχ ἥκιστα ἐχουσιν)";
– *Hist. an.* 7(8).29 (607a11–12): "… even in their appearance they are wilder and fiercer (… καὶ γὰρ τὰς ὄψεις ἀγριώτερα καὶ ἀλκιμώτερα) …".

All these causal links are brought together in a convenient synopsis in the final sections of Ch. 24, which reaffirm the environmental causes of the distinctions between (geographically distributed) dominant types of temperament. Was Aristotle aware of such explanations? Passages like *Hist. an.* 7(8).29, 607a9–13 seem to suggest so.

Furthermore, much as we find in some of the early medical authors, so too in Aristotle's biological studies temperamental inclinations sometimes have a pronounced *moral* dimension.[63] Being warlike is not merely a neutral description, but also a normative comment: the Europeans are presumably more courageous and thus morally superior. Aristotle tacitly accepts this naïve and perhaps comforting view. It should also be noted that while he does sometimes include the Greeks among the Europeans, at other times he points out temperamental and moral differences. Probably thinking of the distinctions found in Herodotus and in *Aer.*, among others, he wonders in *Pol.* 7.7,[64] right before tackling the institutions of the ideal state, how we should define the best citizens. In keeping with his doctrine about moral and intellectual virtues or states of excellence, he confidently responds that their character should display both courage (*thumos*) and intelligence (*dianoia*). And he adds, with an air of patriotism, that the inhabitants of cold regions (ἐν τοῖς ψυχροῖς) and of Europe are more courageous than intelligent; Asian peoples are more intelligent than courageous; but as for the Greeks, they exhibit a wondrous balance (presumably

63 See also Pseudo-Aristotle's *Physiognomics* 806b15 ff.: birds with stiff wings are courageous; those with soft wings cowardly. Human populations living in northern regions have stiffer hair and are also brave; those living in southern regions have soft hair and are cowardly.

64 Cf. Plato's *Laws* 5.747d. For a detailed commentary on *Pol.* 7.7, see Karel Thein's chapter in this volume.

corresponding to their intermediate climate and geographical situation): they are *both* intelligent *and* courageous, despite at times not negligible variations among them.

Moral overtones surface even when he treats strictly of non-human animals.[65] As in the passage quoted above from *Hist. an.* 7(8), 29, the following one combines references to character and to morphological features, and also includes some striking comments on reproductive behaviour:

> In general, the wild animals are wilder (*agriōtera*) in Asia, but all those in Europe are braver (*andreiotera*), while those in Libya are the most varied in form (*polymorphotata*). (…) For it is said that owing to the lack of rain animals meet at the waterholes and mate with each other even if not of the same breed (*mē homophyla*), and bear to term if their periods of gestation are the same and if their sizes are not far off each other's; they become mild (*praynetai*) towards each other because of their need for drink. (*Hist. an.* 7(8).28, 606b18–24; trans. Balme, slightly modified)

At first sight, there is a certain asymmetry between Aristotle's comments on the temperamental-moral attributes of animals in Asia and Europe (indicating, by the way, the same geographical distribution of those attributes as the *Aer.* distinction between Asians and Europeans),[66] on the one hand, and his comments on the variety of *shapes* exhibited by wild animals in North Africa, on the other. The latter, however, turn out to be the result (or so it is said, *legetai*) of a temperamental disposition—mildness—prompted in turn by the scarcity of water and the need for peaceful interaction, and caused ultimately by the climate. This is a curious example of an adaptive strategy aimed at survival and reproduction; ingenious, no doubt, but the argument underlying it could be more convincing. (Why would limited resources of any kind not intensify aggression?)[67] In any case, the need for animals of different kinds to tolerate each other can also lead to interbreeding.

It is noteworthy that, like the early medical authors, Aristotle usually combines multiple outcomes or affections (*pathē*), including temperament, charac-

65 On moral qualities in Aristotle's descriptions of animals, see *Hist. an.* 1.1, 488b12–27 ("… [S]ome are mischievous and wicked, e.g., the fox; others are spirited and affectionate and fawning, e.g., the dog …" Trans. Peck); for modern analyses of the links between Aristotle's biology and his view(s) of moral qualities, see Lennox (1999) and Leunissen (2012), (2017).

66 On the bipartite division of the inhabited world according to *Aer.* (Europe–Asia) and on the tripartite division in Herodotus (Europe–Asia–North Africa / Lybia), see Jouanna (1996a) 68–69.

67 Plentiful food too can relax the enmity between species; cf. *Hist. an.* 9.2, 610b2 ff. on fish.

ter, appearance and overall structure, rather than dealing exclusively with one at a time. Even more consistently, he combines physical factors (landforms, climate, availability of food and water, etc.) into complex causal networks that defy any attempt at a cursory explanation. Aristotle's systematic appeal to such interconnected clusters of material-efficient causes is a considerable methodological achievement, wrong though some of his conclusions may be.

Conclusion

Explanatory mechanisms like the ones outlined in this chapter and mobilized by Aristotle in contexts that generally do not rely on final causes are never thoroughly unified into a complete and fully coherent theory. They do, however, appear frequently and add potentially illuminating details to Aristotle's picture of the realm of life. They also remain compatible with his treatment of formal natures elsewhere. I do not regard such mechanisms as somehow constituting an autonomous or universal mode of explaining animals' features in Aristotle, or as a possible alternative to the sort of consistent reliance on natures that Lennox[68] and Gelber,[69] for instance, discuss in their important studies on the concept of habitat. In other words, in addition to invoking animals' natures as basic metaphysical concepts in much of his biology, he also appeals to (material and efficient) environmental causation to give explicit—and often impressively detailed and elaborate—accounts of animals, which add explanatory rigour to his inquiries. And while such moves remain somewhat paradoxical in a world where major climatic changes are not given much prominence[70] and where species do not evolve, they seem nonetheless to suggest that every now and then Aristotle was contemplating causal mechanisms that go beyond just positing essential natures.

There can be no doubt of the originality in his treatment of environmental causation, but his general approach is steeped in a long tradition. Early medical authors in particular seem to have left a deep imprint on this aspect of his biological research. I have tried to highlight several significant commonalities ranging from general explanatory principles to types of examples and to terminology.[71] Animals (and plants) are occasionally presented as assuming

68 Lennox (2010a, 2010b, 2013).

69 Gelber (2015).

70 An interesting exception can be found in *Mete*. 1.14.

71 As noted above, this is not intended to be an exhaustive discussion, and much more can be said about Aristotelian passages where environmental causes are central, and about

a mainly passive role, while the environment becomes a complex network of efficient causes that can determine the 'chemical' composition of organisms and can impose structural features. Even the explanatory strategies employed by the author of *Aer.* and by Aristotle at times display striking similarities, for instance in the close connections between habitat, nutrition, and physical composition, between composition and morphology, between morphology and temperament, and between temperament and moral qualities. Environmental determinants too are often identified and studied in similarly intertwined fashion in both authors: landforms (valleys and mountains, etc.) can be assigned a causal role in shaping bodies or characters in the same breath as climate generally or as specific types of winds and also of water. We have seen that such causal chains tend not to be reducible to simple, linear explanations.

Although likely indebted to *Aer.*, whether directly or indirectly, Aristotle never adheres strictly and solely to its letter, but bolsters his accounts with other sources (other authors or reports by shepherds, farmers, etc.), including his own investigations (e.g., *Mete.* underlies some of his material explanations in *Gen. an.* and elsewhere). The extent to which Aristotle was familiar with the text of *Aer.*, roughly as we know it today, and with other texts, like *Vict.* 1 and 2, is impossible to determine with certainty. Still, the conceptual and methodological similarities between *Aer.* and numerous passages where Aristotle considers the impact of the habitat, while largely bracketing off final causation, point to a major and stimulating influence on his view of environmental causation and of the defining features of animals.[72]

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the relevance of *Aer.* to Aristotle's biology, as well as about *Sacred Disease*, *Epid.* 1 and 3, and *Vict.* 1 and 2, among other medical texts.

72 An early version of this comparison between *Airs, Waters, Places* and a number of passages from Aristotle was presented at a conference organized mainly by Hynek Bartoš and hosted by Charles University in the fall of 2021. I am deeply grateful to him for his substantial input and for his steady encouragement. I am also thankful to Gábor Betegh, who offered very helpful comments on my paper, to James Lennox, and to the other participants in the conference. I owe any improvements to that earlier version to their keen observations and stimulating objections.

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CHAPTER 10

On the Character of Citizens: Aristotle's *Politics* 7.7 and *Airs, Waters, Places*

Karel Thein

Introduction

In contrast to Aristotle's biological works, where Hippocratic echoes are numerous and clear, the issue of Hippocratic influence on Aristotle's political thought is much more entangled. And if several passages enable us to establish a connection between Aristotle's views on humans as biological beings and his views on ethical matters, these texts are easier to connect to moral development than to the nature of cities.[1] For this reason, my focus will be, quite naturally, on a unique passage from Aristotle's *Politics* 7.7, which addresses the influence of climate on the nature of humans as citizens. The passage has often been discussed, but its most intractable issues remain unresolved and are well worth revisiting.

The first thing to emphasize is that there is no general agreement on the sources that Aristotle appropriates in this chapter's first part. One reason is that, even if the *Airs, Waters, Places* (henceforth *Airs*) and Plato would seem to be the obvious sources, Aristotle, in the context of his *Politics*, offers a relatively simplified version of correspondences between climate and ethnic character. However, we will come to see that the major consequence of this *simplification* is in fact a *complication* concerning the nature of those who live within the Greek geopolitical area. Most often, this complication is left undiscussed, and the uncertainty about Aristotle's knowledge of the *Airs* may be one of several reasons why the issue is rarely raised. In fact, some recent scholars, in the notes to their translations, make no reference to the Hippocratic corpus at all.[2] A more balanced position is given by, for instance, Richard Kraut, whose

1 On the texts in question, see Leunissen (2017) and Connell (2018). On *Pol.* 7.7 and Aristotle's biology, see also Sassi (2001) 114–120. I will mostly leave aside the question of Aristotle's general understanding of climate, including certain passages in the *Meteor.*; for a detailed treatment, see Staszak (1995), who claims that Aristotle turns away from the kind of climatic geography initiated by the *Airs*.

2 E.g. Reeve in Aristotle (1998) and Lord in Aristotle (2013).

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commentary on *Pol.* 7.7 cites the *Airs* as the most detailed discussion of the climate's influence on human nature, without however considering the possibility of a *direct* connection between this discussion and Aristotle.[3] In contrast, from among the recent English translations of the *Politics*, it is Sinclair's translation, revised by Trevor J. Saunders in 1981, that takes the Hippocratic influence very seriously and introduces chapter 7.7 with a summarizing statement that "[i]n this chapter Aristotle is probably indebted to the *Airs, Waters, Places* of Hippocrates, a work dealing with the effect of the climate of a country on the health and character of the inhabitants."[4] The only recent author to argue for this position is Eckart Schütrumpf, whose textual analysis concludes that Aristotle deliberately modelled the first sentence of *Pol.* 7 on the beginning of the *Airs*, thus signalling at the outset the importance of the climate adumbrated in 7.7. Schütrumpf also seems to be the first commentator to follow William Newman's century-old insight that not only *Pol.* 7.11, 1330a38–b14 mentions the role of winds (a39, b14), waters (b4, b6, b13) and places (b9), but that, at 1330b12, Aristotle apparently paraphrases *Airs* 7.1 (his πλεῖστον συμβάλλεται πρὸς τὴν ὑγίειαν does indeed seem to mirror the text of the *Airs*: πλεῖστον γὰρ μέρος ξυμβάλλεται ἐς τὴν ὑγιείην).[5] I will not recapitulate the findings of Newman and Schütrumpf, but I do believe that they present a strong case in favour of direct echoes of the *Airs* in the *Politics*.

Still, determining the nature of the relation between *Pol.* 7.7 and the Hippocratic *Airs* remains difficult. The same is true for the closely related issue of whether we should connect *Pol.* 7.7 to *Pol.* 1 and its treatment of so-called "natural slavery". Again, opinions differ on this question. On the one hand, Pierre Pellegrin assumes, despite various caveats, that *Pol.* 7.7 forms the background to the theory of natural slavery;[6] on the other hand, Laetitia Monteils-Laeng claims that the division of peoples in 7.7 and the idea of natural slavery can-

3 See Kraut in Aristotle (1997) 92–93, where he prefers to connect chapter 7.7 to the issue of natural slavery (on which see below) and to *Pol.* 3.14, 1285a19–22. Kraut also connects 7.7 to *Part. an.* 2.2–4 on the properties of blood and intelligence, but admits that the connection is not truly warranted by the text of the *Politics*. In this chapter, I quote from Kraut's translation (at times modified).

4 Sinclair in Aristotle (1981) 409. For a similarly measured yet clearly affirmative view of Hippocratic influence, see Jouanna (1992) 327–329.

5 See Schütrumpf in Aristoteles (2005) 195 and Newman in Aristotle (1902) 401. It is worth noting that, in English-language scholarship, the references to the *Airs* are most abundant in Newman's commentary. In citing the *Airs*, I use numbers of chapters and their parts according to Jouanna (2003).

6 Pellegrin (2013) 106–107.

not be seamlessly reconciled.[7] My own position will be closer to this latter claim, which is not contradicted by a brief passage in *Pol.* 3.14, where Aristotle sketches, but does not develop, a background to the possible connection between ethnic differences and natural slavery (1285a19–22). Importantly, neither this passage nor Aristotle's remarks on the traditional "assumption that non-Greek and slave are by nature identical" (*Pol.* 1.2, 1252b8–9) amount to identifying, indiscriminately, all "barbarians" as natural slaves.[8] In this respect, a caveat is needed at the outset: *Pol.* 7.7 may offer no direct or unequivocal statement about a *geographic* distribution of natural slavery, but it still gives us a *conceptual* hint that allows us to rethink the issue of natural slavery with a view to the alleged differences between Greece and those regions that Aristotle, in *Pol.* 7.7, calls Europe and Asia. It is especially in this conceptual area that a comparison with the *Airs* proves fruitful.

1 Plato, *Resp.* 4.435e–436a

Before discussing the relation between *Pol.* 7.7 and both the Hippocratic *Airs* and the *Politics* as a whole, I will approach the chapter in question through another text that is often invoked as a possible inspiration for *Pol.* 7.7. In this case, there is no doubt about Aristotle's direct acquaintance with the source material, which comes from Plato's *Resp.* 4.435e–436a, a short passage that postulates a correlation between climate and character. As this text is referenced by all commentators of the *Politics*, my aim is to demonstrate that Aristotle, when composing the first part of chapter 7.7, is less preoccupied with Plato than with the Hippocratic *Airs*: on a closer reading, the differences between Plato and Aristotle become more and more apparent.

The Platonic passage forms part of an argument in which Socrates tries to establish two mutually independent views: (1) that our souls consist of distinct

7 Monteils-Laeng (2019).

8 Cf. Leunissen (2017) 50, on *Pol.* 3.14, 1285a19–22: "Note that although Aristotle here expresses the belief that all barbarians are typically more slavish than Greeks (cf. *Pol.* 1.2, 1252b1–9), this does not necessarily mean that he thinks that all barbarians are automatically natural slaves." It should be added that, at 1252b1–9, the issue is to know why the non-Greeks assign the same status to women and slaves. It is because, states Aristotle, "they do not have that which naturally rules: their association comes to be that of a male slave and a female slave." This implies that, for Aristotle, non-Greek cities are not fully organized according to the "natural" principles of political association. Here and elsewhere, I quote *Pol.* 1 in Saunders' translation from Aristotle (1995).

parts or functions that relate to different objects; and (2) that it is the character of individual souls that determine the overall character of the city:

> Well, then, we are surely compelled to agree that each of us has within themselves the same parts and characteristics (εἴδη τε καὶ ἤθη) as the city? Where else would they come from? It would be ridiculous for anyone to think that spiritedness (τὸ θυμοειδές) didn't come to be (ἐγγεγονέναι) in cities from individuals who are held to possess this quality, such as the Thracians, Scythians, and generally those from the north, or that the same isn't true of the love of learning (τὸ φιλομαθές), which occurs where we live, or of the love of money (τὸ φιλοχρήματον), which we might say is not least likely displayed by the Phoenicians and those who live in Egypt. (*Resp*. 4. 435d–436a)[9]

What Socrates introduces here is a geographical tripartition that is tailor-made to fit the context, one that establishes the three *conceptually* distinct parts of the soul. Elsewhere in the *Republic*, it becomes clear that the tripartite analysis of the soul is a model that replaces the real and irreducible complexity of individual souls. Here, at this stage of the dialogue, tripartition enables Socrates to present the soul as a locus of various alliances between its three parts, alliances that keep the individual—and by analogy the city—operational and capable of avoiding the deadlock that would result from only two mutually opposed forces. It should be added that, as Socrates' argument progresses, it is spiritedness, τὸ θυμοειδές, that saves the day by breaking the deadlock between intellect and appetite. The terms applied here to these two parts, τὸ φιλομαθές and τὸ φιλοχρήματον, are meant to convey one important aspect of what is usually and more generally called τὸ λογιστικόν and τὸ ἐπιθυμητικόν. The text therefore labels these two parts of the souls according to the primary *objects* of their interest. This is not the case with τὸ θυμοειδές: guided by θυμός, this part of the soul can be described as the source of natural self-esteem, which also produces indignation or outrage at perceived injustices, so that this is the only inherently moral part of the soul ("inherently moral" is not the same thing as "good" in the strong Socratic sense, where goodness is based on actual knowledge of the good; τὸ θυμοειδές has no such epistemic claims, but is instead necessary for the development of the *social* good).

In view of our main subject, we must concede that Plato's text does bear a certain obvious resemblance to *Airs* 18.1, which states that all the Scythi-

9 Trans. Grube, modified.

ans (except the Sauromatae) resemble each other but differ from other ethnic groups, just as the Egyptians do: in both cases, this is a consequence of the climate, which is cold in Scythia, and hot in Egypt. The *Airs* will offer further details at 19.1, with a repeated emphasis on the harshness of Scythia's climate, and with a renewed claim that both the Scythians and the Egyptians are more homogeneous than other ethnic groups. Plato, in contrast, advances no such claim, not least because he uses both groups as *projections* of those parts of the soul that occur in each soul regardless of the ethnic character of the individual. In fact, in the broader context of the *Republic*, "those who live in Egypt" in the above-quoted text represent the most variegated part of the soul whose inherent lack of unity is a moral—and by extension political—problem. If, therefore, Socrates concludes that both the "Scythian" and the "Egyptian" characteristics of the soul need to be constantly checked by the rational activity "which occurs where we live," we may read behind this conclusion a reference to the *Airs*. But we can also, more safely, take the passage as a distilled echo of a cultural topos in which climatic influence remains assumed but not explained. After all, Socrates simply states *what* the Scythians and the Egyptians desire, but makes no effort to establish *why* they are so disposed. Plato appears to presuppose that to mention the "North" while relying on the general knowledge that Egypt is the "South" is self-explanatory, since the reader will be familiar with the works of Aeschylus, Herodotus, Thucydides or Aristophanes, all of whom make use of the image of an inhospitable Scythia, whose harsh climate leaves its stamp on the character of its inhabitants.[10]

To counter such a reading and to establish a direct connection between the *Republic* and the *Airs*, one could try to infer this connection from Plato's use, in the *Republic*, not simply of θυμός, but also of the much less common term θυμοειδές, which was arguably first used in the *Airs* (if we agree with Jouanna and others that this treatise can be dated to the second half of the fifth century BCE, perhaps slightly after 430). That Plato borrowed the compound

10 For exact references, see Hartog (2009) 12–14. On correlations between their texts, we should bear in mind that the author of the *Airs* and Herodotus may well be exact contemporaries. For their possible interplay, see e.g. the conclusion of Herodotus' work at 9.12: "Then Cyrus, who thought little of the proposal [*sc.* that the Persians move to a more fertile land], told them to do as they pleased, but warned them not to expect, if they did so, to continue as rulers, but to prepare to be ruled by others. Soft countries, he said, tend to breed soft men; nor was it the lot of one and the same land to produce fine fruits and great warriors. The Persians admitted that this was true, and that Cyrus was wiser than they; so they departed, and chose to live in a poor land and rule, rather than cultivate plains and be slaves to others." Translation from Herodotus (2014). On this text, its irony, and the *Airs*, see Hartog (1995) 101–102.

noun θυμοειδές from the *Airs* was suggested by Werner Jaeger in 1946. Shortly after, in 1953, E.L. Harrison added something crucial that Jaeger seems to have (rather strangely) missed.[11] As we know thanks to Xenophon, θυμοειδές was a term applied in Plato's time to horses naturally keen to participate in the hunt (Harrison lists no less than seven passages), and it is clear that this use inspires Plato, whose Socrates speaks highly of horses and also of well-bred dogs as naturally excellent animals—so much so that a dog, ever ready to defend its household and attack approaching strangers, can be used as a paradigm for the nature of a philosopher (*Resp*. 2.375e9–376c5; and see 5.459b–c, on the same principles for rearing horses, dogs, and human beings). This nature will then be split in two to obtain the guardians, who are individually distinct from the philosopher kings, who are not characterized by a simple suppression of θυμός, but rather by their ability to use it for political and military purposes.

To summarize, Plato may have known the *Airs*, but the correlation he draws between the characters of the citizens and their environment is not enough to prove this definitively. It is likely that Plato uses θυμοειδές for its association with well-bred horses and dogs, since it coheres well with the tendency to naturalize human beings as well-bred citizens that recurs throughout the *Republic* (in which humans are even assigned the rutting season proper for good breeding, almost assimilating humankind to untamed animals).[12] I therefore think that the *Republic* is closer to Xenophon's remarks on horse breeding than to Hippocratic author's detailed attention to the effects of climate on humans. The passage quoted above—both extremely elliptic and highly eclectic—introduces the geoclimatic differences sketchily, less as a causal explanation than as a simple *illustration* of the twofold thesis that the character of the soul determines the character of the city, and that the soul's character is itself the result of the struggle between its parts. It is this struggle that is the issue here, whereas the relation to the climate *as such* is not even mentioned, let alone explained. The opposite geographical regions *and* characters are used here as a well-known cultural topos, not as a theoretical explanation.[13]

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11 See Jaeger (1946) and Harrison (1953).

12 Aristotle, like other authors, is also not averse to speculating about the best season for having children (see *Pol*. 7.16, 1335b1–2), but Plato, in *Resp*. 8.546a–547, implies a true, cosmically grounded determinism for the exact ideal moment of conception.

13 The reference to the role of climate in Plato's *Leg*. 5.747d–e is thus closer to the Hippocratic *Airs*: "Some localities are more likely than others to produce comparatively good (or bad) characters, and we must take care to lay down laws that do not fly in the face of such influences. Some sites are suitable or unsuitable because of varying winds or periods of heat, others because of the quality of the water; in some cases the very food grown in the soil can nourish or poison not only the body but the soul as well. But best of all will be the

Yet this conclusion is not entirely negative, since it is precisely against the Platonic background that we can see how the relation to the Hippocratic treatise goes deeper in the case of Aristotle's *Politics*, although the latter too does not present a detailed analysis of the ways in which climate impacts human nature. To demonstrate this, I will start with *Pol.* 7.7, and then discuss some other passages from the *Politics* and the relevant parts of the Hippocratic treatise.

2 Politics *7.7, 1327b18–36*

Before taking a closer look at the first part of *Pol.* 7.7 and its connection to the *Airs*, we need to emphasize that the second part also relates to Plato's *Republic*, including the issue of the soul's constituent parts and their main features. Here as elsewhere in his ethics and politics, Aristotle introduces only two parts of the soul—the spirit and the intellect. Right after the passage about natures and climates, he describes the desirable balance between spirit and intellect in a way that perfectly conforms with the *Republic* (to which it also directly alludes):

> It is clear that people must be both intelligent and spirited in nature (διανοητικούς τε εἶναι καὶ θυμοειδεῖς τὴν φύσιν), if they are to be easily led towards virtue by a legislator. For as to what some say must belong to guardians—to be friendly towards those they know and fierce towards those they do not know—it is spirit that produces the friendliness. (7.7, 1327b36–41)

The reference to the *Republic* is clear, and the omission of the soul's third part is attuned not only to the focus on good government and friendship, but also to Aristotle's later bipartite distinction, at *Pol.* 7.15, 1334b17–28, between the part of the soul that has reason and the part that does not. Since the latter part is characterized not only by appetite but by spirit too, it is very likely that chapter 7.7 anticipates the same bipartition, although a more detailed explanation is reserved for 7.15.[14] On this basis, the first part of chapter 7.7 mentions

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places where the breeze of heaven blows, where spirits hold possession of the land and greet with favor (or disfavor) the various people who come and settle there." Trans. Saunders. Still, we may note the very general character of this passage, in which Plato does not say *which* winds, waters, soils and other factors are best or at least beneficial.

14 I leave aside partial similarities between *Pol.* 7.15, 1334b17–28 and Plato's *Republic* (such as the attribution of anger, desire and appetite to small children), and also the bipartition in the *Eth. Nic.*, on which see e.g. Fortenbaugh (1976). It is a well-known fact that Aristotle criticizes both the soul's tripartition *and* its bipartition in his biological work; see *De an.* 3.9, 432a22–b3 (but see *De an.* 3.9, 432b5–6, where Aristotle seems to assume a bipartition or indeed, even if hypothetically, a tripartition). On the whole issue, see Vander Waerdt (1987) and Fortenbaugh (1970).

only spirit and intellect, which it does to settle the issue of what nature the citizens should have. This nature is the last in a series of conditions that need to be fulfilled for the city and its legislation to be successful: the size of the population, the territory, and everything that pertains to markets and naval power. In this context, the nature of the citizens belongs to what Aristotle describes, earlier in the *Politics*, as "matter" (ὕλη) from which the city must be crafted (7.4, 1325b39–1326a5). However, the explanation that concerns the nature of the citizens is not only very brief, but its tone is strikingly different from the previous treatments of the city's location and number of citizens. To bring out this peculiar tone, the opening part of chapter 7.7 must be quoted in full:

> We spoke earlier about what the limit should be on the size of the citizenry, but let us now consider what sort of people they ought to be by nature (τὴν φύσιν). This can be grasped well enough by looking both at those cities of the Greeks that are highly esteemed and also at the whole inhabited world as it is divided into nations (ὡς διείληπται τοῖς ἔθνεσιν). The nations in cold regions, particularly in Europe, are full of spirit but are deficient in intelligence and skill (θυμοῦ μέν ἐστι πλήρη, διανοίας δὲ ἐνδεέστερα καὶ τέχνης); which is why they continue to be comparatively free but are apolitical and incapable of ruling their neighbours (τῶν πλησίον ἄρχειν οὐ δυνάμενα). By contrast, those in Asia have intelligent minds and are skilled in the crafts, but they lack spirit (ἄθυμα δέ); which is why they continue to be ruled and enslaved. But as for the race of the Greeks, just as (ὥσπερ) it occupies an intermediate region, so (οὕτως) it shares in both conditions (ἀμφοῖν μετέχει). For it is both spirited and intelligent (ἔνθυμον καὶ διανοητικόν); and this is why it continues to be free, is governed in the best way, and is capable of ruling all of the others, if it acquires a single political system (μιᾶς τυγχάνον πολιτείας). The nations of the Greeks (τὰ τῶν Ἑλλήνων ἔθνη) also differ from each other in the same way. For some have a one-sided nature (τὴν φύσιν μονόκωλον), whereas others have a good mixture of both these capacities (τὰ δὲ εὖ κέκραται πρὸς ἀμφοτέρας τὰς δυνάμεις ταύτας). (7.7, 1327b18–36)

This is the entire passage. The rest of the chapter then focuses on θυμός and friendliness. Leaving aside the properly political issues, we immediately realize that, like Plato, Aristotle does not try to explain how climatic influence on human nature actually works. Instead, he reiterates a probabilistic or approximative view, which is put forward as a simple fact in the case of the Nordic and Asian ethnicities, and as a correspondence in the case of the Greeks: *just as* the Greeks live in the middle, *so* they share in both temperaments. To this

latter case, Aristotle then applies a sort of fractal principle: "The nations of the Greeks also differ from each other *in the same way*," although these differences occur on a smaller geographic scale and, for this very reason, are perhaps less pronounced.[15]

In contrast to Plato's *Republic*, there is no exact correspondence between the number of soul-parts and number of climates. Aristotle introduces two capacities of the soul but three regions, and in doing so reduces climate to temperature alone, presumably as the main factor behind the stated differences. Despite this strong reduction, I believe that the Hippocratic *Airs* is the most prominent source behind this text. The reason is simple: as I have said already, the passage quoted relies on two and only two capacities of the soul, and while these capacities map only partially onto the bipartition of the soul that Aristotle uses elsewhere in his ethics and politics (cf. *Eth. Nic.* 1.7, 1097b34–1098a6), they map very well onto the disposition of (at least some of) the inhabitants of Europe and Asia in the *Airs*. This point is subtle but potentially important: as chapter 7.15 distinguishes between the soul's two parts (δύο μέρη), whose defining states are also two—the desire (ὄρεξις) and the intellect (νοῦς) respectively (1334b17–20)—it subsumes θυμός under desire (ὄρεξις), so that spirit is itself one of desire's parts. Clearly, this is not the same thing as presenting a straightforward opposition between spirit and intellect. In fact, as introduced in chapter 7.7, this simplified opposition is independent of any division of desire in Aristotle's other texts. Instead, the chapter's use of θυμός, θυμοειδές and ἄθυμος corresponds quite neatly to the Hippocratic text.[16]

One might at first object that this is not enough to establish a direct link between the *Airs* and the *Politics*. Still, if we consider intellect and spirit as they are presented in *Pol.* 7.7, that is *at the exclusion of other capacities or parts of the soul*, this connection is closer than what we can find in other cases, either between the *Politics* and the more complex soul of Plato's *Republic* or, more

15 I will focus on the conceptual side of this "fractal principle", but it also reflects certain political realities. Cf. Tuplin (1999) 70: "Athenian law denied citizenship to the offspring of a union between an Athenian and *any* form of non-Athenian: Aristotle (*Pol.* 3.1, 1275b) says such rules were common, and no available evidence disproves this. 'Ethnic' distinctions within the Greek nation (Dorian, Ionian etc.) could arouse strong emotion. So could distinctions *within* these distinctions, if one thinks of attitudes to Asiatic Ionians which evidently circulated in Athens, attitudes not unconnected with those Ionians' fate in relation to Asiatic barbarians. Other Greeks could be assimilated to barbarians if that happened to suit a particular agenda."

16 On ἀθυμία and Asia, see *Airs* 16.1 (11.62 L. = 227,11–228,2 Jouanna) together with 23.3 (11.84 L. = 243,2–12 Jouanna). On the broader cultural context of this alleged "lack of spirit", see Jouanna (1981).

generally, between the *Airs* and any other roughly contemporary text.[17] Simply put, while it is a common strategy to establish a link between geography and human nature, no other text besides *Pol.* 7.7 (with the possible exception of Plato's *Leg.* 5, 747d–e, quoted in note 13 above) seems to contain such a precise reference to the Hippocratic treatment of the issue. However, compared to *Leg.* 5 Aristotle's treatment of climate and character is more detailed, which also means that, due to the quantity of detail alone, there are many differences between *Pol.* 7.7 and the *Airs*. Most significantly, Aristotle departs from the *Airs* on two major points: first, he introduces Greece as a third region in addition to Europe and Asia (in this respect, he follows not only Plato, but the tradition first described in Herodotus);[18] second, he switches the relation in respect to *technê*, since *Airs* 24.8–9 associates superior *technê* with Europe, whereas Aristotle finds the crafts more at home in Asia.

Yet neither of these differences can be taken to exclude Hippocratic influence and are rather the result of context—one of political science in which Aristotle's partial use of the *Airs* constitutes a brief digression within the broader discussion of the optimal political regime. Aristotle is not trying to make a precise point about biological theory and his simplification of the detailed Hippocratic excursus at this point in the *Politics* does not follow from his biology, but from the political agenda of Books 7 and 8. The contentious status of these books within the *Politics* cannot be discussed here, but it is uncontroversial to conclude that Aristotle utilizes Hippocratic climatology to support his own political theory in a passage that does not allow for the nuances of a properly scientific explanation of the impact of the environment on human nature (in this respect, σχεδόν at the opening of *Pol.* 7.7 is rather telling).

Simply put, for Aristotle, a detailed scientific inquiry would stray too far away from the subject matter at hand, not to mention its possibly ambiguous political implications. After all, even the much-simplified explanation in the passage from *Pol.* 7.7 quoted above advances two claims that are not only distinct, but potentially contradictory, namely (1) that the Greeks are naturally fit to rule other ethnicities, but (2) that some Greeks are nevertheless born as "natural" slaves.

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17 This would then explain the introduction, precisely in *Pol.* 7.7., of θυμός as a polar opposite of intellect. The lack of any detailed treatment of θυμός in Aristotle, on which see Saenz (2018), makes its use here all the more remarkable.

18 See Herodotus 2.16 (the Egyptian delta should be included as a fourth part) and 4.42 (on the disproportion in size between these three parts). On the whole issue, see Jouanna in Hippocrate (1996) 68–71. Aristotle also mentions a parallel geographical tripartition in *Hist. an.* 7(8).28, 606b18–24, on which see Tiberiu Popa in this volume 300.

The first of these two claims is perfectly explicit: τὸ τῶν Ἑλλήνων γένος, "the race of the Greeks", can "rule everyone" (ἄρχειν πάντων), if only it obtains "a single πολιτεία". Once they unify themselves, the Greeks can unify the rest of humankind.[19] This statement contains the germ of the second claim, because the establishment of such a unique πολιτεία could hardly be an entirely peaceful process, which implies that some Greeks are more Greek than others.[20] This follows from the fractal principle, which reminds us of the crucial importance of scale: similar differences occur first on the level of humankind, then on the level of the Greek world, and finally on the level of each Greek city.[21] This principle is clearly valid, even if to explain what is particular to each level we would need a truly detailed, biologically grounded explanation that is not available and, in any case, could hardly be incorporated within the *Politics*.

Does this mean that our text and the rest of the *Politics* offer nothing to substantiate the implication that so-called "natural" slaves could well be born in every city, including the most powerful Greek cities? There is no simple answer to this question. The main theoretical reason for this dilemma is that, in *Pol.* 1, the issue of natural slavery receives a very clear teleological treatment, whereas no such teleology is present in *Pol.* 7.7. So, in *Pol.* 1.5 we not only read that

19 Aristotle, like Plato in the *Republic*, seems to assume that the best *politeia* implies expansion. This is clearer in *Resp.* (although not in Plato's *Leg.*), but Aristotle has often been thought to adhere to the same view. Hence of course the problem of how Aristotle would include the Macedonians into his scheme. Cf. already Newman in Aristotle (1902) 365: "Aristotle can hardly include the Macedonians among the 'nations of Europe,' for they were not unable to rule over others, but does he regard them as Greeks?"

20 In Plato, the best position belongs to Athens: in *Ti.* 24c, Solon learns that, while founding her city, the goddess "had chosen the region in which your people were born, and had discerned that the temperate climate in it throughout the seasons would bring forth men of surpassing wisdom." Trans. Zeyl. This view is reasserted (but again not truly developed) in *Crit.*111e, and also in the Pseudo-Platonic *Epinomis*, where the Athenian states that "there is one point which every Greek should bear in mind—that of all Greeks we have a situation which is about the most favorable to human excellence. The praiseworthy thing in it that we have to mention is that it may be taken as midway between a wintry and a summery climate" (987d, trans. Lamb). All this may echo *Airs* 12.3 (11.54 L. = 220,5–10 Jouanna) while transposing what the latter says about Asia to Athens.

21 For a similar emphasis on this usually ignored point, see (besides Tuplin, quoted above n. 15) Dietz (2012) 288: "It seems that 'some' Greeks are as 'one-sided' in nature as the spirited Europeans, whereas others are akin to the intelligent Asians. Still others are 'well blended in relation to both of these capacities,' which can only mean that we now have to speak of the middle inside the middle and try to imagine a dualizer that doubles inside its own dualization. The second aspect of the twofold ambiguity in the meteorological." In Dietz, "meteorological" is equivalent to "climatic"; by "dualizer", she means a notion or a concept that cannot be reduced to binary categories.

free persons and slaves differ in the capacities of their soul, but also that "it is nature's purpose to make the bodies too of freemen and of slaves different" (1254b27–28). In contrast, there seems to be no analogical "nature's purpose" behind the ethnic differences postulated in *Pol.* 7.7, just as there is no such natural purpose in the Hippocratic treatise.

It is precisely this lack of teleology that allows the Hippocratic author to be more flexible when dealing with a wide variety of factors that impact on the character, including the factors that are not directly environmental. The explanation of human natures in the *Airs* clearly includes important influences that Aristotle leaves aside, not only concerning the exact location of cities, the winds, the rain, and the seasons. It also puts a stronger emphasis on the influence of a given political regime or even just local customs on the character of the soul.[22] No such variety is found in the brief text of *Pol.* 7.7 which, consequently, avoids making any explicit connection with Aristotle's treatment of natural slavery in the first book of the *Politics*. This may well be because the natural slaves that fit best into Aristotle's teleologically organized city are certainly not from Asia, but rather the Europeans and some of the Greeks, who may even be the most natural slaves of all.[23] To understand this implication, we must take a brief look at *Pol.* 1.5–6 and at an important passage from *Pol.* 1.13, where Aristotle presents his thoughts on natural slavery.

3 Natural Slavery in *Politics* 1 and Its Implications

Natural slavery is defined at the end of *Pol.* 1.4:

> anyone who, though human, belongs by nature (φύσει) not to himself but to another is by nature (φύσει) a slave; and a human being belongs to another if, in spite of being human, he is a possession (κτῆμα); and a possession is a tool for action and has a separate existence (1254a14–17).

22 See the conclusion of *Airs* 23.4 (11.86 L. = 226,5–6 Jouanna, trans. Jones): "so institutions (νόμοι) contribute a great deal to formation of courageousness;" cf. also *Airs* 14.1 on the striking differences that arise ἢ φύσει ἢ νόμῳ, or *Airs* 16.5 on political autonomy and readiness to wage war.

23 This indicates that, in contrast to what is often assumed, Aristotle does not employ the concept of natural slavery to promote any kind of straightforward racist ideology. On this point, see Karbowski (2013) and Lockwood (2021). On natural slavery and natural teleology, see Kamtekar (2016).

This is the foundation upon which chapters 1.5–6 (and the summary in chapter 1.13) will be built. I cannot explore this much-discussed text in detail, and will only present a brief summary that will take us back to *Pol.* 7.7, and ultimately to the Hippocratic *Airs*.

First, it needs to be strongly emphasized that natural slavery is one of the building blocks in the solidly hierarchical architecture of the city. This consists of several layers, between which relations of power are unidirectional: there must never be any ambiguity about who should govern who. For Aristotle, this causal hierarchy is a natural given: it is a basic methodological supposition that connects his political thought to his approach to natural science, including cosmology. The city, precisely because it is a natural entity and not something established by convention or agreement, therefore has a *natural* ruler and, to put it most generally, this ruler is equated with the rational part of the soul. Hence Aristotle goes on to summarize that both the ruler and the ruled:

> have a share in virtue, but there are differences in it, just as there are among those who are by nature ruled. We have an immediate guide on this point in the case of the soul, where we find natural ruler and natural subject, whose virtues we say are different—that is, one belongs to the rational element, the other to the non-rational (οἷον τοῦ λόγον ἔχοντος καὶ τοῦ ἀλόγου). Well then, it is clear that the same applies in the other cases too, so that most instances of ruling and being ruled are natural. For rule of free over slave, male over female, man over child, is exercised in different ways, because, while the parts of the soul are present in all of them, they are present in them in different ways. The slave is completely without the deliberative element (ὁ μὲν γὰρ δοῦλος ὅλως οὐκ ἔχει τὸ βουλευτικόν); the female has it, but it has no authority; the child has it, but undeveloped. (1.13, 1260a2–14)

As my focus is on slaves, it must be added that the slave's necessary virtue is narrowly circumscribed, since the slave only needs "to ensure that he does not neglect his work through intemperance or corruption" (1.13, 1260a35–36).[24] This fits well with the physical character of the slave's labour, which must not be confused with technical skill: slaves are not craftsmen and they do not engage in *technê* (emphatically stated at 1.13, 1260a36–b7: there are natural slaves, but no natural shoemakers). Clearly, as Aristotle emphasizes already in the second

24 On the whole passage, including the much-discussed issue of female intelligence and "authority", see Modrak (1994), Karbowski (2012), Karbowski (2014), Leunissen (2017) 161–166, Connell (2016) 25–34, Connell (2021) 19–20, Lienemann (2021), Segev (forthcoming).

chapter of the *Politics*, the master relies on his intellect to rule those whose predominant feature is the physical strength required for hard labour (1.2, 1252a31–33). This arrangement is overseen by nature, as neatly encapsulated in *Pol.* 1.5:

> It is, then, nature's purpose to make the bodies too of freemen and of slaves different, the latter strong enough to be used for essentials, the former erect and useless for that kind of work, but fit for the life of a citizen (this too acquires a differentiation, between the needs of war and those of peace). But the opposite also often occurs: some people have the body of a free man, others the soul (τοὺς μὲν τὰ σώματα ἔχειν ἐλευθέρων τοὺς δὲ τὰς ψυχάς). (1254b27–34)

We will return to this peculiar last sentence later. For now, let me point out that Aristotle applies different criteria to the bodies of freemen and slaves, the latter characterized by strength, but the former by their upright posture. Freemen are more perfect in that they have bodies that are better equipped to serve the properly human purpose of thinking. In this respect, the passage seems to espouse the premise of the well-known passages, in *Part. an.* 2.10 and 4.10, about upright posture and its natural purpose of allowing humans (and humans alone) to freely use their intellect.[25]

At this point, it is important to bear in mind that *Pol.* 1.13 and 1.5 pertain to slaves and *not any other* group in the city. This point is by no means trivial, since Aristotle himself stresses that the *specificity* of the relation between the master and the slave is limited to Greek cities (*Pol.* 1.2, 1252a34–b9):

> So it is by nature that a distinction has been made between female and slave. For nature produces nothing skimpily (like the Delphic knife that smiths make), but one thing for one purpose; for every tool will be made best if it subserves not many tasks but one. Non-Greeks, however, assign to female and slave the same status. This is because they do not have that which naturally rules (τὸ φύσει ἄρχον οὐκ ἔχουσιν): their association comes to be that of a male slave and a female slave. Hence, as the poets say, "It is proper that Greeks should rule non-Greeks",[26] on the assumption that non-Greek and slave are by nature identical (ὡς ταὐτὸ φύσει βάρβαρον καὶ δοῦλον ὄν).

25 On this issue, see Gregorić (2005).

26 Eur. *IA* 1400, spoken by Iphigenia, who accepts her fate so that Troy can be punished.

On this account, non-Greeks believe that women and slaves are the same; but Greeks know better—that *non-Greeks* and slaves are the same. The Greek perspective therefore raises two questions: first, what does it mean that non-Greeks "do not have that which naturally rules"? And second, is this somehow related (or at least relatable) to *Pol.* 7.7 and, by extension, to the *Airs*?

Concerning the first question, I basically agree with Trevor Saunder's solution, who understands τὸ φύσει ἄρχον as a rational capacity able "to distinguish the natural roles of women and slave",[27] granted that this is only one aspect of a broader role that the rational element plays in maintaining the city in optimal condition. I also think that Saunders is right in concluding that the alleged lack of distinction between women and slaves in the non-Greek cities implies that non-Greeks, who are reasoning wrongly on this point, thus reveal a certain predisposition to become slaves themselves.[28] Such an inclination, however, cannot be caused by intellect as such: certain other factors must be responsible, which of course leads us to the question of how this point, and everything else from Book 1, relates to *Pol.* 7.7.

At first sight, there are some clear correspondences, but on closer inspection things become more complicated. First and foremost, in *Pol.* 7.7, neither the ethnic groups from the cold regions nor the people from Asia are obvious candidates for the role of natural slaves: the former have a strong θυμός that makes them politically unsuitable but also naturally free (they are bad at ruling *and* at being ruled), while the latter are intelligent and also excellent craftsmen. This leaves two options. We can understand natural slavery as an intellectual construct that would also—as in the case of Greece as a whole—be a (not entirely stable) mixture of the extreme natures as described in *Pol.* 7.7. Or we can conclude that "natural slave" is simply a label for a less intelligent, strong but unwarlike individual suited for manual labour as opposed to skilled craft. On this second understanding, natural slaves could be born in any climate, and so it would be futile to seek any conceptual connection between *Pol.* 7.7 and *Pol.* 1: the influence of climate and the issue of natural slavery would be two entirely distinct issues.

Pol. 7.7 is not detailed enough to prove either alternative as unquestionably superior to the other. Therefore, it is important to realize that, on the first understanding, it would be some of the Greeks themselves who, due to their mixed nature, would be ideal natural slaves: they would have the perfect mixture of strength and obedience. The different mixtures among the Greeks

27 Saunders in Aristotle (1995) 65.
28 See Saunders in Aristotle (1995) 65.

would include the best citizens as well as the best slaves, even if Aristotle makes a categorical distinction between men, women, and children on the one hand and slaves on the other by denying slaves the capacity to deliberate, one of the few important traits that humans do not share with any other animal (cf. *Hist. an.* 1.1, 488b24–25: βουλευτικὸν δὲ μόνον ἄνθρωπός ἐστι τῶν ζῴων). Aristotle's insistence that natural slaves entirely lack this capacity (*Pol.* 1.5, 1254b22–23 and 1.13, 1260a10–12) turns them into peculiar creatures: they are not exactly human, but nor are they tame animals, since the latter are subject only to perceptions and feelings, whereas natural slaves apprehend and follow λόγος but without possessing it (*Pol.* 1.5, 1254b20–26). This is because their soul apparently has only that part of the soul which has no λόγος but listens to it (see *Pol.* 7.14, 1333a16–18), and this passive disposition has been understood by some scholars as the environmentally caused deficiency in θυμός.[29]

Yet this deficiency cannot be distributed along any cleanly delimited geographic lines, and so it cannot provide an answer to our second question on the absence of τὸ φύσει ἄρχον in non-Greeks, because this absence cannot be identified with the absence of the deliberative faculty. Rather, it seems to follow from an interplay between natural character and certain cultural practices and political constitutions. This would further confirm that, in any region, the correspondence between physical types and intellectual capacities exhibits a large degree of plasticity and admits of many exceptions: as Aristotle notes, "the opposite [to what is natural] also often occurs" and "some people have the body of a free man, others the soul" (*Pol.* 1.5, 1254b31–34). Physically strong intellectuals and weak natural slaves do therefore exist, and we have good reason to accept a minimalist conclusion, namely that:

> [i]t seems to follow, then, that whoever is a natural slave may be either barbarian or Greek, with the decisive factor for Aristotle being an internal marker, having a deficiency in deliberative ability.[30]

However, a methodological problem with this conclusion is precisely that it relies on the alleged lack of deliberative capacity as the *internal* feature that, in contrast to the correct or deficient upright posture, has no physical expression. Such unobservability leads us back to the option of "natural slave" as a purely conceptual construct that fills in one position in the overall hierarchical

29 See Heath (2008) 247–251.

30 Ward (2002) 28. For a similar statement, see Leunissen (2017) 57: "there appears to be no geographical area that is naturally productive of the character traits that are most befitting for a (natural) slave."

and teleological scheme of natural city.[31] This may be why Aristotle turns to the Greek world even where slaves are concerned. Here is what we learn in the chapter that discusses the distribution of land and farming:

> As for those who farm, certainly—since one should express one's highest hope—they should be slaves. They should not all be of the same race (μήτε ὁμοφύλων πάντων), nor should they be spirited (μήτε θυμοειδῶν), because then they will be useful in their work and can be relied upon not to revolt. And as second best, they should be barbarians who live in neighbouring areas (βαρβάρους περιοίκους παραπλησίους), whose nature is similar to that just mentioned. (*Pol.* 7.10, 1330a25–30)

What Aristotle recommends here is that one should ideally acquire one's farming slaves on the Greek market, in which the generic variety should be sufficient but not too great. If not, it is advisable to proceed in ever expanding circles, as it were. The distribution between the three geographic regions is thus replaced by a gradation that confirms the above-mentioned fractal principle. Even so, everything we learn about slaves, Greeks, and barbarians in other parts of the *Politics* could clearly be established independently of *Pol.* 7.7. The latter seems to function as an *endoxon* that echoes Hippocratic authority while allowing Aristotle to avoid digging deeper into the relation between human nature and environmental factors: not to go beyond what is required for discussing the best arrangement of city as a natural habitat for humans as *political* animals.

At the same time, it is precisely the issue of natural slavery that allows us to see what connects the Hippocratic and the Aristotelian perspectives. It may be true that Aristotle's claims about natural slavery derive less from reflection on the external environment than from his *a priori* assumptions about the character of rulers, since it is the nature of rulers that constitutes the contrasting standard for the ideal capacities of their slaves. Here Aristotle's perspective is the opposite of what we find in the Hippocratics, insofar as Aristotle, on the conceptual level, derives physical features and properties from the capacities proper to the soul and the intellect: bodies should be naturally attuned to these capacities. However, the conceptual scheme and reality do not always coincide, and we already know that to his claim that nature correlates the bodies and souls of freemen on the one hand, and slaves on the other, Aristotle adds that "the opposite also often occurs." This "often" (πολλάκις) is important: we are not

31 Cf. Parker (2012) 73: "Aristotle needs to create a group of people over whom it *is* just to exert a master's rule (1287b36–88a2, 1324b32–41, 1333b38–34a2). Hence his invention of the slave by nature."

talking about rare exceptions here and Aristotle seems implicitly to acknowledge that humankind can be messy and intractable material to work with.

It is also for this reason that, in *Pol.* 7.7 no less than in the Hippocratic *Airs*, we find no solid "Greek" core surrounded by the neatly delimited barbarian regions. Instead, what connects both texts are the shifting boundaries both outside and *within* Greece. This is true even if the *Airs* and *Pol.* 7.7 differ in that the latter, being much shorter, relapses into the simple juxtaposition of cold regions (Europe) and Asia (an overall warmer region), whereas the former's detailed account sees the determining factor not in the proportion of the cold and the hot as such, but rather in the character of the change of seasons and the extent of their variability throughout the year (see *Airs* 13.3–5). As a result, it is not entirely clear where to situate the whole of Aristotle's intermediate "Greece" on the Hippocratic map. In addition, Aristotle does not spell out which Greek ethnicities are supposed to have a better mixture of spirit and intellect than others. It is possible that Aristotle assumes that the best of the Greeks include the inhabitants of the best part of Asia according to *Airs* 12.4: the part situated equidistant between the hot and the cold, described in terms strongly reminiscent of Ionia in Herodotus 1.142.[32] However, even this limited conclusion is somewhat speculative, and it is more important to dwell on the fact that, despite the different geographical labels they use, both *Pol.* 7.7 and the *Airs* agree that variation within limits is the best condition that can produce a culturally and politically suitable spectrum of natures.[33] It is Aristotle alone who goes a step further and integrates these natures into the new normative framework of a unified political theory. Still, this step does not contradict the possibility that *Pol.* 7.7 also acknowledges the greater variety of natures in the *Airs* by appropriating it into the variation among the Greeks themselves.

Conclusion

Aristotle has borrowed from the *Airs* what suits his much narrower aim in *Pol.* 7, where he elaborates a *model* of the best city. In this context, Aristotle abandons the plurality of Hippocratic explanations for human variability, in which many

32 Here I follow Jouanna in Hippocrate (1996) 296 n. 6.

33 In the Hippocratic case, cf. *Airs* 23.1–2 (82 L. = 241,21–243,2 Jouanna) on the correspondence between climatic variations and variation in the coagulation of the seed. The text mentions this variation to explain the differences between the inhabitants of Europe but, in virtue of the same fractal principle that we found in Aristotle, it should bear its finest (or non-excessive) fruit in a moderate (Ionian or Greek) region.

factors are considered, including different cultural customs and political constitutions. This point is important, since it confirms that the Hippocratic author does not propound an unidirectional causal scheme, but rather a multiplicity of causal chains where culture can modify nature in its turn, not least by introducing inheritable characteristics, as in the much-quoted case of the Macrocephali (*Airs* 14). This interplay between nature and culture is not circumscribed by any hierarchy of the Aristotelian type; in addition, it also presupposes certain biological views different from those of Aristotle. For instance, the modification of φύσις by νόμος produced by the Macrocephali is only possible because "the seed comes from all parts of the body, healthy seed from healthy parts, diseased seed from diseased parts".[34] The influence of a given *politeia* on the character nevertheless implies that there are other causes at play in determining the soul of the citizens, although the *Airs* remains silent on the exact mechanism of this influence. Presumably, it is yet another case of νόμος progressively embedded in the soul that is itself a fully material entity and not an Aristotelian form.

Faced with this and other differences, we may naturally hope for more reliable indications of Aristotle's direct knowledge of the *Airs*, but this would require searching beyond *Pol.* 7.7, perhaps especially in the apparently closely related treatment of animals in Libya, which both *Airs* 12.7 and Aristotle's *Gen. an.* 2.7, 746b7–11 characterize by their disposition for interspecies breeding (cf. also *Hist. an.* 8.28, 606b19–21).[35] This, however, is a subject very different from the relation between the *Airs* and the *Politics*, and the same is *a fortiori* true about the relation between the *Airs* and several *Problemata*.[36] Instead, we need to return to the basic question: what is the first part of chapter 7.7 doing in the *Politics*? The obvious answer is that it furnishes the last in the series of conditions that make good citizens. But, again, the way Aristotle established their φύσις is different from how he established the number of their population or even the city's location. Instead of delving into the issue of the citizen's individual virtues or qualities, Aristotle suddenly has recourse to a kind of common knowledge that can be almost exactly apprehended (see σχεδὸν δὴ κατανοήσειεν at 1327b20) once we take a synoptic view of the whole Greek and non-

34 *Aer.* 14.4 (11.60 L. = 224,17–19 Jouanna, trans. Jones).

35 See Jouanna in Hippocrate (1996) 300 on the difference between the two explanations: "Toutefois Aristote diffère de l'auteur hippocratique dans l'explication des accouplements entre espèces différentes : ce qui est attribué par Aristote à une nécessité géographique semble expliqué dans le traité hippocratique par l'empire du plaisir." To this it must be added that, on the Hippocratic account, "the domination of pleasure" would also follow from climatic factors.

36 For a list of parallel passages in the *Airs* and the *Problemata*, see Jouanna in Hippocrate (1996) 152–153.

Greek inhabited world. The expression σχεδὸν δὴ κατανοήσειεν, with its strong connotation of a vivid imaginative grasp, hints at the use of the Hippocratic scheme that serves almost as a rhetorical device that enables Aristotle to connect geography and human nature or natures.

This certainly does not imply that Aristotle would not take the impact of climate on human nature and politics seriously.[37] On the contrary, *Pol.* 7.7 is an important text insofar as it shows how difficult it is, for Aristotle, to pass from nature to politics once he steps outside the confines of the Greek household and classical polis. There is no doubt that Aristotle looks beyond these confines. But what he sees, or imagines he sees, turns out to be a mirror that reflects the distortions at the heart of his own ideal city, in which the difference between Greek and non-Greek natures cannot stop replicating. Put simply, the concise first part of *Pol.* 7.7 may simplify Hippocratic explanations, but it does not eliminate complications. While reaffirming them in other regions, it invites them, even if somewhat surreptitiously, into the highly political environment of Greek cities as well.[38]

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37 In the broader context of his natural science, Aristotle also allows for gradual and mostly unobserved climatic variations that have a direct impact on the prosperity or malaise of cities; see *Meteor.* 1.14, 351b8–352a17. In *Meteor.* these local changes are said to affect the land and waters, not the nature of the inhabitants. Clearly, Aristotle takes climate on a global scale as a relatively stable equilibrium. On his defense of the overall "homeostasis of local climate changes", see Wilson (2014) 169–178.

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CHAPTER 11

The Enigmatic Presence of Medicine and Physiology in Aristotle's Ethical Writings

Pierre-Marie Morel

Introduction

References to medicine and medical writings in Aristotle's ethical treatises are occasional, isolated and, for the most part, allusive. It is therefore not surprising that they are often neglected when it comes to assessing the importance of medicine in Aristotle's works as a whole.[1]

However, as we shall see, there are compelling reasons to be interested in the presence of physicians in *Nicomachean Ethics* (*Eth. Nic.*) and *Eudemian Ethics* (*Eth. Eud.*). In many cases, in addition to the classical *topos* that identifies vices with diseases of the soul, the investigation of the human good directly calls upon the skills of the physician. For example, it is important to identify, among incontinent people, those who are the "easier to cure" (εὐιατοτέρα): they are those who suffer from "melancholy", a disorder whose main causes are physiological. Conversely, those who are incontinent because they do not follow their own deliberations ("weak" incontinent people) are less easy to cure, while those who are incontinent "by habit" are more easily cured than those who are incontinent "by nature".[2] In other words, in the face of intemperance or incontinence (*akrasia*), talking about healing or therapy is not simply a metaphor, as is clearly shown by the case of melancholic patients, who are afflicted with both a mental and a physical disorder.

1 For example, there are no more than three references to *Eth. Nic.* (and these only in footnotes) and none to *Eth. Eud.*, in C. Oser-Grote's book *Aristoteles und das Corpus Hippocraticum*. See Oser-Grote (2004); Van der Eijk (2012) 1504. I am especially grateful to Robert Bostock for correcting my English, and to István Bodnár for his close reading of my text on the occasion of the Prague conference. Among participants I also thank Philip van der Eijk, Sophia Connell, Lesley Dean-Jones and Ronja Hildebrandt for their useful remarks and suggestions. I would also like to thank Pavel Gregorić for his remarks on a previous version of the text and Carlo Natali for his helpful comments on my lecture in the framework of the seminar on *Nicomachean Ethics* at the University of Rome, Tor Vergata in 2021, organised by Daniela Taormina and Francesco Aronadio.

2 *Eth. Nic.* 7.11, 1152a27–30.

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This does not mean that, in order to cure incontinence or any other type of moral weakness, one must call a doctor. This is instead a task for political science—"political science" in the broader sense, including politics and ethics—whose prescriptions derive, at least at first sight, from proper ethical and political principles. However, the passage just mentioned suggests that physicians do have something to teach us about this issue, especially when they reveal certain physiological characteristics of human nature, knowledge of which can be useful to the ethical theorist or the practicing politician. Here I would like to define more precisely the nature of this contribution.

It is also difficult in this context to separate medicine (as a set of views about human nature and constitution that belong to the art of healing) from physiology (as a set of views about human nature and constitution that belong to the investigation of the natural world), and sometimes even from natural philosophy as a whole. The case of the "melancholic" *akratês* has already given an indication of this ambiguity. This can be seen as a difficulty and an additional source of confusion. Yet one can also use this partial overlap as a methodological principle for the present analysis. My working hypothesis is precisely that the scattered references to the "*physiologoi*" provide a useful thread for us to follow in order to assess Aristotle's debt to medicine in his ethical treatises.

Three times in his ethical writings, Aristotle refers explicitly to the "*physiologoi*": twice in *Eth. Nic.* Book VII (= *Eth. Eud.* Book VI) and once in *Eth. Eud.*.[3] Let us start with the passage from *Eth. Eud.*:

> [1] … some think that like is friend to like, whence the saying 'how God ever draws like to like'; or the saying 'crow to crow'; or 'thief knows thief, and wolf wolf'. The physicists (οἱ δὲ φυσιολόγοι) even systematize the whole of nature on the principle that like goes to like …
>
> *Eth. Eud.* 7.1, 1235a5–12 (transl. Solomon, here and below)

In this text, the reference to physicists (more precisely to those, like Empedocles, who endorse the 'like-to-like' principle) is quite conventional and general. It sounds like a mere *topos*, whose main purpose is to introduce the question of friendship in a typically dialectic way.

By contrast, in both passages from *Eth. Nic.*, the *physiologoi* are taken more seriously, as scientific authorities, on two crucial issues: the resolution of the state of incontinence and the link between pleasure and pain.

About *akrasia*, Aristotle says:

3 *Euh. Eud.* 7.1, 1235a10; *Eth. Nic.* 7.5, 1147b9; 7.15, 1154b7.

> [2] The explanation of how the ignorance is dissolved and the incontinent man regains his knowledge, is the same as in the case of the man drunk or asleep and is not peculiar to this condition; we must go to the students of natural science for it.
>
> Πῶς δὲ λύεται ἡ ἄγνοια καὶ πάλιν γίνεται ἐπιστήμων ὁ ἀκρατής, ὁ αὐτὸς λόγος καὶ περὶ οἰνωμένου καὶ καθεύδοντος καὶ οὐκ ἴδιος τούτου τοῦ πάθους, ὃν δεῖ παρὰ τῶν φυσιολόγων ἀκούειν.
>
> *Eth. Nic.* 7.5, 1147b6–9 (transl. Ross, here and below)

On the connection between natural functions and pain from a zoological point of view, Aristotle refers to *physiologoi* in these terms:

> [3] For animals are always toiling, as the students of natural science also testify, saying that sight and hearing are painful; but we have become used to this, as they maintain.
>
> ἀεὶ γὰρ πονεῖ τὸ ζῷον, ὥσπερ καὶ οἱ φυσιολόγοι μαρτυροῦσι, τὸ ὁρᾶν, τὸ ἀκούειν φάσκοντες εἶναι λυπηρόν· ἀλλ' ἤδη συνήθεις ἐσμέν, ὡς φασίν.[4]
>
> *Eth. Nic.* 7.15, 1154b7

In this passage, unlike the previous case, given that Aristotle disagrees about the painful nature of the sensory activity,[5] the intention of the reference is clearly dialectical, at least in the second part of the quotation ("saying that sight and hearing are painful"). In any case, both passages, despite being somewhat elliptical—especially about the identity of the natural scientists they allude to—are valuable for the explicit link they make between questions of political science and the discourse of natural philosophers. This is rarely the case, and it is worth noting, especially if we consider the interest shown by the recent scholarship on this issue. Although medicine is not mentioned in these passages, we may also note that it is probably indirectly involved to some extent, in particular in text [2]. For these reasons, despite the scarcity of the term *physiologoi* in this context and the allusive mode of expression of both passages, it seems to me that they deserve attention, especially text [2], which is also the most puzzling.

4 Should we read φυσιολόγοι with Aspasius, φυσικοὶ with the Laurentianus, or φυσικοὶ λόγοι with most of the manuscripts? This textual difficulty is not material for my present purpose.

5 See e.g. *Metaph.* 1.1, 980a2.

Some recent studies have indeed emphasised that political science owes an important debt to the natural sciences. I am thinking in particular of several papers from the volume *Bridging the gap*, edited by K. Nielsen and D. Henry.[6] From this perspective, M. Leunissen has published an important book, in which she supports the claim that natural science is, in some way, "foundational" for political science. She states: "*Aristotle believes that at least some of the knowledge produced by natural science is 'foundational' for political science, in the sense that having knowledge of the facts* (*to hoti*) *about human life and nature is an important prerequisite to the political scientist's task of perfecting or completing human nature so as to make a person good*".[7] This is a strong claim and I cannot address the problem in its entirety. This would involve evaluating Aristotle's ethical naturalism as a whole, with a whole host of questions, such as the (possible) biological background of some general assertions regarding ethical principles (e.g., about the proper function, *ergon*, of human beings), the status of emotions and their connection to virtue and vice, the issue of natural tendencies (to live in a community, friendship, etc.), the issue of natural virtues, and so on.[8]

The present investigation is much more modest in scope, in that it merely attempts to make sense of Aristotle's references to medicine and physiology in his ethical works. In principle, three approaches are available: (1) Aristotle simply wishes to eradicate the physiological explanation from the ethical framework in order to impose a strict demarcation between the two disciplines, thereby avoiding a pointless digression. (2) In text [2], Aristotle concedes a degree of epistemological dependence of ethical assertions on natural science and invokes the expertise of the physicists to solve the problem. (3) Some scientific results must be taken into account, without however possessing any real explanatory or even prescriptive function. Here I will adopt this third approach.

If in doing so I reassess in some ways the idea of epistemological connection between physiology and political science, it will be mainly in light of the explicit references to the *physiologoi*. Although this material does not allow us to decide in what way natural science is 'foundational', generally speaking, for political science, it is significant enough to reformulate the issue. In short, it

6 Henry-Nielsen (2015). See also Van der Eijk (2022) 107–108, 118.

7 Leunissen (2017) xxiv.

8 More generally, one may ask whether there is or is not some kind of epistemological subordination of political science to natural philosophy. There is a wide range of interpretations and numerous surveys on this topic. More recently, Silvia Berryman (2019) has published a book on the sources of the ethical life, with strong objections against the naturalistic readings of Aristotle's ethics and politics. For a recent general survey of these issues and debates see also Morel (2021).

offers good support to the second part of Leunissen's claim: texts [2] and [3], and some others, attest to the importance (for the political scientist) of the "facts (*to hoti*) about human life and nature". And this, in my view, is crucial for our understanding of Aristotle's agenda in his ethical and political writings. However, it could hardly be used to support the view that political science and practical prescriptions *depend*, strictly speaking, on physical principles and explanations.

I will first make some general observations about physiology and medicine in the ethical writings before proceeding to consider the three hypotheses I have mentioned.

1 Ethics and Physiology: General Considerations

1.1 *Some Connections*

To begin with, there are several hints of Aristotle's interest in medicine and physiology in his ethical treatises. In the first place, there are analogies. In *Eth. Nic*. 2.5, for instance, the conception of ethical virtue as a mean is related to dietetic recommendations. In 5.15, on justice, the intermediate amount "plays the part here that the healthy does in the medical art, and that good condition does in the art of bodily training".[9] Virtue itself is sometimes compared with states of good health, especially in relation to pleasure.[10] It is true that this is not Aristotle's last word on the topic, since virtue cannot be identified with pleasure. Nevertheless, the idea that there may be a relationship between virtue, pleasure, and good health constitutes a genuine *endoxon* in the course of the investigation. In fact, at *Eth. Nic*. 10.5, 1176a13–19, medical considerations serve mainly to highlight the relativity of pleasures: the latter vary according to the state of health of the agent—just as they differ according to animal species and according to the characters of individual human beings—in contrast to the stability of virtue as a "measure" of good and bad pleasures. One could give further examples of comparisons between morally significant dispositions and good or bad health.[11]

Moreover, the connection is not limited to analogies in the strict sense: sometimes, in relation to emotions, for instance, we are dealing directly with

9 *Eth. Nic*. 5.15, 1138a30–31.

10 See e.g. *Eth. Nic*. 7.15; 10.5, 1176a13–15.

11 See e.g. *Eth. Nic*. 1.13, 1102b18–21, where Aristotle compares the uncontrolled impulses of the irrational part to the uncontrolled movements of the body parts due to paralysis. On the medical background of Aristotle's doctrine of the mean, see Johnson, this volume.

scientific facts, which are not only identified and set forth by the natural scientists, but also taken into account by political science. From that point of view, to put it schematically for now, there may be some instances of overlap between the domains of natural philosophy and practical philosophy.

This is true for specialised investigations relating to physiology proper, such as the generation of children in *Pol.* 7.16:

> [4] The precepts of physicians and natural philosophers about generation should also be studied by the parents themselves; the physicians give good advice about the favourable conditions of the body, and the natural philosophers about the winds; of which they prefer the north to the south.
>
> δεῖ δὲ καὶ αὐτοὺς ἤδη θεωρεῖν πρὸς τὴν τεκνοποιίαν τά τε παρὰ τῶν ἰατρῶν λεγόμενα καὶ τὰ παρὰ τῶν φυσικῶν· οἵ τε γὰρ ἰατροὶ τοὺς καιροὺς τῶν σωμάτων ἱκανῶς λέγουσι, καὶ περὶ τῶν πνευμάτων οἱ φυσικοί, τὰ βόρεια τῶν νοτίων ἐπαινοῦντες μᾶλλον.
>
> *Pol.* 7.16, 1335a39–b2 (transl. Jowett)

Physicians and natural philosophers are distinct groups in this passage; their respective tasks are complementary. However, both kinds of specialists are identified as experts on the physiological conditions for a harmonious generation.

Similarly, certain key notions of ethics and politics are based on physiological considerations about human nature, whether directly or indirectly. The good politician must have at least some understanding of the soul, just as the 'holistic physician' (the expression is mine) who cares for the eyes must also know about the body as a whole.[12] Yet Aristotle does not restrict his interest in psychology to the properties of the soul as such. He probably alludes to psychic faculties as embodied capacities, or functions common to body and soul, in accordance with the psychology of the *De anima* and especially the *Parva naturalia*. Although there are of course differences between the technical psychology of the *De anima* and the *Parva naturalia* on the one hand, and the summary, and probably simplified, psychology of the ethical writings on the other hand, I posit that there is no fundamental discrepancy between them.[13] In this regard, it is significant that, a few lines after the passage where he calls

12 *Eth. Nic.* 1.13, 1102a5–25.

13 Accordingly, the fact that there is no trace of hylomorphism in the ethical writings does not mean that body and soul are not seen as two interrelated terms of the same substantial whole, even in this context.

upon the good politician to take an interest in the soul, Aristotle distinguishes psychic parts or faculties (rational, irrational).[14] In doing so, he alludes to the activity of the nutritive function during sleep in terms that recall (or announce) the *Parva naturalia*: sleep is a period of full activity of the nutritive function and of "inertia" (ἀργία) of the faculty that allows us to determine whether the agent is virtuous or vicious.[15] Further on, he compares the inner conflict in which the impulses of the intemperate oppose reason to a "paralysis of the parts of the body" (τὰ παραλελυμένα τοῦ σώματος μόρια). In general, the idea that psychic faculties are common to both body and soul finds concrete support in several passages of the *Eth. Nic.*, as we will see presently. At this point we can conclude that political science, in so far as it is concerned with psychology, necessarily involves physiology as well, as suggested by the comparison with the holistic physician.

However, at *Eht. Nic.* 1.13, Aristotle adds the qualification that such knowledge is limited "to the extent that is sufficient for the questions we are discussing" (ἐφ' ὅσον ἱκανῶς ἔχει πρὸς τὰ ζητούμενα):[16] there is no need for a detailed and comprehensive knowledge of the physical properties of the object under investigation, whether it be human nature in general or the specific nature of the *ethnos* concerned, as in *Pol.* 7.7.[17] The specialist in politics is clearly permitted to leave this work to the professional natural scientist.

1.2 *Political Science and Scientific Authorities: Who Are the* physiologoi*?*

It is therefore not surprising that Aristotle—just like politicians and sometimes even the citizens as a whole—refers to the authority of scientists, certainly including himself as a physicist and the scientific work of his own school. But who are the *physiologoi*?

Firstly, some clarifications are needed in respect to the term "physiology", which I have used above to designate a set of views about human nature and the human constitution that arise out of the investigation of the natural world. Yet, if one examines Aristotle's own terminology, things are not quite so simple. There is only one occurrence of the word *physiologia* in Aristotle,[18] and it is not

14 *Eth. Nic.* 1.13, 1102a26–1103a10.

15 See e.g. *Parv. nat.*, *Insomn.* 3.461a4, on the "inertia" (ἀργία) of the faculty of sensation during sleep. On the activity of the nutritive faculty during sleep, see *Parv. nat.*, *Som.* 1.454b32–455a3. On sleep and food, see Bubb, this volume.

16 *Eth. Nic.* 1.13, 1102a24–25.

17 On this important text, see Thein, this volume.

18 *Parv. nat., Sens.* 4.442b25.

particularly significant for our purpose: he simply states that "the affections of savours are examined in their proper place in connection with the natural history (φυσιολογία) of plants". In view of this, it is doubtful that it designates an independent scientific discipline. However, we can still talk about 'physiology' in Aristotle, in the modern sense, to denote that part of natural philosophy that explores the organic functions of living beings.[19] In Aristotle's terminology, it corresponds to the part of physics which, when applied to the states and faculties of a living being, takes into account both formal and material features. This is the right way, Aristotle says in *De an*. 1.1, to describe and explain the affections of the soul (or at least most of them). This is also the way he proceeds in the *Parva naturalia*, whose agenda, according to the prologue of the *De sensu*,[20] consists of a series of surveys on attributes, functions or affections (the text is imprecise on this point), which are 'common to body and soul'. As we shall see, the reference to the *Parv. nat*. is particularly important for an understanding of the physiological background of the ethical writings.

As for the term *hoi physiologoi*, it is very often apparently synonymous with *hoi physikoi*, especially in *Physics* and *Metaphysics*. This is the case in text [1], in which the term is not directly associated with the study of the organic functions of living beings but with a more general knowledge of nature, or of the *kosmos*, as a whole.

However, I do not think that the issue is that simple, and instead suggest that, alongside the general meaning of '*physiologoi*', there is a more specific use of the word, which is aligned with the idea of physiology described above. To put it differently, it is possible that *physikoi* and *physiologoi* are the same people—after all, the same physicists before Aristotle had often explored not only the natural world as a whole but also the organic functions of living beings. However, some of them deserve particular attention because of their knowledge of living bodies as such, and Aristotle prefers to call these *physiologoi*. At the very least, using *hoi physiologoi* rather than *hoi physikoi* is more likely to include the physicians belonging to this group of scientists.

This is supported by the following observation: Aristotle never uses the term "*hoi phusikoi*" in the ethical writings, but does so twice in the *Politics*, where he contrasts them with physicians (*hoi iatroi*; see text [4]). While physicians provide sound advice on the best physiological conditions, natural scientists are more knowledgeable about the winds and their properties. Now such climatological considerations apply only incidentally to the generation of living

19 See Mingucci (2015) 15–16.

20 *Parv. nat., Sens*. 1.436a1–b2. On this agenda and its function within the biological framework, see e.g. Morel (2007).

beings. Beyond the distinction between two categories of scientists, the most important is this: regarding generations, politicians and citizens must take advice from natural scientists and doctors.

According to P. Pellegrin in his French translation of Aristotle's *Politics*, winds from the north are more favourable for the birth of males, because these winds are drier than those from the south.[21] This is probably the reason why the physicist prefers them. It is uncertain whether Aristotle is referring here to a specific medical treatise. In *Airs, Waters, Places*, as is well known, the physician pays greater attention to climatic factors. Perhaps the *iatros* in question in text [4] is not one of the more sophisticated physicians, whose methodology is to some degree informed by natural science, but just an ordinary practitioner, a mere tradesman of therapeutic procedures.[22] In any case, Aristotle is probably thinking of certain medical doctrines, since *kairos* is a central concept in the Hippocratic corpus.[23] The most significant point is this: in this passage, the *phusikoi* are the most informed about the external factors and probably the elementary properties, whereas the *iatroi* have a better understanding about what may occur within the body at a given time. Therefore, we cannot rule out the possibility that, when describing the specific tasks of the physicists, Aristotle sometimes prefers to use *hoi physikoi* about external and elementary factors, and *hoi physiologoi* in a more restricted sense, in reference to bodily states, affections, or functions. Yet it must be said that this distinction is one of emphasis only, and does not imply an epistemological demarcation between two clearly identified disciplines within physics.

However this may be, there is probably a degree of permeability between the skills of the physicians and those of natural scientists, especially if the latter are *physiologoi* in the restricted sense. After all, among the different areas of natural science, physiology is probably the nearest to medicine. It is certainly no coincidence that the most explicit connections between medicine and natural science are found in the *Parva naturalia*, in *De sensu*[24] and *De vita et morte*;[25]

21 Pellegrin (2015) 513 n. 3.

22 On this distinction, see *Politics*, 3.11, 1282a3–7; on the specific task of 'cultivated' physicians and there engagement with natural philosophy, see Arist., *Parv. nat., Vit*. 5.480b21–480b30; on the medical interpretation of dreams, see Arist., *Parv. nat., Div. somn*. 1.463a5. On the contrast between sophisticated doctors and mere therapeutic artisans, see Van der Eijk (2005) 193–195.

23 As recently emphasised by Longhi (2020) 166–167.

24 *Parv. nat., Sens*. 1.436a1–b2.

25 *Parv. nat., Vit*. 5.480b21–480b30.

that is, at the beginning and at the end of the book as we read it today. As Aristotle says in the *De sensu*:

> [5] we may say of most physical inquirers, and of those physicians who study their art more philosophically, that while the former end with a discussion of medicine, the latter start from a consideration of nature.
>
> διὸ σχεδὸν τῶν περὶ φύσεως οἱ πλεῖστοι καὶ τῶν ἰατρῶν οἱ φιλοσοφωτέρως τὴν τέχνην μετιόντες, οἱ μὲν τελευτῶσιν εἰς τὰ περὶ ἰατρικῆς, οἱ δ' ἐκ τῶν περὶ φύσεως ἄρχονται.
>
> *Parv. nat., Sens.* 1, 436a29–b2 (transl. J.I. Beare; with slight modifications)

So if physicists extend their investigations into medicine, while cultivated physicians to some extent engage with natural philosophy, there will inevitably be an overlap between the two disciplines. I cannot discuss at length the exact nature of this connection;[26] briefly put, Aristotle's stress on the connection between medicine and natural philosophy in these two key passages of the *Parva naturalia* is due to the fact that the subject matter of these investigations—the study of attributes or states "common to body and soul"—is precisely the place where both disciplines characteristically overlap. *Parva naturalia* are in fact much more preoccupied with particular states or properties of the compound than with the faculties as such (nutritive, sensitive, rational). This latter area seems to be reserved for the *De anima*.[27] Now, each particular state of the compound—as opposed to the faculties as such, whose presence is not susceptible to degrees—entails a certain balance or imbalance of contraries, especially of hot and cold, either directly or indirectly. Consequently, in accordance with the standard Aristotelian definition of health and disease,[28] each state studied in the *Parva naturalia* corresponds, even if only implicitly, to a certain state of health or disease. Hence, studying states that are "common to body and soul" requires a good understanding of health and disease as principles of variation of the relatively 'normal' state. From that perspective, medicine is necessarily related to the specific purpose of the *Parva naturalia*. Aristotle therefore has every reason to exhort the student of nature

26 On this, see Van der Eijk (2005); Bartoš (2015) 283–286; Lefebvre (2019); Bartoš (2021); Morel (forthcoming).

27 *Parv. nat., Sens.* 1.436a1.

28 See especially the treatise *On life and death* (*de vita et morte*) in the *Parv. nat.* See also *Ph.* 7.3, 246b3–6; *An. post.* 1.13, 78b18–19, where health is defined as a sort of balance, *summetria*, and sickness a lack of it.

to learn at least the starting points of medicine and, in turn, to urge the more learned and open-minded physicians to continue to use the principles of physics as their starting point: this is not an emphatic appeal to general culture but a consistent and philosophical justification of the overlap.

To sum up, the specific identity of the *physiologoi* in the ethical treatises cannot be ascertained. Nevertheless, it is clear that in this framework Aristotle recognises as authorities those who have identified certain facts about what is common to the body and the soul. From this point of view, allusions to the *Parva naturalia*—or to the corresponding topics—where natural science is explicitly involved with medicine, are fully justified. These allusions, then, reinforce the hypothesis of a joint appeal to medicine and physiology. As we will now see, the *Parva naturalia* are precisely at the core of Aristotle's strategy in relation to *akrasia*.

2 The *physiologoi* on *akrasia* (*Eth. Nic.* 7.5)

2.1 *First Hypothesis: Setting Physiology aside*

Let us now return to text [2], *Eth. Nic.* 7.5, 1147b6–9. Although the issue of *akrasia* has received greater attention from scholars, this particular sentence has been relatively neglected.[29] A notable exception is Francis,[30] who offers a careful and detailed analysis, and I generally agree with her conclusions. The text is sometimes read as a mere parenthesis, whose purpose is essentially negative: Aristotle simply wants to reject the physiological explanation, as the clause "δεῖ παρὰ τῶν φυσιολόγων ἀκούειν" may initially suggest.[31]

Aristotle does indeed seem to refer to the kind of explanation he gives in the *Parva naturalia*, about sleep and awakening:

> [6] Owing to the fact that the blood formed after the assimilation of food is especially in need of separation, sleep occurs until the purer part of

29 M. Leunissen does not quote the passage in Leunissen (2017), but she does in Leunissen (2015) 226 n. 20.

30 Francis (2011). See also Van der Eijk (2007, 412) about *Eth. Nic.*: "la faiblesse morale, l'*akrasia*, y est présentée comme le produit d'une constitution physiologique anormale et pathologique." See also Van der Eijk (2022) 117.

31 See in this sense Gauthier-Jolyf (1970); Aubry (2009) 249 n. 39. From this perspective, regarding the weak *akrates*, who is unable to draw the right conclusion from the premises he knows, or to act in accordance with it, D. Charles (2007, 197) observes: "no doubt, it will be said, more work is needed at the psychological level, involving perhaps the study of self-deception, to fill out the relevant description. But, it may be said, for Aristotle this is the task of an independent scientific (or physiological) investigation."

> this blood has been separated off into the upper parts of the body, and the more turbid into the lower parts. When this has taken place animals awake from sleep, being released from the heaviness consequent on taking food.
>
> διὰ δὲ τὸ γίγνεσθαι ἀδιακριτώτερον τὸ αἷμα μετὰ τὴν τῆς τροφῆς προσφορὰν ὕπνος γίγνεται, ἕως ἂν διακριθῇ τοῦ αἵματος τὸ μὲν καθαρώτερον εἰς τὰ ἄνω, τὸ δὲ θολερώτερον εἰς τὰ κάτω· ὅταν δὲ τοῦτο συμβῇ, ἐγείρονται ἀπολυθέντα τοῦ ἐκ τῆς τροφῆς βάρους.
>
> *Parv. nat., Som.* 3, 458a21–25 (transl. Beare)[32]

In fact, the parenthesis concludes right after text [2] and Aristotle moves directly to the question of the final premise of the practical syllogism. Broadly speaking, the proper description of intemperance, in the context of *Eth. Nic.* 7, consists in showing, through the model of the practical syllogism, that the weak *akratês* opposes his appetite and the perception of the particular (and the opinion that goes with it) to the universal and first premise. Consequently, as Socrates rightly argued, intemperance does not involve real knowledge, but only perception. Now, Aristotle can reach this conclusion independently from any physiological account.

It seems then that here he applies the rule, fixed in the *Posterior analytics*, which in most cases prohibits epistemological kind-crossing, *metabasis eis allo genos*. There are exceptions to this rule, as Aristotle himself points out in the *Posterior analytics*, but subordination of ethics or politics to natural philosophy does not count, at least explicitly, as a valid exception to the rule. Moreover, the *Posterior analytics* are remarkably quiet about practical philosophy as a scientific area, and when Aristotle comes to talk about ethics, it is precisely in order to dissociate ethics from psychology.[33]

Generally speaking, I do not believe that Aristotle's practical philosophy is absolutely independent from theoretical assertions and principles.[34] On the

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32 On drunkenness and sleep, see also *Ph.* 7.3, 247b13–16, and the analysis of this important chapter by Leunissen (2017) 110–138. On the different sorts of blood within the body and the consequences of this distinction for the explanation of "intelligence", see *Part. An.* 2.2, 647b29–648a19. On the fact that the quality of the blood depends on nutrition, see *Part. An.* 2.3, 650a32–b13. On the interaction between blood, natural heat, brain and sleep, see *Part. An.* 2.7, 653a10–20. With consequences for disease, death or temporary madness: 653b2–8. Cf. Leunissen (2017) 15–21. For a recent survey of blood and its modifications in Aristotle, see Bubb (2020).

33 *An. Post.* 1.33, 89b7–9.

34 For this line of argument one can refer, among other studies, to Johnson (2015, 186), who

other hand, we know that Aristotle highlights the differences between the disciplines several times in the *Nicomachean Ethics*. He frequently insists that practical philosophy has a specific purpose: not knowledge for its own sake, but in its practical application. From that point of view—which, again, is not the only one—he may justify passing over scientific investigations when they are not necessary for his argument and restricting his analysis to the elements which are directly relevant for moral or political activity.

For all these reasons, it is quite understandable that many scholars take text [2] as a supplementary proof of scientific demarcation. According to this line of interpretation, this passage, like text [3] about animals' natural exertion, would only indicate that physiological explanations are indeed available but are not necessary for the present survey. From that perspective, the general view is apparently the same as at the beginning of the study of friendship:

> [7] The scientific problems we may leave alone (for they do not belong to the present inquiry); let us examine those which are human and involve character and feeling …
>
> τὰ μὲν οὖν φυσικὰ τῶν ἀπορημάτων ἀφείσθω (οὐ γὰρ οἰκεῖα τῆς παρούσης σκέψεως)· ὅσα δ' ἐστὶν ἀνθρωπικὰ καὶ ἀνήκει εἰς τὰ ἤθη καὶ τὰ πάθη, ταῦτ' ἐπισκεψώμεθα …
>
> *Eth. Nic.* 8.2, 1155b8–10

However, in view of this, how are we to justify the frequent allusions to medicine and the borrowings from physiology we have already discussed?

2.2 *Second Hypothesis: a Scientific Explanation*

Text [2] is in fact more accurate and more instructive than it appears at first glance, and this is due to internal and contextual reasons. Let us take a closer look at text [6], on sleep and awakening. By applying this explanatory model, the kind of ignorance that characterises intemperance would be dissolved when the purest blood flows upwards. One may suppose that the *akratês* recovers the ability to infer, or merely to grasp, the right conclusion from the premises he knows. This explanation might work quite well if one admits that the state of intemperance is a period of physiological confusion due to a mixture of differ-

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argues that "an architectonic conception of philosophy in which theoretical science is authoritative is essential to any interpretation of Aristotle's practical sciences." See also Karbowski (2019) on the scientific and deductive aspects of Aristotle's practical philosophy.

ent kinds of blood in the region of the heart. This is perfectly understandable if one keeps in mind that, according to the famous physical definition of anger in *De an*. 1.1, anger is a sort of 'boiling' (ζέσις) in the region of the heart.[35] This model coheres with the general explanation of emotions in the *Eth. Nic*. itself, as the analysis of courage clearly attests:

> [8] Passion also is sometimes reckoned as courage; those who act from passion, like wild beasts rushing at those who have wounded them, are thought to be brave, because brave men also are passionate; for passion above all things is eager to rush on danger, and hence Homer's 'put strength into his passion' and 'aroused their spirit and passion' and 'bitter spirit in his nostrils' and 'his blood boiled'. For all such expressions seem to indicate the stirring and onset of passion.
>
> *Eth. Nic*. 3.11, 1116b24–30

The last quotation, 'his blood boiled' (ἔζεσεν αἷμα), echoes the canonic definition of *orgê* in *De an*. 1.1.[36] This is hardly incidental. Although it is difficult to detect a unified and perfectly consistent doctrine of emotions or passions in Aristotle's corpus, there is at least a transversal physiological explanation, a common pattern, whose expression and level of accuracy may vary according to the context.[37] This is probably the kind of pattern to which Aristotle alludes in relation to *akrasia*.

Moreover, the change described in text [2] is a 'dissolution', a *lusis*, as indicated by the use of the verb λύεται. This is not metaphorical terminology, but a term that belongs not only to Aristotle's own physiology but also to medical vocabulary (as well as *luô, eklusis, apolusis, dialusis*). In the Hippocratic corpus, it designates a kind of release or evacuation.[38] It can also mean 'remission', as opposed to *krisis*, 'remission of fever'.[39] Accordingly, in *Eth. Nic*. 7.9, 1150b33–34, Aristotle explains that *akrasia* is an occasional disease, like epilepsy.

Aristotle shows in the *Parva naturalia* that sleep is an 'incapacity' (*adunamia*) and 'bond' (*desmos*) for sense-perception, while waking up is a sort of *lusis*. The following text, in this sense, clearly echoes our text [2]:

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35 *De An*. 1.1, 403a31.

36 As pointed out by Zingano (2020).

37 Morel (2016); Morel (2021) 83–95.

38 For λύω in this sense cf. e.g. *Vict*. 1.59 (VI.572 L. = 182,15 Jouanna), 1.62 (VI.576 L. = 184,27 Jouanna). On Aristotle's conception of "dissolution" (especially in *Gen. an*. and *De insomniis*) and its Hippocratic background, see Van der Eijk (2007) 416–422.

39 *Aph*. 7.42 (IV.588.13 L. = IV.202 Loeb). On the medical background of the passage, see Francis (2011).

> [9] we assert that sleep is, in a certain way, or, as it were, a motionless bond, imposed on sense-perception, while its loosening or remission constitutes the being awake.

> τῷ γὰρ αἴσθησιν ἔχειν ὥρισται τὸ ζῷον, τῆς δ' αἰσθήσεως τρόπον τινὰ τὴν μὲν ἀκινησίαν καὶ οἷον δεσμὸν τὸν ὕπνον εἶναί φαμεν, τὴν δὲ λύσιν καὶ τὴν ἄνεσιν ἐγρήγορσιν.
>
> *Parv. nat., Som.* 1, 454b24–27 (transl. Beare)

Similarly, ἀπολυθέντα in text [6] is significant. Just as an animal recovers its active capacity to perceive by the senses when it wakes up, being "released (ἀπολυθέντα) from the heaviness consequent on taking food", so an akratic or drunk person may recover the cognitive ability to follow moral rules.

Let us now take a closer look at the immediate context of text [2]. Although the main line of argumentation about *akrasia* is not itself dependent on physiology, the physiological considerations in text [2] are not isolated. A few lines before, Aristotle reminds us that the same person can in a sense have knowledge and yet not have it, as in the case of a person "asleep, mad or drunk" (1147a13–14); accordingly, Aristotle adds, emotions alter "our bodily condition as well" (καὶ τὸ σῶμα μεθιστᾶσιν; 1147a16). He also says that appetite "can move each of our bodily parts" (1147a35), and this in accordance with the doctrine of bodily motion as dependant on desire in *De anima*, III, 10 or in *De motu*. Moreover, immediately after text [2], he compares the false knowledge of the akratic to the state of a drunk person who utters verses of Empedocles (1147b12) without understanding their meaning. Now, this echoes not only the same example in *Eth. Nic.* 7.3, 1147a20, but also the examples of mental agitation and verbal incoherence in *De memoria*, 2, 453a14–b10, a text which foregrounds physiological and medical accounts. At the end of *Eth. Nic.* 7, right after our text [3], he compares young people to drunk people (1154b10) because of their common instability. The case of melancholic people is also considered in the same passage (1154b11) because of their excitement, and this example may refer to the sort of analysis we find in the *Parva naturalia*, where it appears several times.[40]

I do not intend here to take a position on the chronology of the treatises, and I could not say whether or not the *Nicomachean Ethics* could refer to pre-existing works that comprise the *Parva naturalia*. Even the chronology of the *Parva naturalia* is debatable. Some of them seem to belong to the last stages of Aristotle's psychology (if we accept a degree of evolution in this domain), but

40 *Parv. nat., Mem.* 2.453a19; *Som.* 3, 457a27; *Insomn.* 3.461a22; *Div. somn.* 2.463b17; 464a32.

others probably have several layers and may have been written, elaborated, or compiled over a long period.

At any rate, we can draw two conclusions from this reading of text [2]:

a) Aristotle does not dissociate ethical arguments on *akrasia* from the physiological account of it. He clearly thinks that states of moral disorder are also states of bodily disorder.

b) When he refers to the *physiologoi* in text [2], this should not necessarily be understood as an allusion only to Aristotle's predecessors or to contemporary physicists outside the school. He refers also, and in fact probably mainly, to himself or to his own school.

2.3 *Third Hypothesis: Considering Natural Facts*

My second hypothesis proposed that we give a positive meaning to the expression 'δεῖ παρὰ *x* ἀκούειν'. It may actually signify that we must consult the *physiologoi* or take into account our own physical investigations (i.e.: Aristotle's own physical investigations) in order to explain the cessation of the state of akratic ignorance. Taken this way, it means that physiological considerations are not to be rejected at all.

Does this entail that the physical *explanation* is necessary for the ethical account of intemperance in the sense that it should be inserted in the reasoning that leads to the conclusion of the enquiry? The answer must be negative, since, although this chapter undoubtedly has a physiological background, the line of thought would be consistent even without these physiological data. Moreover, Aristotle does not draw any explicit conclusion from text [2]. As previously noted, the text comes to an abrupt stop and is immediately followed by new claims about the final premises of the practical syllogism.[41]

In addition, the information presented does not provide us with practical solutions. It does not help solve the practical problem of the cessation of *akrasia*. How can intemperance be cured? Our brief passage remains silent on this. Aristotle also says that the explanation of the *lusis* "is not peculiar to this condition" (οὐκ ἴδιος τούτου τοῦ πάθους). This remark indicates that the explanation is not specific enough to give a proper account of the dissolution of akratic ignorance as such. We know that this dissolution is the same kind as occurs in waking up and sobering up, but we do not know precisely to what extent these states differ from each other. This reservation reflects Aristotle's rejection of physical investigations in text [7]: "they do not belong to the present inquiry"

41 "Now, the last proposition both being an opinion about a perceptible object, and being what determines our actions …" (ἐπεὶ δ' ἡ τελευταία πρότασις δόξα τε αἰσθητοῦ καὶ κυρία τῶν πράξεων …).

(οὐ γὰρ οἰκεῖα τῆς παρούσης σκέψεως). This probably means that, in accordance with the methodological rules from the *Analytics*, they do not belong to the same epistemological domain, and therefore they do not consider the same relevant matter or 'proper' subject.[42]

For all these reasons, I do not believe that, in this case—where, exceptionally in the *Ethics*, Aristotle explicitly refers to the authority of *physiologoi*—natural philosophy offers scientific principles or foundational propositions or explanations for the ethical investigation. At this point of the analysis, it seems that there is no satisfactory solution.

However, if physiological *explanation*, properly speaking (the text clearly alludes to a sort of explanation: *πῶς* δὲ λύεται …) is to be set aside or just allusively evoked, this does not imply that the *fact* it brings to light does not matter, or that reference to it is merely empirical in the weakest sense. To put it differently, it could be that, on the one hand, Aristotle sets aside the scientific *account of the cause* because it is irrelevant to the context, but on the other hand he mentions a scientific *fact* because it is important for the practical case he is dealing with.

The distinction between explanation and fact, between *to dioti* and *to hoti*, is emphasised and explained in the *Posterior analytics* (I, 13; II, 1–2), but it is also present in *Eth. Nic.*, for instance in text [10]:[43]

> [10] Presumably, then, we must begin with things familiar to us. Hence any one who is to listen intelligently to lectures about what is noble and just and, generally, about the subjects of political science must have been brought up in good habits. For the facts are the starting-point, and if they are sufficiently plain to him, he will not need the reason as well; and the man who has been well brought up has or can easily get starting-points.
>
> ἴσως οὖν ἡμῖν γε ἀρκτέον ἀπὸ τῶν ἡμῖν γνωρίμων. διὸ δεῖ τοῖς ἔθεσιν ἦχθαι καλῶς τὸν περὶ καλῶν καὶ δικαίων καὶ ὅλως τῶν πολιτικῶν ἀκουσόμενον ἱκανῶς. ἀρχὴ γὰρ τὸ ὅτι, καὶ εἰ τοῦτο φαίνοιτο ἀρκούντως, οὐδὲν προσδεήσει τοῦ διότι· ὁ δὲ τοιοῦτος ἔχει ἢ λάβοι ἂν ἀρχὰς ῥᾳδίως.
>
> *Eth. Nic.* 1.2, 1095b3–8

42 Examples of the use of *oikeion* in this sense in *An. post.*: 1.2, 71b23; 72a6; 6, 74b26; 12, 77a39; 17, 80b18 *sq*. With *idion*: 1.7, 75b18–20; 9, 76a16; a38–b3.

43 See also *Eth. Nic.* 1.7, 1098b1–2. In a different context (*Eth. Eud.* 1.6, 1216b36–39), Aristotle urges the specialist of politics to consider not only the facts, but also the explanation (*to dioti*).

We must start with facts and, in certain circumstances, when they are clear enough, there is no need to search for *explanations* strictly speaking. It is true that in his ethical writings Aristotle refers mainly to anthropological and social facts: how people live, what their customs and habits are, etc. Yet nothing prevents us from inferring that, in text [10], some data derived from natural philosophy also are alluded to. Indeed, in some circumstances, scientists have to start from facts, and Aristotle shows in the *Posterior analytics* (1.13) in what sense there can be 'syllogisms from the facts'. For example, from the fact that some stars do not twinkle, we may infer by induction that they are close. However, the real explanation is not given by this kind of syllogism, but by the deduction that starts from the closeness of the stars. Even if we are dealing with *scientific* facts (not with ordinary, common observations), and even when we can start from them, they cannot be foundational for subsequent propositions (in our case: ethical assertions), in the same way that real principles or explanations (of the same epistemological kind) can.

For all these reasons, we should take the physical considerations of the ethical writings as based on a minimal and pragmatic physiology, rather than engaged with a scientific technical discourse or discipline, on which political science would in turn be dependent. By 'minimal and pragmatic physiology', I mean that these kinds of considerations are simplified (in contrast to technical scientific explanations) and subordinated to the specific needs of practical philosophy. These specific needs are, in simple terms, how to realize good actions or how to acquire the knowledge that is necessary to govern a city.[44] From that point of view, the physiological discourse is primarily instrumental, in so far as it contributes to an additional argument that serves—and is subordinate to—the overriding ethical purpose. In the case of *akrasia*, this is apparently to identify a phenomenon—a lack of control due to a physiological state—which usually escapes our notice whereas it can have important practical consequences. If things work like this, the difficulty of kind-crossing sciences, caused by conflating different scientific disciplines, as envisaged in the *Posterior analytics*, is significantly reduced, if not eliminated.

Are natural facts foundational for ethical propositions? In a loose sense, perhaps they are. They are *archai*, in the sense of 'starting-points' in text [10], at 1095b6.[45] In text [3], significantly, what *hoi physiologoi* (or the physical treat-

44 This type of consideration could be extended to other texts, such as the famous '*ergon* argument' in *Eth. Nic.* 1, 1097b22–1098a1, whose scientific features are rather schematic, and do not presuppose a detailed scientific understanding of human nature. See further Henry (2015) 189; Morel (2021) 106–121.

45 Natali (2017) 60.

ises) teach us, or "attest" (μαρτυροῦσι) is above all this: "animals are always toiling". Although Aristotle alludes to a sort of explanation or middle term—i.e.: *because* sight and hearing are painful—this is not what matters for the argument at hand, which is concerned with the connection between pleasure and pain.

Lastly, what exactly is the fact in question about akratic ignorance? Clearly the simple fact that its dissolution is similar to waking up and recovering from drunkenness. In other words, the fact that this dissolution depends on physiological factors and is therefore not absolutely under control. This is by no means a marginal issue: Aristotle several times addresses the question of what control we have over our dispositions. Changing our habits is no easy task, as he says for instance at *Eth. Nic.* 5.1, 1129a13–16 or at 3.7, 1114b30–1115a4 about what is voluntary (*ekousion*), when discussing responsibility for our dispositions.[46] He compares them to diseases (ὥσπερ ἐπὶ τῶν ἀρρωστιῶν) whose progression escapes our notice. At 1114a14–19, in comparison with disease, he refers to his version of the principle of inertia: when someone lets a stone go, it is no longer possible for him to call it back. This is a well-known mechanical issue, which Aristotle examines in *Parva naturalia* and in *Physics*.[47]

But the most important point is this: it is crucial for the ethical purpose to bear in mind that the cessation of akratic ignorance is at least partly beyond our control. Now, this is precisely what we are told by the *physiologoi*, and probably by some physicians as well. To solve the practical problem, this information is not sufficient, and scientific *explanations* are not fully relevant because they do not lead to a practical conclusion. If someone explains, from the physiological point of view, *why* it is so, it is not of very much help. However, knowing—that is, grasping the *fact*—that there *is* a lack of control is crucial if one wants to evaluate the limits of voluntariness and, conversely, to be aware of what role habits play in right action. After all, the acquisition of the virtue of temperance through moral education and habits remains the surest way to prevent *akrasia*.

The preceding discussion has focused on short passages, which are not in themselves sufficient to solve the general issue I addressed at the outset, and a wide range of additional problems need to be considered. However, these texts are significant and at the very least invite us to reformulate the issue: rather than asking whether physiology, taken as a distinct scientific discipline, is or is not foundational for political science, they instead suggest that we should

46 See also, in *Eth. Nic.* 7.11, 1152a30. Intemperance is not in itself a habit, to the extent that it is not exactly a vice, even if some people seem to be incontinent because of their habits.

47 See e.g.: *Parv. nat., Mem.* 2.453a14–31; *Ins.* 2.459a23–b7; *Phys.* 4.8, 215a 15; 8.10, 266b28–267a20; see also *DC* 3.2, 301b23–30.

reflect on the kind of support political science can expect to receive from a minimal and pragmatic physiology as I have defined it. From that point of view, mentioning *facts* is perhaps more useful than invoking complete scientific explanations. This physiology, clearly connected to medicine, is simplified and summary in nature, so that it is accessible to non-specialists of natural science. Nevertheless, it is precisely in this way that the specialist of political science must investigate the soul, that is: "to the extent which is sufficient for the questions we are discussing".[48] In other words, if any information is to be borrowed from physiology and medicine in ethical writings, it is probably observed facts rather than real scientific principles.

Finally, a nuanced approach is needed. On the one hand, based on the texts discussed above, neither medicine nor physiology provide us with practical solutions or prescriptions for the political and ethical spheres. On the other hand, it is crucial to take into account the physiological aspects of moral states. Given that certain moral disorders are at the same time physical disorders, examining moral facts implies that we are also able to identify certain states that are common to both the body and the soul—exactly the sort of facts that medicine and physiology bring to light.

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48 In this sense, Leunissen (2015) 226–227.

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CHAPTER 12

The Medical Background and Inductive Basis of Aristotle's Doctrine of the Mean

Monte Ransome Johnson

Introduction

Two arguments in *Eudemian Ethics* 2 that are crucial to Aristotle's definition of moral virtue as a mean state[1] contain claims that Aristotle says are clear by induction.[2] In these contexts, he explicitly appeals to examples coming from arts and sciences like gymnastic training and medicine for evidence. But Aristotle does not here, or elsewhere (at least in any extant work), including the parallel arguments in the *Nicomachean Ethics*, actually supply or discuss the evidence that makes these inductive arguments clear. Fortunately, strong support for them can be found in the Hippocratic Corpus, especially in *On Ancient Medicine* and *On Regimen*.

Discussions of Aristotle's definition of virtue and doctrine of the mean typically suffer from one or more of the following interpretive deficiencies. First, many influential studies focus exclusively on *Nicomachean Ethics* 2, and either ignore or pay little attention to the parallel *Eudemian Ethics* 2 arguments.[3] Second, and partly as a result, many studies ignore the inductive form of the arguments as Aristotle explicitly describes them in the *Eudemian Ethics*. Third, and again partly because of the foregoing, most commentators ignore or downplay the medical background which, in my interpretation, forms almost the

1 "Virtue of character is essentially a mean state in each case, and concerns certain means (τὴν ἠθικὴν ἀρετὴν καθ' αὑτὴν ἑκάστην μεσότητα εἶναι καὶ περὶ μέσ' ἄττα) in pleasures and pains, and things pleasant and unpleasant" (*Eth. Eud.* 2.5, 1222a10–12, trans. Woods, following Woods' proposed reading of the text noted on p. 190). (Unless otherwise noted, translations are mine and the *Eth. Eud.* text follows Susemihl.) See also the definition at *Eth. Nic.* 2.6, 1106b36–1107a2, discussed below in part 4.

2 ταῦτα δὲ δῆλα ἐκ τῆς ἐπαγωγῆς (*Eth. Eud* 2.1, 1220a28–29); καὶ τοῦτο δῆλον διὰ τῆς ἐπαγωγῆς καὶ τοῦ λόγου (*Eth. Eud.* 2.3, 1220b29–30).

3 For example, the influential account of Urmson (1973) (reprinted in 1980 and recapitulated in 1988) ignores the *Eth. Eud.* Urmson was criticized in Hursthouse (1980) and (2006), where the *Eth. Eud.* is only very briefly mentioned.

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entire basis of the arguments. For example, Hursthouse acknowledges that "intimations of the doctrine of the mean—in literature, medicine, mathematics, and philosophy—seem to have been around well before Aristotle, but, for the purposes of this chapter, I will go no further back than Plato."[4] Nevertheless, recognizing the existence of this background and that the doctrine "is not peculiar to the ethical works" (she mentions the presence of the doctrine in several of Aristotle's theoretical works, especially biological ones), she considers that "the principle of charity does not apply to it in the same way", and we are entitled to assess the doctrine of the mean "on its own merits". Unfortunately, when she does: "it stands revealed as, to be blunt, simply whacky, emphatically not 'a principle worthy of his genius' … but a bit of completely misguided science-cum-metaphysics that appears to have been generally accepted in his day".[5] Although Hursthouse is extreme in her belittlement of both the scientific background of the doctrine and Aristotle's adaptation of it in his ethics, she is certainly not alone in failing to appreciate the full significance of the medical background.

Fortunately, Rapp has since made progress in interpreting the doctrine in a way that avoids the problems discussed by Hursthouse. He also pays close attention to both the *Eudemian* and *Nicomachean Ethics*. He shows that the doctrine was never intended as any kind of "practical guideline" (or "decision procedure" or "action-guiding rule"), but rather as a conceptual tool for clarifying the conditions under which the non-rational soul can be said to be in a good condition in the context of specific actions.[6] Unfortunately, Rapp does not discuss the inductive form of the arguments or their medical background and so his interpretation, while essentially correct, could still be strengthened.

I propose to remedy these deficiencies as follows. First, I will begin with the *Eudemian Ethics* and the context of the inductive arguments found in 2.1 and 2.3 (in parts 1 and 2). I will only briefly discuss the more familiar *Nicomachean* arguments because I perceive them to be later reuses and refinements of the *Eudemian* ones. Second, I will interpret these arguments in a syllogistic form

4 Hursthouse (2006) 96.

5 Hursthouse (2006) 99.

6 "The doctrine of the mean does not attempt to determine the individual parameters by a quantitative account of what is good or bad, but it clarifies the conditions under which the impulses of our non-rational soul and the corresponding actions can be said to be good or right. And this is exactly what the context of the doctrine in *Eth Eud.* 2 and *Eth. Nic.* 2 requires." Rapp (2006) 126. Rapp's account has recently been approved of and built upon by Brown (2014), see, e.g., ibid. 67 n. 5.

consistent with Aristotle's logic, and I will try to reconstruct their inductive form. Third, I will build on earlier work that has already demonstrated the importance of the medical background for Aristotle's philosophy in general and ethics specifically[7] by looking at some passages in *On Ancient Medicine* and *On Regimen* (in parts 3 and 4).

1 Eudemian Ethics *2.1*

In *Eth. Eud.* 1, Aristotle discusses *eudaimonia* and in 2.1 arrives at and confirms his definition: "the activity of a complete life in accordance with complete virtue" (1219a38–40). The next step is to explain what is meant by "complete virtue". This explanation, he says, requires discussion of the parts of the soul, "for virtue belongs to the soul and necessarily so" (1219b26). After eliminating the vegetative part from the discussion, he focuses on the two parts of the soul that have reason: one partaking of reason by "its natural tendency to command", and the other by "its natural tendency to obey and listen" (1219b30). Human beings, and only human beings, have both parts, "for if a part belongs to a human being qua human being, it necessarily includes reasoning and a ruler and action (λογισμὸν ἐνεῖναι καὶ ἀρχὴν καὶ πρᾶξιν), but reasoning rules (ἄρχει) not reasoning, but desires and passions (ὀρέξεως καὶ παθημάτων), so that it is necessary to have these parts" (1219b40–1220a2). Then, by an analogy to the good physical condition of the body, "complete virtue" will mean the virtue of both of these parts of the soul: "Just as the good physical condition (ἡ εὐεξία) is composed out of the virtues of the parts, so too is the virtue of the soul insofar as it is complete" (1220a2–4). Two kinds of virtue correspond to these two parts of the soul: intellectual virtue to "that rational part which commands the soul by its possession of reason"; and moral virtue to "the part which is irrational but by nature follows the part having reason" (1220a9–11). This distinction between two parts of the soul and their virtues then structures the ensuing discussion of moral virtues in books 2–4, followed by the intellectual ones in 5.

7 Most studies of the influence of medicine on Aristotle have understandably focused on theoretical philosophy, for example Solmsen (1960), Lloyd (1966), Longrigg (1993), van der Eijk (2005), Johnson (2012), Bartoš (2015), Morel (2024), and several authors in this volume. For practical philosophy specifically, see Wehrli (1951), Jaeger (1957), Lloyd (1968) (and Lloyd 2003, 181–185), Tracy (1969), Hutchinson (1988), and in this volume, Thein, Morel, and Thumiger. Tracy's extensive discussion of how Aristotle's doctrine of the mean is informed by the medical background of his own theoretical (especially physiological) views (1969, 222–282) is mostly a summary of Aristotle's position and does not discuss the exact form of Aristotle's argument or its relationship to specific medical texts.

Aristotle says that we must first investigate what moral virtue is (and what its parts are), as well as what produces it (*Eth. Eud.* 2.1, 1220a13–15). But before doing so, he offers a brief methodological reflection: "we must make our search with some grasp of the matter, as all who seek in other areas do, so as to try, by working through what is expressed truly but unclearly, to arrive at what is both true and clear" (1220a15–18). Aristotle thus takes his lead from a method already employed in other areas. What those areas are will become clear, but Aristotle offers a hint: "As things are, we are in a state comparable to knowing that health is the best disposition of the body" (ὑγίειαν … ἡ ἀρίστη διάθεσις τοῦ σώματος, 1220a18–19). Knowing only this, one would not know what health is, but knowing this could nevertheless be helpful to conceptualizing both what health is and how to produce it. Similarly, knowing that virtue is the best disposition of the soul does not afford us knowledge of what virtue is, but it will prove helpful to conceptualizing how it is produced, and what it is. Aristotle begins by discussing how virtue is produced.

> ⟨1⟩ First of all, let it be established that the best dispositions are produced by means of the best things, and to act best concerning each thing is produced from the virtue of each thing. For example, *the best exercises and nourishment are produced from a good physical condition, and out of the good physical condition they exercise best*. Further, every disposition is produced and destroyed by the same things being applied one way or another, *such as health by food, exercise, and season or climate. This is clear by induction*. ⟨2⟩ And the virtue, therefore, is this kind of disposition, a disposition which is produced by the best processes concerning the soul, and a disposition from which the best deeds and passions of the soul are accomplished; and by the same things, if they happen in one way, it is produced, but if they happen in another, it is destroyed, and the use of virtue is related to the same things by which it is increased and destroyed, in relation to which it disposes us towards the best things. ⟨3⟩ An indication of this is that both virtue and vice are concerned with the pleasant and the painful. For their punishments *being medical treatments* and being produced through opposites, are produced through opposites just as those others are. That moral virtue concerns the pleasant and the painful, then, is clear. (1220a22–39).

It is highly significant that at the outset of his discussion of moral virtue, Aristotle presents a general account of the formation of dispositions by reference to medicine in section ⟨1⟩, and then confirms the results of his inference by appeal to a different point about medicine in ⟨3⟩. In ⟨1⟩ he mentions

three examples: "nutrition", "exercise", and "season" (ὥσπερ ὑγίεια ὑπὸ τροφῆς καὶ πόνων καὶ ὥρας). Each of these factors are extensively discussed and in fact emphasized by medical writers.[8] In his commentary, Woods says that what is clear by induction relates to the "empirical thesis" that "every state (disposition) is both produced and destroyed by the application, in a certain way, of the same things".[9] Woods says that the examples mentioned above are supposed to support that thesis: "just as the right sort of food promotes, so the wrong sort ruins, health, and similarly with exercise".[10] As a further indication that this is a "substantial thesis", Woods points to another set of examples offered in support of the same claim in *Eth. Nic.* 2, at 1103b6–25 and 1104a11–27.

But when Aristotle says "this is clear by induction", he presumably means more than that telegraphic examples can be given in support (i.e., τροφῆς καὶ πόνων καὶ ὥρας). According to *Prior Analytics* 2.23, "induction consists in deducing a relation between one extreme and the middle by means of the other extreme, e.g. if B is the middle term between A and C, it consists in proving through C that A belongs to B. For this is the manner in which we make inductions" (68b15–17, trans. Jenkinson). Accordingly, in what follows, I attempt to reconstruct as syllogisms both Aristotle's overall deductive argument and the inductive argument that is supposed to make its major premise clear.

The conclusion comes at the beginning of section ⟨2⟩: "virtue, therefore (ἄρα), is this kind of disposition" (1220a29). I interpret the argument as follows.

4. The best disposition inheres in doing the best things. (1220a22–23)
5. Doing the best things inheres in the virtue. (1220a23–24)
6. Thus, the best disposition inheres in the virtue. (1220a29)

I have numbered the propositions in this way because another argument (the inductive argument discussed below) needs to be supplied in support of the

8 The author of *On Regimen* 1.2 discusses the importance of determining correctly "the proportion of exercise to bulk of food, to the nature of the individual, to the age of the body (τὰς ἡλικίας τῶν σωμάτων), to the season of the year (τὰς ὥρας τοῦ ἐνιαυτοῦ), to the changes of the winds, to local conditions, and to the constitution of the year." (VI.470. L. = 124,11–14 Joly-Byl, trans. Jones, discussed below). See also *Nature of Man* 9 (VI.54. L. = 190,16–192,5). Woods (1982, 97) is mistaken when he translates ὥρας not as "season" but as "time of life" and remarks: "the example of time of life (*hôra*) is rather strange: it is not something that can be applied either in a beneficial or a deleterious way."

9 Woods (1982) 97.

10 Woods (1982) 97.

major premise, proposition 4. Now, if the conclusion at 6 is secured, then Aristotle has deduced that "the virtue is this kind of disposition" (καὶ ἡ ἀρετὴ ἄρα ἡ τοιαύτη διάθεσις ἐστίν, 1220a29), i.e., the best disposition, the disposition "which is produced by means of the best movements of the soul" (ἣ γίνεταί τε ὑπὸ τῶν ἀρίστων περὶ ψυχὴν κινήσεων, 1220a29–30) and "from which the best deeds and passions of the soul are produced" (καὶ ἀφ' ἧς πράττεται τὰ ἄριστα τῆς ψυχῆς ἔργα καὶ πάθη, 1220a30–31).

Whether the conclusion is secured depends on whether the major premise is acceptable. In order to see that it is, we must examine its inductive basis, which may be interpreted as follows:

1. The best disposition (ἡ βελτίστη διάθεσις) inheres in the good condition (ἡ ὐεξία).
2. The best application of the same things (e.g., exercise and nutrition) inheres in the good condition. (1220a24–25)
3. The good condition inheres in the best application of the same things (e.g., exercise and nutrition). (1220a25–26)
4. Thus, the best disposition inheres in the best application of the same things. (1220a26–27; cf. a22–23).

This conclusion is stated with positive superlative valences (the *best* disposition inheres in the *best* application of the same things, etc.) corresponding both to Aristotle's examples and to the proposition that he is trying to support. However, Aristotle clearly intends that supplying opposite valences would produce opposite results (so the *worst* disposition inheres in the *worst* application of the same things, etc.). Thus, he expresses the conclusion generally: "Every disposition is produced and destroyed by the same things being applied *in a certain way*" (πᾶσαν διάθεσιν ὑπὸ τῶν αὐτῶν γίγνεσθαι καὶ φθείρεσθαι **πὼς** προσφερομένων, 1220a26–27). But the application of this general principle to the *best* disposition and *best* things allows him to reach as an interim conclusion the major premise (number 4 above) of the overall argument: that "the best disposition inheres in doing the best things", assuming that "the best application of the same things" is equivalent to "doing the best things". Certainly "the best application of the same things", as we have just seen, results in doing the best things. Thus, with this conclusion at 4 secured, Aristotle can reach the conclusion at 6, that every virtue is a disposition "of a certain kind".

The inductive argument involves the convertibility of the terms "the best application of the same things" and "the best condition" in premises 2 and 3. These terms are argued to be convertible on the basis of a medical doctrine: "the best exercises and nutrition are those from which are produced the good physical condition" (οἷον πόνοι τε ἄριστοι καὶ τροφὴ ἀφ' ὧν γίνεται εὐεξία, 1220a24–

25) and "from their good physical condition they exercise best" (ἀπὸ τῆς εὐεξίας πονοῦσιν ἄριστα, 1220a25–26). Thus, the entire inductive basis for the overall argument in the *Eth. Eud.* is this medical doctrine.[11] Here is what Aristotle says in the parallel argument in the *Eth. Nic.*:[12]

> First, then, let us consider this, that it is the nature of such things ⟨sc. virtues⟩ to be destroyed by deficiency and excess, as we see in the case of strength and health (for to gain light on things imperceptible we must use the evidence of sensible things); both excessive and deficient exercise destroys the strength, and similarly drink or food which is above or below a certain amount destroys the health, while that which is proportionate (σύμμετρα) both produces and increases and preserves it. So too it is, then, in the case of temperance and courage and the other virtues. (2.2, 1104a11–19, trans. Ross)

The examples of "strength and health", which are produced, increased, and preserved by proportionate but destroyed by excessive or deficient food and exercise, underwrite the principle that the moral virtues are produced, increased, and preserved by some kind of proportion avoiding excess and deficiency. So here too, the account of virtue depends on medical doctrine.

Returning to the *Eth. Eud.* passage, in section ⟨2⟩, Aristotle applies the general principle based on medicine to moral virtue, and then confirms this application by invoking yet another medical analogy in ⟨3⟩ between punishments and medical treatments (αἱ γὰρ κολάσεις ἰατρεῖαι οὖσαι). Medical treatments and punishments both operate through application of opposites, that is, application of the quality opposite to the quality causing the bad condition. So, for example, if repletion or insufficient exercise is causing the bad condition of the body, a restricted diet or intensive exercise should be prescribed;[13] similarly, if

11 The "good condition" is defined in the *Precepts* 9 in terms of "movement": "the healthy condition of a human being (Ἡ τοῦ ἀνθρώπου εὐεξίη) is a nature that has naturally attained a movement (κίνησιν), not alien but perfectly adapted, having produced it by means of breath, warmth, and concoction of humors, in every way, by complete regimen and everything combined, unless there should be some congenital deficiency (ἔλλειμμα)." (IX.266 L. = 33, 25–29 Heiberg, trans. Jones).

12 See also *Eth. Nic.* 2.1, 1103b6–12, where Aristotle makes a similar argument on the basis of flute-playing and building.

13 In *On the Nature of Man* (*Nat. Hom.* 9 /VI.54 L. = 189,3–10 Jouanna, trans. Jones): "diseases of repletion are cured by evacuation, and those due to evacuation are cured by repletion; those due to exercise are cured by rest, and those due to illness are cured by exercise. To know the whole matter, the physician must set himself opposite to the established char-

too much pleasure is taken in drink or food or sex, restrictions on these should be imposed for the sake of moral virtue.

Moral virtue, virtue of character, Aristotle says, is produced by habit. The very name "character" (ἦθος) indicates something that grows "from habit" (ἀπὸ ἔθους). When habituated (ἐθίζεται), one is led by a non-innate source to an efficacious or capable state "by being moved repeatedly *in a certain way*" (τῷ πολλάκις κινεῖσθαι **πώς**, 1220b1–2). As in the foregoing, although the principle is stated generally, we may substitute the superlative valence to see how this applies to virtue: one is habituated to the *best* condition by being moved repeatedly in the *best* way. Regarding character itself, it is said to be a certain quality of that part of the soul that is capable of following reason (1220b5–6). We have seen that this part is the desiderative or sensitive soul, the part which experiences the passions, in which there is pleasure and pain. Aristotle next examines "what it is in accordance with which the soul has a character of a certain quality" (κατὰ τί τῆς ψυχῆς ποιότης τὰ ἤθη). Aristotle gives two answers: "in accordance with the capabilities of the passions, in virtue of which people are said to be subject to the passions" and "in accordance with their habits, in virtue of which people are said, with respect to these passions, either to experience them in a certain way, or to be immune to them" (1220b7–10). Character and virtue will certainly be related to the passions and our capabilities for them, as we have seen; they include anger, fear, appetite, and "in general whatever, as such, usually gives rise to perceived pleasure or pain" (ὅλως οἷς ἕπεται ὡς ἐπὶ τὸ πολὺ ἡ αἰσθητικὴ ἡδονὴ ἢ λύπη καθ' αὑτά, 1220b13–14). But he says that "habits are what are responsible for whether these occur in accordance with reason, or the reverse" (1220b18–19). And, for this reason, habit is the genus of both virtue and vice.[14]

The next step will be to determine the specific difference of virtue, which will allow Aristotle to offer a general definition of virtue according to its genus

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acter of diseases, of constitutions, of seasons, and of ages; he must relax what is tense and make what is tense relaxed. For in this way the diseased part would rest most, and this, in my opinion, constitutes treatment." Cf. *Nat. Hom.* 2 (11.36 L. = 169,9–170,1 Jouanna). See Wehrli (1951) 53–54.

14 According to Jaeger (referring to the parallel passage in the *Eth. Nic.*), in calling moral virtue a "*hexis*", Aristotle was adapting medical terminology: "to attempt a definition of virtue … we must determine its genus, and this will not be difficult after we have compared the moral virtues with those of the body such as strength, health, etc. These are called a permanent disposition of the body (ἕξις) in medical terminology, and Aristotle does not hesitate to apply the same word to the ethical phenomenon of virtue". Jaeger (1957) 58.

(habit) and specific difference (a mean state avoiding excess and deficiency). The account of this specific difference is where the second inductive argument about virtue appears.

2 Eudemian Ethics *2.3*

A complete argument showing that virtue is a mean state appears in *Eth. Eud.* 2.3. I have divided the argument into three sections for ease of reference.

> ⟨1⟩ One must grasp that in everything continuous and divisible there is excess and deficiency and mean (ὑπεροχὴ καὶ ἔλλειψις καὶ μέσον). And these either in relation to others or in relation to us, *for example in gymnastic training, in medicine, in building, in piloting, and in any action whatsoever, both scientific and unscientific, and skilled and unskilled.* For motion (ἡ κίνησις) is continuous, and action (ἡ πρᾶξις) is a motion. ⟨2a⟩ And in every case the mean in relation to us is best. For this is as science and reason prescribe (ὡς ἡ ἐπιστήμη κελεύει καὶ ὁ λόγος). And in every case, this is and produces the best condition (τὴν βελτίστην ἕξιν); and *this is clear through induction and argument.* ⟨2b⟩ For opposites destroy one another. But the extremes are opposites both to each other and to the mean. For the mean is an extreme to each extreme, for example the equal is more than the less, but less than the more. Therefore, it is necessary that moral virtue concerns a mean and is a mean state. (περὶ μέσ' ἄττα εἶναι καὶ μεσότητα τινά). (1220b21–35)

In section ⟨1⟩, Aristotle argues deductively that excess, deficiency, and mean inhere in every action. In ⟨2a⟩, Aristotle argues inductively to the interim conclusion that the mean in relation to us is the best condition for us. In ⟨2b⟩, Aristotle argues deductively from this interim conclusion to the overall conclusion that every virtue concerns (or is) a mean. Here is a syllogistic interpretation of section ⟨1⟩:

1. Excess, deficiency, and mean inheres in every divisible continuum.
2. A divisible continuum inheres in every motion.
3. Motion inheres in every action.
4. Therefore, excess, deficiency, and mean inheres in every action.

The first premise has the appearance of a mathematical axiom. However, as stated, it is overly brief because it is plainly false that every continuum contains excess, deficiency, and mean. A random line of arbitrary length is continuous and divisible, but does not contain excess, deficiency, or mean. What it does contain as a divisible continuum is "more", "less", and the "equal", terms which are mentioned immediately below in section ⟨2b⟩. That everything con-

tinuous and divisible admits of "more, less, and equal" involves a mathematical principle also applied by Aristotle in his physics. Everything continuous can be divided into subdivisions that are themselves always divisible: the continuous is infinitely divisible.[15] It is always possible to take "more", "less", and "equal" amounts of a divisible quantity. Thus, every divisible continuum contains more, less, and equal, but some continua can be taken not only "in relation to others" but also "in relation to us". "In relation to others", only the abstract mathematical terms "more", "less" and "equal" apply; but "in relation to us", these terms correspond to "excess", "deficiency", and "mean". Ethics is concerned exclusively with this second class of continua.

The second premise, that every "movement" (*kinesis*) is continuous and divisible, is another principle employed in Aristotle's physics. Every motion is divisible into sub-movements that are themselves always divisible. Thus, every movement is infinitely divisible and, insofar as it is a single motion, continuous.[16]

The third premise, that every action (*praxis*) is a movement (*kinesis*), is needed to explicitly link "excess, deficiency, and mean" to ethics.[17] Ethics, of course, is concerned not with "movements" generally (like physics), but specifically with movements that are "actions", in which there can be too much or too little of something. By linking two abstract assumptions from his physics with the metaethical assumption that every "action" is a "movement", Aristotle is able to draw the conclusion that in every action there is excess, deficiency, and mean.

But this deductive argument in section ⟨1⟩ only gets Aristotle so far. The mere existence of a mean in every action does not in fact come very close to showing what Aristotle wants to conclude into his definition of virtue, i.e., that every action should be concerned with a mean or aimed at a mean. To show that, Aristotle offers the inductive argument in ⟨2a⟩, which I interpret syllogistically as follows:

1. A mean in relation to us inheres in every prescription of science and reason (e.g., those of gymnastic training, dietetics).

15 See *De caelo* 1.1: "a continuum is that which is divisible into parts always capable of subdivision" (268a6, trans. Stocks). That everything continuous is infinitely divisible is a point repeatedly made by Aristotle in *Physics* 6, e.g., 231b16; cf. 232b24, 233a25.

16 See *Ph.* 4.2, 210a10–13 and 5.4: "Since every movement is continuous (συνεχὴς πᾶσα κίνησις), a movement that is one in an unqualified sense must (since every movement is divisible) be continuous, and a continuous movement must be one" (228a20–22, trans. Hardie and Gaye, adapted).

17 See also 1222b28–29. For *pathê*, see *Eth. Nic* 1106a4–5.

2. The best condition for us inheres in every prescription of science and reason.
3. The prescription of science and reason inheres in every best condition for us. (conversion of 2)
4. Thus, a mean in relation to us inheres in every best condition for us. (1+3)

Since Aristotle says that the conclusion (that "the mean is the best condition": τὴν βελτίστην ἕξιν) "is clear through induction", I have interpreted him in accordance with the syllogistic account of induction in *Prior Analytics*. Now, if premise 2 is convertible with premise 3, then an induction linking "the mean in relation to us" and "the best condition for us" would be possible. So, on this interpretation, the claim that "every prescription of science and reason is the best condition for us" and "every best condition for us is the prescription of science and reason" would have to be convertible. And that seems right: insofar as science and reason prescribe a condition for us, this must be the best condition for us, and insofar as something is the best condition for us, this must be what science and reason prescribe for us. This turns out to be the deep meaning of the very first claim that we examined, the one that comes in the methodological digression before Aristotle sets out to define moral virtue: virtue is the best condition of the soul, which Aristotle said was not yet a definition of virtue but would be useful in obtaining a definition. Its usefulness is that it shows a similarity with health, so that we can extrapolate from the methods of gymnastic training and medicine, arts that hold the authoritative account on the virtues of the body and, as we will see, are very much concerned with excesses, deficiencies, and means. Aristotle was not then offering an offhand remark before when he said that "as things are, we are in a state comparable to knowing that health is the best disposition of the body" (1220a18–19). He was explicitly following the same method as the arts of fitness and health.

Section ⟨2b⟩ has been interpreted as an independent argument leading to the conclusion that every moral virtue is a mean,[18] but I interpret it as an extension of the previous one. This is because the argument in ⟨2a⟩ says nothing whatsoever about virtue, but only reaches the conclusion that the mean in relation to us inheres in the best condition for us (i.e., proposition 4 above). A further argument is still needed to reach the overall conclusion about virtue, and this is what I see as the function of ⟨2b⟩, which I interpret as follows:

4. Thus, a mean in relation to us inheres in every best condition for us. (1+3 above)
5. The best condition inheres in every opposite of deficiency and excess.

18 Woods (1982) 105, commenting on 1220b30–35.

6. The opposite of deficiency and excess inheres in every moral virtue.
7. Thus, the best condition for us inheres in every moral virtue. (5+6)
8. Therefore, a mean in relation to us inheres in every moral virtue. (4+7)

In support of my interpretation is the presence of the inferential particle γὰρ ("for") at 1220b30, where the idea that opposites destroy one another is offered as warrant for the claim that every moral virtue is the best condition for us (premise 7 above), not for the overall conclusion that every moral virtue is a mean in relation to us. But if it is possible to reach the overall conclusion from the argument in ⟨2a⟩ without the argumentation in ⟨2b⟩, my main point will remain the same. The overall conclusion nevertheless depends entirely on the inductive argument given in ⟨2a⟩, and specifically the claim that every prescription of science and reason (e.g., of gymnastic training and medicine) is a mean in relation to us.

I think this close reading of the relatively neglected *Eth. Eud.* passage can cast much needed light on the exactly parallel argument that appears in the same relative position in *Nicomachean Ethics* 2. In both arguments, Aristotle begins with an abstract mathematical principle, "in everything continuous and divisible …" (ἐν ἅπαντι συνεχεῖ καὶ διαιρετῷ: *Eth. Eud.* 1220b21–22; *Eth. Nic* 1106a26). Moreover, both arguments conclude with the definition of virtue: "thus it is necessary that ethical virtue concerns some middle and is a mean state" (ὥστ' ἀνάγκη τὴν ἠθικὴν ἀρετὴν περὶ μέσ' ἄττα εἶναι καὶ μεσότητα τινά: *Eth. Eud.* 1220b34–35); "therefore virtue is a mean state" (μεσότης τις ἄρα ἐστὶν ἡ ἀρετή: *Eth. Nic.* 1106b27–28).

Aristotle is clearer in *Eth. Nic.* 2.6 than he was in *Eth. Eud.* 2.3 in some respects. First, Aristotle is clearer that every divisible continuum contains "the more, the less, and the equal" (τὸ μὲν πλεῖον τὸ δ' ἔλαττον τὸ δ' ἴσον, 1106a27), and it is only continua taken in relation to us that contain "a mean of an excess and a deficiency" (μέσον τι ὑπερβολῆς καὶ ἐλλείψεως, 1106a28–29). Second, the terminology of the distinction between "in accordance with the thing itself or in relation to us" (ἢ κατ' αὐτὸ τὸ πρᾶγμα ἢ πρὸς ἡμᾶς, 1006a27) is clearer than the distinction between "in relation to others or in relation to us" (ἢ πρὸς ἄλληλα ἢ πρὸς ἡμᾶς, *Eth. Eud.* 1220b23).[19] Third, in the *Eth. Nic.*, Aristotle elaborates on one of the examples mentioned in the *Eth. Eud.* in support of the inductive argument.

> For example, if ten is many but two few, six takes the middle in accordance with the thing. For it exceeds and is exceeded by an equal amount.

19 Woods (1982) 103.

> And this is a mean according to the arithmetic proportion. But this must not be taken as the mean in relation to us. For it is not the case that if for someone ten pounds is a lot and two is a little to eat, the gymnastic trainer will order six pounds. For this is perhaps a lot or a little for the one who is taking it; indeed, for Milo it is a little, but for the one who is just beginning gymnastic training it is a lot. (1106a33–1106b4)

The distinction between the mean relative to us, which is of concern to ethics, and the arithmetic mean, which is not, relates to the core methodological point that different degrees of precision apply in political discussions and mathematical proofs.[20] If we are looking for the arithmetic mean, we should expect the exactitude of mathematics and reject an answer such as "neither too much nor too little". But the situation is different in ethics: the mean in action avoids taking too much or too little pleasure and pain with respect to the various objects it encounters in action, and it is difficult to say much more about it in general *precisely*. Of course, more may be said when specific objects and parameters are taken into consideration, and Aristotle does indeed say more about each specific virtue and vice in the ensuing discussion.

In the detailed example drawn from medical dietetics in the *Eth. Nic*., which some commentators have considered "confusing",[21] a comparison is made between Milo the experienced wrestler and an unnamed beginner. The issue is how much food to prescribe each given that ten pounds is too much and two too little. As Hippocratic medicine tells us, meats of different kinds and quantities are to be prescribed to experienced athletes and non-athletes.[22] The dietetic trainer must prescribe the correct *proportion* of food to exercise. It is not that Milo needs more meat than the beginner because he is more experienced, it is rather because he is engaged in more intensive (or numerous) exercises than the tyro. Similarly, the amount of pleasure (or pain) in the agent must be proportionate to the objects in their activity: the perfectly virtuous person will

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20 The point introduced at *Eth. Nic*. 1.2, 1094b13–27 is reiterated at 2.2 with a pertinent comparison to medicine: "matters concerned with conduct and questions of what is good for us have no fixity, any more than matters of health. The general account being of this nature, the account of particular cases is yet more lacking in precision: for they do not fall under any art or set of precepts, but the agents themselves must in each case consider what is appropriate to the occasion, as happens also in the art of medicine" (1104a3–9, trans. Ross). See Jaeger (1957) 56.

21 Brown (2014) 71 n. 10.

22 For example: "pork is good for creating top condition (εὐεξίην) and strength in exercisers (πονέουσι) and gymnasts, but too strong for the sick or even normal person (ἰδιώτῃσιν)" *Aff*. 52 (VI.263.15–17 L.= V.80.8–10 Loeb, trans. Potter, adapted).

neither experience too much nor too little pleasure (or pain) in any action, but rather the correct and proportionate amount.

How is the correct and proportionate amount determined? Aristotle says that "all of the sciences avoid the excessive and the deficient, while the mean is sought and this is chosen, though not the mean of the object but the mean in relation to us" (1106b5–7). He refers to "all sciences" (πᾶσα ἐπιστήμη, 1106b8), but he never names one. Various arts and sciences could be described as seeking the mean.[23] But the only science that Aristotle discusses is the one involving the correct allocation of food to an experienced athlete versus a beginner, that is, the dietetic aspect of gymnastic training. The inductive basis of the *Eth. Nic.* argument is thus narrower than in the *Eth. Eud.*, where Aristotle referred not only to gymnastic training and medicine but also to piloting. But if we are to focus the *Eth. Nic.* version, as so many commentators have, we must acknowledge that Aristotle is in even greater need of inductive support coming from medicine here than he was in the *Eth. Eud.*

The final thing that Aristotle makes clearer in the *Eth. Nic.* version is the set of parameters in action with respect to which the experience of a passion can be considered deficient, excessive, or in accordance with the mean, and thus virtuous or vicious. This discussion of parameters leads into the overall conclusion that moral virtue is a mean state.

> I mean moral virtue. For this is concerned with passion and action, and in these there is excess and deficiency and the middle. For example, it is possible to feel fear and to feel confidence and to feel desire and to feel anger and generally to feel pleasure and to feel pain more and less, and in either case not well. But to do so when one should, and for what one should, and towards what one should and for the sake of what one should and generally as one should, is both a middle and also best, which is characteristic of the virtue. And in the same way also concerning the actions there is excess and deficiency and the mean. But virtue is concerned with passion and action in things which, on the one hand, the excess and deficiency miss the mark but, on the other hand, the mean is praised and succeeds. And these are both characteristics of virtue. Therefore virtue is a mean state, since it is skilled at hitting a mean. (1106b16–28)

23 Kalchreuter usefully collects relevant texts in epic, lyric, and drama, as well as in prose writers of various kinds, including Hippocrates (1911, 35–38). Welton and Polansky (1995) discuss some of these and also arts like music, sculpture, and painting.

Every moral virtue is concerned with hitting a mean and avoiding excess and deficiency in both passion and action, that is with feeling something (any passion, but in the final analysis pleasure and pain) in a certain amount in each action, each action being capable of specification by a complete set of relevant parameters for the purposes of moral analysis. For example, moral virtue involves not feeling a deficient or excessive amount of anger in response to a peevish student interrupting the beginning of a lecture with an impertinent question—there is an appropriate amount of anger to feel in this situation. And there is an appropriate amount to feel in response to an affable student asking a similar question during a lull in the question-and-answer period. And there are some students and questions towards which one should feel no anger whatsoever, for example a request for clarification coming from a new student; and others in relation to which one should feel a lot of anger, for example one involving hostile comments made towards another student.

Nothing that Aristotle has said in any of his arguments or in any of his numerous examples ever suggests that the conception of moral virtue as a mean state that avoids deficiency and excess is meant to directly inform a single decision or choice for how one should act and feel in specific situations. All that he has argued is that, with respect to every action (action being conceived as a continuously divisible movement), there is an excess, deficiency, and a mean in the passions—ultimately the pleasures and the pains—that the agent may experience in response, and that the virtuous condition will, in every case, correspond to avoiding extremes and hitting a mean, just as it is with the healthy conditions in the body according to the sciences of medicine and gymnastics. Thus, any criticism of the practicality of the doctrine of mean is irrelevant to Aristotle's argument: the doctrine shows how Aristotle thinks we should conceive of virtues and vices. Realizing this helps us understand why he goes on to define and structure his theoretical account of specific moral virtues and vices as he does. The doctrine of the mean is not something that he imagines agents consciously (or even unconsciously) incorporating into decision-making processes. The way that virtue is produced is not by pursuing the mean in every action, but by being habituated, through education, training, and punishment, to feel the appropriate amount of pleasure and pain in response to every action.[24]

24 For a compatible and persuasive account of habituation, see Leunissen (2017), especially 135–138 and 177–178. Note that Leunissen argues that physiognomy is another and parallel domain (besides ethics) in which Aristotle applies a doctrine of the mean (see especially 73–77).

Since the success of Aristotle's doctrine of the mean depends, then, not upon its practical usefulness but on its theoretical soundness, we should assess it by investigating how solid the inductive basis on which it rests is.

3 On Ancient Medicine 9

Aristotle has staked his claim that ethical virtue is a mean state upon the grounds that gymnastic training and medicine aim at a mean avoiding excess and deficiency. And we find this verified in *On Ancient Medicine* 9 (with traditional section numbers).

> ⟨1⟩ Now if it were as simple as has been suggested, and stronger foods harmed while weaker ones benefited and nourished both the sick and the healthy, then things would be easy: for it would simply be necessary to lead a patient towards the weakest diet, and one could do so with a good deal of security. ⟨2⟩ But in fact the error is no less, nor does it harm the human being less, *if one administers food deficient in quantity and quality to what is needed* (ἐλάσσονα καὶ ἐνδεέστερα τῶν ἱκανῶν προσφέρηται): for the might of hunger penetrates forcefully into the human constitution to lame and weaken and kill. And many other ills, different from those arising from repletion but no less serious, also arise from depletion. ⟨3⟩ For this reason, the doctor's tasks are much more varied and require more precision. For *one should be skilled at hitting a mean* (Δεῖ γὰρ μέτρου τινὸς στοχάσασθαι); but you will find no mean—nor number nor weight besides—by referring to which you will know with precision, except the perception of the body (τοῦ σώματος τὴν αἴσθησιν). Hence it is difficult to acquire knowledge so precise that one errs only slightly in one direction or the other.[25]

In sections ⟨1–2⟩, the author identifies two extremes that must be avoided in prescribing a diet for a patient. One extreme, the most obvious, is repletion, too much food, the excess. The author emphasizes that depletion, too little food, the deficiency, is equally harmful and must also be avoided. He makes this point by referring to the "application" (προσφέρηται) of food, which parallels the principle for which Aristotle offers an inductive proof in *Eth. Eud.* 2.1: "Every disposition is produced and destroyed by the same things *being applied* in a certain way" (πᾶσαν διάθεσιν ὑπὸ τῶν αὐτῶν γίγνεσθαι καὶ φθείρεσθαι πῶς

25 *VM* 9 (1.570 L. = 84,1–15 Schiefsky), trans. Schiefsky, adapted.

προσφερομένων, 1220a26–27). Recall that the examples given there were, "just as for health" (ὥσπερ ὑγίεια), "nutrition and exercise" (τροφῆς καὶ πόνων).

In section ⟨3⟩, the author makes the essential claim that Aristotle has said is made in the art of medicine: "one should be skilled at hitting a mean" (Δεῖ γὰρ μέτρου τινὸς στοχάσασθαι). In fact, Aristotle may deliberately echo this in the conclusion to the *Eth. Nic.* 2.6 argument: "therefore virtue is a mean state, since it is skilled at hitting the mean" (μεσότης τις ἄρα ἐστὶν ἡ ἀρετή, στοχαστικὴ γε οὖσα τοῦ μέσου) (1106b27–28).

What the author goes on in ⟨3⟩ to say about finding the mean is interesting because of his modesty about the limited precision (ἀκριβὲς) that is possible. The degree of precision that Aristotle says is possible in the analogous case of ethics is similarly limited. The Hippocratic author says that precision is limited because we depend on "the perception of the body" (τοῦ σώματος τὴν αἴσθησιν).[26] Does this refer to the perception in the body of the patient (e.g., the pain or pleasure experienced by the patient in reaction to treatment), or to the perception on the part of the physician of the patient's reaction?[27] Although there are considerable arguments that can be given for either interpretation, the use that Aristotle makes of these ideas might suggest that it is the feeling in the body of the patient that is important. As Aristotle applies the doctrine, it is the agent's own feeling of pleasure or pain that may be deficient or excessive, or at a mean, in the context of parameterized actions, thus indicating the absence, or presence, of moral virtue. Moral virtue, and thus the mean, is concerned with *both* actions and passions, the passions being feelings in the part of the soul that is obedient to reason, feelings ultimately reducible to pleasure and pain, kinds of *aisthêsis*. But what could correspond to "the perception of the physician" in the ethical case would be the perspective of the teacher, trainer, or judge who, observing the subject's reactions, tries to determine the right amount of reward or punishment to apply for the sake of reforming their habits.

4 On Regimen

Commentators on *Eth. Nic.* 2.6 have often noted the close parallel with *On Ancient Medicine* 9,[28] but the views contained in *On Regimen* fit even more per-

26 Jaeger (1957) 56, 58.

27 Schiefsky (2005) 196–199 offers a useful summary of the alternatives but concludes that αἴσθησις "refers to the body's reaction … *as it is perceived by the patient*" (199).

28 See Stewart (1892) 175; Kalchreuter (1911) 49; Wehrli (1951) 40–41; Jaeger (1957) 56–58; Lloyd (1968) 74n16; Gauthier and Jolif (1970) 118–119; Hutchinson (1988) 42–43.

fectly with Aristotle's claim that medicine aims at a mean avoiding deficiency and excess. Hynek Bartoš has shown that Aristotle was familiar with this text, and that reflections of *On Regimen* appear in the theoretical works.[29] Here I will build on his results and extend them to Aristotle's ethics.

I begin by pointing out that the Hippocratic author makes the same assumptions about the importance of the proportionality of food to exercise for producing health that Aristotle makes in the Milo example.

> Eating alone will not make a human being healthy; one must also take exercise. For food and exercise, while possessing opposite qualities, yet work together to produce health. For it is the nature of exercise to use up material, but of food and drink to fill up what has been depleted (ἐκπληρῶσαι τὰ κενωθέντα). And it is necessary, as it appears, to discern the power of the various exercises, both natural exercises and artificial, to know which of them tends to increase flesh and which to lessen it (ἐς αὔξησιν … ἐς ἔλλειψιν); and not only this, but also the proportion (τὰς ξυμμετρίας) of exercise to bulk of food, to the nature of the individual, to the age of the body, to the season of the year, to the changes of the winds, to local conditions, and to the constitution of the year. One must observe the risings and settings of stars, that he may know how to watch for change and excess (τὰς μεταβολὰς καὶ ὑπερβολὰς) in food, drink, wind, and the whole universe, from which diseases grow naturally for human beings.[30]

The author refers not only to food and exercise, but also to season, and so this passage fits perfectly into the network of passages we have been discussing, especially *Eth. Eud.* 2.1, where Aristotle says "every disposition is produced and destroyed by the same things applied one way or another, such as health by food, exercise, and season. This is clear by induction". For here in *On Regimen*,

29 "Aristotle knew *On Regimen* and read it closely. Moreover, accepting that Aristotle regularly alludes to the text of *On Regimen* and presents even the most peculiar of its ideas as if they were commonplace, one may infer that he reads the text as a representative of a more general approach and that he even expects his audience or intended readers to be well acquainted with the dietetic account. This suggests that already in Aristotle's time *On Regimen* stood as a standard point of reference … there is no other extant text of the time which shows so convincingly the debt of Aristotle to his medical predecessors" (pp. 288–289). Bartoš (2015) briefly refers to parallels to the *Eth. Eud.* (1220a24–28 at 288 n. 258) and *Eth. Nic.* (1103a23–26 at 283 n. 242).

30 *Vict.* 1.2 (VI.466–468 L. = 125,4–17 Joly-Byl) trans. Jones, adapted. On the parallel between *On Regimen* 1.2 and Aristotle's *Eth. Nic.* 2, see: Kalchreuter (1911) 38, 53; Wehrli (1951) 43n. 23; Lloyd (1968) 75 n. 17; Hutchinson (1988) 23–24.

we find the very support needed for the doctrine that excess and deficiencies of various kinds cause diseases and sufferings of the body, and that the remedy involves the determination of proportionality of exercise to food, adjusted for all parameters including season, age, physique, etc. The Hippocratic author continues by emphasizing the importance of avoiding both excesses and deficiencies.

> ⟨1⟩ But even when all this is discerned, the discovery is not complete. If indeed in addition to these things it were possible to discover relative to each nature (πρὸς ἑκάστην φύσιν) a due measure (μέτρον) of food and a proportionate amount (ἀριθμὸς σύμμετρος) of exercise, neither for the more nor the less (μήτε ἐπὶ τὸ πλέον μήτε ἐπὶ τὸ ἔλασσον), a discovery of health for human beings would have been made precisely (ἀκριβῶς). ⟨2⟩ But as it is, although all the things previously mentioned have been discovered, this last discovery cannot be made. Now if one were present and saw, he would have knowledge of the man as he stripped and practiced his exercises, so as to keep him in health by taking away here and adding there. But without being present it is impossible to prescribe the exact amount of food and exercise … In fact, if there occur even a small deficiency (ἐνδεέστερα) of one or the other, in course of time the body must be overpowered by the excess (ὑπὸ τῆς ὑπερβολῆς) and fall sick. ⟨3⟩ Now the other investigators have attempted to carry their researches to this point, but they have not gone on to set them forth. But I have discovered these things, as well as the forecasting of an illness before the patient falls sick, *based upon the direction in which is the excess*.[31]

In section ⟨1⟩, the author verges on claiming that finding the "mean" for food and "the proportionate amount" of exercise is the entire focus of medicine, which would fit with Aristotle's inductive claims perfectly.[32] In ⟨2⟩, however, the author discusses a limitation: the failure of perception (of "seeing") on the part of the physician that would, if successful, allow him to determine the "mean" and "proportionate amount" precisely. This relates to the concern of the author of *On Ancient Medicine* that the mean cannot be determined precisely because of dependence on "the perception of the body", where this apparently referred to the reaction of the patient. But, as we saw, that passage could be

31 *Vict*. 1.2 (VI.470–472 L. = 124,17–26 Joly-Byl), trans. Jones, adapted.

32 On this passage, see further Hutchinson (1988) 34.

interpreted so as to refer to the perception on the part of the physician of the patient's reaction. The main concern of the author of *On Regimen* seems to be with the impracticality of observing the exercise and dietary regimen closely enough, making it difficult for the physician to determine the mean amount of food and the proportionate amount of exercise precisely.

In ⟨3⟩, the Hippocratic author claims that he has, after all, determined how to forecast illness based on "the direction of the excess" (ἀπὸ τῆς ὑπερβολῆς). Thus, he continues to provide inductive support for Aristotle's arguments about the importance of the mean and the extremes in the arts and sciences. The Hippocratic author's commitment to this medical methodology and his humility about the amount of precision possible is consistent in several later reiterations of his account.[33] Extensive and detailed prescriptions based on this theory are offered in *On Regimen* 2–3, specifying the appropriate amount and kind of food, and proportionate amount (and kind) of exercise, all of this relativized to certain physiques, seasons, climates, wind situations, and ages of the patient, thus avoiding, in every case, the excesses and deficiencies that cause various kinds of disease.

In a way one could read Aristotle's *Eudemian* and *Nicomachean Ethics* 2–3 as counterparts to *On Regimen* 2–3, since Aristotle develops a general theory of moral strength and health and offers his accounts of the specific virtues as "mean states" in both passions and actions, states that avoid excesses and deficiencies relative to the parameters mentioned above. The Hippocratic author with whom he agrees on so much does not supply such an account, although in 1.35 he offers an account of how intellectual virtue can be improved or weakened by the food and exercise regimen. An example of what he says there shows the similarity to Aristotle's way of thinking.

> Following such a regimen should make them more healthy and more intelligent (ὑγιεινότερος ἂν καὶ φρονιμώτερος). But if the fire should be mastered to a greater extent by the water in the soul, we have then cases of what are called by some 'senseless' people and by others 'grossly stupid'. Now the imbecility of such inclines to slowness; they weep for no reason, fear what is not dreadful (δεδίασί τε τὰ μὴ φοβερὰ), are pained at what does not affect them, and their perceptions are really not at all those appropriate to the sensible or intelligent people (αἰσθάνονταί τε ἐτεῇ οὐδενὸς ὡς προσήκει τοὺς φρονέοντας).[34]

33 E.g., 2.66 and 3.67–69.

34 *Vict.* 1.35 (VI.518–520 L. = 154,6–11 Joly-Byl), trans. Jones, adapted.

The Hippocratic author thus proposes a regimen based on avoiding deficiencies and excesses and aiming at a mean amount of food and proportionate amount of exercise that promises to improve not only health but also intelligence, thus avoiding a condition that renders people unable to properly regulate their emotions, so that they do not fear as one should, or feel pain as one should, and in general do not have the right perceptions (αἰσθάνονται), that is, not those *appropriate to the sensible or intelligent people* (προσήκει τοὺς φρονέοντας). We are very close to Aristotle's own conception of moral virtue, defined in the *Nicomachean Ethics* as "a state concerned with choice, lying on a mean relative to us, this being determined by reason and in the way in which the sensible or intelligent person would determine it" (ὁ φρόνιμος ὁρίσειεν) (1106b36–1107a2). But although the Hippocratic author in the above passage does mention passions relevant to the moral virtues (like fear and pain), in the very next chapter of *On Regimen*, he pointedly denies that his account applies to other important moral virtues and vices.[35]

> It is this blending, then, that is, as I have now explained, the cause of the soul's intelligence or want of it; regimen can make this blending either better or worse. When the fire prevails in his courses, it is doubtless possible to add to the water, and, when the water prevails in the blend, to increase the fire. These things are the source of greater or less intelligence in souls. But in the following cases the blend is not the cause of the characteristic: irascibility, indolence, craftiness, simplicity, quarrelsomeness and benevolence. In all these cases the cause is the nature of the passages through which the soul passes. For such dispositions of the soul depend upon the nature of the vessels through which it passes, upon that of the objects it encounters and upon that of the things with which it mixes. It is accordingly impossible to change the above dispositions through regimen, for invisible nature cannot be molded differently.[36]

It is remarkable that the Hippocratic author claims that his account of "physical blending" can account for intellectual virtue (and thus vice) but admits that the same account cannot deal with "irascibility, indolence, craftiness, simplicity, quarrelsomeness and benevolence". These virtues and vices the author attributes not to the proportionality of food and exercise that affects the proper blending of hot and cold elements causing health or disease, but to "the pas-

35 See also Wehrli (1951) 53; Hutchinson (1988) 19.

36 *Vict*. 1.36 (VI.522–524 L. = 156,19–27 Joly-Byl), trans. Jones.

sages through which the soul passes". The author also mentions "the objects the soul encounters" and "the things with which it mixes", which may be related to the parameters in action that Aristotle insists must be taken into account in determining the virtuous amount of passion (pleasure or pain) for a subject to experience in a particular set of circumstances. Although the Hippocratic author cannot supply an account of these objects and how they relate to a healthy experience of passions, we know that Aristotle at least attempted to do so in his *Ethics*.

That he was influenced in this attempt by the medical literature seems beyond doubt. Moreover, it can be said that Aristotle stands on solid inductive ground when he claims that arts such as gymnastic training and medicine aim at a mean and avoid excess and deficiency. This really was a credible medical theory of the "good condition" that could be extended to a theory of habits of the soul and thus an account of moral virtue.

Conclusion

The ground for extrapolation from the medical doctrine of the mean to the moral one was prepared by Aristotle's main predecessors in ethics, Plato, Isocrates, and Democritus.[37] They had already compared politics and medicine, and were the crucial intermediaries between medical doctrines and Aristotle's moral and political extrapolations from them. However, the passages that we have examined in the Hippocratic Corpus so perfectly fit Aristotle's claims, and his claims are so much in need of their support by his own indications, that it is tempting to think that these very texts, and whatever other medical texts are parallel to them, are precisely those texts on which Aristotle's inductive claims are based.[38]

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37 See further Hutchinson (1988) and Bartoš (2015) 175–181, 231–241.

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CHAPTER 13

Medicine and the Emotions: The *Problemata* in Dialogue with the Hippocratic Writings

Chiara Thumiger

> Why do those who are anxious sweat in the feet, but not in the face? (*Probl.* 2.26)

This question, and indeed this observation, is not something one would expect to find in the Hippocratic texts.[1] But it is also very different from the approach to the emotions for which Aristotle has been examined most in recent years, at least in the flourishing field of emotions studies, and in particular his approach in the *Rhetoric*, where he gives the following definition of the emotions (*Rh.* 2.1, 1378a19–22):[2]

> The emotions are all those **affections which cause men to change their opinion in regard to their judgements, and are accompanied by pleasure and pain, for example anger, pity, fear, and all similar emotions and their contraries.** Each of them must be divided under three heads; I mean for instance, in regard to anger, **which dispositions of mind** make men

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2 The definition of 'emotion' is controversial and approximate in modern psychology as well. We could take the following: 'A complex reaction pattern involving experiential, behavioural, social and physiological elements, by which an individual person deals with a significant event, external datum, or mental representation of one of these. The specific quality of the emotion is linked to the specific significance of the event'.

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> angry, the **persons** with whom they are usually angry, and the **occasions** which give rise to anger. For if we have one or even two of these heads, but not all three, it would be impossible to arouse the emotion. The same applies to the rest. Just as, then, we have given a list of propositions in regard to matters we have previously discussed, let us do the same here and divide the emotions in the manner described.[3]

> ἔστι δὲ **τὰ πάθη δι' ὅσα μεταβάλλοντες διαφέρουσι πρὸς τὰς κρίσεις οἷς ἕπεται λύπη καὶ ἡδονή, οἷον ὀργὴ ἔλεος φόβος καὶ ὅσα ἄλλα τοιαῦτα, καὶ τὰ τούτοις ἐναντία.** δεῖ δὲ διαιρεῖν περὶ ἕκαστον εἰς τρία, λέγω δ' οἷον περὶ ὀργῆς πῶς τε διακείμενοι ὀργίλοι εἰσί, καὶ τίσιν εἰώθασιν ὀργίζεσθαι, καὶ ἐπὶ ποίοις· εἰ γὰρ τὸ μὲν ἓν ἢ τὰ δύο ἔχοιμεν τούτων, ἅπαντα δὲ μή, ἀδύνατον ἂν εἴη τὴν ὀργὴν ἐμποιεῖν· ὁμοίως δὲ καὶ ἐπὶ τῶν ἄλλων. ὥσπερ οὖν καὶ ἐπὶ τῶν προειρημένων διεγράψαμεν τὰς προτάσεις, οὕτω καὶ περὶ τούτων ποιήσωμεν καὶ διέλωμεν τὸν εἰρημένον τρόπον.

This perspective, summed up as 'cognitive' and 'social' by modern readers,[4] foregrounds the inclination of the person (πῶς … διακείμενοι), the interlocutor/target (τίσιν εἰώθασιν), and the kind of occasion or situation (ἐπὶ ποίοις).

The text I will discuss in this chapter, the *Problemata*,[5] with its micro-physiological questions and its concern with the determinacy of individual bodily signs in relation to the emotions, offers a rather different view, which foregrounds the body of the person undergoing the emotion in its small-scale reactions and bodily states. Many of these are similar to the material the Hippocratic physicians noted and described, as is the interest in the value of individual cases. As such, the emotions in the *Problemata* provide a perfect occasion for exploring Aristotle, or rather the Aristotelian school, as reader(s) of Hippocrates. The *Problemata* of course pose fundamental difficulties as aggregate testimony for the Peripatetic tradition and for Theophrastus' research interests, rather than for Aristotle's first-person activity. These difficulties can be resolved only to a limited extent. Nonetheless, they are useful for exploring the choice of topics, the critical dialogue with, and the possible complementarity between Aristotelian interests in the emotions and contemporary medical doctrinal traditions and practices.

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3 All translations are from the relevant Loeb edition, at times slightly amended by the author.

4 The key comprehensive studies are those by Fortenbaugh (1975/2002) and Konstan (2006); see also Cairns (2017), (2019a) 10. Many other scholars have focused on individual emotions.

5 For bibliography on the genre of *Problemata* in natural philosophy, see the papers in Centrone (2011), Mayhew (2015), Meeusen (2021).

I am interested here not so much in textual correspondences with particular works (duly explored by others),[6] but in the *Problemata's* expansion of the range of details and experiences found in the Hippocratic observations, especially clinical, in regard to the emotions. In fact, the *Problemata* move over a much broader psychological territory, including more complex emotions such as anxiety, shame, and disgust, and delineate them with a variety of bodily details. This neatly complements the more famous socio-cognitive view of the *pathē* of the *Rhetoric*, on the one hand, and a critical engagement with and integration of the Hippocratic medical material, on the other.

The texts of the Hippocratic corpus are conspicuously reticent and selective in their treatment of psychological matters.[7] Despite the well-known physiological import of the emotions, whose embodied effects are traditionally recognised in Greek culture—body-parts are often 'animalised' in poetic imagery; emotions, when activated, are localised in the body in specific 'organs' or 'parts'—the Hippocratics surprisingly devote very limited attention to them. Likewise, Aristotle, although he does indeed discuss the *pathē* at length in a cognitive frame in the *Rhetoric* and *De Anima*, also takes for granted their status as *both* cognitive and psycho-social event *and* embodied fact, as the mention of pleasure and pain, as well as the reference to *tarachē*, demonstrate.[8] In *De Anima*, a key feature of the emotions seems to be that they are in various ways necessarily implicated with the body, being "enmattered accounts" (λόγοι ἔνυλοί, *De An.* 1.1, 403a25): the body can play an active part in determining the experience of an emotion with varying degrees of external triggering or even causation.[9] It is thus clear that both the physiological and the socio-cognitive are utilized as valid accounts, even though Aristotle does demarcate them as independent research perspectives, as explicitly stated at *De Anima* 1.1 403a29–b1 on anger: "Hence a natural scientist would define each of these [affections of the soul] differently from a dialectician. The latter would define e.g. anger as an appetite for returning pain for pain, or something like that, while the former would define it as a boiling of blood or a warm substance surrounding the heart."[10] In the *Problemata*, this second member of the distinction, the

6 Especially Poschenrieder (1887), Jouanna (1996), Bertier (1989); see also the many remarks in Flashar (1962), and studies mentioned in the previous footnote.

7 On our understanding of the term: personal mental life, emotions, preferences, private memories and tastes.

8 *Rh.* 2.1, 1378a20–21; cf. Cairns (2019) 10.

9 Cf. especially *De An.* 1.1, 403a3–25; 2.1, 412a1–413a10; see Cairns (2019) 10–11 for a useful summary.

10 διαφερόντως δ' ἂν ὁρίσαιντο ὁ φυσικὸς τε καὶ ὁ διαλεκτικὸς ἕκαστον αὐτῶν, οἷον ὀργὴ τί ἐστιν· ὁ μὲν γὰρ ὄρεξιν ἀντιλυπήσεως ἤ τι τοιοῦτον, ὁ δὲ ζέσιν τοῦ περὶ καρδίαν αἵματος καὶ θερμοῦ.

perspective of the *physikos*, is developed in greater detail and at times tested. The medical data is complemented and expanded, and corrections are made to it, largely leaving aside cognitive reflection on emotional exchanges.

Before we examine the material in the Hippocratic texts, and then the *Problemata*, three observations must be made about the *status quaestionis*. First, scholars working on the history of the emotions have (with some recent exceptions)[11] shown relatively little interest in the Hippocratic texts in general or in the *Problemata* specifically,[12] preferring to look at richer, more 'humanistic' narratives such as those offered by Plato or by Aristotle in his *Rhetoric*, or in the more structured theoretical approach of *De Anima*. In medicine, the contributions of Galen, whose psychological interests are clearly defined in his works, have received the lion's share of scholarly attention.[13] Literary texts, finally, have been the primary body of evidence to be scrutinised. All of this is strange given the current popularity in emotion studies of approaches that go under the umbrella of 'cognitive embodiment' or 'embodied cognition': scholars have placed lyric poetry, epic, and tragedy under the microscope to look for parallels to embodied or distributed cognition, but have largely failed to engage precisely those sources that have the animated body as their stated object. Once one does so, it is easy to see that the remarks on the bodily and physiological aspects of the *pathē*/emotions in the *Problemata* are rich in strikingly physiological details, 'deeper', and broader than their Hippocratic counterparts.[14]

Second, philosophical scholarship on Aristotle and the emotions has only recently looked at the *Problemata*,[15] and has rarely devoted detailed attention to how they have been influenced by or engage in dialogue with classical medicine.

Third, scholarship on the relationship of the *Problemata* with the Hippocratic texts has previously devoted more attention to a quest for *loci paralleli*,[16] while some recent studies have looked at modes of reference and at the genre of questions as a whole.[17]

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11 Chapter 5 in Thumiger (2017); Kazantzidis (2019); McNamara (2015) on *eros*, if only to assert its conspicuous absence from the Hippocratic material.

12 Although see recently Castelli (2011), Fortenbaugh (2015 a, 2015b, 2017).

13 See the commentaries and survey in Singer (2013); Gill (2010, 2018).

14 For a rare study of the physiological interface between rhetoric and medicine, and the physiology of good and bad character and their expressions through speech, see Petit (2022).

15 Castelli 2011, Fortenbaugh (2015 a, 2015b, 2017).

16 Poschenrieder (1887); Flashar (1962) 327–328; Bertier (1989), Jouanna (1996).

17 Flashar (1962) 338–341, Ulacco (2011); Thomas (2015); Oikonomopoulou (2015), Meeusen (2020), (2021a), Pelavski (2021). Debru (2005) offers an important discussion of critical

It seems appropriate at the outset to introduce the emotions in the Hippocratic material before turning to the *Problemata*. The *Problemata*, I suggest, fill a gap in Hippocratic medicine and cross-pollinate the ethical questions and topics Aristotle addressed in the *Nicomachean Ethics*, the *Rhetoric* and *De Anima* with physiological details harvested from Hippocratic patient observations.

1 Emotions in the Hippocratic Sources: an Overview

Corpus Hippocraticum, and even 'Hippocratic authors', are labels increasingly used with caution if not scepticism.[18] We should accordingly refer to these as conventional markers for a collection comprising disparate texts and projects mostly from the classical period (5th and 4th centuries BCE). I subdivide the evidence into four groups: (a) passages that 'thematize' the emotions (from *Regimen*, *On Humours*, and *Ancient Medicine*, but also sections of the *Epidemics*); (b) references to the emotions as signs of illness in nosological and clinical passages; (c) physiognomic approaches (rare) and (d) cognitive approaches (evident in only two isolated cases). In all but (d), the emotions are considered to be an entirely embodied phenomenon. Let us now examine these four groups more closely.

2 Emotions Thematized as a Group

Some emotions, or propensities to emotion, are treated as a category and grouped together with other 'qualitative states' in *Regimen* 1.36 (*Vict.* 1.36, VI.522.22–524.3 L. = 156,23–27 Joly-Byl):

> The blend [of fire and water in the soul] is not the cause of such circumstances [as the following ones]: for example, *irascibility/anger and indolence, cunning and simple-mindedness, quarrelsomeness and benevolence*. The nature of the passages through which the soul passes, of the objects it encounters, and of the things with which it mixes, determines the performance of the soul.

engagement with the medical tradition. See also Fortenbaugh's recent work on individual cases, as well as (2003); Mayhew (2015).

18 See Perilli in this volume.

> τῶν δὲ τοιούτων οὐκ ἔστιν ἡ σύγκρησις αἰτίη· **οἷον ὀξύθυμος, ῥᾴθυμος, δόλιος, ἁπλοῦς, δυσμενής, εὔνους**· τῶν τοιούτων ἁπάντων ἡ φύσις τῶν πόρων, δι' ὧν ἡ ψυχὴ πορεύεται, αἰτίη ἐστί. δι' ὁποίων γὰρ ἀγγείων ἀποχωρεῖ καὶ πρὸς ὁποῖά τινα προσπίπτει καὶ ὁποίοισί τισι καταμίσγεται, τοιαῦτα φρονέουσι.

On Humours, in an account of aspects of life that fall under the control or domain of the ψυχή (*Hum.* 9, v.488.15–490.8 L. = 168,3–13 Overwien), offers a longer list. Here too, the focus is on qualities in general, things which "derive from character", ἐκ τῶν ἠθέων. These include matters of taste and self-control, moral qualities and traits, and emotional features of personality, and are juxtaposed to an interest in 'how the body behaves' in response to the emotion in question:

> Intemperance of the soul in drink and food, in sleep and in wakefulness, either due to various passions or love of dice or due to crafts or due to matters of necessity [...] **From moral characteristics: diligence of mind whether in inquiry or practice or speech or something else, for example bouts of grief, passionate outbursts, desires.** Accidents that upset the mind either through the eyes or through the sense of hearing or through the mind. **How the body behaves**: when a mill grates against itself and teeth are set on edge, or legs shake when one walks alongside a cliff, or when one lifts a load that one shouldn't with one's hands, they too shake. The sudden sight of a snake causes pallor. **Fear, shame, pleasure, pain, passion and so forth. To each of these the body responds by its action. In these cases there is sweating, a palpitation of the heart and the like.**

> ψυχῆς ἀκρασίη ποτῶν καὶ βρωμάτων, ὕπνου, ἐγρηγόρσιος ἢ δι' ἔρωτάς τινας ἢ κύβους ἢ διὰ τέχνας ἢ δι' ἀνάγκας. [...] **ἐκ τῶν ἠθέων· φιλοπονίη ψυχῆς ἢ ζητῶν ἢ μελετέων ἢ λέγων ἢ εἴ τι ἄλλο, οἷον λῦπαι, δυσοργησίαι, ἐπιθυμίαι.** τὰ ἀπὸ συγκυρίης λυπήματα γνώμης ἢ διὰ τῶν ὀμμάτων ἢ διὰ τῆς ἀκοῆς καὶ διὰ τῆς γνώμης. οἷα τὰ σώματα· **μύλης μὲν τριφθείσης πρὸς ἑωυτὴν ὀδόντες ἠμώδησαν, παρά τε κρημνὸν παριόντι σκέλεα τρέμει ὅταν τε τῇσι χερσί τις, ὧν μὴ δεῖται, αἴρῃ, αὗται τρέμουσιν. ὄφις ἐξαίφνης ὀφθεὶς χλωρότητα ἐποίησεν. οἱ φόβοι, αἰσχύνη, ἡδονή, λύπη, ὀργή, ταῦλλα τὰ τοιαῦτα. οὕτως ἐνακούει ἑκάστῳ τὸ προσῆκον τοῦ σώματος τῇ πρήξει. ἐν τούτοισιν ἱδρῶτες, καρδίης παλμός, τὰ τοιαῦτα.**

Third, in a nicely packaged section in *Epidemics* 6.8, 7–15 (v.344-17-348.22 L. = Manetti-Roselli 167,1–179,35), the author speaks of certain "material from the small tablet" (τὰ ἐκ τοῦ σμικροῦ πινακιδίου), which appears to contain a kind of

case-taking checklist of major σκεπτέα ("matters to observe"). Among various factors, we find details of behaviour relevant to the emotions:

> speech, silence, [ability or inability] to say what one wants to say. The words with which he speaks: loudly or many, unerring or molded
>
> Λόγοι, σιγὴ, εἰπεῖν ἃ βούλεται· λόγοι, οὓς λέγει, ἢ μέγα, ἢ πολλοὶ, ἀτρεκέες, ἢ πλαστοί.

There are explicitly psychological aspects:

> concerning the mind: self-consciousness/anxiety,[19] *by itself* [for no reason?], independent from the sensory organs and from one's actions: **the person is angry, rejoices or is afraid and regains confidence, and hopes, and despairs** …[20] Like the servant of Hippothous, although her mind was left by itself, she was conscious of the things that happened through her disease
>
> καὶ τῆς γνώμης· ξύννοια, αὐτὴ καθ' ἑωυτήν, χωρὶς τῶν ὀργάνων καὶ τῶν πρηγμάτων, ἄχθεται, καὶ ἥδεται, καὶ φοβεῖται, καὶ θαρσέει, καὶ ἐλπίζει, καὶ +ἀδοξέει, οἷον ἡ Ἱπποθόου οἰκουρὸς, τῆς γνώμης αὐτῆς καθ' ἑωυτὴν ἐπίστημος ἐοῦσα τῶν ἐν τῇ νούσῳ ἐπιγενομένων.

The emotions are thus *skeptea*, 'to be observed' for the sake of something else. *Phoboi, orgē, dysthymia* are signs, self-explanatory, elemental and irreducible building blocks in this medical portrayal rather than phenomena to be analysed as a problem.

There is an additional dimension about the visibility of emotions in these sources: they are always observed *qua* pathological, or *when* pathological. As a consequence, they are notably delocalized and 'holistic'. Because the emotions are taken to be an irreducible attribute of the individual, like fever or sweat, they are not further deconstructable, and as such they are understood as an experience of the individual as a whole, not an affection of one body part in particular.[21]

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19 Manetti-Roselli ad loc. translates ξύννοια 'stato ansioso'; Smith (1994, 266) offers instead 'the mind's consciousness'. The English phrase 'self-consciousness' perhaps brings the two together.

20 Taking the corrupt ἀδοξέει to mean 'despair, diffidence', as in Smith's translation (Smith 1994, 267 ad loc.; see Manetti-Roselli 1982, 174–175 ad loc.).

21 See Katzantzidis (2019) on this point.

This is clear from category (b), clinical and nosological texts. Here the dominant emotions are anger, joy, sadness, and fear, which are variously tokenized rather than discussed in depth. The medical writer begins from the state of illness under scrutiny in one particular individual and attributes to it, among other things, a given emotion; there is no further behavioural detail or interpersonal elaboration, and no cognitive colouring. Significantly, the emotion can be common to very different physiologies and illnesses, just like constipation or lack of appetite.

Anger is perhaps the most conspicuous example in this sense, often appearing in lists of signs: "Melancholic characteristics as far as the mental sphere is concerned (τὰ περὶ τὴν γνώμην μελαγχολικά). … aversion to food, despondency, troubled sleep, **bouts of anger** (?), restlessness" (ἀπόσιτος, ἄθυμος, ἄγρυπνος, **ὀργαί**, δυσφορίαι, *Epid.* 3.17, case 2 [III.108.6–112.12 L. = 234,3–235,6 Kühlewein]); or "in her activities shouting, anger" (ἐν δὲ τοῖσι ποιευμένοισι [L. πνευμένοισι] βοῆς, ὀξυθυμίης, *Epid.* 6.4 [V.308.5–6 L. = 84,9–10 Manetti-Roselli]). Anger must also be considered when deciding on a course of treatment: "[purge only] if the patient is not subject to ὀργή; generally he is not", ἢν μὴ ὀργᾷ· τὰ δὲ πλεῖστα οὐκ ὀργᾷ, *Aph.* 1.22 (IV.468.13–14 L. = 384,8–385,1 Magd.). It can have physiological consequences, which makes it relevant to the doctor's observations: "ὀξυθυμίη contracts the heart and the lungs and draws the hot and the moist substances into the head … Contentment, on the other hand, relaxes the heart", ἡ δ' εὐθυμίη ἀφίει καρδίην, *Epid.* 6.5.5 (V.316.5–6 L. = 108,1–2 Manetti-Roselli). Behaviours resulting from intense emotions are seen as pathological for the body: to be delirious with rage (ἢν ὀλίγα θρασέως παρακρούσωσιν) may lead to the evacuation of dark stools (*Prorrh.* 1.85, V.532.3 L. = 85,8 Polack).

Joy and sadness are also observed, although less often, and again in a manner that detaches them from personal psychology and its existential content. "Fears and despondency" (φόβοι and δυσθυμίαι) in phrenetics are mentioned (*Epid.* 1.18, II.652.3 L. = 194,21–22 Kühlewein); a patient is described as "silent, and would not converse at all. Depression, the patient despairing of herself" (σιγῶσα, οὐδὲν διελέγετο. δυσθυμίη, ἀνελπίστως ἑωυτῆς εἶχεν, *Epid.* 3.1, case 6 [II.52.7–8 L. = 221,1–2 Kühlewein]). "Fear and a sad or disturbed mood" (φόβοι, δυσθυμίη) are noticed (*Epid.* 3.17, case 11 [III.134.5 L. = 241,8 Kühlewein] elsewhere as signs of melancholy ("If fear or despondency (φόβος ἢ δυσθυμίη) last for a long time, this is melancholic", *Aph.* 6.23 (IV.568.11–12 L. = 453,1–2 Magd.). *Lupē*, grief, can cause illness, as at *Epid.* 3.17, case 15 (III.142.7 L. = 244,1–2 Kühlewein), "Fever accompanied by shivering, of the acute kind, took hold as a result of grief" (πυρετὸς φρικώδης, ὀξύς, ἐκ λύπης ἔλαβεν). Euphoria and excessive joy are also to be noted: "Much talking, laughing, singing; could not be restrained" (λόγοι πολλοί, γέλως, ᾠδή, κατέχειν οὐκ ἠδύνατο), *Epid.* 1.26, case 2

(II.686.6–7 L. = 203,23–204.1 Kühlewein). At times, they can be indications of severe trauma: when the brain is struck, the result is mental disturbance "with grinning laughter and grotesque visions" (σεσηρόσι μειδιήμασι καὶ ἀλλοκότοισι φαντάσμασιν). *Gland.* 12 (VIII.568.3 L. = 119,25–26 Jouanna).

We would expect fear to be a common emotional feature of illness and of being a patient. It too, however, is rarely conceptualised as a personal emotion. We hear of specific 'phobias' (of the sound of the flute, of bridges),[22] and most often of a general, unmotivated fear: the patient "is despondent, and does not seem to focus her sight, and is afraid" (καὶ ἀθυμέει, καὶ ἐμβλέπειν οὐ δοκέει, καὶ δέδιεν, *Mul.* 1.8, VIII.36.6–7 L.); following a miscarriage, the patient "is deranged, there are episodes of fear and despondency" (παρέκρουσεν, φόβοι, δυσθυμίαι, *Epid* 3.1, case 11 (III.62.4.5 L. = 222,19 Kühlewein). "Moments of fear, much talking, despondency", φόβοι, λόγοι πολλοί, δυσθυμίη are mentioned (*Epid.* 3.17, case 11, III.134.5 L. = 241,8 Kühlewein); and so on.

Then there are few cases (c) in which the emotions are part of a physiognomic account of human physiology. In a somewhat exceptional cluster of paragraphs in *Epidemic* 2, a number of physiognomic-sounding remarks are found in two passages, one of which in particular is relevant to emotions (*Epid.* 2.6.1, V.132.15–21 L.):[23]

> If the head is large and the eyes small, if they are stammerers, they **are quick to anger**. People who are long-lived have more teeth. Stammerers, rapid talkers, melancholic, people who do not blink, are **quick to anger**. Those with a large head, large dark eyes, a thick, blunt nose, are **good** … Blue eyed, large … Those with a small head, thin neck, narrow chest, are **equable/well adjusted**. If someone's head is large, he will not stammer or be bald unless his eyes are grey.

> ἢν ἡ κεφαλὴ μεγάλη, καὶ οἱ ὀφθαλμοὶ σμικροί, τραυλοί, **ὀξύθυμοι**. οἱ μακρόβιοι πλείους ὀδόντας ἔχουσιν. οἱ τραυλοί, ταχύγλωσσοι, μελαγχολικοί, κατακορεῖς, ἀσκαρδαμύκται **ὀξύθυμοι**. μεγάλη κεφαλὴ ὀφθαλμοὶ μέλανες καὶ μεγάλοι, ⟨…⟩ ῥίς παχείη καὶ σιμή, ἐσθλοί. χαροποὶ, μεγάλοι, κεφαλὴ σμικρή, αὐχὴν λεπτός, στήθεα στενά, **εὐάρμοστοι**. κεφαλὴ σμικρή, οὐδ' ἂν εἴη τραυλὸς οὐδὲ φαλακρὸς ἢν μὴ γλαυκὸς ᾖ.

22 *Epid.* 5.81–82 (V.250.10–17 L. = 37,7–38,4 Jouanna).

23 The other is *Epid.* 2, 5.1–2 (V.128.3–13 L.); see Thumiger (2016) on how these are not really physiognomic.

Finally, there is one isolated example of a cognitive account (d) of the emotions endowed with content and personal significance. This is a truly exceptional case in the Hippocratic material, since it alone explicitly addresses a topic of social psychology and interpersonal behaviour: the feeling of shame and/or fear experienced by epileptics on the occasion of a seizure, and the age variables involved, in *De Morbo Sacro*. In this passage, shame (*aischunesthai*) is explored in a unique fashion as something that can be known (*ginōskousin*) and learnt (*Morb. Sacr.* 12.1–2, = VI.382.19–384.3 L. = 22,13–23,5 Jouanna). The topic is epileptic patients when they sense they are about to collapse:

> Those, however, who are used to the disease know beforehand when they are about to be seized, and flee from people. If their house is nearby, they run home, but if not, to a completely deserted place, where as few people as possible will see them collapsing, and they immediately cover themselves up. They do this out of shame for the affliction, and not from fear of the divinity, as many suppose. Little children at first fall down wherever they happen to be, from inexperience. But when they have often been seized and feel its approach beforehand, they flee to their mothers, or to any other person they are acquainted with, out of terror and dread of the affliction, for being still infants they do not yet know what it is to be ashamed.

> ὅσοι δὲ ἤδη ἐθάδες εἰσὶ τῇ νούσῳ, προγινώσκουσιν ὅταν μέλλωσι λήφθήσεσθαι, καὶ φεύγουσιν ἐκ τῶν ἀνθρώπων· ἢν μὲν ἐγγὺς ᾖ αὐτῷ τὰ οἰκία, οἴκαδε, εἰ δὲ μή, ἐς τὸ ἐρημότατον, ὅπῃ μέλλουσιν αὐτὸν ἐλάχιστοι ὄψεσθαι πεσόντα, εὐθύς τε ἐγκαλύπτεται. τοῦτο δὲ ποιεῖ ὑπ' αἰσχύνης τοῦ πάθεος, καὶ οὐχ ὑπὸ φόβου, ὡς οἱ πολλοὶ νομίζουσι, τοῦ δαιμονίου. τὰ δὲ παιδάρια τὸ μὲν πρῶτον πίπτουσιν ὅπῃ ἂν τύχωσιν ὑπὸ ἀηθίης, ὅταν δὲ πλεονάκις κατάληπτοι γένωνται, ἐπειδὰν προαίσθωνται, φεύγουσι παρὰ τὰς μητέρας ἢ παρὰ ἄλλον ὅντινα μάλιστα γινώσκουσιν, ὑπὸ δέους καὶ φόβου τῆς πάθης· τὸ γὰρ αἰσχύνεσθαι οὔπω γινώσκουσιν.

To sum up: the emotions in the Hippocratic texts are largely a phenomenon with a bodily, medical, pathological, or physiological *retrospective* meaning and nothing more; the complex shame of the epileptic is the exception that confirms the rule. The movement is unidirectional, from this meaning to the observed individual. The emotion-sign is not to be unpacked, just as sleep or mania or diarrhoea are not. It is instead a unit, a brick in the prognostic or clinical edifice. Moreover, there is contiguity or unstable differentiation between temporary emotion and qualitative state. Unlike Aristotle, who in the *Categor-*

ies contrasted ποιότητες (durable 'affective qualities') with πάθη ('affections' in reaction to something) (9b33–10a10), the medical authors tend to treat these as equivalent items, all ψυχῆς, 'of the soul', and 'deriving from character', ἐκ τῶν ἠθέων, as evidenced by the author of *De Humoribus* quoted above and the examples of individual emotions I have noted.

3 Emotions in Aristotle

In Aristotle, two kinds of narrative are deployed, as I intimated at the beginning: on the one hand, the cognitive kind exemplified by the *Rhetoric*—the discussion of emotions in terms of social interaction, values, and psychological engagement—and on the other hand, reflection on the physiological and embodied, 'enmattered' nature of psychological data.

A view of the emotions in an embodied frame is also central, of course, to parts of *De Anima*, where the demarcation between a cognitive and an embodied approach is explained as a matter of academic 'genre' and not of substance. Discussing the *pathē* of the soul, Aristotle makes the following assertion at *De Anima* 1.1, 403a29–b1:

> Hence a *natural scientist* and a *dialectician* would define each of these [affections of the soul] differently, for example what **anger** is. The latter would define it as an appetite for returning pain for pain or something like that, while the former would define it as a boiling of blood or of a warm substance surrounding the heart.
>
> διαφερόντως δ' ἂν ὁρίσαιντο ὁ φυσικὸς τε καὶ ὁ διαλεκτικὸς ἕκαστον αὐτῶν, οἷον ὀργὴ τί ἐστιν· ὁ μὲν γὰρ ὄρεξιν ἀντιλυπήσεως ἤ τι τοιοῦτον, ὁ δὲ ζέσιν τοῦ περὶ καρδίαν αἵματος καὶ θερμοῦ.

The perspective of the *physiologoi* is evident in various other texts: at *Part. an.* 2.4, 650b35–651a1, anger is analysed in terms of heat: 'For anger produces heat; and when solids have been made hot, they give off more heat than fluids. The fibres are earthy and solid, as a consequence of which they are transformed into something like hot embers in the blood and cause ebullition in the fits of passion' (Θερμότητος γὰρ ποιητικὸν ὁ θυμός, τὰ δὲ στερεὰ θερμανθένα μᾶλλον θερμαίνει τῶν ὑγρῶν· αἱ δ' ἶνες στερεὸν καὶ γεῶδες, ὥστε γίνονται οἷον πυρίαι ἐν τῷ αἵματι καὶ ζέσιν ποιοῦσιν ἐν τοῖς θυμοῖς). Likewise, at *MA* 8, 702a2–7, "For courage and fear and sexual arousal and other bodily conditions, pleasant or painful, are all accompanied by heating or cooling, some in a particular part, others in

the body generally" (θάρρη γὰρ καὶ φόβοι καὶ ἀφροδισιασμοὶ καὶ τἆλλα σωματικὰ λυπηρὰ καὶ ἡδέα τὰ μὲν κατὰ μόριον μετὰ θερμότητος ἢ ψύξεώς ἐστι, τὰ δὲ καθ' ὅλον τὸ σῶμα).

Elsewhere, at *MA* 8, 701a20–23, Aristotle reflects on the ability of the physiological reaction to endure after the object that caused it is no longer present, and the fact that it can even be triggered in the object's absence, through imagination alone:

> Sensations are clearly a form of change in quality, and imagination and thinking have the power of the objects. For in a certain way the mental image conceived, whether it is of something hot or cold or pleasant of fearful, is just like what each of the objects would be, and so people shudder and are frightened by the act of thinking alone.
>
> αἱ μὲν γὰρ αἰσθήσεις εὐθὺς ὑπάρχουσιν ἀλλοιώσεις τινὲς οὖσαι, ἡ δὲ φαντασία καὶ ἡ νόησις τὴν τῶν πραγμάτων ἔχουσι δύναμιν· τρόπον γάρ τινα τὸ εἶδος τὸ νοούμενον τὸ τοῦ θερμοῦ ἢ ψυχροῦ ἢ ἡδέος ἢ φοβεροῦ τοιοῦτον τυγχάνει ὂν οἷόν περ καὶ τῶν πραγμάτων ἕκαστον, διὸ καὶ φρίττουσι καὶ φοβοῦνται νοήσαντες μόνον.

Along similar lines, and more clearly, he writes at *De Anima* 1.1, 403a22–28: "Here is a still clearer case [*in support of the claim that all affections of the soul also involve the body*]: in the absence of any external cause of terror, people find themselves experiencing the feelings of a man in terror. If this is so, it is obvious that the emotions of the soul are enmattered forms of thinking" (ἔτι δὲ μᾶλλον τοῦτο φανερόν· μηθενὸς γὰρ φοβεροῦ συμβαίνοντος ἐν τοῖς πάθεσι γίνονται τοῖς τοῦ φοβουμένου. εἰ δ' οὕτως ἔχει, δῆλον ὅτι τὰ πάθη λόγοι ἔνυλοί εἰσιν).[24] Moreover, the perspective of the *physiologos* looms large in the *Physiognomics* (cf. 1, 805a29–31), where ethical traits, mental dispositions and the state of the body are placed in correspondence. It is also central, finally, to the discussions attested in the *Problemata*, to which I will now turn.

The two strands of discussion are not incompatible, nor should they be opposed to one another. It is important to stress this point, and Aristotle himself, as we have seen, speaks explicitly of the distinction as a matter of *horizein*, a distinction in terms of sphere of research, not reality. The coexistence of these two approaches in the same system of thought is quite acceptable from the point of view of current approaches to the emotions, according to which physiological and psychological, subjective experience exist along a non-discrete continuum.

24 Quoted by van der Eijk (2005) 236–237.

4 Emotions in the *Problemata*

The emotions feature prominently in the *Problemata*.[25] Relevant discussions are contained in the first 11 Books, which are concerned with living beings, but also in the Books devoted to the voice (11) and climate (14). Most interesting, there are Books that thematize 'sympathy' (7), 'fear and courage' (27) and 'moderation-continence' and their opposites (18), which also contribute in various ways to our topic.[26]

From a general glance at this material, it is immediately evident that, unlike the Hippocratic sources, which basically take the emotions as a datum of immediate significance, the *Problemata* start from the emotion as an object of inquiry and problematize, dissect, and unpack it in its corporeal effects and physiological determination. The bodily features placed under observation are largely taken from the medical tradition, along lines observed already by other readers. Among them stand out, in connection with emotions, the reference to heating and chilling, a key observation in Aristotelian biology generally (and their physiologies, with dryness and thirst, as in *Probl.* 27.3 *passim*);[27] the observation of facial appearances; the role played by wine; the contiguity of emotions and madness; the thematization of pain and pleasure; the importance of voice, a fundamental indicator in Hippocratic medicine (*Probl.* 11.32);[28] the role of the environment (if less so than in Book 1, where this topic is prominent; see however *Probl.* 14.15, 14.16); a reliance on and problematization of the 'water-fire' allegory, which is important in the Hippocratic *Regimen* 1.35 (*Probl.* 3.16);[29] a particular interest in tremors as physiological datum and sign; and close observations of the behaviour of the bowels (*koiliai*). These numerous common interests should not distract from fundamental differences. Several of the concrete observations are in fact harvested from the Hippocratics. But this does not make the *Problemata* a passive assimilation of data, and yields instead an active, interpretative reading and engagement.

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25 A more complete list: *Probl.* 2.26, 2.31, 3.16, 3.17, 3.24, 3.27, 3.29, 3.31, 3.32, 44.10, 4.27, 7.5, 7.7, 8.20, 10.60, 14.15, 14.16, 20.2, 27, 28.3, 30,1.

26 I have omitted 31.1 on melancholy, a longer and more complex narrative and a much-discussed example. Relevant to *Probl.* 31.1 are 953b15 ff., on the emotions of melancholics; 954a25, on *euthymia*; 33 on melancholics being *erotikoi*; 36, on wine as a cause of emotions; 954b16–20, on the *athymia* of melancholics; 954b36 on *dysthymia*; 955a2, 6.

27 Bartoš (2015) 77–80, 125–126, 187–196 on water and fire in *Regimen* and the tradition behind the idea; Bartoš and King (2020) on heat in ancient biology, with Bartoš (2020); Flashar (1962) 328–329.

28 See Thumiger (2017) 140–143; Webster (2015).

29 See again Bartoš (2015), n. 27 above.

First, the *Problemata* reverse the hermeneutic order when it comes to observing emotions in human individuals. The Hippocratics viewed the emotions as one symptom among many, like runny stools or dry eyes. For the *Problemata*, the emotions are instead an explanandum and a physiological construct and they accordingly start from the *pathos* and then ask about the illness or physiological background. Anxiety, revulsion, shame, anger, fear, and courage become questions and research topics. At *Probl.* 2.26, 2.31, for example, anxiety is explored as part of the larger inquiry into sweat in Book 2: "*Why* do those who are anxious sweat in the feet, but not in the face? For it is more reasonable that when the whole body sweats, the feet would sweat more: for this region is the coldest, which is why it sweats least" (*Probl.* 2.26, 868b34–869a8). Or *Probl.* 2.31, 868b34–869a7: anxious people are one category within the larger group of active human beings with respect to sweating: "Why do those who are anxious sweat in the feet and not in the face, whereas in the other circumstances in life we sweat most in the face and least in the feet?" This variation in localisation is due to the analogy with fear, and is manifested in the body in a variety of behaviours: paleness, bouncing on one's feet, fidgeting, all described in detail (they "rub their hands, stoop, stretch, fidget, and are never still"). These behaviours have to do with individual bodies and cognition: "for they are eager with respect to their task, owing to the heat that has collected in the region around the chest, which is rather substantial".

In a similar way, revulsion or shame regarding one's own sexual activities are dissected in socio-psychological *and* physiological terms (*Probl.* 4.10, 877b9–13; *Probl.* 4.27, 880a7–11). Anger is accounted for in terms of chilling and heating, the latter being its physiological marker, and is compared and contrasted with its opposite, 'cold' cowardice ("Why do those who are angry not become chilled? Is it because anger and spiritedness are the opposite of cowardice? Now anger is from fire, for it is by retaining a great deal of fire that they grow warm within", *Probl.* 8.20, 889a15–26). The whole of Book 27 analyses fear and courage and their respective physiologies, for example 27, 948b7–13: "Why do those experiencing fear tremble, especially in the voice and, concerning the body, in the hands and the lower lip? Is it because the heat departs from the part in which the voice resides and, with respect to the lip and the hands, because these are most easily moved and have the least blood in them?" It is about anatomy and temperature, but also about voice, behaviour, and the presence of blood.

The emotion is, then, an interface between all these, and the tip of an iceberg to be uncovered and investigated. The details of observation might resemble the Hippocratic or medical repertoire. But the project is altogether different,

and the relevance and intelligibility of the emotions in their mechanisms of causation and expression are incomparably greater.

5 An Example: Sweating and Emotions

Book 2 of the *Problemata*, 'On Sweat', overlaps significantly with Theophrastus' treatise by the same title, and allows for a more direct inquiry into the Peripatetic use of Hippocratic material.[30] Sweat is not only a physiological topic, but is also relevant to emotions as a sign of intense affect of various kinds, especially anxiety.

Probl. 2.26 (868b34–869a8) and 31 (868b34–869a7) speak about those who are anxious (οἱ ἀγωνιῶντες) and ask why they sweat in the feet, not the face (Διὰ τί οἱ ἀγωνιῶντες ἱδροῦσι τοὺς πόδας, τὸ δὲ πρόσωπον οὔ;). As part of the explanation, it specifies that each body part has a particular state of heat: there is a kind of 'thermo-geography' of the body. Feet are cold by nature, and *this is why the doctors* (οἱ ἰατροί) *warm the feet of patients*:

> And the physicians, in the case of illnesses, give orders particularly to wrap the feet, because they are easily cooled, such that at the beginning they readily produce shivering even in the rest of the body.
>
> καὶ οἱ ἰατροὶ ἐν ταῖς ἀρρωστίαις μάλιστα περιστέλλειν τοὺς πόδας παραγγέλλουσιν, ὅτι εὔψυκτοί εἰσιν, ὥστε ἀρχὴν ῥᾳδίως ῥίγους ποιοῦσι καὶ τῷ ἄλλῳ σώματι.

To begin with, the author(s) implicitly makes a claim about the different skills and agendas of physicians and natural philosophers: the latter know more than the doctors themselves do about their methods. The doctor, in fact, appears to apply certain measures almost mechanically, while the scientist knows the rationale behind this effect. It is also noteworthy that, while the passage as a whole is replicated in Theophrastus' *On Sweat* 36 (46 Fortenbaugh), this particular sentence is not, which suggests an additional level of engagement with medical practices or medical writings by the author of the *problema* under discussion.[31]

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30 Fortenbaugh (2003), 46–50 on *On Sweat* 36.220 ff.; Debru (2005), Flashar (1962) 338, 321–322 on Theophrastus and the *Problemata*, 423–424 on Book 1.

31 References to cold feet are common in the Hippocratic writings; regarding therapy, see most explicitly the parallel at *Ac.* (*Sp.*) 8.2 (2.424 L.), Ὁκόσοισι δὲ διὰ τέλεος ἡ κοιλίη ἐν τοῖσι

Second, despite the emphasis on localisation, in *Probl.* 26 the emotions appear to have their own specific directionality and kinetics within the body. This provides the second answer to the posed *problema*, 'why does sweating occur in the feet?' This specific determination is a point not found in the medical material and offers a good illustration of how Peripatetic readers strive to refine and further qualify information from medical sources:

> Is it also because **anxiety** is not a transference of heat from the upper regions to the lower, as in the case of **fear** (which is why the bowels are loosened in those who are afraid), but an increase of heat, as in the case of **anger**? For in fact, anger is a boiling of the heat around the heart; and the one who is **anxious** is affected not by **fear** or by cold, but by an increase in heat.

> ἢ ὅτι καὶ **ἡ ἀγωνία** ἐστὶ θερμότητος οὐ μετάστασις, ὥσπερ ἐν τῷ **φόβῳ**, ἐκ τῶν ἄνω τόπων εἰς τοὺς κάτω (διὸ καὶ αἱ κοιλίαι λύονται τῶν φοβουμένων), ἀλλ' αὔξησις θερμοῦ, ὥσπερ | **ἐν τῷ θυμῷ**; καὶ γὰρ **ὁ θυμὸς** ζέσις τοῦ θερμοῦ ἐστὶ τοῦ περὶ τὴν καρδίαν· καὶ ὁ **ἀγωνιῶν** οὐ διὰ **φόβον** καὶ διὰ ψύξιν πάσχει, ἀλλὰ διὰ τὸ μᾶλλον[32] ἐκθερμαίνεσθαι.

In anxiety, the heat goes *up*; in fear (ἐν τῷ φόβῳ), it goes *down*, with corresponding physiologies. Anger is heat boiling *around* the heart (ὁ θυμὸς ζέσις τοῦ θερμοῦ ἐστὶ τοῦ περὶ τὴν καρδίαν). Anxiety is thus not caused by cold or by chilling emotions, but by the departure of heat. This passage admittedly feels in part like a series of disconnected points, but the desire to systematize the localization of the emotions and their thermo-dynamics in the body is clear.[33]

πυρετοῖσιν ὑγρὴ, τουτέοισι **διαφερόντως τοὺς πόδας** θερμαίνων, καὶ περιστέλλων κηρώμασι, καὶ ταινιδίοισι περιελίσσων πρόσεχε.

32 With Forster's correction for μέλλον.

33 Cf. also *Probl.* 2.31, 868b34–869a7, 'Why do those who are anxious sweat in the feet and not in the face, whereas in the other circumstances in life we sweat most in the face and least in the feet? Is it because anxiety is a fear with respect to the beginning of a task, and fear is a cooling of the upper parts? And this is why those who are anxious grow pale in the face, and move and bounce on their feet. For those who are anxious act this way, as if they were exercising; therefore, it is reasonable that they sweat in the parts with which they exert themselves. They also rub their hands, stoop, stretch, fidget, and are never still, since they are eager with respect to their task owing to the heat that has collected in the region around the chest, which is rather substantial. As this heat and the blood rush in all directions from there, movement becomes frequent and varied. And they sweat most in the feet, because these exert themselves continually, while the other parts of the body get a rest through the changes of position and movement' (Διὰ τί οἱ ἀγωνιῶντες ἱδροῦσι τοὺς

6 The Emotions as Subjective Experience

I have characterised the emotions in the Hippocratics as completely physiological and externalised, oblivious to personal or subjective data. In the *Problemata*, by contrast, there is a sense of persistent embodied self that is made to come within range of the medical observer. Consider *Probl.* 3.17 (873b1–5) on hangovers. These are deemed more painful than drunkenness, just as fevers are more painful upon recovery. It is only afterward, in fact, that the 'full self' can appreciate the negative event. (Both hangover and recovery from illness occur ἐν αὐτοῖς οὖσι, 'in the persons themselves'.) *Probl.* 3.17, 20–23:

> Why does cabbage prevent hangovers? Is it because it has juice that is sweet and able to cleanse (and this is why physicians rinse out the stomach with it[34]), whereas in itself it is cold? This is a sign of this: physicians use it in severe cases of diarrhea, boiling it thoroughly, drawing off the juice and cooling it. […] It is more painful than drunkenness, because this utterly changes them, whereas a hangover produces pain in those who are themselves. They are therefore just like those who are attacked by fevers, who **are amused rather than suffering, but when the same persons come to themselves and are freed from their disease, they suffer**; for the same things happen in the case of the hangover and in the case of drunkenness.

Διὰ τί ἡ κράμβη παύει τὴν κραιπάλην; ἢ ὅτι τὸν μὲν χυλὸν γλυκὺν καὶ ῥυπτικὸν ἔχει (**διὸ καὶ κλύζουσιν αὐτῷ τὴν κοιλίαν οἱ ἰατροί**), **αὐτὴ δ'** ἐστὶ ψυχρά; **σημεῖον δέ· πρὸς γὰρ τὰς σφοδρὰς διαρροίας χρῶνται αὐτῇ οἱ ἰατροί**, ἕψοντες σφόδρα καὶ ἀποχυλίζοντες καὶ ψύχοντες. […] λυπεῖ δὲ μᾶλλον τῆς μέθης, ὅτι ἐκείνη μὲν ἐξίστησιν, ἡ δὲ κραιπάλη ἐν αὐτοῖς οὖσι τὸν πόνον παρέχει· καθάπερ οὖν καὶ ὑπὸ τῶν πυρετῶν οἱ λαμβανόμενοι **παίζουσι μᾶλλον ἢ ἀλγοῦσι**, παρ' αὐτοῖς δὲ

πόδας, τὸ δὲ πρόσωπον οὔ, ἐν τῷ ἄλλῳ βίῳ ἱδρούντων ἡμῶν μάλιστα μὲν τὸ πρόσωπον, ἥκιστα δὲ τοὺς πόδας; ἢ ὅτι ἡ ἀγωνία φόβος τίς ἐστι πρὸς ἀρχὴν ἔργου, ὁ δὲ φόβος κατάψυξις τῶν ἄνω; διὸ καὶ ὠχριῶσι τὰ πρόσωπα οἱ ἀγωνιῶντες. κινοῦνται δὲ καὶ σκαίρουσι τοῖς ιοποσίν· ποιοῦσι γὰρ τοῦτο οἱ | ἀγωνιῶντες καὶ καθάπερ γυμνάζονται· διόπερ εἰκότως ἱδροῦσι ταῦτα οἷς πονοῦσιν. καὶ τρίβουσι δὲ τὰς χεῖρας καὶ συγκαθιᾶσι καὶ ἐκτείνονται καὶ ἐξάλλονται καὶ οὐδέποτε ἠρεμοῦσιν· ὁρμητικοὶ γάρ εἰσι πρὸς τὸ ἔργον διὰ τὸ θερμὸν αὐτῶν ἠθροῖσθαι εἰς τὸν περὶ τὸ στῆθος τόπον ὄντα εὐσωματωδέστερον· | ὅθεν πάντῃ διάττοντος αὐτοῦ τε καὶ τοῦ αἵματος συμβαίνει πυκνὴν καὶ ποικίλην γίνεσθαι κίνησιν. μάλιστα δὲ ἱδροῦσι τοὺς πόδας, ὅτι οὗτοι μὲν συνεχῶς πονοῦσι, τὰ δὲ ἄλλα μέρη τοῦ σώματος ἀναπαύσεως τυγχάνει ταῖς τῶν σχημάτων καὶ κινήσεων μεταβολαῖς).

34 Another learned explanation of what the physicians seem to do on an empirical basis.

> γενόμενοι οἱ **αὐτοί, κουφισθέντες τοῦ πάθους, ἀλγοῦσιν**. ταὐτὰ γὰρ καὶ ἐπὶ τῆς κραιπάλης καὶ ἐπὶ τῆς μέθης συμβαίνει.

The bodily state produces the cause of the emotion, but this can be appreciated by the subject only afterwards, when the impairing bodily condition has been removed. This is a chronological depth that the Hippocratics ignore; the emotions there are acute and signal a present state.

Along comparable lines of development, a similar medicalization of subjectivity and interest in personality is evident in *Probl.* 4.10 (877b9–13) and *Probl.* 4.27 (880a7–11) on sexual intercourse, a theme the Hippocratics eschew in any sense other than the physiological.[35] In *Probl.* 4.10, sexual experiences are at stake, and at the centre is a μεταβολή, a great change in one's body and physiological state.

> Why do young men, when they first begin to have sex, after the act **loathe/are repelled by** the women with whom they had intercourse? Is it because the change brought about is great? For remembering the corresponding **discomfort/unpleasantness** that comes after, they avoid the woman with whom they associated, as being the cause.

> Διὰ τί οἱ νέοι, ὅταν πρῶτον ἀφροδισιάζειν ἄρχωνται, αἷς ἂν ὁμιλήσωσι, μετὰ τὴν πρᾶξιν **μισοῦσιν**; ἢ διὰ τὸ μεγάλην γίνεσθαι τὴν μεταβολήν; τῆς γὰρ συμβαινούσης ὕστερον **ἀηδίας** μεμνημένοι, ὡς αἰτίαν ᾗ ἐπλησίασαν φεύγουσιν.

μεταβολή is recognised by the Hippocratics as pathogenic on various occasions: e.g, *Aer.* 16 (11.64.4 L. = 228,6–8 Jouanna), where we read that changes, αἱ μεταβολαί, always keep the mind on edge (ἐγείρουσαι τὴν γνώμην) and do not leave it in peace, literally "free from tremors" (οὐκ ἐῶσαι ἀτρεμίζειν). The Peripatetic author of *Probl.* 4.10 starts from this physiological, clinical Hippocratic point about change as disruptive to explain disgust (ἀηδία) followed by an over-reactive hatred ("they hate" their sexual partner, μισοῦσιν). In this way, the emotion is unpacked as a complex experience caused by the physiological event (the dramatic change in the body), but crucially by its perception, and by the *memory* of it even, at a later time (μεμνημένοι, "as they remember"). This degree of psychological (to use our term) elaboration is unparalleled in the Hippocratics. The question is not even posed, and an empathetic, humane authorial voice is absent.[36]

35 McNamara (2015).

36 This is the case even from *On Generation*, where sexual issues are discussed and a rare 'we'

The same goes for the second example, *Probl.* 4.27, which discusses the shame (αἰσχύνονται, a highly socialized emotion) of *admitting* (ὁμολογεῖν) a *desire* (ἐπιθυμοῦντες) for sex—a quite complex emotional matter:[37]

> Why **are** those men **who desire (passive) sex** extremely **ashamed** to admit it, but they are not ashamed to admit to a desire for drinking or eating or any other such actions? Is it because the desires for most things are necessary, and some even destroy those who do not satisfy them? But the desire for sex comes from what is superfluous.
>
> Διὰ τί μάλιστ' **αἰσχύνονται** ὁμολογεῖν οἱ ἐπιθυμοῦντες ἀφροδισιάζεσθαι, ἀλλ' οὐ πιεῖν οὐδὲ φαγεῖν οὐδὲ ἄλλο τῶν τοιούτων οὐδέν; ἢ ὅτι τῶν μὲν πλείστων ἀναγκαῖαι αἱ ἐπιθυμίαι, ἔνια δὲ καὶ ἀναιρεῖ τοὺς μὴ τυγχάνοντας; ἡ δὲ τῶν ἀφροδισίων ἐκ περιουσίας ἐστίν.

The differential comparison with the more acceptable desire to eat is articulated by reference to biological necessity and superfluity: there are desires, ἐπιθυμίαι, which are ἀναγκαῖαι (food) and others which are superfluous, ἐκ περιουσίας (sex, especially sex of the passive kind, as ἀφροδισιάζεσθαι indicates when used of male subjects[38]). The Hippocratics also make this distinction: at *Coac.* 97 (v.604.2–3 L. = 126,3–4 Potter) we read that "derangements that concern necessities are most severe, and exacerbations that arise from these are fatal" (αἱ περὶ ἀναγκαῖα παραφροσύναι κάκισται, οἱ ἐκ τούτων παροξυνόμενοι ὀλέθριοι. *Coac.* 97, v.604.2–3 L. = 126,3–4 Potter), which I understand as especially disorderly behaviours associated with sleeping and eating.[39] The Aristotelian reader adopts this concept and proposes that it might explain the greater indulgence towards oneself vis-a-vis the desire to eat, a pleasure which, unlike sex, is necessary to survival (at least to individual survival, if we take ἀφροδισιάζεσθαι as not referring exclusively to passive male sex).

The same reflection is occasioned by the topic of Book 7, 'sympathy', a concept which brings together a variety of different phenomena for the Peripatetic thinkers. The term *sympatheia*, as Fortenbaugh notes, is otherwise absent

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is sometimes adopted by the author; cf. Thumiger (2017) 237. Flashar (1962) 462 ad loc. offers parallels reduced to the physiological level: the lack of interest in sex after ejaculation ('Unlustgefühl nach dem Heraussenden des Samens bei jungen Menschen'). What we have here, however, includes a broader interpersonal, emotional sphere.

37 See Flashar (1962) 468 for this passage as fundamentally 'Aristotelian', comparing *Rhetoric* 2 (1383b22; 1384b20).

38 I thank Douglas Olson for pointing this out.

39 Thumiger (2017) 59.

from Aristotelian works, although the idea is found in a variety of observations in the Hippocratic texts.[40] Several topics in this Book derive directly from Hippocratic observations. At *Probl.* 7.5, for example, the list of things that cause shuddering comes from *De Humoribus* 9.[41] At 7.7 (887a15–22), however, something much more complex than 'infective yawning' (*Probl.* 7.1, 7.6) or *aimōdia*, bleeding gums or a metallic taste in the mouth (*Probl.* 7.9), is under discussion:[42] the emotions aroused by pain experienced by others.

> Why, when we see someone being cut or burned or tortured or experiencing something else terrible, do we suffer along with him mentally? Is it because **nature is common** to all of us? So, when it [nature][43] sees something of this kind, it suffers along with the person experiencing it, owing to **our kinship**. Or is it that, as noses and ears receive certain emanations according to their own capacities, so too does sight experience the same thing from both what is **pleasant and what is painful**?
>
> Διὰ τί, ἐπειδὰν τεμνόμενόν τινα ἴδωμεν ἢ καιόμενον ἢ στρεβλούμενον ἢ ἄλλο τι τῶν δεινῶν πάσχοντα, **συναλγοῦμεν τῇ διανοίᾳ**; ἢ ὅτι ἡ **φύσις** ἡμῖν **κοινὴ** ἅπασιν; συνήλγησεν οὖν, ἐπειδάν τι τοιοῦτον ἴδῃ, τῷ πάσχοντι **διὰ τὴν οἰκειότητα**. ἢ ὅτι ὥσπερ αἱ ῥῖνες καὶ αἱ ἀκοαὶ λαμβάνουσί τινας ἀπορροίας κατὰ τὰς οἰκείας δυνάμεις, οὕτω καὶ ἡ ὄψις αὐτὸ πάσχει καὶ ἀπὸ τῶν ἡδέων καὶ λυπηρῶν;

Why, it is asked, does the pain of others cause pain in us through *thought* (διανοίᾳ)? The first proposed cause is our shared nature, ἡ φύσις … κοινή, i.e. our kinship (διὰ τὴν οἰκειότητα). This is quite in line with the well-known cognitive interpretation of pity, *eleos*, in the *Rhetoric*, as Fortenbaugh notes.[44] Alternatively, it is suggested, our reaction might be a result of the nature of the sense

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40 Fortenbaugh (2017) 126; see Thumiger (2017) 41 on *De Humoribus*, 322–326 on touch.

41 *Hum.* 9 (= v.488.15–490.8 L. = 168,3–13 Overwien).

42 It is in my view nonetheless important not to discount this topic, for example (with Fortenbaugh 2017, 126) as an example of a 'largely irrelevant addition to Book 7. It comes at the end and most likely was added by a late editor/compiler, who wanted to include a stray piece of text within the *Problems* and could do no better than attach it to the end of the book'. In fact, the combination of bodily micro-detail and a larger issue are characteristic, and *sympatheia* is here intended as emotional, but also as reference to disease, or to urine, for example. *Aimōdia* is an instructive example of external datum (bleeding) with subjective feeling (teeth on edge) in the Hippocratics; see Thumiger (2017) 321.

43 I correct here Mayhew's translation, which translates an impersonal 'one' as subject of 'suffers' following a suggestion by Arnaud Zucker, whom I thank.

44 Fortenbaugh (2017) 127. Or, still more to the point, of the φιλάνθρωπος man in the *Poetics* 13 (1452b38–1453a3) (I thank Spyridon Rangos for this suggestion).

of sight itself, which unlike other senses might also have 'pain' (and, in general, emotional experience) as one of its content objects: one cannot smell, taste, or touch the pain of others, but one can see it. The ethical-political point about communality and shared sensibility is here attached to a physiological-sensorial specification, with neither being exclusive. Flashar[45] mentions a Hippocratic parallel, the concept of the 'common nature' in the body that allows doctors to recognise disease patterns across individuals: at *Epid.* 1.23 (12.670 L. = 33,5–6 Jouanna), we read "concerning diseases, from which [signs] we gain our knowledge, learning from the *common nature* of everything" (τὰ δὲ περὶ τὰ νουσήματα ἐξ ὧν διεγινώσκομεν, μαθόντες ἐκ τῆς κοινῆς φύσιος ἁπάντων). The parallel illuminates the differences: here, as elsewhere, the Peripatetic extension of the universalizing value of *physis* (φύσις … κοινή) is noteworthy, from the realm of the body and disease, in the words of the author of the *Epidemics*, to that of a seemingly deeper human familiarity (οἰκειότης) that involves emotions, compassion, and the capacity for sympathy. The terms *physis* and *oikeiotēs* are then revealed as less than exact synonyms. The second is a specification of the first, in a direction we might define as socio-cognitive: not only do we share fixed physiologies across (human) individuals, but we also share an ability to *imagine* this shared body and bodily experience, and to participate in it to the point of reacting physically. What allows the epistemological move of the systematizing doctor is the same trait of human cognition that makes us feel and be subject to the emotions and experiences of others.

This psychological elaboration sometimes means that in the *Problemata* a lack of distinction between *pathē* and *poiotētes* becomes noticeable, an indeterminacy which is more Hippocratic than Aristotelian. (As Fortenbaugh and Konstan show, in the *Rhetoric* the emotions have to do with *action*—as trigger and consequence—not with a lasting quality.[46]) At *Probl.* 8.20 for example, δειλία and θυμός, cowardice and courage, appear to be enduring qualities, while at *Probl.* 14.15, age and geographic setting are examined for their effect in determining *andreioi*, *euelpides* and *sophōteroi* characters.

7 The Issue of Determination

A recurring question that sets apart the Hippocratic and Peripatetic approaches to our topic is the relationship between bodily fact and emotion. Is

45 Flashar (1962) 490 ad loc.

46 Fortenbaugh (1975/2002), Konstan (2006).

it in fact a 1:1 relation? Or could a bodily fact signal two opposite emotions, or *vice versa*? The authors of the *Problemata* seem to be attempting to impose order upon the wealth of medical observations at their disposal. *Probl.* 11.31 (902b30–35) engages precisely with the problem of the underdetermination of the bodily phenomenon. The same sign, a trembling voice, occurs with both anxiety and fear ("Why does the voice tremble in those who are anxious and in those who are frightened? Is it because the heart is shaken by the heat exiting? For people experience this in both cases; indeed, it happens in those who are anxious and in those feeling fear".). At *Probl.* 11.32 (902b37–903a4), high and low voices depend on the emotion, fear, or anxiet, while shame resembles anxiety in this respect, since it is conducive to it ("Why do those who are anxious utter low sounds, but those who are feeling fear high ones? [...] just as it does in those who feel shame? For people are also anxious because of shame"). In *Probl.* 27.3 (947b24–949a5), the heat associated with anger and fear produces different physiologies because of different localizations and directions: around the heart in the former, and down through the bowels in the latter. At the same time, thirst and dryness are common to both because of the heat, a complex semiotic matrix:

> Why, in those who are **spirited**, when the heat collects within, are they heated and **bold**, but in those who are **afraid** (the effect) is the opposite? Or does (the heat collect) not in the same area, but in those feeling **anger** it collects around the heart, and this is why they are bold, red-faced, and full of breath, as the course of the heat is upward, but in those feeling **fear** the course is downward, as the blood and the heat escape together, and this is why there is a loosening of the bowels? And the beating of the heart is not the same (in both cases), since in those feeling **fear** it is rapid and punctuated, as would happen from the departure (of heat), whereas in those feeling **anger** it is as would happen when a great deal of heat collects; [...] How, then, does the same region—the one in which we feel thirst—become dried up in both cases, in feeling fear and in feeling **anger**? Now that fear is thirst-producing is shown by men in a rout; for nowhere are people so thirsty. And those feeling great **anxiety** too are thirsty; [...] Or is this not thirst in these people, but dryness from the blood escaping, for which reason too they are pale?

Similar considerations are taken up at *Probl.* 27.9 (948a20–27) on fear and pain (φόβος and λύπη): despite being typologically related, the two produce different vocal symptoms, crying and the holding of breath, respectively:

> Why, although both **fear** and **pain** are a sort of **grief**, do those who feel pain cry out, whereas those who feel fear remain silent? Is it because those who feel pain hold their breath (which is why, exiting in a mass, it exits with a cry), whereas the bodies of those who feel **fear** cool down, and the heat, which creates breath, is carried downward? Now it creates breath most in the place to which it has been carried. And this is why those who feel **fear** break wind.

It is thus a question concerning air, heating, and movements in the body. The cognitive, personal dimension—the similitude between the two subjective experiences—is important and central to the surprising difference in symptoms vis-a-vis the voice, which is explained by reference to physiological factors.

8 Localizing Emotional Experiences

Perhaps the clearest manifestation of the embodied emotions explored by *Problemata*, and departing from the unreflective Hippocratic use of them, is the intense interest in their localization not in parallel to but in cooperation with cognitive questions. Consider *Probl.* 27.6 (947a35–b6) and *Probl.* 27.10 (948b35–949a8). These two *problemata* are fine examples of the cognitive, action-based understanding of emotion (here fear) familiar to readers of Aristotle (they are reactions to an external stimulus), combined with the physiological point. At 6, first the emotion is specified along with its physiological symptoms:

Why do those **experiencing fear** tremble most in the voice, the hands, and the lower lip?

Then comes a hypothesis about the reason for the behaviour:

> Is it because this condition is a departure of heat from the upper parts? And this is why they grow pale. Now the voice trembles because of the departure of heat from the chest, when that by which it is set in motion is cooled.

A few corroborating parallels follow:

> It is the same with the hands as well; for they depend upon the chest. Now the lower lip, but not the upper, hangs downward in the direction it tends (naturally); and the lower lip moving in an upward direction is contrary

> to nature, but it stays up because of the heat. So when the heat is withdrawn, it trembles owing to the cooling. And in those who are spirited, the lip hangs down for the same reason. This is clear in the case of children; for the heat goes into the heart.

The emotions, in their 'thermodynamic' capacity, strike and affect different body parts. At 27.10, the initial focus is on the effect, the pathological consequence:

> Why do the bowels loosen in those experiencing **fear**, and (why do those experiencing **fear**) desire to urinate?

Then a *prima facie* animalistic explanation for the emotion is proposed:

> Is the heat in us like a living being? Therefore, this flees whatever it **fears** …

What follows as a development of this is extremely interesting. Fear, we read, is a reaction caused by a perceived threat being literally 'inscribed' on the body: "Fears due to anxiety *and such things* come *from outside* [an action/reaction-based view of emotions usually discussed in relation to the *Rhetoric*] *and from the upper parts to the lower, and from the surface to the interior*" (ἔξωθεν οὖν γινομένων τῶν τε ὑπὸ τῆς ἀγωνίας φόβων καὶ τῶν τοιούτων, καὶ ἐκ τῶν ἄνωθεν εἰς τὰ κάτω καὶ ἐκ τῶν ἐπιπολῆς εἰς τὰ ἐντός). The existential, social, interpersonal causation (i.e. the object of the fear) is here reduced to, or presented as, a movement analogous to the top-down, heart-bowel, skin-innards physiological chain of effects, in which the heat 'is like a kind of animal (ὥσπερ ζῷον)'. At *Probl.* 27.11, this is described with detailed examples that are again familiar from Hippocratic descriptions: trembling, contractions, cold, rumbling.

9 Correcting the Hippocratic Doctrine

Finally, there is explicit engagement with and correction of the Hippocratic texts. In the sphere of emotions, one text which establishes a particularly explicit dialogue is *Regimen*.

Regimen greatly influenced the Peripatetic tradition.[47] In respect to psychology, the well-known doctrine on the soul at *Regimen* 1.35 (VI.512–522 L. = Joly-

47 See Debru (2005).

Byl 150–156)[48] is worth comparing. Here the author offers a 'psycho-gnomic' illustration that is highly relevant to the topic of emotions as embodied. The soul is qualified by its blend of fire and water, i.e. 'dry' and 'moist', as well as 'quick' or 'slow' in its movement around the body. There is an associated variation in intellectual abilities, sensation, emotional dispositions, and even character:

> The facts are as follows with regard to what is called the intelligence of the soul and the lack of it. **The moistest fire and the driest water, when blended in a body, result in the most intelligence, because the fire has moisture from the water, and the water has dryness from the fire. Each is thus most self-sufficient** (πυρὸς τὸ ὑγρότατον καὶ ὕδατος τὸ ξηρότατον κρῆσιν λαβόντα ἐν τῷ σώματι φρονιμώτατον, διότι τὸ μὲν πῦρ ἔχει ἀπὸ τοῦ ὕδατος τὸ ὑγρόν, τὸ δὲ ὕδωρ ἀπὸ τοῦ πυρὸς τὸ ξηρόν).

One or the other element may prevail and thus determine certain 'psychological' characteristics, in the sense of characteristics of the soul:

> If in any case fire receives a power inferior to that of water, such a soul is necessarily slower (βραδυτέρην), and persons of this type are called stupid (ἠλίθιοι). For as the circuit is slow, the senses, being quick, meet their objects spasmodically, and their combination is very partial owing to the slowness of the circuit. For the senses of the soul that act through sight or hearing are quick.

And elsewhere, "Now the madness of such persons inclines to slowness" (ἔστι δ' ἡ μανίη τοιούτων ἐπὶ τὸ βραδύτερον) …, later "if the power of the water is further mastered by the fire, the soul must be quicker, in proportion to its more rapid motion, and strike its sensations more rapidly" (ἀνάγκη εἶναι τὴν ψυχὴν ὅσῳ θᾶσσον κινεῖται, καὶ πρὸς τὰς αἰσθήσιας θᾶσσον προσπίπτειν). Again, "if the fire is mastered to a greater extent by the water in the soul, we have in that case

48 To summarize this long and famous passage, a sequence of six 'kinds of' *psychai* are said to characterize different individuals depending on the blend of fire and water in them, which appear to be innate. Various qualitative variations follow the blends, in terms of intelligence, rationality, emotional dispositions and 'goodness'; the mixture typifies the person across these categories. What stands out in each type is the water-and-fire, moist-and-dry, slow-and-fast pairs which shape the variations. The idea behind the reference to speed in particular is that of a soul circulating inside the body, thus informing the various parts of the body with acquired sensorial data.

instances of what are called by some 'senseless' (ἄφρονας) people, and by others 'grossly stupid' (ἐμβροντήτους). Now the imbecility of such persons inclines to slowness. They cry for no reason, fear what is not dreadful, feel pain at what does not affect them, and their sensations are not at all those that sensible persons should feel".

This fundamental polarity—water-fire, moist-dry, slow-fast—is problematized by readers of the *Problemata*, tested against and at times openly criticised by reference to more general theories about the importance of heat for human health. Consider *Probl.* 3.16 (873a23–37) on wine and drunkenness: wine is said to have *different* effects on *different* characters, so that a single assessment of it would not be appropriate for everyone:

> Why does wine make people both stupefied and frenzied? For these dispositions are opposite: the latter actually involves more movement, the former less. Is it just as Chaeremon said: "Wine is mixed with the **characters** of the users"? It therefore produces opposite results not with respect to the same things, but to things that are dissimilar.

Likewise, fire and water have different effects on different characters. Is this a criticism of the idea that fire and water themselves could be the primal elements?

> … just as **fire** dries some things, and makes others **moist**, but not the same things (ὥσπερ καὶ τὸ πῦρ τὰ μὲν ξηραίνει, τὰ δὲ ὑγραίνει, ἀλλ' οὐ ταὐτά): it melts ice and solidifies salt. *Wine as well—for it is moist by nature—tightens the **slow** and makes them **quicker**, but relaxes the **quick*** (**καὶ ὁ** οἶνος—ὑγρὸς γάρ ἐστι τὴν φύσιν—**τοὺς** μὲν βραδυτέρους **ἐπιτείνει καὶ** θάττους ποιεῖ, **τοὺς δὲ** θάττους **ἐκλύει**). *This is why some of those who are melancholic by nature become completely relaxed during drinking bouts. For just as a bath makes those who are stiff in body and hard able to move more easily, while it relaxes those who move easily and are moist, so wine, as if bathing the insides, accomplishes the same thing*.

Thus wine too "tightens the slow and makes them quicker, but relaxes the quick", quick and slow being a key pair in *Reg*. 1.35. Is this also, as suggested above, an objection to 'fire' and 'water' as innate and irreducible qualities?

Two more examples are less critical, and instead confirm and further qualify the doctrine of *Regimen* regarding the soul. Consider *Probl.* 8.20 (889a15–26), discussing anger and cowardice as episodic affections, caused when fire and chill are present.

> Why do those who are angry not become chilled (οὐ ῥιγῶσιν)? Is it because anger and spiritedness are the opposite of cowardice? Now anger is from fire (ὀργὴ ἀπὸ τοῦ πυρός), for it is by retaining a great deal of fire that they grow warm within (πολὺ γὰρ τὸ πῦρ κατέχοντες εἴσω χλιαίνονται). This is observable most of all in children. For men are distressed (when angry), but children first draw in deep breaths, and then grow red; for the quantity of heat within being great and causing liquefaction makes them grow red, since if one were to pour a large quantity of cold water over them, they would cease being angry, since their heat would be extinguished. But cowards and those who are afraid are the opposite. For they are chilled, and become cold and pale, since the heat leaves them from the surface regions.

The fire-water, hot-cold polarity is here unpacked, explained, supplied with details and examples, and its embodied nature visually depicted by the vignette of the child growing angry, internally (the liquefaction through heat) and externally (the visible redness), with the reverse case included (chilling and cowardice).

An opposite possibility, this time consistent with rather than emending the schema offered by *Regimen* 1.35, is hinted at at *Probl.* 10.60 (898a4–8), where three elements are discussed in their interrelation: courage, hardness of the flesh, and heat (and their opposites). Courage is characterized by heat, whereas water and cooling typify the body of the fearful:

> Why are birds and human beings and the courageous animals the hardest (τὰ **ἀνδρεῖα** σκληρότερα)? Is it because spirit (ὁ **θυμός**) involves heat? For fear is a process of cooling (ὁ γὰρ **φόβος** κατάψυξις). Therefore, those beings whose blood is hot (τὸ αἷμα ἔνθερμόν) are courageous and spirited (**ἀνδρεῖα καὶ θυμοειδῆ**). Indeed, blood is (their) nourishment. Further, plants that are watered with warm water are all harder (σκληρότερα).

The heat under discussion materializes in the 'hardness' of the hot-blooded, courageous animals. The significance extends still further: this biological axis of connections is mirrored across taxonomies in that the hardest *plants* are those that are warm-watered.

In this final case, only two elements of the triad are found (heat, hardness), courage being irrelevant to plants. This illustrates very clearly the deconstruction of the observed data into its minimal components and the productive search for all possible new combinations and extensions of its significance. The minimal components, in the cases analysed here, might have come from

fifth/fourth century medicine, but the heuristic project is entirely extraneous to it. In fact, this project and its potentially unlimited reach by analogy and connection are evident in the fact that the emotions as a topic are dispersed in clusters within the Books of the *Problemata*, regardless of the date conjecturally assigned to their titles. The Book-titles are themselves heterogeneous in the content they compartmentalise, so this miscellaneity surely belongs to the nature of the collection. Still, discussion of the emotions is strikingly scattered. Book 27 is on 'Problems connected with fear and courage', but elsewhere we find important analyses of the emotions in other groups: within the discussions 'On sweat' (Book 2, part of the 'Problems on medicine'), 'On wine drinking and drunkenness' (Book 3), on sexual intercourse (Book 4), 'Effects of sympathy' (Book 7), and 'Effects of chill and shivering' (Book 8); in Book 11 'On voice', and Book 14 'Problems connected with climate'. Even the Books entitled 'Epitome of natural problems' (10) and 'Problems connected with shrubs and vegetables' (20) discuss the *pathē*, opening the topic up to non-human animals and plants, as we have seen. In the latter, *Probl.* 20.2, 923a9–12, the matrix of connections is pharmacological, botanical, ethical, and behavioural (cooling, courage, and mint), occasioned by scrutiny of a prescriptive piece of popular knowledge, a proverb:

> Why is it said: "Neither eat nor plant mint in wartime"? Is it because mint cools bodies? Its corruption of seed proves this. This is contrary to courage and spirit, which is the same in kind.
>
> Διὰ τί λέγεται "μίνθην ἐν πολέμῳ μήτ' ἔσθιε μήτε φύτευε"; ἢ ὅτι καταψύχει τὰ σώματα; δηλοῖ δὲ ἡ τοῦ σπέρματος φθορά. τοῦτο δὲ ὑπεναντίον πρὸς ἀνδρείαν καὶ θυμὸν ταὐτὸν ὂν τῷ γένει.

Conclusions

Analysis of a prismatic topic such as the emotions in two composite, stratified sets of source material such as the Hippocratic corpus and the Peripatetic tradition as it appears in the *Problemata* cannot hope to yield a unified thesis or a tidy set of observations. From the examples discussed, however, we can perhaps shed light on some aspects of the relationship between medicine and philosophy after the classical era. Most strikingly, the *Problemata* depart from the approach of the Hippocratics in that the emotions are not treated as self-explanatory facts but as composites to be unpacked, deconstructed, and explored in their interrelations among themselves and with various bodily

facts. They are primarily analysed as antecedent to bodily states and warrant description and explanation for their effects on the body. In short, they raise questions rather than provide answers: this is the crucial difference between their status here and in the medical evidence, from which they, sometimes very ostensibly, derive their data and observations. The material and its analysis is too heterogeneous to allow a categorical and general statement; nonetheless, a few concluding observations can be made.

First, when it comes to the emotions, the Hippocratic texts defined a 'more sober' territory, where personal and subjective emotions are intentionally eschewed. The authors of the *Problemata*, on the other hand, scrutinize spheres as diverse and every-day as sexual desire, detailed levels of behaviour such as facial expressions, and social attitudes.

Second, we must not forget that the Hippocratic texts are primarily concerned with gathering data and curing people, in that order, rather than speculating on the information accumulated. The emotions they considered are accordingly those that are acute and pathological, which express the physiological state of the person as a whole at the time of the curative medical encounter. In the *Problemata*, by contrast, a 'Hippocratic' range of material (physiological aspects such as heat, voice, the face, trembling, sweating) is used to pose a much larger range of questions, filling a gap left by the medical writers and extending their research beyond the restricted area of pathology. Emotions are considered to be medically interesting in themselves, not just for the sake of the information they supply to help treat a specific individual.

This line of inquiry remained largely peripheral to the dominant tradition of ancient medicine. The reduction to physiology in the latter and the elevation of philosophical therapy in the former constitute fundamentally separate paths vis-a-vis the emotions. The combination of corporeal attention to the experience of the emotions without renouncing recognition of its cognitive identity, its social and interpersonal contractedness, and its stake in subjectivity, is unique in the natural inquiry of ancient cultures. Physiognomy is perhaps the only place, and it is rather unsatisfactory in its results. Nor does any literary text, be it poetry or prose, exhibit the same degree of commitment to realistic detail and the explanatory desire as we find in the Peripatetic *Problemata*.

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Index locorum

Aelian
De natura animalium
IX.33 61

Aeschylus
Prometheus vinctus (*PV*)
476–483 74*n*23
Tetralogia 9, play A
Fr. 67,12 (Nauck) 71*n*4

Aetius
Placita (*Plac.*)
V.24 (909d–f) 172*n*16
V.25 (909f–910b) 172*n*17
V.25 (909f) 172*n*18

Alcmaeon
B4 (DK 24) 72

Alexander of Aphrodisias
In Aristotelis Metaphysica commentaria
103,35–104,19 158*n*132

Anaxagoras
B4 (DK 59) 72*n*10

Anonymus Londiniensis
5.35–36.18 6*n*29
6.31–40 180*n*54
6.31–44 6*n*23
7 11*n*53
8.11–28 181*n*51
19 11.53

Aristophanes
Acharnians 74*n*22
Aves (*Birds*)
695 230*n*16
Nubes
201–203 132*n*26

Aristotle and *Corpus Aristotelicum*
Analytica Posteriora (*Post. An.*)
1.2, 71b23 345*n*42
1.2, 72a6 345*n*42
1.6, 74b26 345*n*42
1.7, 75b18–20 345*n*42
1.9, 76a16 345*n*42
1.12, 77a39 345*n*42
1.13 98, 277*n*4, 346
1.13, 78b18–19 338*n*28
1.17, 80b18 345*n*42
1.33, 89b7–9 340*n*33
Analytica Priora (*Pr. An.*)
2.23, 68b15–17 355
Categoriae (*Cat.*)
8b35–9a1 84*n*85
9b33–10a10 385
De anima (*De an.*)
1.1, 403a3–25 377*n*9
1.1, 403a22–28 386
1.1, 403a25 377
1.1, 403a29–b1 377, 385
1.1, 403a31 342*n*35
1.1, 403a32–b1 90*n*121
1.2, 403b24 147*n*89
1.2, 405a21 2*n*6
1.2, 405a29 2*n*6
1.2, 405b1–5 91*n*123
1.2, 405b5–8 90*n*122
1.4, 407b27–29 91*n*128
1.4, 407b27–32 92*n*130
1.4, 407b30–32 91*n*127
1.4, 407b32–34 92*n*132
1.4, 408a2–4 92*n*131
1.4, 408a9–12 92*n*134
1.4, 408a13–18 92*n*133
1.4, 408a13–23 72*n*9
1.4, 408a18–24 92*n*133
2.1, 412a1–413a10 377*n*9
2.4, 416a19–20 113*n*14
3.9, 432a22–b3 312*n*14
3.9, 432b5–6 312*n*14
3.12, 434a22–30 113*n*14
De caelo (*Cael.*)
1.1 360*n*15
1.1, 268a6 360*n*15
2.1, 286a5 147*n*89
2.12 206*n*71
De divinatione per somno (*Div. somn.*)
463a5 337*n*22
463a5–6 2*n*12

De divinatione per somno (*Div. somn.*) (*cont.*)
463a6–7 52
463b17 343*n*40
464a32 343*n*40
De generatione animalium (*Gen. an.*)
1.1, 715a18–716a2 189*n*4
1.2, 716b1–3 83*n*75
1.16, 721a18–20 212*n*84
1.17–21 191
1.17–22 189, 190, 191, 193
1.17–23 191, 194
1.18, 722a18–26 191
1.18, 722b32 191
1.18, 723b3–8, 19–32 193*n*27
1.18, 723b19–32 193*n*27
1.18, 723b32–724a3 226*n*9
1.18, 724a14–25 191*n*14
1.18, 725b34–726a3 193*n*27
1.19, 726b15–23 191
1.19, 726b22–24 118*n*18
1.19, 727a22–23 208*n*77
1.19, 727a26–30 196
1.19, 727b2–6 193*n*27
1.19, 727b6–11 196
1.19, 727b9–33 191
1.20, 727b33–728a25 191
1.20, 727b34–728a1 200
1.20, 728a9–14 226*n*9
1.20, 728a34–728b3 193*n*27
1.20, 728b14–15 208*n*77
1.20, 728b14–18 208
1.20, 728b21–32 191
1.20, 729a4–12 193
1.20, 729a32–33 88*n*105
1.21, 729b22 193*n*27
1.21, 729b33–730a25 193
1.21, 730a4–7 231*n*18
1.21, 730a24–32 189*n*6
1.21, 730a24–33 193*n*27
1.23, 732a30 189*n*4
2.1, 732b31–32 208
2.1, 734b24–27 118*n*18
2.2, 735b13–17 295*n*57
2.2, 736a1–2 225
2.3, 736b25–27 88*n*105
2.3, 736b30–737a8 286*n*30
2.3, 736b30–737a17 225
2.3, 737a30–34 231*n*18
2.4, 737b25 189*n*7
2.4, 737b27–738a6 226*n*9
2.4, 738b4–5 208*n*76
2.4, 738b5–20 198
2.4, 739a26–35 226*n*9
2.4, 739b9–20 228
2.4, 739b20–33 256
2.4, 739b33–740a4 250*n*2
2.4, 740a36 218*n*100
2.5, 741a16–32 231*n*18
2.6, 741b34–37 266*n*34
2.6, 742a15 226
2.6, 743a18–20 256
2.6, 743a31 120*n*22
2.6, 743b33–744a14 198*n*47
2.6, 744a26–29 208
2.6, 744a26–31 90*n*119
2.6, 744a30 79*n*48
2.7, 746b7 85*n*94
2.7, 746b7–11 324
2.7. 746b10–12 218*n*98
2.7, 746b12–15 83*n*75
2.7, 746b21–24 83*n*75
2.7, 746b21–25 198
2.7, 746b22–24 198*n*45
2.8, 747a8–14 197
2.8, 747a19–22 198
2.8, 747b6–8 83*n*75
2.8, 748b31–33 83*n*75
3.1, 749a34–b7 231*n*18
3.1, 750b1–751a26 231*n*18
3.1, 750b34–751a2 226*n*9
3.1, 751b2–9 193*n*26
3.2, 752b24–26 2*n*6
3.2, 753a18–21 206
3.10, 761a10 48
3.11, 761a32 286
3.11, 761a32–b23 286
3.11, 761b13–15 238*n*34
3.11, 761b15–16 286*n*31
3.11, 762a8–24 231*n*20
3.11, 762a19–24 225
4.1, 765a24–25 2*n*6
4.1, 765a25 37*n*22
4.1, 765b6–8 191
4.1, 766a16–22 87*n*99
4.1, 766b12–16 87*n*99
4.1, 766b19–24 214
4.2, 766b28 234
4.2, 766b29–34 234

De generatione animalium (*Gen. an.*) (*cont.*)
4.2, 766b32 239
4.2, 766b34–767a1 234
4.2, 766b35–37 281
4.2, 766b37 281
4.2, 767a1–7 206*n*69
4.2, 767a8–13 235
4.2, 767a13–23 87*n*99
4.2, 767a22–23 83*n*75
4.2, 767a23–28 87*n*99
4.2, 767a28–34 281
4.2, 767a28–35 235
4.2, 767a30–35 59, 87*n*99
4.3, 767b10–13 234*n*28
4.3, 767b16–23 87*n*99
4.3, 768b27–33 87*n*99
4.4, 772a36–37 207
4.4, 772a37–772b7 208
4.4, 772b1 207
4.4, 772b1–8 218*n*98
4.4, 772b2–5 203
4.4, 772b4–5 208
4.4, 772b8–11 202
4.4, 772b11–12 203
4.5, 773a33–34 207
4.5, 773b6–7 207*n*75
4.5, 773b7–9 208
4.5, 773b10–774a14 201*n*50
4.5, 773b22–25 207
4.5, 773b26–27 218
4.5, 774a2–6 200
4.6, 775a11–14 211
4.6, 775a11–21 211
4.6, 775a27–775b2 216
4.6, 775a28–b16 243
4.6, 775b6 208*n*76
4.7, 775b27–33 209
4.7, 776a8–9 209
4.7, 776a9–12 209
4.8, 776a20–21 203
4.8, 776a23–24 202*n*54
4.8, 776a34–777b12 210
4.8, 776b26–27 198, 208*n*76
4.9, 777a28–31 58
4.10, 777a33–35 210
4.10, 777b6–8 236*n*31
4.10, 777b7–8 85*n*90
4.10, 777b17–31 205
4.10, 777b18–29 87*n*100
4.10, 777b28–30 237*n*33
5.1, 778a32 290
5.1, 778b1–6 118*n*19
5.2, 781a33–34 238*n*34
5.2, 781a33–b2 84*n*83
5.2, 781b19–22 189*n*5
5.3, 782a27 290*n*46
5.3, 782b5 295*n*56
5.3, 782b14–18 295*n*56
5.3, 782b20 290
5.3, 782b26 290
5.3, 782b29 291
5.3, 782b32–783a1 280*n*15
5.3, 782b33–783a1 237
5.3, 783a4 290*n*43
5.3, 783a12–33 237
5.3, 783a13–20 292
5.3, 783a19 292
5.3, 783a33 283*n*23, 292
5.3, 783b26–784a4 199
5.6, 786a30–34 238*n*34
5.7, 788a22–26 58
5.8, 789b5–11 225
De Generatione et Corruptione (*Gen. corr.*)
1.1, 314b6–8 80*n*55
1.2, 315a33–35 80*n*58
1.2, 316a5 51*n*56
1.6, 322b8–9 80*n*54
1.6, 322b13–14 2*n*6
1.7, 324a15–19 84*n*85
1.7, 324a29–30 72*n*12
1.7, 324b1–4 84*n*85
1.8, 324b35–325a3 80*n*58
1.8, 325b13–16 80*n*58
1.8, 325b18–20 80*n*59
1.8, 325b20–24 80*n*57
1.9, 327a18 81*n*66
1.10, 328a2 81*n*62
1.10, 328a9 83*n*74
1.10, 328a9–10 81*n*61
1.10, 328a11–13 81*n*62
1.10, 328a26–32 82*n*68
1.10, 328b1–5 82*n*72
1.10, 328b3–5 81*n*65
1.10, 328b7–9 81*n*67
1.10, 328b20–22 81*n*64
1.10, 328b23 81*n*63
2.2, 330a5–7 81*n*65
2.2, 330a13–15 81*n*66

De Generatione et Corruptione (*cont.*)
2.3, 330b16–17 78*n*47
2.6, 333b13–20 72*n*10
2.7, 334a18–21 80*n*57
2.7, 334a26–31 80*n*57
2.7, 334b20–31 82*n*71
2.10, 336b20–21 79*n*49, 83*n*74, 85*n*90
De insomniis (*Insomn.*)
2, 459a23–b7 347*n*46
3, 461a4 335*n*15
3, 461a6–7 89*n*116
3, 461a22 343*n*40
De interpretatione (*Int.*)
16a2 47
22a22 45
De iuventute (*Iuv.*)
1, 467b20–25 268*n*36
1, 467b32–468a12 267
1, 468a9–12 264*n*33
2, 468a13–17 259, 263
2, 468a22–23 251*n*5
2, 468a30–31 267*n*35
2, 468b5–9 254
3, 468b16–28 266
3, 468b28–30 269
3, 468b29–30 268*n*36
4, 469a23–28 251*n*5
4, 469a28–32 268*n*36
4, 469b6–9 255
4, 469b18–20 252, 255
5, 470a5–7 255
6, 470a22–27 271
6, 470a27–32 270
6, 470a27–b4 255
12, 473a3–14 260
12, 473a5–6 261
12, 473a11 261
12, 473a11–12 261
12, 473a14 261
14, 474a25–28 257*n*18
De longitudine et brevitate vitae (*Long.*)
1, 464b30–33 4*n*19
3, 465b25–29 236*n*31
4, 466a9–10 295*n*55
5, 466a17–23 212
5, 466a33–b2 295
5, 466b5–16 212
5, 466b17–28 294
5, 467a7–10 295*n*55
De memoria (*Mem.*)
2, 453a14–31 347*n*47
2, 453a14–b10 343
2, 453a19 343*n*40
De motu animalium (*MA*)
8, 701a20–23 386
8, 702a2–7 385
De mundo (*Mund.*)
5, 396b12 126*n*1
De partibus animalium (*Part. an.*)
1.1, 639a5 190*n*10
1.1, 639a16–30 110*n*11
1.1, 639a36–b14 190*n*10
1.1, 639b5 189
1.1, 640a10–33 118*n*19
1.1, 640b5–16 117
1.1, 640b23–34 118
1.1, 641a1 118*n*18
1.1, 641b1 132*n*35
1.1, 642a13–24 119*n*20
1.1, 642a16–23 80*n*56
1.1, 642a17–22 72*n*9
1.1, 645a21–23 147*n*89
2.1, 646a12–a29 119*n*20
2.1, 646a24–29 118*n*19
2.2, 647b29–648a19 340*n*32
2.2, 647b31–34 88*n*107
2.2, 648a2–4 90*n*118
2.2, 648a9–11 90*n*119
2.2, 648a37–649b8 287*n*35
2.2, 648b2–6 84*n*80
2.3, 650a32–b13 340*n*32
2.3, 650a35–b2 88*n*108
2.4, 650b27–33 90*n*120
2.4, 650b28–33 287*n*37
2.4, 650b35–36 90
2.4, 650b35–651a1 385
2.4, 651a12–15 89*n*111
2.4, 651a12–17 236*n*30
2.4, 651a13–15 88*n*106
2.4, 651a14–17 88*n*107
2.7, 652a28–29 89*n*112
2.7, 652b20–22 89*n*113
2.7, 652b26–27 89*n*114
2.7, 652b33–36 90*n*117
2.7, 652b36–653a10 3*n*15
2.7, 653a1–2 181*n*56
2.7, 653a4–10 181*n*56
2.7, 653a8–10 6*n*29

De partibus animalium (*Part. an.*) (*cont.*)
2.7, 653a10–20 340*n*32
2.7, 653a31–32 212*n*84
2.7, 653b2–8 340*n*32
2.10, 656a3–6 189*n*7
2.10, 656a7–13 207
2.10, 656a27–31 89*n*116
2.16, 659b30–34 189*n*5
3.4, 665a33–b2 269*n*37
3.4, 666a36–b1 88*n*109
3.4, 667a16–19 90*n*120
3.6, 669a7–14 86*n*98
3.6, 669b3 212*n*84
3.10, 673a10–26 46
3.12, 673b24–31 89*n*110
3.12, 673b26 79*n*48
4.5, 681a9 292*n*51
4.8, 684a21–22 212*n*84
4.9, 685b5 2*n*8
4.10, 686a5–11 89*n*115
4.10, 686a27–b2 207
4.10, 687a5 189*n*5
4.10, 689a29–32 226
4.10, 689b5 189*n*5
4.11, 692a22–25 90*n*120
4.12, 695a22–25 201
De progressu animalium (*Prog. an.*)
5, 706b8–10 206
De respiratione (*Resp.*)
13, 477a27–31 237*n*32
14, 477b14–478a1 237*n*32
14, 477b16 279
14, 477b18–24 284
14, 477b31–478a1 280
20, 479b31–32 226*n*7
21, 480a25–480b12 228
21, 480b22–30 4*n*17
21, 480b21–31 122
De sensu (*Sens.*)
1, 436a1 338*n*27
1, 436a1–b2 336*n*20, 337*n*24
1, 436a17–b1 3*n*14
1, 436a29–b2 338
2, 439a1–2 89*n*116
3, 440a28–29 83*n*75
4, 442a12–13 83*n*75
4, 442b25 335*n*18
7, 449a17 89*n*116
De somno (*Somn.*)
454b24–27 343
454b32–455a3 335*n*15
455b10 89*n*116
456b3–5 170*n*3
456b10–11 169*n*1
456b17–19 170*n*2
456b20–23 170*n*7
456b24 170*n*8
456b26 170*n*6
456b28–32 171*n*9
456b32 170*n*6
456b33 170*n*8
456b33–34 228*n*13
456b34–457a1 171*n*10
457a1–2 171*n*11
457a3–5 71*n*12
457a12 228*n*13
457a17–21 171*n*11
457a25–27 171*n*13
457a27 343*n*40
457a27–31 171*n*14
457b4 170*n*6
457b22–25 170*n*7
457b31–458a5 170*n*7
458a2–3 181*n*56
458a10 171*n*15
458a21–25 340
De sophisticis elenchis (*Soph. el.*)
20, 177b6 38
34, 183a20–22 148*n*95
34, 183a37–184a9 147*n*92
34, 183b17–20 41
34, 184b1–3 148*n*96
34, 184b6 148*n*97
De vita et morte (*Vit.*)
5, 480b21–480b30 337*n*25
Ethica Eudemia (*Eth. Eud.*)
1.6, 1216b36–39 345*n*43
2.1, 1219a38–40 353
2.1, 1219b26 353
2.1, 1219b30 353
2.1, 1219b40–1220a2 353
2.1, 1220a2–4 353
2.1, 1220a9–11 353
2.1, 1220a13–15 354
2.1, 1220a15–18 354
2.1, 1220a18–19 354, 361
2.1, 1220a22–23 355

Ethica Eudemia (*Eth. Eud.*) (*cont.*)
2.1, 1220a22–27 84*n*84
2.1, 1220a22–39 354
2.1, 1220a23–24 355
2.1, 1220a24–25 356
2.1, 1220a24–28 368*n*29
2.1, 1220a25–26 356, 357
2.1, 1220a26–27 356, 367
2.1, 1220a28–29 351*n*2
2.1, 1220a29 355, 356
2.1, 1220a29–30 356
2.1, 1220a30–31 356
2.2, 1220b1–2 358
2.2, 1220b5–6 358
2.2, 1220b7–10 358
2.2, 1220b13–14 358
2.2, 1220b18–19 358
2.3, 1220b21–22 362
2.3, 1220b21–35 359
2.3, 1220b23 362
2.3, 1220b29–30 351*n*2
2.3, 1220b30 362
2.3, 1220b30–35 361*n*18
2.3, 1220b34–35 362
2.3, 1220b37 45
2.5, 1222a10–12 351*n*1
2.5, 1222a28–31 84*n*84
2.6, 1222b28–29 360*n*17
2.10, 1226a34 2*n*7
7.1, 1235a5–12 330
7.1, 1235a10 330*n*3
7.10, 1243b20–25 37*n*22
7.10, 1243b24 2*n*6
Ethica Nicomachea (*Eth. Nic.*)
1.2, 1094b13–27 363*n*20
1.2, 1094b24 147*n*90
1.2, 1095b3–8 345
1.2, 1095b6 346
1.7, 1097b22–1098a1 346*n*44
1.7, 1097b34–1098a6 314
1.7, 1098a20–26 41
1.7, 1098a22–26 147*n*91
1.7, 1098b1–2 345*n*43
1.13, 1102a5–25 334*n*12
1.13, 1102a24–25 335*n*16
1.13, 1102a26–1103a10 335*n*14
1.13, 1102b18–21 333*n*11
2.1, 1103a23–26 368*n*29
2.1, 1103b6–12 357*n*12
2.1, 1103b6–25 355
2.1, 1104a3–9 363*n*20
2.2, 1104a11–19 357
2.2, 1104a11–27 355
2.2, 1104a12–19 84*n*84
2.5, 1106a4–5 360*n*17
2.6, 1106a26 362
2.6, 1106a27 362
2.6, 1106a28–29 362
2.6, 1106a33–b4 363
2.6, 1106b5–7 364
2.6, 1106b8 364
2.6, 1106b16–28 364
2.6, 1106b27–28 362
2.6, 1106b36–1107a2 351*n*1
2.7, 1107a33 45
3.5, 1114a14–16 84*n*87, 347
3.7, 1114b30–1115a4 347
3.11, 1116b24–30 342
5.1, 1129a13–16 347
5.15, 1138a30–31 333*n*9
7.3, 1147a13–14 343
7.3, 1147a16 343
7.3, 1147a20 343
7.3, 1147a35 343
7.3, 1147b9 330*n*3
7.3, 1147b6–9 331, 339
7.3, 1147b12 343
7.7, 1150b1–16 243*n*44
7.8, 1150b33–34 342
7.10, 1152a27–30 329*n*2
7.10, 1152a30 347*n*46
7.14, 1154b7 330*n*3, 331
7.14, 1154b10 343
7.14, 1154b11 343
7.14, 1154b12–15 84*n*82
8.2, 1155b8–10 341
10.3, 1173a24–28 84*n*81
10.5, 1176a13–15 333*n*10
10.5, 1176a13–19 333
10.9, 1180b18–19 2*n*8
10.10, 1181b16 44*n*39
Fragmenta
Fr. 258 202*n*58
Historia animalium (*Hist. an.*)
1.1, 487a10–13 229
1.1, 487a14–b7 279*n*11
1.1, 488b12–27 300*n*65
1.1, 488b24–25 321

Historia animalium (*Hist. an.*) (*cont.*)
1.6, 491a6–14 48
1.6, 491a12 50
1.6, 491a19–21 189*n*7
1.11, 492a14 2*n*6
1.15, 494a26–b1 206
1.16, 495a11–19 198
1.17, 497a32 45*n*44
2.1–4.7 190
2.1, 499a31 189*n*5
3.1, 510a11–14, a29 45*n*44
3.1, 510a29 45*n*44
3.1, 510a30 45
3.2–3 2, 232
3.2, 511b25–30 11
3.2, 511b30–512b11 2*n*6
3.3, 512b10–513a8 11
3.3, 512b12–513a7 60
3.4, 514b2 2*n*7
3.19, 520b10–11 88*n*104
3.19, 520b19–31 83*n*78
3.19, 521a15 173*n*23
3.19, 521a26–27 208*n*76
3.20, 521b26–32 257
4.1, 523a31–32 190*n*10
4.1, 525a7–9 45*n*44
4.9, 535b22–23 226*n*7
4.11, 538a22–25 212*n*84
4.11, 538a25–30 212*n*84
4.11, 538a30–b2 212*n*84
5.1, 539a31–b2 230
5.5, 541a26–31 229
5.8, 542a26 217
5.9, 542b28–29 239*n*36
5.11, 543b18–31 238*n*34
5.11, 543b23–31 264*n*33
5.16 264*n*33
5.19, 551a2–4 239*n*36
5.19, 551a12–13 2*n*6
5.19, 552a7–8 231*n*19
5.19, 552a10–11 231*n*19
5.19, 552a28–29 231*n*19
5.23 49
6.2, 559b20–560a8 230
6.2, 560b13–16 230
6.3, 561a4–8 193, 206, 210
6.3, 561a4–562a21 193, 210
6.3, 561a5–b29 269
6.3, 561a24, b27 206
6.10, 565a2–13 45*n*44
6.11, 566a13–15 45*n*44
6.17, 570b43–44 215*n*89
6.18–25 239
6.18, 571b32–572a5 239
6.18, 572a8–22 231
6.18, 572a20–29 239
6.18, 572a22–27 200
6.18, 572a25–28 231*n*22
6.18, 572a32–33 239
6.18, 572b29–31 208*n*76
6.18, 573a1–2 239
6.18, 573b1–2 231*n*21
6.19 232, 238
6.19, 573b26–27 239
6.19, 573b32–574a4 238*n*35
6.19, 574a14 239
6.20, 574a20–27 217
6.20, 574b6 207*n*70
6.20, 574b14–18 239
6.21, 575a26 239
6.21, 575b2 239
6.22, 575b30–31 217*n*95
6.22, 576a20–21 239
6.22, 576b2–4 217
6.22, 577a7–13 231*n*22, 239
6.23, 577b13–15 239
7.1 194
7.1, 581a14 207*n*70
7.1, 581b16–22 199
7.1, 582a16–19 234*n*28
7.1, 582a29–32 234*n*28
7.1, 582b28–30 208*n*76
7.2 194
7.3 194
7.3, 583a14–15 225*n*5
7.3, 583a26–33 257
7.3, 583a31, 583b4, 13 206*n*70
7.3, 583a34–583b2 225*n*5
7.3, 583b10–13 204
7.3, 583b18–21 209
7.3, 583b21–24 209
7.4 194, 233, 243, 246
7.4, 584a2–13 215
7.4, 584a3–9 225*n*5
7.4, 584a33–584b1 224
7.4, 584a36–584b1 202
7.4, 584b1–14 224
7.4, 584b8–10 216

Historia animalium (*Hist. an.*) (*cont.*)
7.4, 584b18–25 224
7.4, 584b22 227
7.4, 584b26–27 194
7.5 194
7.5, 585b3 206*n*70
7.6 194
7.7, 586a15–17 226
7.9 194
7.9, 586b34–587a4 215
7.9, 586b35–587a5 244*n*45
7(8).2, 589a11–18 86*n*96
7(8).2, 589b23–26 86*n*97
7(8).2, 590a13–19 86*n*98
7(8).10, 596a27–29 239*n*36
7(8).12–17 238*n*34
7(8).13, 597b9–13 239*n*36
7(8).13, 597b31–598a5 285
7(8).13, 598a7–8 285
7(8).19, 602a16 293*n*52
7(8).19, 602a22–25 239*n*36
7(8).19, 602a23–25 293*n*52
7(8).19–28, 602b12–605b22 1*n*5
7(8).20, 603a13 293*n*52
7(8).20, 603a25 293*n*52
7(8).24, 605a2–7 231*n*22
7(8).24, 605a9–17 280
7(8).24, 605a13 280*n*16
7(8).28, 605b22 238*n*34
7(8).28, 605b22–24 85*n*91
7(8).28, 606a21–b3 294
7(8).28, 606a25–b6 85*n*93
7(8).28, 606b3–10 294
7(8).28, 606b17–19 238*n*34
7(8).28, 606b17–20 85*n*91
7(8).28, 606b18–24 300, 315*n*18
7(8).28, 606b19–21 324
7(8).28, 606b20–24 218*n*98
7(8).28, 607a1–5 83*n*75
7(8).29, 607a9–10 299
7(8).29, 607a9–12 85
7(8).29, 607a9–13 238*n*34, 297, 299
7(8).29, 607a11–12 299
7(8).30, 607b1–27 215
9.1, 608b30 218
9.2, 610b2 300*n*67
9.37, 621b3–6 280
9.44 218*n*96
9.41–43, 627b23–629b5 49
10.2, 634a34–35 232*n*25
10.3, 635b4–9 232
10.3, 636a4–8 232*n*25
10.3, 636a9–10 233
10.3, 636a9–26 232
10.3, 636a9–28 232
10.3, 636a24–26 233
10.5, 637a15–36 232*n*25
10.6, 637b16–20 192*n*23
10.7, 638b15 2*n*8
10.7, 638b5 120*n*22
Metaphysica (*Metaph.*)
1/A.1, 980a2 331*n*5
1/A.1, 980b26–981a12 146*n*88
1/A.1, 980b26–981b24 134*n*37
1/A.1, 981a12–b7 2*n*10
1/A.1, 981b8–9 2*n*11
1/A.1, 981b14 146*n*88
1/A.1, 982a4–6 146*n*87
2/α.1 147*n*92
4/Γ.3, 1005b2 134*n*35
6/E.1, 1025b19 134*n*35, 134*n*36
6/E.1, 1026a12 134*n*35
6/E.1, 1026a19 134*n*35
6/E.1, 1026a36 134*n*35
8/H.2, 1042b15–19 93*n*135
8/H.2, 1042b27–32 93*n*136
11/K.7, 1063b35–1064b3 130*n*15
11/K.7, 1064a31 134*n*35
Meteorologica (*Mete.*)
1.10, 347a36–b11 238
1.12, 348b2–5 270*n*38
1.14 301*n*70
1.14, 351b8–352a17 326*n*37
2.3, 358a27–358b3 238
2.4, 359b27–360a17 238
2.4, 359b28–34 170*n*3
2.4, 360a12–13 238
2.4, 361a4–22 238
2.5, 362b12–20 85*n*92
4.1, 378b27–379a14 237*n*33
4.1, 379a14–16 295*n*58
4.1, 379b7–9 280*n*14

Meteorologica (*Mete.*) (*cont.*)
4.2, 379b12–17 120*n*21
4.3, 381a9–12 157*n*131
4.3, 381a24–381b9 156
4.3, 381b6 126*n*1
4.4–11 120
4.4, 382a1 133*n*29
4.6, 383a32–b2 298*n*61
4.7 287*n*37, 295*n*57
4.7, 384a21 2*n*7
4.8, 385a12–19 120*n*23
4.9, 386a26–29 286*n*29
4.12 290*n*45
4.12, 389b23–32 121
4.12, 390a10–13 118*n*18
Physica (*Ph.*)
1.1, 184a10–12 130*n*17
1.1, 184a14–16 130*n*18
1.1, 184a15 132*n*28
2.1, 192b13–33 149*n*101
2.1, 192b21–23 149*n*100
2.1, 193a9–28 120*n*20, 149*n*102
2.1, 193a31–33 149*n*103
2.2, 194a15–194a27 151
2.2, 194a21 126*n*1
2.2, 194a23–24 83*n*78
2.8, 198b17–199a8 158*n*133
2.8, 199a8–20 159
2.8, 199a13 159*n*136
2.8, 199a13–14 161*n*139
2.8, 199a17 126*n*1
2.8, 199a20–32 160*n*138
2.8, 199a28–31 160
3.1, 201a34–b3 83*n*78
3.5, 204a35 147*n*89
4.2, 210a10–13 360*n*16
4.3, 210a20–21 84*n*85
4.3, 210b24–27 84*n*85
4.6, 213a19–22 44*n*37
4.8, 215a15 347*n*47
6.1, 231b16 360*n*15
6.2, 232b24 360*n*15
6.2, 233a25 360*n*15
7.3, 246b3–6 338*n*28
7.3, 246b4–6 83*n*79
7.3, 247b13–16 340*n*32
8.2, 253a7–21 236*n*31
8.3, 246b5–6 236*n*31
8.10, 266b28–267a20 347*n*47
Physiognomica
805a29–31 386
806b15 299*n*63
Poetica (*Poet.*)
13, 1452b38–1453a3 394*n*44
26, 1462a11–17 33*n*13
Politica (*Pol.*)
1.2, 1252a31–33 319
1.2, 1252a34–b9 319
1.2, 1252b1–9 308*n*8
1.2, 1252b8–9 308
1.3, 1253b2–3 216
1.3, 1253b8–18 216
1.3, 1253b23–30 217
1.4, 1254a14–17 317
1.5, 1254b11–12 217
1.5, 1254b20–26 321
1.5, 1254b22–23 321
1.5, 1254b27–28 317
1.5, 1254b27–34 319
1.5, 1254b31–34 321
1.5–6 317
1.13 317, 318, 319
1.13, 1260a2–14 318
1.13, 1260a10–12 321
1.13, 1260a35–36 318
1.13, 1260a36–b7 318
2.1, 1262b18 83*n*75
2.5, 1264b6 216
3.11, 1282a3–7 337*n*22
3.14 208
3.14, 1285a19–22 307*n*3
3.16, 1287a37–41 1*n*3
3.17, 1287b36–88a2 322*n*31
4.3, 1290a13–14 238
4.6, 1293b33–34 84*n*75
4.9, 1294b13–14 83*n*75
6.5, 1319b40 47
7.2, 1324b32–41 322*n*31
7.4, 1325b39–1326a5 313
7.4, 1326a15–16 2*n*6
7.7 17, 18, 299, 306, 307, 308, 312, 313, 314, 315, 316, 317, 318, 320, 322, 323, 324, 325, 335
7.7, 1327b18–36 312, 313
7.7, 1327b20 324
7.7, 1327b29 242*n*43
7.7, 1327b35 242*n*43

Politica (*Pol.*) (*cont.*)
7.7, 1327b36–41 312
7.10, 1330a25–30 322
7.11, 1330a34–41 242*n*42
7.11, 1330a38–b14 307
7.14, 1333a16–18 321
7.14, 1333b38–34a2 322*n*31
7.15, 1334b17–20 314
7.15, 1334b17–28 312
7.16 246, 334
7.16, 1335a21–24 201*n*52
7.16, 1335a35–b2 84*n*88, 245
7.16, 1335a39–b2 334
7.16, 1335a40 205
7.16, 1335a40–41 2*n*7
7.16, 1335b1–2 311*n*12
7.16, 1335b6–8 84*n*84
7.16, 1335b13–14 216
7.17, 1336b37–1337a2 203
8.5, 1340b10–19 91*n*128
Problemata (*Prob.*)
2.26, 868b34–869a8 388, 389
2.31 387*n*25, 388, 389, 390*n*33
3.16 387
3.16, 873a23–37 400
3.17 287*n*25
3.17, 873b1–5 391
3.17 391
3.20–23 391
3.24 387*n*25
3.27 387*n*25
3.29 387*n*25
3.31 387*n*25
3.32 387*n*25
4.2, 876a36–b22 199*n*48
4.10 392
4.10, 877b9–13 388, 392
4.27 387*n*25, 393
4.27, 880a7–11 388, 392
7.5 387*n*25, 394
7.6 394
7.7 387*n*25
7.7, 887a15–22 394
7.9 394
8.20 387*n*25, 395
8.20, 889a15–26 388, 400
10.47 217*n*95
10.60 387*n*25
10.60, 898a4–8 401
11.31, 902b30–35 396
11.32 387
11.32, 902b37–903a4 396
14, 909a12–909b9 79*n*50
14, 909a13–18 84*n*89
14.5, 909a32–35 235*n*29
14.15 387, 387*n*25, 395
14.16 387
20.2 387*n*25
20.2, 923a9–12 402
27, 947a35–b6 397
27.3 387
27.3, 947b24–949a5 396
27.9, 948a20–27 396
27, 948b7–13 388
27.10 397, 398
27.10, 948b35–949a8 397
27.11 398
28.3 387*n*25
30.1, 953b25–954a4 226*n*8
30.1, 954a25 387*n*26
30.1, 954b16–20 387*n*26
30.1, 954b36 387*n*26
30.1, 955a2 387*n*26
31.1 387*n*26
33 387*n*26
36 387*n*26
44.10 387*n*25
Protrepticus (*Protr.*)
Fr. 46 3*n*16
Rhetorica (*Rhet.*)
1.1, 1355a17–18 130*n*14
1.2, 1357a7–13 130*n*14
1.12, 1373a31 83*n*75
1.12, 1373a32–35 82*n*73
1.13, 1373b5–7 47
2.1, 1378a19–22 375
2.1, 1378a20–21 377*n*8
2.6, 1383b22 393*n*37
2.6, 1384b20 393*n*37
2.13, 1389b31–32 90*n*120
2.21, 1394a19 41
3.1, 1403b1–22 47
3.1, 1404a18 47
Rhetorica ad Alexandrum (*Rhet. ad Alex.*)
37, 1444a19 47

Topica (*Top.*)
1.1, 100b18 44
1.10, 104a8–15 44
1.14, 105a34–36 44, 46
1.14, 105b12–18 44*n*38
1.14, 105b13 46
4.2, 122b26–33 79*n*53
4.2, 123a4–5 79*n*53
6.2, 139b19–21 83*n*76
6.6, 145b7–11 83*n*76

Aristoxenus
Elementa Harmonica (*Harm. elem.*)
II. 35*n*16

Athenaeus of Naucratis
Deipnosophistae
9.43 156*n*128

Caelius Aurelianus
Tardarum passionum
1.1.14 185*n*70

Celsus
De medicina
1.2.2 185*n*67

Cicero
De legibus (*Leg.*)
1.26 155*n*122

Corpus Hippocraticum
Aphorismi (*Aph.*)
1.15 (IV.466 L. = 104,1–3 Jones) 176*n*36
1.22 (IV.468.13–14 L. = 384,8–385,1 Magd.) 382
2.34 6*n*31
3.24–31 204*n*62
4.13–15 (IV.504–506 L. = 136,1–138,3 Jones) 177*n*44
4.41 (IV.516 L. = 144,1–3 Jones) 176*n*37
5.59 (IV.554.3–6 L. = IV.174.1–4 Loeb) 197*n*42
5.62.5 (IV.554–556 L.) 73*n*13
5.62 (IV.556 L. = 174,18 Jones) 73*n*56, 87, 87*n*101
6.23 (IV.568.11–12 L. = 453,1–2 Magd.) 382
7.42 (IV.588.13 L. = IV.202 Loeb) 342*n*39
Coa praesagia (*Coac.*)
97 (V.604.2–3 L. = 126,3–4 Potter) 393
De aere locis aquis (*Aer.*)
1 (II.12 L. = 24,1–26,4 Diller) 240
1 (II.12 L. = 24,17–26,2 Diller) 283*n*23
3 (II.14–18 L. = 26,22–28,23 Diller) 282
3 (II.14–18 L. = 26,23–28,10 Diller) 241
3 (II.16 L. = 28,6 Diller) 285
4 (II.18–22 L. = 28,24–32,5 Diller) 282
4 (II.18 L. = 30,4 Diller) 288
4 (II.22 L. = 30,22–32,3 Diller) 241
5 (II.22–24 L. = 32,6–24 Diller) 282
5 (II.22 L. = 32,12–13 Diller) 87*n*101
5 (II.22–24 L. = 32,16–20 Diller) 77*n*40
5 (II.24 L. = 32,17 Diller) 288
5 (II.24 L. = 32,19 Diller) 241
5 (II.24 L. = 32,20–21 Diller) 87*n*101
5 (II.24 L. = 32,20–24 Diller) 74*n*28, 87*n*102
6 (II.24–26 L. = 32,25–34,15 Diller) 288
7 (II.26 L. = 34,16–19 Diller) 240*n*38
7 (II.26–32 L. = 34,16–40,6 Diller) 283
7 (II.26–28 L. = 34,19–36,23 Diller) 243
7 (II.30 L. = 38,15–17 Diller) 241
9 (II.38 L. = 44,13–14 Diller) 242

De aere locis aquis (*Aer.*) (*cont.*)
10 (11.42 L. = 46,16–22 Diller) 74*n*29
10 (11.44 L. = 48,13–18 Diller) 245*n*46
10 (11.44–46 L. = 48,13–19 Diller) 242
12 324
12 (11.52 L. = 54,10–11 Diller) 297
12 (11.52 L. = 54,10–12 Diller) 296
12 (11.52–54 L. = 54,10–17 Diller) 74*n*27, 85*n*95
12 (11.52 L. = 54,11–12 Diller) 297
12 (11.52–54 L. = 54,12–13 Diller) 242*n*43
12 (11.52.19 L. = Diller 54,13) 73*n*16, 242*n*43
12 (11.54 L. = 56,1–5 Diller) 296
12 (11.54 L. = 56,6–7 Diller) 296
12 (11.54.3 L. = 56,16 Diller) 73*n*14
12 (11.54 L. = 220,5–10 Jouanna) 316*n*20
13 323
13 (11.58 L. = 56,19–58,16 Diller) 298
14 (11.60 L. = 224,17–19 Jouanna) 324*n*34
15 (11.60 L. = 60,10–11 Diller) 285
15 (11.60–62 L. = 60,1–22 Diller) 283
16 317*n*22
16 (11.62 L. = 62,1–6 Diller) 85*n*95
16 (11.62 L. = 227,11–228,2 Jouanna) 314*n*16
16 (11.64 L. = 62,6–7 Diller) 298
16 (11.64.4 L. = 228,6–8 Jouanna) 392
18 309
18 (11.68 L. = 66,4 Diller) 244
18 (11.68 L. = 66,9–10 Diller) 288
19 310
19 (11.70–72 L. = 66,21–68,9 Diller) 243
19 (11.72 L. = 68,7–9 Diller) 296
19 (11.72 L. = 68,14–17 Diller) 298
19 (11.72 L. = 68,15–19 Diller) 243
20 (11.74 L. = 70,14 Diller) 244
21 (11.74–76 L. = 70,20–72,9 Diller) 243
21 (11.76 L. = 72,5–6 Diller) 245
21 (11.76 L. = 72,7–9 Diller) 245
22 (11.76 L. = 72,10–12 Diller) 243
23 (11.82–86 L. = 76,5–78,8 Diller) 288, 296
23 (11.82 L. = 76,6–7 Diller) 289
23 (11. 82 L. = 241,21–243,2 Jouanna) 323*n*33
23 (11.84 L. = 76,15 Diller) 298*n*60
23 (11.84 L. = 76,17–78,8 Diller) 85*n*95
23 (11.84 L. = 76,18 Diller) 298*n*62
23 (11.84 L. = 76,19–20 Diller) 298
23 (11.84 L. = 76,22–78,1 Diller) 76*n*38
23 (11.84 L. = 243,2–12 Jouanna) 314*n*16
23 (11.86 L. = 226,5–6 Jouanna) 317*n*22
24 315
24 (11.86 L. = 78,11 Diller) 289*n*41
24 (11.86 L. = 78,13 Diller) 299
24 (11.86 L. = 78,15–17 Diller) 298*n*61
24 (11.86 L. = 78,16–17 Diller) 299

De aere locis aquis (*Aer.*) (*cont.*)
24 (II.86 L. = 78,17 Diller) 283*n*23, 289, 292
24 (II.90 L. = 80,4 Diller) 285
24 (II.90 L. = 80,8–9 Diller) 242*n*43
24 (II.90 L. = 80,9 Diller) 75*n*34, 289
24 (II.90 L. = 80,16 Diller) 289
24 (II.90 L. = 82,4 Diller) 289
24 (II.92 L. = 82,9 Diller) 289
De affectionibus (*Aff.*)
46 (VI.254.16–18 L.) 73*n*19
52 (VI.263.15–17 L. = V.80.8–10, Loeb) 363*n*22
De alimento (*Alim.*)
36 (IX.110.15 L. = 82,24 Heiberg) 195*n*38
39 (IX.112 L. = 145,12 Joly) 129*n*10, 141*n*65
De arte (*De arte*)
1.2 (VI.5 L. = 226,3–4 Jouanna) 140*n*60
11.1 (VI.19–20 L. = 237,4–20 Jouanna) 139*n*59
De articulatione (*Artic.*)
45 (IV.194.3 L.) 57
De carnibus (*Carn.*)
2–3 (VIII.584–588 L. = 132–136 Potter) 144*n*76
15 (VIII.602–604 L. = 152,23-154-5 Potter) 84*n*83
19 (VIII.608.22 L. = 200,25 Joly) 206*n*70
19 (VIII.608.22–610.4 L. = 200,25–203,7 Joly) 204
De dentitione (*Dent.*)
15 (VIII.546 L. = 223,11–12 Joly) 176*n*35
28 (VIII.548 L. = 224,21–22 Joly) 176*n*34
De flatibus (*Flat.*)
14 (VI.110 L. = 99,20–100,3 Heiberg) 91*n*125
De genitura pueri (*Genit.*)
4 (VII.474.14–18 L. = 46,21–47,1 Joly) 195
De glandibus (*Gland.*)
12 (VIII.568.3 L. = 119,25–26 Jouanna) 383
De hebdomadibus (*Hebd.*)
24 (VIII.647.25–26 L.) 73*n*13
50 (VIII.667 L.) 133*n*34
De humoribus (*Hum.*)
9 (V.488.15–490.8 L. = 168,3–13 Overwien) 380, 394*n*41
De internis affectionibus (*Int.*)
20 (VII.216 L. = 122,9–14 Potter) 178*n*45
De locis in homine (*Loc. Hom.*)
1.2–3 (VI.276 L. = 38,16–39,5 Joly) 180*n*53
46 (VI.342 L. = 84,18–21 Craik) 135*n*39
46 (VI.342 L. = 84,23–24 Craik) 135*n*40
De morbis (*Morb.*)
1.30 (VI.200 L.) 91*n*124
2.27 (VII.44 L.) 178*n*45
De morbo sacro (*Morb. Sacr.*)
1.4 (VI.354 L. = 3,18–4,5 Jouanna) 142*n*68
2.1 (VI.364 L. = 10,4–11 Jouanna) 142*n*69
4 230*n*14
12.1–2 (VI.382.19–384.3 L. = 22,13–23,5 Jouanna) 384
16 230*n*14, 242*n*40
19–20 291*n*49
De mulierum affectibus (*Mul.*)
1.1 (VIII.10.2–4 L.= IX.8.1–5 Loeb) 198
1.1 (VIII.12.17–14.7 L.) 214
1.8 (VIII.36.6–7 L.) 383
1.17 (VIII.56.18–22 L = XI.58.24–60.4 Loeb) 199
1.71 (VIII.148–150 L. = X 156.12–14 Loeb) 210*n*79
1.78 (VIII.178.15–15 L. = XI.186.25–26 Loeb) 197
1.92–109 29

De mulierum affectibus (*Mul.*) (*cont.*)
2.111 (VIII.238.2–240.1 L.) 212
2.157 (VIII.322.8–14 L. = XI.358.17–21 Loeb) 197*n*42
2.170 (VIII.350.11–20 L. = XI.388.14–25 Loeb) 197
3.230 (VIII.444 L. = 372 Potter) 133*n*33
De natura hominis (*Nat. hom.*)
2 (VI.36 L. = 169,9–170,1 Jouanna) 357*n*13
3 (VI.36–38 L. = 170,8–172,12 Jouanna) 192*n*21
3 (VI.38 L. = 170,11–172,2 Jouanna) 87*n*101, 88*n*103
3 (VI.38 L. = 172,1 Jouanna) 73*n*16
9 (VI.52–54 L. = 188,15–17 Jouanna) 83*n*77
9 (VI.54 L. = 189,3–10 Jouanna) 357*n*13
9 (VI.54. L. = 190,16–192,5) 355*n*8
11 (VI.58–60 L. = 192,15–196,5 Jouanna) 60
De natura muliebri (*Nat. Mul.*)
1 (VII.312.6–7 L. = 1,8–9 Bourbon) 212
10 (VII.324 L. = 13,4–5 Bourbon) 227*n*12
96 (VII.412.19–414.3 L. = 81,15–82,4 Bourbon) 197*n*43
99 (VII.416.1–3 = 83,15–17 Bourbon) 197
De natura ossium (*Nat oss.*)
9 (IX.174–178 L. = 144,18–146,22) 60
De natura pueri (*Nat. Puer.*)
1 (VII.470 L. = 146,3–15 Giorgianni) 256*n*13
9 (VII.482 L. = 160,6–19 Giorgianni) 264
12 (VII.486 L. = 164,7–11 Giorgianni) 256*n*13
12 (VII.486 L. = 164,7–166,2 Giorgianni)257*n*20
12 (VII.486 L. = 164,7–166,5 Giorgianni) 254
12 (VII.486 L. = 164,13–166,1 Giorgianni) 262*n*31
12 (VII.486 L. = 164,15 Giorgianni) 257*n*22
12 (VII.486 L. = 166,1–5 Giorgianni) 257*n*19
12 (VII.486 L. = 166,5–19 Giorgianni) 261
12 (VII.486 L. = 166,11–12 Giorgianni) 251*n*5
12 (VII.488 L. = 166,23 Giorgianni) 257*n*22
12 (VII.488 L. = 166,24 Giorgianni) 257*n*22
12 (VII.488 L. = 168,5–9 Giorgianni) 257*n*21
12 (VII.488 L. = 168,9–20 Giorgianni) 256*n*14
12 (VII.488 L. = 168,14–20 Giorgianni) 262
13–14 (VII.490–492 L. = 172,3–13 Giorgianni) 263*n*32
13 (VII.492 L. = 174,1–2 Giorgianni) 257*n*22
13 (VII.492 L. = 174,11 Giorgianni) 258*n*26
13 (VII.492 L. = 174,11–19 Giorgianni) 263*n*32
13 (VII.492 L. = 174,18 Giorgianni) 257*n*22
13–14 (VII.492–494 L. = 174,20–176,11 Giorgianni) 196, 257*n*19
14 (VII.492.8–10 L. = 56,13–15 Joly) 196
14 (VII.492.21–494.2 L. = 57,5–9 Joly) 214
14 (VII.492 L. = 56,19–20 Joly) 227*n*11
17 (VII.496 L. = 59,9–10 Joly) 227*n*11
17 (VII.498 L. = 180,16–17 Giorgianni) 256*n*15
17 (VII.498 L. = 182,8–9 Giorgianni) 258*n*23
17 (VII.498 L. = 182,13–15 Giorgianni) 259
17–18 (VII.498–500 L. = 184,7–19 Giorgianni) 258
17 (VII.500 L. = 186,3–10 Giorgianni) 258*n*24

De natura pueri (*Nat. Puer.*) (*cont.*)
18 (VII.500–506 L. = 60,19–64,7 Joly) 210
18 (VII.504 L. = 188,18 Giorgianni) 250*n*3
18 (VII.504 L. = 190,15 Giorgianni) 251*n*5
18 (VII.504–506 L. = 63,17–64,4 Joly) 209
19 (VII.506 L. = 192,1–4 Giorgianni) 259
19 (VII.506 L. = 64,8–11 Joly) 227*n*11
20 (VII.508.6–7 L. = 65,11–17 Joly) 199*n*49
21 (VII.512 L. = 198,22–26 Giorgianni) 256*n*16
21 (VII.514 L. = 200,12–17 Giorgianni) 264*n*33
21 (VII.514.1–5 L. = 68,14–18 Joly) 200, 210
22–23 (VII. 514–518 L. = 200,17–204,12 Giorgianni) 265
22 (VII.516 L. = 202,16–19 Giorgianni) 267*n*35
23 (VII.518 L. = 204,29–31 Giorgianni) 269
25 (VII.524 L. = 210,8–18 Giorgianni) 270
26 (VII.526 L. = 212,6–11 Giorgianni) 270
26 (VII.526 L. = 212,11–17 Giorgianni) 271
27 (VII.528 L. = 214,3–11 Giorgianni) 266
27 (VII.528 L. = 214,15–24 Giorgianni) 264*n*33
29 (VII.530 L. = 216,4–23 Giorgianni) 268
29 (VII 530–532 L. = 77,14–78,9 Joly) 203*n*59
29 (VII.530.3–15 L. = 77,19–78,4 Joly) 193
30 (VII.532 L. = 79,6–9 Joly) 58, 232
30 (VII.532–534 L. = 79,4–25 Joly) 226
30 (VII.534 L. = 220,12 Giorgianni) 251*n*5
30 (VII.536 L. = 222,15–16 Giorgianni) 256*n*17
31 (VII.540 L. = 226,17 Giorgianni) 258*n*26
31 (VII.540.12 L. = 83,12 Joly) 192
De octimestri partu (*Oct.*)
1 (VII.436.1–4 L. = 164,1–9 Joly) 204
4 (VII.442.1–4 L. = 167,6–11 Joly) 202
9 (VII.446.19–448.2 L. = 170,11–174,3 Joly) 204
9 (VII.448.5–7 L. = 171,11 Joly) 206
9 (VII.448.10–11 L. = 171,15–16 Joly) 203
9 (VIII.450.6–8 L. = 172,16–24 Joly) 211, 218
9 (VIII.450.10 L. = 172,24 Joly) 216
10 (VII.452.4–8 L. = 174,4–6 Joly) 204
De salubri diaeta (*Salubr.*)
4 (VI.76 L. = 210,12 Jouanna) 174*n*26
7 (VI.84 L. = 218,8 Jouanna) 174*n*26, 177*n*42
De sterilibus (*Steril.*)
1 (VIII.412.11–15 L. = 73,3–8 Bourbon) 197
2 (VIII.414.20–21 L. = 74,21–22 Bourbon) 197*n*42
21 (VIII.446.17–19 L. = 96,3–5 Bourbon) 210*n*78
De superfetatione (*Superf.*)
1 (VIII.476 L. = 276,1–277,2 Bourbon) 207*n*74
De vetere medicina (*VM*)
1.1 (I.570.1–7 L. = 118,1–9 Jouanna) 103
1.2 (I.572.2–5 L. = 118,4–7 Jouanna) 108
1.2 (I.570 L. = 118,10–12 Jouanna) 135*n*43
1.2 (I.570 L. = 118,14–119,1 Jouanna) 135*n*42
1.3 (I.572 L. = 119,4–5 Jouanna) 136*n*46

De vetere medicina (*VM*) (*cont.*)
2.1 (I.572 L. = 119,12–13 Jouanna) 136*n*44
2.1 (I.572 L. = 119,12–14 Jouanna) 137*n*49
2.1 (I.572.9–13 L. = 119,12–15 Jouanna) 104
2.3 (I.572.19–574.3 L. = 120,3–12 Jouanna) 108
3.1–3 (I.574.8–576.5 L. = 120,16–121,9 Jouanna) 107
3.1–6 (I.574–578 L. = 120,16–123,8 Jouanna) 136*n*45
3.2 (I.574.12–576.1 L. = 121,2–5 Jouanna) 107
3.3 (I.576.6 L. = 121,5–12 Jouanna) 107
3.4 (I.576.9–20 L. = 121,15–122,8 Jouanna) 107
3.5 (I.576.20–578,7 L. = 122,8–123,3 Jouanna) 107
3.6 (I.578.7–11 L. = 123,3–8 Jouanna) 107
5 (I.582 L. = 39,22–24 Heiberg) 73*n*16
5 (I.580–582 L. = 39,6–26 Heiberg) 74*n*24
7.2 (I.584.11–16 L. = 126,8–14 Jouanna) 107
9.1–3 (I.588.4–590.1 L. = 127,15–128,15 Jouanna) 108
9.2 (I.588.8–11 L. = 128,3–7 Jouanna) 109
9.2 (I.588.11–13 L. = 128,7–9 Jouanna) 109
10 (I.590–592 L. = 129,17–130,5 Jouanna) 174*n*26
10–11 (I.590–594 L. = 129,14–132,9 Jouanna) 175*n*32
10.2 (I.592.2–7 L. = 130,3–9 Jouanna) 109
10.3 (I.592 L. = 130,11–12 Jouanna) 175*n*32
11.1 (I.594.6–12 L. = 131,11–18 Jouanna) 109
12.2 (I.596.10–598,2 L. = 132,15–18 Jouanna) 110
14 (I.602 L. = 46,1–4 Heiberg) 87*n*101
14.3 (I.602.4–8 L. = 136,3–8 Jouanna) 112
16 (I.606 L. = 47,15 Heiberg) 73*n*16
17.2 (I.612.10–14 L. = 141,15–142,2 Jouanna) 105*n*7
19 (I.618–620 L. = 50,28–51,4 Heiberg) 87*n*101
20.1–3 (I.620.5–622.12 L. = 145,17–147,4 Jouanna) 104, 115*n*16
20.2 (I.620.9–12 L. = 146,3–7 Jouanna) 118
20.6 (I.624.5–10 L. = 147,16–148,3 Jouanna) 112
22.1 (I.626.6–7 L. = 149,1–3 Jouanna) 111
22.1 (I.626.8–9 L. = 149,3–4 Jouanna) 112
22.1–3 (I.626.8–19 L. = 149,4–16 Jouanna) 114
22.6 (I.628.11–12 L. = 150,15–17 Jouanna) 114
24 (I.634 L. = 55,8 Heiberg) 75*n*33

De victu (*Vict.*)
1.2 (VI.466–468 L. = 125,4–17 Joly-Byl) 368*n*30
1.2 (VI.470 L. = 124,11–14 Joly-Byl) 355*n*8
1.2 (VI.470–472 L. = 124,17–26 Joly-Byl) 369*n*31
1.2 (32–33) 204*n*62
1.3 (VI.472.12–14 L. = 126,5–6 Byl) 192*n*21
1.4 (VI.474 L. = 126,20–28 Joly-Byl) 87*n*101
1.4 (VI.476 L. = 128,6–7 Joly-Byl) 80*n*55
1.7 (IV.480 L. = 130,18–20 Joly-Byl) 73*n*17
1.7 (VI 480.7–8 L. = 130,18 Byl) 192*n*21
1.8 (VI.482 L. = 132,6–15 Joly-Byl) 77*n*43
1.8 (VI.482 L. = 132,6,9 Joly-Byl) 77*n*43
1.8 (VI.482 L. = 132,9 Joly-Byl) 77*n*43
1.11 (VI.486 L. = 134,21–24 Joly-Byl) 138, 153*n*115

De victu (*Vict.*) (*cont.*)
1.11 (VI.486 L. = 136,2 Joly-Byl) 140*n*61
1.13 138
1.15 (VI.490 L. = 136,28–138,1 Joly-Byl) 140*n*62
1.16 138
1.17 138
1.18 138
1.18 (VI.492 L. = 138,22–24 Joly-Byl) 139*n*57
1.18 (VI.492 L. = 138,25 Joly-Byl) 77*n*43
1.19 138
1.25 (VI.496 L. = 142,6–8 Joly-Byl) 73*n*16
1.28 281*n*18
1.30 (VI 504–506 L. = 146,17–28 Byl) 207*n*73
1.32 295*n*54
1.32 (VI.506 L. = 148,4 Joly-Byl) 83*n*77
1.32 (VI.506 L. = 148.9–10 Joly-Byl) 81*n*67
1.33 295*n*54
1.34 (VI.512.13–19 L. = 150,23–28 Byl) 216
1.35 (VI.512 L. = 150,29–31 Joly-Byl) 73*n*17
1.35 (VI.512–522 L. = 150–156 Joly-Byl) 398
1.35 370, 387, 398, 400, 401
1.35–36 73*n*19, 74*n*20
1.35 (VI.518–520 L. = 154,6–11 Joly-Byl) 370*n*34
1.35 (VI.518 L. = 154,21–156,3 Joly-Byl) 91*n*126
1.36 (VI.522 L. = 156,19–20 Joly-Byl) 74*n*20
1.36 (VI.522–524 L. = 156,19–27 Joly-Byl) 371*n*36
1.36 (VI.522.22–524.3 L. = 156,23–27 Joly-Byl) 379
1.36 (VI.524 L. = 156,28–32 Joly-Byl 58
1.59 (VI.572 L. = 182,15 Jouanna) 342*n*38
1.62 (VI.576 L. = 184,27 Jouanna) 342*n*38
2.37 74*n*28, 283
2.37 (VI.528 L. = 158,3–7 Joly-Byl) 283
2.37 (VI.528 L. = 158,10–16 Joly-Byl) 283
2.37 (VI.528 L. = 158,13–14 Joly-Byl) 292
2.37–38 293*n*52
2.38 229*n*14
2.38 (VI.532 L. = 160,22–26 Joly-Byl) 74*n*26
2.56 (VI.566 L. = 178,16–18 Joly-Byl) 87*n*101
2.60 (VI.572–574 L. = 182,21–26 Joly-Byl) 178*n*46
2.66 370*n*33
3.67–69 370*n*33
3.68 (VI.600 L. = 198,10–11 Joly-Byl) 75*n*34
3.68 (VI.602 L. = 198,29–30 Joly-Byl) 179*n*47
3.68 (VI.604 L. = 200,17–18 Joly-Byl) 179*n*47
3.71 (VI.610 L. = 202,34–204,4 Joly-Byl) 179*n*48
3.73 (VI.612–614 L. = 204,27–206,13 Joly-Byl) 179*n*49
3.75 (VI.616 L. = 206,32–33 Joly-Byl) 179*n*50
3.78 (VI.622 L. = 210,3–4 Joly-Byl) 179*n*51
3.81 (VI.630 L. = 214,4 Joly-Byl) 83*n*77
3.82 (VI.632 L. = 214,26 Joly-Byl) 83*n*77
4.86 (VI.640 L. = 218,8 Joly-Byl) 178*n*46
4.89 (VI.644 L. = 220,20 Joly-Byl) 83*n*77
4.90 (VI.654 L. = 226,14 Joly-Byl) 91*n*126

De victu acutorum (*Acut.*)
A 11 (II.246–248 L. = 40,10–19Joly) 175*n*26
A 28 (II.284 L. = 48,8–10 Joly) 175*n*28
A 29 (II.286 L. = 48,15–16 Joly) 175*n*29
A 30 (II.290 L. = 49,10 Joly) 175*n*31

De victu acutorum (*Acut.*) (*cont.*)
A 42 (II.312–314 L. = 54,2–13 Joly) 175*n*30
A 49 (II.330 L. = 57,16–18 Joly) 175*n*30
B 42 (II.478 L. = 87,21–88,1 Joly) 175*n*29
B 42 (II.478 L. = 87,21–88,8 Joly) 177*n*43
B 43 (II.480 L. = 88,9–20 Joly) 177*n*43
De virginibus (*Virg.*)
1 (VIII.466–468 L. = 181–191 Bourbon) 201
Epidemiae (*Epid.*)
1.18 (II.652.3 L. = 194,21–22 Kühlewein) 382
1.23 279*n*9
1.23 (II.670 L. = 33,5–6 Jouanna) 395
1.26 205*n*68
1.26.2 (II.686.6–7 L. = 203,23–204,1 Kühlewein) 382–3
2.5.1–2 (V.128.3–13 L.) 383*n*23
2.6.1 (V.132.15–21 L.) 383
2.6.17 (V.136,8–9 L.) 210*n*79
3.1.6 (III.52.7–8 L. = 221,1–2 Kühlewein) 382
3.1.11 (III.62.4.5 L. = 222,19 Kühlewein) 383
3.17.2 (III.108.6–112,12 L. = 234,3–235,6 Kühlewein) 382
3.17.11 (III.134.5 L. = 241,8 Kühlewein) 382, 383
3.17.15 (III.142.7 L. = 244,1–2 Kühlewein) 382
5.81–82 (V.250.10–17 L. = 37,7–38,4 Jouanna) 383*n*22
6.4 (V.308.5–6 L. = 84,9–10 Manetti-Roselli) 382
6.4.12 (V.310 L. = 238,6–7 Smith) 177*n*41
6.4.18 (V.312 L. = 238,16 Smith) 177*n*40
6.5.1 (V.314 L. = 254 Smith) 129*n*10, 140, 154*n*117
6.5.5 (V.316.5–6 L. = 108,1–2 Manetti-Roselli) 176*n*38, 382
6.5.15 (V.320 L. = 244,22–23 Smith) 177*n*39, 177*n*41
6.8,7–15 (V.344-17-348.22 L. = Manetti-Roselli 167,1–179,35) 380
7.3.3 (VII.372 L. = 52,9 Jouana/Grmek) 174*n*26
Epistola ad Ptolemaeum regem de hominis fabrica 7*n*37
Epistula ad Ptolemaeum regem 7*n*37
Mochlion (*Mochl.*)
4 (IV.340.15 L.) 57
Praecepta
9 (IX.266 L. = 33,25–29 Heiberg) 357*n*11
Prognosticon (*Progn.*)
20 8*n*42
Prorrheticon (*Prorrh.*)
1.85 (V.532.3 L. = 85,8 Polack) 282
2.4 (IX.14.16–23 L.) 73*n*19
2.12.22 (IX.34.11–13 L.) 73*n*19

Cratinus
Ploutoi 74*n*22
Seriphioi 74*n*22

Democritus
68B (154 DK) 129*n*1

***Derveni papyrus* (*Derv.*)**
Fr. F14 (380 Laks-Most) 133*n*32

Diocles of Carystus
Fr. 45a 202*n*55
Fr. 45a–b 202*n*55
Fr. 47 210*n*78
Fr. 48b–c 202*n*57
Fr. 55b 6*n*30
Fr. 109,23–35 183*n*64
Fr. 171 217*n*94
Fr. 182 174*n*27
Fr. 182,3–8 182*n*60
Fr. 182,11 198*n*45
Fr. 182,47–53 182*n*61
Fr. 182,96–97 183*n*62
Fr. 182,145–148 183*n*63

Diogenes Laertius
Vitae philosophorum (*D.L.*)
9.7.47 133*n*29
3.16 141*n*66
5.26 41
5.2.37 42

Empedocles
A40 (DK 31) 72a10
A72 (DK 31) 86*n*98
A78 (DK 31) 80*n*56
B4 (DK 31) 72*n*10
B8 (DK 31) 72a10
B22 (DK 31) 72*n*9
B84 (DK 31) 111*n*13
B96 (DK 31) 80*n*56, 111*n*13
B98 (DK 31) 80*n*56, 111*n*13
B105 (DK 31) 91*n*123

Epicrates
Fr. 10 33

Euripides
Aiolos
Fr. 21,4 71*n*6
Iphigenia in Aulis (*IA*)
1400 319*n*26
Phaethon
Fr. 779,2 74*n*25

Galen
De alimentorum facultatibus (*Alim. Fac.*)
I.2 (VI.487 K. = 29 Wilkins) 184*n*68
De locis affectis (*Loc. Aff.*)
I.2 (VIII.20–23 K. = 248–253 Gärtner) 185*n*69
De naturalibus facultatibus (*Nat. Fac.*)
7 (II.17–18 K. = 113,15–17 Helmreich) 155*n*123
De placitis Hippocratis et Platonis (*PHP*)
9.8.26 (V.810 K. = 586,22–23 De Lacy) 140*n*63
De sanitate tuenda (*San. tu.*)
IV.4.16–18 (VI.247 K. = 109 Koch) 184*n*68
VI.4.3 (VI.401 K. = 176 Koch) 184*n*68
De symptomatum causis (*Caus. Sympt.*)
I.2.7 (VII.97 K.) 185*n*69
I.7.7 (VII.137 K.) 185*n*69
I.8.2 (VII.140 K.) 185*n*71
I.8.2–3 (VII.141–142 K.) 185*n*71
De Temperamentis (*Temp.*)
I.1 (I.509 K.) 94*n*138
I.3 (I.522–523 K.) 94
I.4 (I.527 K.) 94
I.4 (I.530–532 K.) 94
I.7 (I.554 K.) 94
I.9 (I.565–566 K.) 95
II.3 (I.603 K.) 94
II.4 (I.605 K.) 94*n*139
II.6 (I.624 K.) 95
II.6 (I.628 K.) 95*n*140
III.2 (I.660 K.) 94
III.4 (I.672 K.) 95*n*140
In Hippocratis De Articulis (*Hipp. Art.*)
4.40 (XVIIIA.731.9 K.) 6*n*24
In Hippocratis De natura hominis commentaria (*HNH*)
prooem. (XV.15,4–5 K. = Mewaldt 4.19–5.9) 5*n*25
prooem. (XV.15,9–11 K. = Mewaldt 7.15–8.18) 11*n*54
prooem. (XV.15,26–16,11 K.) 6*n*29
I.1 (XV.25,15–26,2 K.) 53*n*65
In Hippocratis Epidemiarum Liber VI commentaria
XVIIB.283 (259,12–13 K.) 140*n*63
XVIIB.286–287 (261,8–14 K.) 140*n*63
Medical Definitions (*Def. Med.*)
XIX.381–382 K. 185*n*72
Methodus medendi (*Meth. Med.*)
I.2.14–16 (X.14,15–15,17 K.) 10*n*50, 31

Heraclitus
266B (22 DK) 173*n*22

Herodotus
Historiae (*Hist.*)
1.142 323
2.16 315*n*18

Historiae (*Hist.*) (*cont.*)
4.42 315*n*18
9.122 298*n*59
9.12 310*n*10

Hippocrates see *Corpus Hippocraticum*

Homer
Ilias (*Il.*)
XVI.148–151 232*n*23
XX.221–225 232*n*23

Iamblichus
Protrepticus (*Protr.*)
9 (49,3–50,2) 128*n*8
9 (49,3–51,6) 127*n*1
10 (54,22–55,1) 156*n*129

Isocrates
Or. 11 ad Nicoclem
44 41

Lucretius
De Rerum Natura (*Nat. re.*)
1091–1109 154*n*119
1361–1416 154*n*120

Mnesitheus
Fr. 45,14–15 183*n*65

Parmenides
B8 (DK 28) 72*n*10
B16 (DK 28) 71*n*8

Philolaus
B20(DK 44) 205

Plato
Charmides (*Charm.*)
156b3–c5 3*n*14
Crito (*Cri.*)
111e 316*n*20
111e4–5 77*n*39
Epinomis (*Epin.*)
976a1–4 77*n*39
987d 316*n*20
Gorgias (*Gorg.*)
463a3–4 144*n*79
464a3 145*n*82
464c4 145*n*83, 146*n*86
464c5–e2 145*n*84
465a3–6 145*n*81
Leges (*Leg.*)
5, 747d 299*n*64, 311*n*13
5, 747d–e 315
5, 773d1–4 71*n*2
7, 810e10–14 45
10, 889b–d 91*n*128
10, 889b1–d6 128*n*8
10, 889b1–e1 159*n*135
10, 889d 128*n*8
Meno (*Men.*)
97e5–98a8 131*n*19
Phaedo (*Phd.*)
59a1–7 77*n*41
85e3–86c2 77*n*44
91c–94e 77
111b1–6 76*n*37
Phaedrus (*Phdr.*)
269e4 142*n*70
270a1 142*n*71, 143*n*72
270b4–6 143*n*73
270c1–5 5
270c10–d7 144
270d1 143*n*74
270d2 143*n*75
271d–e 144*n*77
Philebus (*Phlb.*)
26a6–b1 77*n*39
47c1–d6 77*n*42
47c1–5 78
47c3–d3 79*n*52
47d8–9 78
50c10–e2 77*n*42
50d4–6 78
63c5–7 78
63e9–64a1 79*n*52
64d9–e3 78*n*46
Politicus (*Plt.*)
272a6–b1 77*n*39
Respublica (*Resp.*)
2, 372c3 144*n*80
2, 373a3–4 144*n*80
2, 375e9–376c5 311
3, 405d1–6 63*n*95
4, 435d–436a 17, 309
4, 435e–436a 308
5, 459b–c 311
8, 546a–547 311*n*12

Symposium (*Symp.*)
186b5–6 75
186d5–e3 76*n*35
187b4–5 77*n*43
187c4–5 75
188a4–b3 76*n*35
Theaetetus (*Tht.*)
151e 230*n*16
Timaeus (*Ti.*)
24c 316*n*20
24c4–7 76*n*38
24c6 75
37a2–4 78
43c7–e4 78
45d–e 173*n*20
74c5–d4 79*n*52

Pliny
Naturalis historia (*NH*)
VIII.16.44 43
XXVI.6.10 182*n*58

Plutarch
Quaestiones convivales
733c9 6*n*29
De sollertia animalium (*De soll. an.*)
20 = *Mor.* 974A8–11 129*n*11, 153

Praxagoras
Fr. 70/71 59

Pseudo-Plutarch
Placita (*Dox. Gr.* 420,7)
37*n*22

Sappho
Fr. 148,2 71*n*5

Seneca
Epistulae Morales
90.22 155*n*121

Simplicius
In Aristotelis physicorum libri
1.375,1–5 160*n*137

Strabo
XVI 2,24 43*n*35

Tertullian
De anima
43.1–2 173*n*19

Theophrastus
De causis plantarum (*Caus. pl.*)
2.4.12 37*n*22
2.18.1 155*n*124
2.18.2 155*n*126
De lapidibus (*Lapid.*)
60 156*n*127
De sensibus (*Sens.*)
58 72*n*11
39 72*n*11
De sudore (*On swaet*)
36.220 389*n*30
Historia plantarum (*Hist. plant.*)
3.13.1 45

Thucydides
Historiae (*Hist.*)
1.138 140*n*63
2.51.3 75*n*31
8.97.2.6–7 75*n*30

Xenophanes
B5 (DK 21) 71*n*2

Xenophon
Memorabilia
3.9.1 133*n*30
Symposium (*Symp.*)
3.1 71*n*7

Index rerum

Academy, Plato's 1, 10, 33, 34, 35*n*16, 43, 131
action 47, 159, 171, 256, 257, 317, 347, 352, 353, 359, 360, 363, 364, 365, 372, 380, 390, 397, 398
Alcmanes 180
Alcmaeon 2*n*6, 70, 103*n*4, 171
Anonymous, Londynensis 180–181
anger 90, 312*n*14, 342, 358, 364, 365, 375–377, 379, 382–383, 385, 388–390, 396, 400, 401
animals, tame 218, 321
Aristagoras 61
art, see craft
art imitates nature (ἡ τέχνη μιμεῖται τὴν φύσιν) 16, 126, 127, 128, 129, 130, 150, 151, 152, 154, 155, 156, 157, 158, 159, 160, 161
Asia 76*n*38, 85, 241, 296, 298–300, 300*n*66, 308, 313–317, 320, 323
awakening 170, 171, 182, 183, 339, 341

balance 70, 72, 73, 75, 76*n*38, 77, 78, 84, 90, 93, 95, 103*n*5, 104*n*6, 105*n*7, 109, 112–115, 194, 213, 235, 236, 270, 279, 279*n*9, 282, 285, 299, 325*n*37, 338, 338*n*28
barbarians, see non-Greeks
blood 11, 39, 58, 60, 61, 71, 80*n*56, 83*n*78, 88–91, 94, 111*n*13, 115, 169–173, 177, 192, 196, 212–214, 226, 226*n*7, 227*n*11, 234, 236, 250, 257, 258, 262, 295, 307, 339, 340–342, 377, 385, 388, 390*n*33, 396, 401
  blood vessels 11, 12*n*57, 39, 58, 60, 61, 88, 89*n*116, 197, 198, 199, 200, 282
body 2, 3, 5, 9, 11, 59, 71, 71*n*8, 72, 73, 76*n*38, 77, 78, 79, 83, 83*n*77, 84, 84*n*89, 86, 87, 88, 89, 91, 92, 92*n*131, 94, 95, 102, 103, 103*n*5, 104, 104*n*6, 105, 105*n*7, 107, 108, 109, 111, 112, 113, 114, 116, 118, 119, 121, 123, 132, 133, 137, 139, 141, 143, 142*n*71, 144, 145, 146, 151, 153, 156, 157, 172, 173*n*23, 175, 176, 178, 179, 180, 181, 191, 195, 197, 198, 199, 200, 201, 203, 205, 206, 208, 213, 214, 217, 218, 227, 228, 232*n*25, 233, 234, 235, 236, 249, 250, 253, 255, 257, 258, 260, 261, 262, 263, 267, 269*n*37, 272, 273, 279, 279*n*9, 281, 284, 287, 290*n*48, 291*n*49, 311*n*13, 319, 321, 324, 333*n*11, 334, 334*n*13, 335, 336, 337, 338, 339, 340, 348, 353, 354, 355*n*8, 357, 358*n*14, 361, 365, 366, 367, 367*n*27, 368, 369, 376, 377, 378, 380, 381, 382, 386, 388, 389, 390, 392, 395, 397, 398, 399, 400, 401, 403
  bodily parts 92, 94, 101, 103, 116–118, 196, 229, 243, 254
bowels 176, 179, 182, 183, 185, 387, 390, 396, 398
brain 89, 90, 170, 179, 180, 197*n*43, 198, 198*n*46, 340*n*32, 383

catalogues, ancient 26, 52, 53, 132
catalogues, Arabic 51, 52, 53, 54
Caelius Aurelianus 185, 185*n*70
Chamaeleon of Pontus 156
cause 31, 59, 74*n*20, 85, 89, 91, 103, 107, 116, 117, 127, 135, 141, 145, 149*n*100, 151, 152, 154, 157, 158, 162, 169, 171, 172, 175, 176, 180, 185*n*72, 200, 201, 205, 210, 211, 213, 217, 218, 227–229, 231*n*18, 235, 236*n*30, 237, 241, 244, 256, 264, 265, 271, 272, 276, 277*n*5, 282, 284, 287, 290*n*46, 291, 292, 294, 296, 298, 346, 369–371, 375, 379, 382, 385, 386, 387*n*26, 392, 394
Celsus 184
character (moral ch., ch. of human beings) 76*n*38, 85, 89, 90, 95, 241, 277, 297, 298, 298*n*62, 299, 300, 306–325, 341, 358, 378*n*14, 380, 385, 399
classifications 33–35, 115
climate 17, 74, 76, 76*n*38, 79, 84, 85, 85*n*92, 104*n*6, 238, 277, 278, 279*n*9, 282, 287, 288, 289, 291–297, 291*n*48, 300–302, 306–325, 354–387, 402
cognition 2, 71*n*8, 75*n*32, 77*n*40, 208, 215, 378, 388, 395, 403
  embodied cognition 378
cold 4, 59, 73, 73*n*18, 76, 77, 77*n*40, 82–84, 87, 88–90, 90*n*120, 91, 94, 95*n*140, 102, 103, 104*n*6, 105*n*7, 111*n*13, 116, 120, 172*n*18, 198, 198*n*46, 199, 206*n*69, 208*n*77, 211, 212*n*84, 233, 234, 235, 246, 236*n*30, 237, 238, 240, 241, 242, 245, 254, 255, 257, 257*n*21, 260–262, 270,

cold (*cont.*) 270*n*38, 271, 281, 282, 283*n*23, 285, 287, 287*n*35, 287*n*37, 288, 289, 291, 292, 295, 296, 297, 298*n*61, 299, 310, 313, 320, 323, 338, 371, 386, 388–391, 389, 401
complexion 77*n*40, 282, 288, 289
conception 12, 17, 32, 57, 58, 70, 74, 90, 92, 136, 149, 193–196, 205, 214, 223–225, 225*n*5, 226, 227, 227*n*10, 228, 230, 231*n*18, 246, 250, 253, 255, 273, 281, 285, 311*n*12, 333, 340*n*34, 342*n*38, 365, 371
conjectures (ὑποθέσεις) 102
continuum 109, 170, 359, 360, 360*n*15, 362, 386
cooking 101, 106, 107, 109, 110*n*11, 113, 120, 138, 157, 162*n*142
craft (τεχνή), craftsman 2, 3, 16, 101, 103, 104, 106–109, 111, 113, 116–118, 120, 127, 127*n*4, 128, 128*n*8, 129–132, 135–136, 150*n*105, 153*n*11, 153*n*113, 313, 315, 318, 320, 330, 333, 338, 367, 371, 380

deduction 148, 346
deficiency 109, 321, 357, 359–360, 362, 364–366, 368–369, 372
Democritus 27, 37*n*22, 53*n*69, 70, 80, 92, 117, 128, 128*n*8, 129, 129*n*11, 131*n*19, 132*n*29, 150, 153, 154*n*118, 156, 159*n*135, 160, 160*n*138, 218*n*99, 372
diagrams 38, 43, 45, 46
diet, see regimen
differentiation 34, 108, 114, 211, 217, 233–236, 238–239, 241, 245, 281, 319, 384
digestion 16, 157, 169, 171–173, 175–180, 181*n*56, 182–183, 183*n*65, 184, 184*n*66, 185, 271
Diocles 6, 6*n*31, 174, 182–183, 192, 194, 196*n*39, 202*n*57, 204, 217*n*94
Diogenes 1*n*5, 2*n*6, 27, 42, 51–52, 72*n*11, 103, 132, 141, 172, 232
discovery (εὕρησις) 137, 156
disease, sacred 91, 141, 142
disposition 143, 184, 286*n*29, 300, 314, 321, 324, 354–356, 358*n*14
dogs 192, 206*n*70, 216, 239, 311, 361, 366, 368
domesticated animals 192, 206*n*70, 215, 217, 239
drugs 170, 177, 213

education (παιδεία) 1, 1*n*2, 2, 137, 137*n*51, 140*n*63, 147, 148, 203, 347, 365
eggs 141, 191, 192, 193, 210, 228, 229, 230, 231, 261, 268, 269, 273
Egyptian medical papyri 36–37
Egyptians 37, 309–310, 315*n*8
embodiment 378
emotions 18–19, 90, 332, 333, 342, 343, 371, 375–379, 381–387, 387*n*26, 388–399, 401–403
Empedocles 4, 15, 37*n*22, 44, 57–59, 70, 71, 72, 80, 80*n*56, 92*n*133, 100, 102, 103*n*5, 104, 111*n*13, 116, 118, 136, 150, 171, 172, 191, 279, 343
endoxa 12, 130*n*14, 232
environment 71–73, 77, 79, 83, 86, 112, 123, 211, 231, 236, 238*n*34, 234, 249, 253, 254–256, 257*n*21, 262, 267, 270, 276–285, 287, 289, 291, 296, 297, 302, 311, 315, 322, 325, 287
equilibrium, see balance
Europe 76*n*38, 85, 241, 288, 289, 296, 298–300, 298*n*60, 300*n*66, 308, 313–315, 316*n*19, 316*n*21, 317, 323, 323*n*33
Euryphon of Cnidos 180
excellence, see virtue
excess 73, 155, 176, 212, 213, 242–245, 279, 282, 286, 357, 359–362, 364–366, 368–370, 372
exercise 72, 84, 179, 182, 184, 185, 213, 216, 264, 354–357, 363, 367–371
experience (ἐμπειρία) 143–144
experts (τεχνικοί) 143–144, 157, 162
extracts 37–38, 43–46

face 297, 311*n*13, 329, 375, 388, 389, 390*n*33, 403
fertility 76, 85–86, 188*n*3, 194–196, 198–199, 224, 229*n*14, 246
  fertility tests 188*n*3, 196, 199
fluidity 30, 198, 199, 208, 215
foetal development 234
food 13, 59, 72–74, 76*n*38, 83, 85, 86, 88, 104, 107–109, 112, 117, 153, 156, 157, 169–185, 193, 217, 235, 236, 254, 259, 226o, 265*n*33, 267, 268, 271, 280, 283, 284*n*24, 286, 293*n*52, 294, 300*n*67, 301, 311*n*12, 339, 340, 343, 354, 355, 357, 358, 363, 364, 366–371, 380, 382, 393

function 89, 101–103, 111, 113–119, 121, 123, 191, 263, 291*n*49, 332, 335

gestation, gestational period 194, 201, 202, 204, 206, 208, 210, 217, 218
gymnastics 130, 131, 144, 365

harmony 75–78, 91, 92, 270
Harvey 129, 129*n*12
head 11, 13, 34, 37, 46, 58, 89, 90, 170–172, 174*n*25, 179, 180, 181, 181*n*56, 183, 185, 198, 199, 214, 261, 282, 375, 376, 382, 383
health 3, 4, 4*n*18, 4*n*19, 6*n*29, 13–16, 70, 71, 71*n*8, 72–75, 75*n*32, 76, 77, 77*n*40, 79, 83, 83*n*77, 83*n*78, 84, 84*n*85, 88–90, 92, 92*n*131, 100*n*2, 101, 104*n*6, 105*n*7, 107, 108, 110, 111, 114, 115*n*16, 119, 122–124, 136, 141, 144*n*80, 145, 146, 146*n*85, 150, 151, 159, 161, 174, 181, 182, 188, 191, 194–195, 197–199, 203–205, 212, 227*n*12, 236, 240, 240*n*37, 240*n*38, 241, 242*n*42, 250, 252, 253, 263, 264, 264*n*33, 279*n*9, 282, 284, 293*n*52, 297, 307, 324, 333, 338, 338*n*28, 354, 355, 357, 357*n*11, 358, 361, 363*n*20, 367–371, 400
heat 16, 46, 87, 89, 90, 90*n*119, 120, 156, 157, 169, 172, 172*n*18, 176, 178, 179, 205, 208, 208*n*77, 211, 212*n*84, 215, 217, 225, 228, 229, 231, 232, 234–238, 240–242, 249, 250, 253–257, 257*n*18, 260, 263, 270, 271, 279, 279*n*10, 279*n*11, 280*n*14, 281, 282, 283, 285, 287, 289, 290, 291*n*49, 292, 298*n*61, 311*n*13, 340*n*32, 385, 387*n*27, 388, 389, 390, 390*n*33, 396, 397, 398, 400, 401, 403
heart 11, 88–91, 94, 103*n*5, 115, 170, 172*n*18, 198, 226*n*7, 234, 255, 269, 291*n*49, 325, 342, 377, 380, 382, 385, 390, 396, 398
Hippocratic question 5, 8, 10
Hobbes 129, 129*n*12
homonymy principle 118
horse(s) 107, 207, 217, 217*n*95, 218, 224, 231, 232, 239, 243, 280, 311
House of Life 37, 40
human nature 95, 103, 104–106, 112, 115, 123, 136–138, 142, 145, 153, 307, 312, 313, 315, 322, 325, 330, 332, 334, 335, 346*n*44
humoral theory 60
humours 11, 60, 62*n*94, 73, 103*n*5, 111, 112, 115, 121, 123, 279

iatrika 1, 26, 49, 50, 51, 52, 53, 54, 57*n*78, 62
imitation 3, 93, 110, 127, 128*n*8, 129, 137, 138, 139, 142, 148, 152, 153, 154, 156
induction 346
infertility, impotence 194, 197, 198*n*44, 232, 236, 242–245, 288*n*39
inquiry (ζητήσις) 134, 137
intellect 18, 74, 90*n*119, 102, 309, 312–314, 315*n*17, 319–323, 399
intelligence 71, 74*n*20, 76, 77*n*40, 90, 91, 140*n*63, 205, 283, 289, 291*n*49, 295*n*54, 299, 307*n*3, 313, 318*n*24, 340*n*32, 371, 399
intemperance (ἀκρασία) 318, 329, 340, 341, 344
Isocrates 41

labour 13, 42, 176*n*38, 184, 194, 215, 216, 217*n*94, 245, 318, 319, 320
library of Neleus 55
liquids 81, 82, 104, 113, 114, 287*n*37
luck (τύχη) 135–136, 141, 157, 161
Lyceum, Aristotle's 10, 61, 92*n*131, 152

mean 82, 333, 333*n*11, 351–353, 359–372
melancholy, melancholic 329, 330, 343, 382, 383, 387*n*26, 400
memoranda 43
Menedemus 33
menstruation 194, 196*n*41, 197, 201, 204, 206, 208, 213, 216
method 5, 15, 16, 26, 37, 40, 41, 43, 44, 45, 48, 56, 100–103, 105, 107, 108, 110*n*11, 126, 128, 129, 130, 135–138, 140, 142, 142*n*71, 143, 144, 146–148, 153–158, 161–162, 191, 298*n*61, 354, 361, 389
  method of Hippocrates 5, 130, 142, 142*n*71
Methodists 185
Milo the wrestler 363, 368
mixture (μίξις, κρᾶσις) 70, 71–83, 87, 90, 92, 94, 112, 123, 196, 210, 236, 241, 241*n*40, 242, 257, 280*n*17, 313, 320, 323, 341, 399*n*48
mola uteri 201, 208, 208*n*77, 215
motion 112, 148, 149, 171, 185, 226, 231*n*19, 256, 270, 271, 343, 359, 360, 387, 399

nature (φύσις) 3, 3*n*16, 4, 5, 5*n*23, 10, 13, 15–18, 26, 31, 34, 36, 44, 48, 63, 72, 73, 75, 78, 80, 82, 89, 90, 93, 95, 101–106, 110, 112, 115, 115*n*16, 116, 117, 121, 123, 126, 126*n*2, 127, 127*n*4, 127*n*5, 127*n*6, 128, 128*n*8, 129, 130, 133*n*29, 134*n*35, 136–140, 140*n*61, 140*n*63, 141, 142, 142*n*71, 143, 144, 145, 146, 147, 148, 149, 149*n*99, 149*n*100, 150, 150*n*105, 151–153, 153*n*111, 153*n*113, 154, 155, 155*n*121, 155*n*122, 155*n*123, 156, 157, 157*n*132, 158, 159, 159*n*135, 160, 160*n*137, 161, 162, 170, 176, 185, 189, 198, 201, 203, 205, 208, 211, 212, 214, 215, 217, 218, 226, 228, 232, 236, 236*n*30, 236*n*31, 237, 238, 241, 249, 250, 253, 254, 272, 273, 276, 279, 279*n*10, 280, 281, 283, 284, 284*n*24, 285–287, 289, 290, 290*n*42, 292, 295–298, 301, 306–308, 311–313, 315, 316*n*21, 317, 318–320, 322–325, 329–336, 338, 346*n*44, 348, 353, 355*n*8, 357, 357*n*11, 363*n*20, 368, 369, 371, 379, 385, 389, 394, 395, 398, 400–402
natural science 4, 13, 31, 35, 43, 93, 94, 122, 126*n*2, 128–130, 131, 132, 151, 154, 161, 318, 265*n*37, 331, 332, 337, 339, 348
natural history (περὶ φύσεως ἱστορία) 101
non-Greek, barbarians 308, 314*n*15, 319–323, 325
nourishment 79, 85, 87, 88, 94, 103, 104*n*6, 107, 117, 196*n*41, 208, 213, 236, 236*n*30, 244, 256, 257, 264, 265, 267, 270, 280, 281, 354, 401

Oribasius 182, 202*n*57

pain 76–78, 104*n*6, 107, 115, 145, 148, 213, 215, 216, 330, 331, 347, 358, 363–367, 371, 372, 376, 377, 380, 385, 387, 391, 394–397, 400
passions 358, 365, 367, 370–372, 380, 342, 353, 354, 356
patient 106–109, 133, 149*n*101, 177, 197, 366, 367, 369, 370, 379, 382, 383
physician 1–11, 27–28, 31, 35*n*17, 37*n*22, 38, 39, 56, 61, 62, 73*n*18, 75, 100*n*2, 110*n*12, 122, 135, 161, 180, 182, 183, 194, 207, 245, 246, 271, 282, 330, 334–339, 347, 357*n*13, 367, 369, 370, 376, 389, 391
physics (φυσική) 132–134, 151
physiologoi 37*n*22, 382, 330–332, 335–337, 339, 344–347, 385
physiology 8*n*43, 31, 32, 105, 106, 111, 157, 170, 177, 179, 181*n*56, 192, 215, 253, 261, 330, 332–337, 339–348, 378*n*14, 383, 403
pleasure 77, 78, 134, 144*n*80, 145, 193, 195, 196, 199, 200, 223, 226, 281, 324*n*25, 330, 333, 347, 352*n*1, 358, 363–365, 367, 372, 375, 377, 380, 387, 393
pleasure, sexual 193, 226
Pliny the Elder 43, 51*n*56, 182
pneuma 172, 225–228, 231, 246, 286*n*30
political science 143, 144, 315, 330–335, 345–348
Polybus 11, 11*n*52, 11*n*53, 12*n*57, 37, 37*n*22, 39, 41, 61, 62, 62*n*94, 232
posture, upright 189*n*5, 206, 268, 319, 321
powers 101, 103, 105, 107, 111–113, 116, 119–121, 123, 176, 193, 232*n*23
pregnancy 194, 200, 201, 204–205, 213–216, 223–225, 227–229, 231–233, 243–246, 258
principles, first 3, 108, 123, 130*n*16, 131*n*19, 147, 157
proportion 76, 78, 80–84, 87, 89, 90, 92, 94, 111*n*13, 120, 171, 179, 196, 210, 236, 260, 264, 323, 356*n*8, 357, 363, 364, 368–371, 399
psychology 334, 335, 340, 343, 375*n*2, 382, 384
Ptolemy el-Gharib 27, 52*n*62, 55
public demonstration 35

regimen 72*n*8, 73, 84, 106, 107, 146, 182, 216, 282, 284, 357*n*11, 364, 366, 370, 372
rhetoric 43, 127*n*4, 130, 142, 143, 144, 146*n*85, 147, 147*n*92, 148, 162, 251*n*5
routine (τριβή) 143–146, 148

science 4, 13, 16, 18, 31, 32, 34, 35, 41, 43, 75, 93, 94, 104, 109, 122, 123, 126, 126*n*2, 127*n*4, 128, 129, 130, 130*n*16, 130*n*18, 131, 131*n*19, 132, 133*n*32, 134, 134*n*35, 137*n*51, 143, 144, 146, 148, 150, 151, 152, 154, 157, 158, 161, 162, 189, 192, 193*n*25, 204, 240, 249, 284, 315, 318, 325*n*37, 330, 331, 332, 332*n*8, 333, 334, 335, 337, 339, 340*n*34, 345, 346, 347, 348, 351, 352, 359, 360, 361, 362, 364, 365, 370

Scythians 237, 242, 243, 245, 288, 289, 291, 292, 296, 298, 309–310
Season(s) 74, 76, 77*n*40, 99, 84, 133, 176, 203, 205, 206, 217, 238, 240, 241, 245, 255, 270, 279, 280, 288, 289, 293*n*52, 294, 296–298, 311, 316*n*20, 317, 323, 354, 355, 358*n*13, 368–370
sedentary lifestyle 215, 216, 217, 218, 243, 244, 245
seed 91, 154, 155, 192, 195*n*38, 200, 208, 212, 214, 225, 226, 228, 235*n*25, 233–235, 243, 250, 253, 254, 256, 262, 263, 265–267, 272, 296, 323*n*33, 324, 402
seven, the number 205
sex difference 16, 189, 189*n*4, 195, 212, 235, 236
shivering 382, 389, 402
slavery, natural 307–308, 315–318, 320–322
sleep 4*n*19, 169–186, 228*n*13, 335, 335*n*15, 339, 340, 340*n*32, 342, 343, 380, 382, 384
Solon 203, 205, 316*n*20
soul 3, 71, 73, 76*n*38, 77–79, 90–93, 95, 113, 143, 147*n*89, 169, 170, 172, 178*n*46, 205, 225, 249, 253, 257, 261, 263, 272, 291*n*48, 309–314, 317–319, 321, 322, 324, 329, 334, 335, 336, 338, 339, 348, 352, 353, 354, 356, 358, 361, 367, 370–372, 377, 379, 380, 385, 386, 398, 399, 400
  bipartition of soul 312, 314
  tripartition of soul 309, 312*n*14
Speusippus 33
spirit (θυμός), spiritedness (τὸ θυμοειδές) 212, 289, 290, 298, 298*n*62, 300*n*65, 309, 312–314, 322, 323, 342, 388, 396, 398, 401, 402
stoics 31, 94, 129, 172
structures 15, 93, 101, 111–116, 119, 121, 210, 278, 353
superfetation 194, 201, 207, 208, 218*n*98
syllogism 147*n*92, 340, 344, 346, 352, 355, 359, 361
Syennesis 37, 198*n*45, 232
sweat 175–176, 375, 380–381, 388–390, 390*n*33, 403

tablet 29, 36, 40, 380
teleology 13, 101, 126*n*1, 127, 127*n*6, 129, 130, 152, 158*n*33, 277*n*3, 284*n*24, 290, 290*n*42, 292*n*51, 316, 317, 317*n*23
Tertullian 172
textual unit 11*n*54, 36, 37*n*24, 38, 39, 40, 41, 52, 57, 61
Timotheus of Metapontum 181
tremor 387, 392
twins 192, 207

uterus 192, 193, 195, 196, 197, 201*n*50, 207, 211, 214, 217, 223, 225, 226, 227, 227*n*11, 228, 228*n*25, 233, 243, 246, 262

vice 45, 329, 332, 334, 347*n*46, 354, 358, 363, 365, 371, 396
virtue (ἀρετή) 45, 71, 86, 117, 132, 135, 150, 161, 265, 266, 267*n*35, 291, 299, 312, 318, 323*n*33, 324, 323, 333, 347, 351, 353–367, 370–372
Vita Menagiana 27, 52*n*62, 52*n*63

weather 59, 74, 79, 238, 255, 270, 279*n*9, 282, 289, 293*n*52, 297, 298*n*60
wind-eggs 228–231
winds 46, 104*n*6, 223–246, 277, 281, 282, 283, 292, 302, 307, 311*n*13, 312*n*13, 317, 334, 336, 355*n*8, 368
women 59, 84, 87, 133, 188, 189, 191, 192*n*23, 193–218, 223–246, 256, 308*n*8, 320, 321

zoika 26, 49, 50, 51, 51*n*56, 53, 54

ARISTOTLE READS HIPPOCRATES

Edited by Hynek Bartoš and Vojtěch Linka

Despite Aristotle's family background and his undeniable impact on ancient Greek medicine, the influence of medicine on Aristotle's philosophy is controversial and far from universally acknowledged. The aim of this volume is to re-examine the influence of medical knowledge and literature on Aristotle's work, in particular to explore the connections with the Hippocratic writings. The volume encourages further exploration of this interdisciplinary area and offers new insights by presenting a series of case studies that examine in detail specific debates within the Aristotelian corpus in relation to the medical literature.

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