Introduction

1 Aristotle and Theophrastus on Animals and Plants

Two separate corpora of writings have come down to us: one by Aristotle on animals and another by Theophrastus on plants. They are two parts of a single project. This project amounted to a systematic and theoretically motivated study of living beings as encountered here on earth. My ambition in this book is to reconstruct the main lines of this project.

The title *The Architecture of the Science of Living Beings* conveys the message that I am primarily concerned with the scope, organization, and deep structure of the Peripatetic study of animals and plants. Ancient authors are rarely self-reflective in their extant works. Aristotle and Theophrastus are no exception to the rule. When it comes to their intentions and plans, the best course of action is to focus on programmatic or transitional passages where they tell us what they are hoping to achieve. Most of the relevant passages are found at the beginning of their writings. There Aristotle and Theophrastus do not simply announce the subject (or subjects) they plan to treat; they also provide us with a first orientation and a rough idea of what lies ahead. I will engage in a close reading of a few of these passages and reflect on the implications they have for how we should understand what Aristotle and Theophrastus are doing (or trying to do). Here I recall the opening lines of Aristotle's *De anima*, the transitional statement at the beginning of the essay *De sensu*, where Aristotle introduces and motivates what he is doing in the essays collectively known as *Parva naturalia*, the outline of the research in natural philosophy offered at the start of his *Meteorology*, and the beginning of *History of Plants*, where Theophrastus negotiates the transition from the study of animals to the study of plants. My working assumption is that all these texts (and a few others) are not only authentic but also carefully written and contain crucial information on the deep structure of the Peripatetic science of living beings.

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Since I make a great deal out of the above passages, one may legitimately wonder: what if they are not as carefully crafted as the author of this book claims they are? Is there always an intentional choice of words on the part of Aristotle and Theophrastus? And if so, how could we know? These are legitimate questions. Unfortunately, we do not have an independent way to answer them. We only have the above passages, so we have no choice but to take them as seriously as possible. The only way to vindicate my working assumption is by means of the outcomes it generates. If by taking seriously a programmatic or transitional passage I can make good sense of a large stretch of text, or I can cast new light on certain decisions taken by Aristotle and Theophrastus, then my working hypothesis is fully justified. I will assume that Aristotle and Theophrastus have full control over the way in which they create, organize, and present their arguments and, until the contrary is proven, everything in the passages discussed in this book is intentional and meaningful.[1] But this, I hasten to add, does not rule out other possible approaches to the same texts. Furthermore, no single text, however important, either on its own or in conjunction with others, can solve all the problems presented by works as difficult and complex as those written by Aristotle and Theophrastus. No single reading can do justice to the complexity of those works and all the interpretive challenges they pose.

The overall strategy I adopt in this book is in line with one recommended by Andrew Cunningham for a truly historical study of the intentional activity we call "science."[2] Instead of uncritically applying today concepts to the study of the past, as if they were universally accepted and fully understood, we should try to find out what our predecessors were doing by taking seriously their own description (or descriptions) of their activity. This is the only way to reconstruct what that activity meant to them. Cunningham's immediate critical targets were two: the very idea of science as a universal and transcultural knowledge-producing activity and what he perceived as our uncritical application of contemporary scientific concepts to the study of the past. To be as clear as possible: I am not advocating a purely historical approach to ancient science and ancient philosophy. I believe that ancient thinkers have something interesting to say to us today even if they do not necessarily share our philosophical agenda. But I also believe that we need to learn their lingo if we want to engage in a constructive dialogue with them. I do not mean to suggest that

[1] Helpful thoughts on this version of the principle of charity can be found in VAN DER EIJK 2017: 182–186.

[2] CUNNINGHAM 1988: 365–389.

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we should all learn ancient Greek or Latin. Reading ancient texts in their original languages is surely important, but it does not guarantee by itself that we are not going to fall into the trap of historical anachronism. To avoid this trap, we need to take the conceptual tools developed by our predecessors seriously. Not only the presence but also the absence of a certain concept (or set of concepts) may have philosophical consequences. In due course I will return to the topic of historical anachronism, with a focus on our less than ideal (and mostly unreflective) use of the term "biology" in connection with the Peripatetic study of perishable living beings. There is no equivalent to this term in Aristotle and Theophrastus. I will argue that this absence tells us something important about their approach to the topic of life.

For the time being, however, I would like to concentrate on the most obvious feature of the Peripatetic study of living beings: *Aristotle and Theophrastus were engaged in the study of life via separate studies of animals and plants*. But this does not mean that they implemented a rigid division of labor – namely, that Aristotle wrote on animals and Theophrastus on plants.[3] Both philosophers appear to have been engaged in the study of both animals and plants. We are better informed about Theophrastus and his contribution to the study of animals (I refer the reader to Appendix II). The extant evidence that Aristotle wrote on plants is not as good. Leaving aside a few references to a study of plants in the Aristotelian corpus that are impersonal and mostly looking ahead to a study to come (I review them in Appendix I), we have a reference to a work on plants in two books listed in the three ancient catalogues of Aristotle's writings. The catalogues attached to the life of Aristotle by Diogenes Laertius and to the so-called *Vita Hesychii* go back to a lost Hellenistic catalogue,[4] whereas the

[3] The tradition that reads into the two corpora of writings a division of labor between Aristotle (animals) and Theophrastus (plants) is old. It goes back at least to the first century BC. It is already found in Cicero:

> Aristotle discussed the birth, mode of life, and form of all animals, and Theophrastus the nature of plants and the causes and principle of almost all things born from earth. From this knowledge the investigation of the most obscure is made clear. (*De fin.* V 10 = FHS&G 385)

The source of Cicero is Antiochus of Ascalon, who was a major player in the revival of interest in Aristotle and Theophrastus in the first century BC. On Antiochus and his interest in the Peripatetic philosophy of nature, see TSOUNI 2019: 183–201. There is no compelling reason to think that this idea originated with Antiochus. Probably, Antiochus relied on an earlier (late Hellenistic) tradition. Unfortunately, we are in complete darkness as to his possible source (or sources) of information.

[4] The ultimate source of this catalogue is disputed. For Paul Moraux (MORAUX 1951: 237–247), the catalogue goes back to the early Peripatos (Ariston of Ceos). Compare DÜRING 1956: 11–27, who attributes the catalogue to Hermippus of Smyrna, active in Alexandria in the second half of the third century BC.

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information preserved in the Arabic tradition derives from a post-Hellenistic source.[5] This work on plants by Aristotle may have circulated until at least the end of the second century AD.[6] The relationship between this now lost work and the extant work known as [Aristotle]'s *On Plants* (*De plantis*) remains, to say the least, elusive. The reader will find an introduction to the historical significance of the latter text in Appendix III. In addition to the title of a lost work by Aristotle on plants, we have a few indirect testimonies transmitted by later authors. None of them amount to conclusive evidence.[7] Given how frustratingly scanty the extant information is, it is quite tempting to suggest that Aristotle did not write on plants but delegated this task to Theophrastus.[8] I refrain from endorsing this suggestion. Even though the extant evidence that Aristotle wrote on plants is not very good, there is no compelling reason to think that Aristotle programmatically limited himself to the study of animals to the exclusion of plants.

We can enlarge the scope of our investigation by considering the extant evidence for other members of the early Peripatos beyond Aristotle and Theophrastus. While Clearchus of Soli and Eudemus of Rhodes concerned

[5] This source is a lost catalogue by Ptolemy al-Gharîb ("the unknown" or "the stranger"). The identity and date of this Ptolemy are disputed. The Greek original of this second catalogue is also lost. Its contents are transmitted by two indirect witnesses (Ibn al Qiftî and Ibn abî Usaibi'a) and two Arabic manuscripts. A critical edition of this important catalogue is now available in Rashed 2021. From the newly translated prologue we learn that Ptolemy's catalogue was written upon the request of an otherwise unknown Gallus, who had an interest in Aristotle but was not able (or willing) to engage in the study of the *pinakes* produced by Andronicus. As a result, Ptolemy produced his own catalogue, which he addressed to Gallus. While shorter, this catalogue need not be an abridgement of the work produced by Andronicus. Marwan Rashed has argued, convincingly, that Ptolemy did not follow Andronicus and his *pinakes*. Rather, Andronicus relied on a previous (Hellenistic) tradition, which may be identical with the *pinakes* produced by Hermippus of Smyrna (third century BC) (Rashed 2021: xx–xxviii combined with ccxcviii–cccii). This conclusion has an important (although largely negative) consequence for us: we cannot (and, indeed, should not) use Ptolemy's catalogue to try to shed light on what Andronicus may have accomplished in his *pinakes*.

[6] Alexander of Aphrodisias does not appear to have access to it: "There exists an inquiry on plants written by Theophrastus. *Aristotle's does not survive*" (*In Sens.* 87.10–11). But Marwan Rashed finds a reference to this work in Galen's Περὶ ἀλυπίας (*De indolentia*). See Rashed 2011: 55–77.

[7] For instance, Athenaeus of Naucratis (active in the late second and early third century AD) refers to a work by Aristotle on plants (*apud* Athenaeus, *Deipn.* XIV 652 A). But Athenaeus does not appear to have access to this work; in all probability, he found this information in a Hellenistic source that remains unknown to us.

[8] Senn 1930: 113–140 comes to this conclusion after reviewing the cross-references to a study of plants in Aristotle's extant writings. Compare Regenbogen 1937: 469–475, who shows that at least a couple of the passages examined by Senn (*GA* I 1, 715a16–716a1 and *HA* I 5, 539a15–24) cannot contain a reference to the extant works on plants by Theophrastus. More on this scholarly dispute in Appendix I.

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themselves with animals,[9] Phanias of Eresus wrote on plants.[10] A study of the testimonies for Clearchus and Eudemus on animals and Phanias on plants goes beyond the scope of this book. What matters here is that this supplementary evidence, regardless of how meager it is, confirms that the study of living beings in the early Peripatos was approached via separate studies of animals and plants.

What we know about the ancient Greek study of living beings before Aristotle and Theophrastus suggests that *the Peripatetic approach to the phenomenon of life was far from obvious, let alone uncontroversial*. In fact, it was an important innovation. This innovation has been so successful that it may look to us like an entirely unproblematic starting point for a study of life. But it isn't (and it wasn't). As a result, it is simply impossible for me to start this book *in medias res* by stating that the Peripatetic study of living beings is divided into a study of animals and plants. Instead, I must recall the discourse on and around life before Aristotle and Theophrastus.[11] I do this in the first part of Chapter 1, where I concentrate on the ambiguity between ζῷα/animals and ζῷα/living beings. This is not an ambiguity that is native to the Greek language. Rather, it is an ambiguity created by the superposition of the Peripatetic theory onto a prior usage that is innocent with respect to that theory. While a few of Aristotle's predecessors operated on the assumption that they were concerned with ζῷα/living beings, Aristotle and Theophrastus approached the study of perishable living beings starting from the distinction between ζῷα/animals and φυτά/plants.[12] This distinction is presupposed by Aristotle and Theophrastus when they engage in their study of living beings. When considered in its

[9] We have eight testimonies for Eudemus: One comes from Apuleius (second century AD) and seven from Aelian (end of the second and beginning of the third century AD). They are collected in Wehrli 1969[2] (fragments 125–132). A good discussion of these fragments is offered in White 2002: 207–241. The extant evidence (mostly from Athenaeus) that Clearchus concerned himself with aquatic animals is now edited and translated in Dorandi-White 2022: 227–234. For a discussion of how this evidence may fit into the Peripatetic study of animals, see Hellmann 2022: 553–579.

[10] We have a dozen testimonies for Phanias. They can be found in Hellmann-Mirhady 2015 (fragments 42–55). Phanias wrote a work on plants consisting of at least seven books. In a couple of cases (fragments 43 and 50), what he contributed to the study of plants is recalled next to what Theophrastus said. Clearly, our ancient sources (or their sources of information) could still distinguish between Phanias's and Theophrastus's contributions on the topic of plants. For Phanias on plants, see Zucker 2015: 377–405.

[11] A more extensive attempt to reconstruct this discourse can be found in Meyer 2015: 24–245.

[12] A similar point can be made in connection with δένδρα, which is ambiguous between "plants" and "trees." This word is used by Theophrastus to refer to a specific group of plants that play an important explanatory role in his theory. But δένδρα need not be understood in this narrow way, and trees need not enjoy a special status within the study of plants. In fact, the early use of the term is innocent with respect to the explanatory concerns motivating Theophrastus. More on this in Chapters 1 and 5.

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historical context, their choice to approach this study by assuming the distinction between animals and plants takes the contours of a momentous decision.

2 Outline of the Book and Main Argument

There are at least two questions that are prompted by the idiosyncratic approach to the phenomenon of life sketched so far. The first and more pressing is what licenses this approach. In the second part of Chapter 1, I look at the foundational role that Aristotle's research into the soul plays for the Peripatetic study of animals and plants. Aristotle opens this research by saying that the soul is a principle of living beings. Here "principle" means explanatory starting point. According to Aristotle, there is no more basic feature (or set of features) from which to engage in a scientifically sound investigation of living beings than the soul. Among other things, the investigation into the soul provides Aristotle with the conceptual resources to isolate perishable from imperishable living beings and to approach the study of the former via separate studies of animals and plants. In this sense, Aristotle's research into the soul is the first, indispensable step toward a theoretically informed study of perishable living beings. When approached in this way, Aristotle's *De anima* turns out to be a treatise devoted to finding out the first principle (or principles) to be employed in the study of perishable living beings, whereas the writings on animals and plants are concerned with the application of that principle (or principles) to the explanation of the relevant phenomena.

The second question is whether separate studies of animals and plants exhaust the Peripatetic study of perishable living beings. I do not have in mind the inevitable difficulties that Aristotle and Theophrastus face when they deal with the boundaries between animals and plants and are concerned with those intermediate creatures that resist a clear-cut division into animals and plants. Important as they are, those difficulties do not undermine the approach to the study of perishable life outlined here. The question that interests me is whether this approach allows for a study of what animals and plants have in common *qua* perishable living beings. In Chapter 2, I argue that this question should be answered in the affirmative. In the Peripatetic science of perishable living beings there is room, at least in principle, for such a study. This is an important result, and one that is far from obvious given how Aristotle and Theophrastus conceive of perishable life. I argue that the conceptual space for a study of animals and plants *qua* perishable living beings is to be found in the short essays that are

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collectively known as *Parva naturalia*. These essays are to be read right after the research into the soul. In this sense, they presuppose the main results reached in Aristotle's *De anima*. But they are not simply a sequel to the research conducted in this work. This becomes fully apparent as soon as we reflect on what we are told in the opening statement of his *De sensu*, where a shift in focus is announced from the study of the soul to the study of "animals and everything that has life." With this choice of words Aristotle is creating the conceptual space for research that goes beyond animals and is not just concerned with plants.

A third question looms large at this point: *how far is Aristotle able to carry forward a common study of animals and plants* qua *perishable living beings?* I address it in the second part of Chapter 2. I do so by engaging in an in-depth study of the last two instalments of the project of the *Parva naturalia*. The first is Aristotle's explanation of longevity. This explanation is offered in the essay transmitted to us with the title *On Length and Shortness of Life*. In this short but remarkable text, Aristotle shows that there are scientific questions that ought to be answered in common for both animals and plants. The second is the treatise known as *On Youth and Old Age, Life and Death, Respiration*. Here Aristotle advances his own account of why every perishable living being, whether animal or plant, goes by nature through a cycle of growth, activity in its prime, decline, and eventually death.

By the end of Chapter 2 the reader should be able to appreciate that the Peripatetic study of perishable living beings consists of at least three distinct but related components: a study of what is common to animals and plants followed by separate studies of animals and plants. The ultimate motivation for such a complex architecture is to be found in the theory of scientific demonstration advanced in the *Posterior Analytics*, where Aristotle recommends that we look for explanations that are as general as possible while at the same time remaining sufficiently specific to capture salient aspects of the phenomenon under discussion. At the same time, the reader should not remain blind to the fact that what Aristotle is able to say in common for both animals and plants, important as it is, is truly limited. This conclusion is neither surprising nor controversial given that the short essays transmitted as part of Aristotle's *Parva naturalia* are concerned for the most part with sense-perception and its manifestations (e.g., in sleep and dreams). However, the theoretical implications of this largely negative result have not been fully appreciated. On the one hand, Aristotle provides himself with the conceptual resources to speak of animals and plants *qua* perishable living beings. On the other, he has very little to say on this front.

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This creates an obvious tension to which I return in Chapter 6. It is only at that point that I directly confront the question whether, and eventually how, Aristotle and Theophrastus bridged the gap that they created for themselves within their study of perishable living beings. Clarity on this point is especially important for the claim implied by the title I have chosen for this book. By my lights, there was a science of perishable living beings in the early Peripatos, even though this science was pursued via separate studies of animals and plants.

Chapters 3, 4, and 5 jointly offer an outline of the main contents of the Peripatetic science of perishable living beings. They do so by looking at how Aristotle and Theophrastus proceed in their extant works devoted to the study of animals and plants. I have chosen my words carefully. I speak of an outline because it is simply impossible to do full justice to the richness and complexity of the Peripatetic science of perishable living beings in just three chapters. And yet, an important asymmetry must be highlighted right away: while Aristotle's works on animals have generated an enormous scholarly output, Theophrastus's writings on plants have drawn limited attention. On the one hand, even the expert reader is overwhelmed by how much has been written on and around Aristotle's study of animals. On the other, one is disappointed by how little ink has been spilled on Theophrastus and his study of plants.[13] While I can safely take for granted deep familiarity with Aristotle, I find myself compelled to introduce the reader to Theophrastus, since this reader may not be familiar with the contents of his two major contributions to natural philosophy: *History of Plants* and *Causes of Plants*. So, in the three subsequent chapters, I offer an overview of the main structure and organization of Aristotle's study of animals followed by a highly selective exploration of especially significant aspects of what Theophrastus says on the topic of plants.

Chapter 3 discusses the most significant explanatory strategies Aristotle adopts in his study of animals. These strategies appear to be already at work at the stage of the collection and presentation of the relevant data. They are subsequently implemented at the stage of the explanation of those data. In due course, I show that these strategies are also at work in Theophrastus, so it is important to be as clear as possible about them at the outset to

[13] This study is, of course, not *terra incognita*. In addition to the reliable editions of the Greek text produced by Suzanne Amigues (see the References for the relevant bibliographical information), I would like to single out at least two other works: Wöhrle 1985 is a perceptive study of the rules of scientific inquiry adopted by Theophrastus in his study of plants; Sharples 1995 is an incredibly rich source of information organized around the extant testimonies for Theophrastus on animals and plants collected in FHS&G.

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appreciate how they are adopted, and indeed adapted to his specific subject, by Theophrastus.

Chapter 4 introduces the reader to how Theophrastus approaches the topic of plants by offering a selective discussion of the first book of his *History of Plants*. The first part of this book is a prolegomenon to the study of plants. It is also a liminal space where Theophrastus negotiates the transition from the study of animals to the study of plants. It does not take long to see that this transition is especially important for the purposes of my book since a great deal depends on the level of unity and cohesiveness Aristotle and Theophrastus are able to find in their separate studies of animals and plants. When Theophrastus refers to the study of animals, he takes it for granted that his reader is familiar with the main results achieved in the study of animals. In other words, he is building his study of plants on the study of animals. But he is doing so without ascribing the study of animals to Aristotle or claiming ownership of the study of plants. The impression is that he is contributing to a shared project that is to be approached in the following order: *first animals, then plants*. Toward the end of the chapter I address a delicate question: *is Theophrastus working within the theoretical framework provided by Aristotle's* De anima*?* This is emphatically not an easy question to answer. On the one hand, Theophrastus shows a great deal of independence in his investigation of the complex and wonderful world of plants, so we cannot assume that the results reached by Aristotle are binding for him. On the other hand, he takes plants and animals to be not only different kinds of perishable living beings but also separate objects of study. By so doing, he implicitly accepts one of the main results achieved by Aristotle in his research into the soul. Upon reflection, I conclude that the research into the soul conducted in *De anima* plays a foundational role not only for Aristotle but also for Theophrastus.

My focus in Chapter 5 shifts to the five books of Theophrastus's *Causes of Plants*. I concentrate my attention on the first book since it plays a pivotal role in Theophrastus's exploration of how plants propagate. Right from the start of the book, we are told that we are about to engage in a study of the various modes of plant generation. I speak of modes of generation because plants can reproduce in more than one way. It is enough to think of grafting and budding to realize that the reproductive capacity of plants is simply unmatched in the animal kingdom. By looking at how Theophrastus approaches the topic of plant propagation, we can better appreciate what Aristotle tells us at the outset of his *Generation of Animals*, where he says that plants ought to be investigated separately.[14]

[14] Aristotle, *GA* I 1, 716a1.

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As I concentrate my attention on the deep structure of the *separate but coordinated studies of animals and plants left by Aristotle and Theophrastus*, I also reflect on how far their scientific practice is controlled by the theory of scientific explanation advanced in Aristotle's *Posterior Analytics*. Scholars remain deeply divided on this issue. A few have argued that Aristotle's study of animals is largely informed by the theory of scientific inquiry outlined in the *Posterior Analytics*.[15] Others have resisted this conclusion, insisting that the actual practice in Aristotle's writings on animals does not always conform to the theory.[16] Others still, while not directly challenging the relevance of what Aristotle has accomplished in his *Posterior Analytics*, are not centrally concerned with the question of how far the rules of inquiry outlined in Aristotle's *Posterior Analytics* are implemented in the Peripatetic practice of science.[17]

I do not expect this debate to end any time soon. I contribute to the ongoing discussion by showing that Aristotle and Theophrastus share a set of explanatory concerns, and indeed procedures, suggesting that they interpret their task, broadly speaking, in the same way. A few of those shared concerns and procedures can be traced back to Aristotle's *Posterior Analytics*. For the time being, I recall the obvious articulation of the scientific enterprise into stages, with a focus on the existence of both pre-explanatory and explanatory stages of inquiry, and the epistemic principle that requires the investigator to give explanations at the right level of generality. This principle can be restated by saying that the investigator is expected to produce explanations that apply as broadly as possible while at the same time also grasping salient articulations of the natural world. We can call this approach to explanation "the commensurate universal approach."[18]

[15] The volume jointly edited by Allan Gotthelf and James G. Lennox remains the seminal work exploring how the theory outlined in *Posterior Analytics* is applied to the study of animals (Gotthelf-Lennox 1987). Despite the half-hearted reception of this volume in the second, revised edition of the Clarendon translation of Aristotle's *Posterior Analytics* (Barnes 1994²: xix–xx), the essays collected in this volume have inspired a great deal of scholarly work. Here I recall two collections of essays that carry further that research program beyond the narrow boundaries of Aristotle's study of animals. While the first is a special issue of *Apeiron* edited by James H. Lesher (Lesher 2010), the second is a collection of essays put together by David Ebrey (Ebrey 2015).

[16] Lloyd 1990: 371–401 remains the best introduction to the tensions between the Aristotelian theory and practice of science. This article (reprinted in Lloyd 1996a) is an eloquent defense of the view that in his actual investigation of the natural world Aristotle is not bound by the theoretical pronouncements made in his *Posterior Analytics* or *De anima*. But see also Grene 2000: 444–459, who expresses skepticism as to the applicability of the theory of *Posterior Analytics* to Aristotle's study of animals.

[17] Here I single out King 2001 and Zatta 2022.

[18] The *locus classicus* for a discussion of how this epistemic principle controls the study of animals remains Lennox 1987: 90–119 (reprinted in Lennox 2001a: 7–38).

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Both the insight that the scientific enterprise unfolds in stages and the commensurate universal approach have architectonic implications for the Peripatetic science of living beings. The articulation of the scientific enterprise in stages hardly needs a defense since both Aristotle and Theophrastus have manifestly structured their studies of animals and plants into a pre-explanatory and an explanatory stage of inquiry. However, the implications of the search for the commensurate universal are not immediately obvious. Aristotle often invokes the following rule of inquiry: "*first what is first.*"[19] If what is first is fixed with reference to the rule that mandates us to look for explanations at the right level of generality, one may end up thinking that we should begin our investigation by looking for the most common or most widespread feature (or set of features) that animals and plants share *qua* perishable living beings. More to the point: one may even be tempted to argue that what can be found to be true in common for all animals and plants should serve as a foundation to the whole study of animals and plants.

A concrete example helps here. Consider the theorem that animals and plants *qua* perishable living beings possess innate heat. This theorem is a by-product of the search for the definition of the nutritive power of the soul.[20] It does a great deal of explanatory work for Aristotle. For example, the various modes of animal generation observed in nature crucially depend on the quantity and quality of innate heat present in the animal. According to Aristotle, the hotter and moister the nature of the animal, the more perfect the product of its generation. While live-bearing animals give birth to something that is like themselves, egg-laying animals produce either a perfect or an imperfect egg; finally, there are animals producing something that is even less perfect than an egg, namely a grub.[21] It is also possible to establish a *scala naturae* in which we rank not only animals but also plants based on the relative presence or absence of internal heat.

So why not make this theorem the cornerstone of our whole scientific project? This is a difficult question to answer. At the very least, we can say that this is not how Aristotle proceeds in his extant writings. Instead of starting his investigation from this first universal, and building his entire

[19] Here are a few passages from the zoological corpus where this rule is invoked: *Sens.* 1, 436a6; *PA* I 5, 646a4; *PA* II 10, 655b28–29; *GA* II 4, 737b25–27. But the significance of this formulation goes emphatically beyond the study of perishable living beings: *EE* I 6, 1217a18–21; *Poet.* 1, 1447a12–14.

[20] More on this point in Chapter 6, Section 4.

[21] Two independent introductions to this idea can be found in Leunissen 2017: 58–62 and Cerami 2017: 130–138. Aristotle, *GA* II 1, 733a32–b16 is the key text for this idea.

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edifice on it, Aristotle adopts an alternative strategy captured by the following catchphrase: "*animals first, and the human being first*." Aristotle does not begin his inquiry into perishable living beings from what is common to animals and plants but rather from animals, and within animals from the human animal. A clear formulation of this alternative strategy is found in Aristotle's explanation of why all animals (none excluded) must alternate between periods of sleep and waking. We must assume, Aristotle says, that the causes of this alternation are the same or analogous in the other animals as in blooded animals, and the same in other blooded animals as in the human being.[22] Evidently, when it comes to the study of animals, the human being is the starting point not only for the presentation of the relevant data but also for their explanation.[23]

It is important to stress that a similar strategy is also at work when Aristotle goes beyond the study of animals and is programmatically concerned with what is common to animals and plants. I have already suggested that the short essays known as *Parva naturalia* are not only about animals but also about everything that has a share in perishable life. I now add that even when Aristotle is concerned with everything that has a share in perishable life, animals rather than perishable living beings are his primary focus. Evidently, Aristotle does not take the rule "*first what is first*" to mean that he must begin his investigation by searching for what is common to animals and plants in order to build his account from there. Rather, Aristotle applies another epistemic principle with architectonic implications for how his whole scientific project is structured. According to this alternative principle, Aristotle is required to start his investigation of perishable life from the most organized and most determinate form of life. He is required to take that form of life as his starting point to generate results that can subsequently be extended to what is comparatively less organized and less articulate. At every single stage of his inquiry, he is also required to look for the commensurate universal. The thought behind this strategy is this: distinctions and differences found in the more determinate and more organized form of life (animal life) can also be found in the less determinate and less organized form of life (plant life), albeit with less clarity. In due course I will show that

[22] Aristotle, *Somn.* 2, 455b31–34. The qualification "the same *or analogous*" is important because when one moves beyond the case of blooded animals, one is forced to employ analogy. I will have a great deal more to say on analogy in due course.

[23] For a discussion of the special role that the human being plays in Aristotle's study of animals, see Lloyd 1983: 26–43.

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Theophrastus applies the same epistemic principle in the context of his study of plants.

At least at first sight, then, there appears to be a tension, if not even an outright conflict, between the epistemic principle that requires us to begin our investigation from the most organized and most determinate and the one that mandates starting our inquiry within a given field from the most widespread phenomenon. The most organized and most determinate form of life need not coincide with the most widespread phenomenon. In fact, it only rarely does. Think of the human being in relation to the other animals, and of animals in relation to plants. Aristotle is often blamed for adopting an *anthropocentric* approach to the study of animals and a *zoocentric* approach to the study of perishable living beings. To make a long story short: these two epistemic principles seem to pull the investigator in different directions. They also generate alternative strategies to deal with the phenomenon of perishable life. And yet both appear to have architectonic relevance for Aristotle and Theophrastus. I am concerned with how Aristotle and Theophrastus negotiate the application of both epistemic principles as they investigate animals and plants, with a focus on the role that both principles play in shaping up the Peripatetic study of perishable living beings.

There is another epistemic principle that has architectonic implications for both Aristotle and Theophrastus. This is the principle that requires the investigator to begin the study of perishable living beings from the most familiar form of life. In the case of animals, the most familiar form of life turns out to coincide with the most organized and most determinate one: the human being. When considered from this angle, the principle "*animals first, and the human being first*" can also be regarded as an application of the principle that we should start our investigation from that which is more knowable to us. This puts some additional pressure on us to decide whether the most organized and most determinate form of life is invoked because it is more knowable to us or because it is more knowable by nature (*alias* more knowable per se). In Chapter 3, I argue that the most organized and most determinate form of life, namely the human being, is invoked primarily because it is more knowable by nature. The human being can serve to find out differences and determinations that are present also in the less determinate form of animal life, although they are more difficult to discern in the latter case.

I would like to end this Introduction with a brief note on Theophrastus and his works on plants. The relative lack of scholarly engagement with these works is due not only to their nature (they are perceived as written in

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a dry and technical style with little or no regard for philosophy) but also to a certain idea of Theophrastus. While Aristotle is considered an audacious and ground-breaking philosopher, Theophrastus is often regarded as a thinker of limited or even no depth.[24] On this view, Theophrastus is not an original thinker; rather, he is a loyal collaborator and a continuator of Aristotle's research project. This is a project that Theophrastus would have found already delineated and to which he would have contributed his works on plants as well as a few additional essays on natural philosophy. This view is not only widespread; it is also quite old. It has prompted a distinctive approach to Theophrastus's writings that is best exemplified in the Aldine edition of Aristotle (the *editio princeps* of Aristotle). In this edition, a few works by Theophrastus, including his extant writings on plants and his short work known with the slightly misleading title *Metaphysics*, are printed as a complement to *Aristotle*'s works.[25]

I cannot rule out this scenario. In other words, I cannot exclude that Theophrastus completed an explanatory project left unfinished by Aristotle, who was also the owner of that project. However, I tend to give considerably more credit to Theophrastus – not only as a thinker but also as a scientific writer. I consider his writings on plants a tremendous achievement. More to the point: I consider them an achievement second to none. In my view, they deserve the same level of attention we give to Aristotle's writings on animals. When we look at these writings as contributing to a single project to which Aristotle and Theophrastus contributed, the alternative between original thinker and loyal pupil is far from compelling. Theophrastus worked within a research program that went back to Aristotle; however, he adopted this project not as a pupil following in the footsteps of his master but rather as an intelligent and equal collaborator fully aware of the complexity, and indeed flexibility, of that project.

[24] The perception of Theophrastus as an unoriginal thinker is so ingrained in us that scholars have felt the need to defend the view that Theophrastus is a significant philosopher and even to explain in what sense he is a philosopher. See Sorabji 1998: 203–222 and Sharples 1998: 267–280.

[25] This edition was issued in five folio volumes in Venice between November 1495 and June 1498. Volume 2 contains the following *opuscula* by Theophrastus: *On Fire* (*De igne*), *On Winds* (*De ventis*), and *On Stones* (*De lapidibus*). It also contains the work *On Weather Signs* (*De signis*), which is published *adespotus* (*incerti autoris*). Theophrastus's *History of Plants* (*Historia plantarum*) and his *Causes of Plants* (*De causis plantarum*) are printed in Volume 4. This volume also contains Theophrastus's *Metaphysics*, which is printed after the fourteen books of Aristotle's *Metaphysics*.

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