

## *The Transition from the Study of Animals to the Study of Plants* (History of Plants I)

### 1 Introduction

As we turn to Theophrastus and his study of plants, we must recall that, according to the procedures of inquiry mandated in Aristotle's *Posterior Analytics*, the scientific enterprise proceeds in stages, and the two main stages of any scientific inquiry are the collection and organization of the relevant data followed by their explanation – respectively, the ὅτι and the διότι stages of inquiry. I speak of two main stages of inquiry because the διότι-stage itself may unfold in various stages. In other words, the work that is required to arrive at an adequate (i.e., scientific) explanation may take place in steps and may require accomplishing various tasks. In Chapter 5 I will look at how Theophrastus adopts this style of inquiry in his explanation of the ways (rather than way) in which plants propagate. In this chapter I would like to concentrate on the ὅτι-stage of inquiry, with the caveat that the distinction between a ὅτι- and a διότι-stage of investigation in Aristotle and Theophrastus is not as sharp as we often think it is because the collection of the data is never innocent with respect to their subsequent explanation. Quite the opposite: the selection of the relevant data is always an explanatorily sensitive selection of features that are important to characterize each *explanandum* as the *explanandum* it is.<sup>1</sup> In light of this, the ὅτι-stage is best understood as a *pre-explanatory* rather than a *non-explanatory* stage of inquiry.<sup>2</sup>

The insight that the scientific inquiry unfolds in stages, with an emphasis on the distinction between a pre-explanatory and an explanatory stage of investigation, can hardly be overestimated. It shapes the scientific enterprise as understood by both Aristotle and Theophrastus. And yet this key methodological insight is subordinated to another one, which is even more fundamental for the Peripatetic practice of science: a proper study of

<sup>1</sup> ANGIONI 2019: 144–177.    <sup>2</sup> See Chapter 3, Section 2.

perishable living beings is to be approached through separate studies of animals and plants. It is because of this second insight that the Peripatetic tradition has left us two separate scientific enterprises: a study of animals and a study of plants, both organized into a collection and organization of the relevant data followed by their explanation.

The ὄτι-stage of Theophrastus's research into plants is collected in the nine books of *History of Plants* (*HP*). It is now clear that the actual organization of this work goes back to Andronicus of Rhodes, who reorganized and consolidated a previous edition of *HP* in ten books.<sup>3</sup> Evidence of a *HP* in ten books is found in the Hellenistic catalog preserved by Diogenes Laertius in his *Life of Theophrastus*.<sup>4</sup> The discrepancy between this now lost version in ten books and the extant in nine is not necessarily the result of the loss of a book. It can be explained by invoking the fact that the last book circulated as two separate entities in Hellenistic times.<sup>5</sup>

The διότι-stage of the study of plants is transmitted in the work *On the Causes of Plants* (*CP*). In its present form, this work consists of six books. However, the Hellenistic catalog preserved by Diogenes Laertius mentions a treatise in eight books. This second discrepancy is resolved if we accept the hypothesis that the lost work *On Wine and Olive Oil* mentioned by Diogenes Laertius and the extant essay *On Odors* were respectively the seventh and the eighth book in the Hellenistic edition of *CP* known to the source of Diogenes Laertius.<sup>6</sup> The advantage of this hypothesis is that it gives us a conceptual context for the extant treatise *On Odors*. On this hypothesis, *CP* IV would be a self-contained and relatively independent essay on natural juices and odors.<sup>7</sup> The lost work *On Wine and Olive Oil* and the extant treatise *On Odors* would complement the discussion of natural juices and odors with a discussion of artificially produced juices and

<sup>3</sup> For a review of the evidence for the Hellenistic and post-Hellenistic editorial work on *HP*, see AMIGUES 1998: 191–202 (reprinted in AMIGUES 2002: 45–54). Compare KEANEY 1968: 293–298, which is not superseded.

<sup>4</sup> Diogenes Laertius V 42–50.

<sup>5</sup> A full discussion of the evidence regarding the ancient transmission of the last book of *HP* is available in AMIGUES 2006: vii–xiii, xli–lvii.

<sup>6</sup> This hypothesis was first formulated by G. R. Thompson in an unpublished PhD dissertation from 1941 (THOMPSON 1941: 8–34). It is now defended in WÖHRLE 1998: 3–13. A more nuanced interpretation of the extant evidence is offered in AMIGUES 2017: xiii–xvii. She suggests that the work *On Odors* is a sourcebook for our *CP* VI. In the introduction to her critical edition, Amigues defends the unity and self-sufficiency of our *CP* in six books (with *CP* VI as an integral part of that project).

<sup>7</sup> Tellingly, the title *On Juices and Odors* is registered for this book in the manuscript tradition (MS U, *Vaticanus Urbinas* gr. 61). This conventional title reuses the first words of the book, which is announced as a study of juices and odors with a concentration on their kinds and causes. See Theophrastus, *CP* VI 1.1.

odors. While the lost work would deal with the two most important juices artificially produced by the human being, namely wine and olive oil, the work on odors would be concerned with fragrant preparations like perfumes, ointments, powders, and the like.<sup>8</sup>

The Hellenistic list of writings reported in Diogenes Laertius also registers a work *On Juices* in five books. An educated guess is that this title groups together all the extant and lost essays on plant juices. Recall that the last book of *HP* (our *HP IX*) is concerned with plant juices, and that this book circulated as two separate monographs in the Hellenistic period. If we add these two monographs to the three books on juices known to us, we obtain a work in five volumes. In this scenario, the lost work *On Juices* in five books did not add new materials; rather, it was a Hellenistic edition that collected everything Theophrastus wrote on the topic of juices. At the very least, we can say that the corpus of writings on plants that has partly survived was available in more than one edition in antiquity.<sup>9</sup>

So much for what concerns the transmission of the botanical corpus by Theophrastus. The present chapter is centrally concerned with the ὄτι-stage of his research. I will not consider the full collection of botanical data transmitted in *HP*. I will concentrate my attention on *HP I*. This is not as arbitrary a restriction as it might appear at first sight. *HP I* is a prolegomenon to the whole study of plants. It is also a liminal space where Theophrastus negotiates the transition from the study of animals to the study of plants. A closer look at how Theophrastus introduces and motivates his research into plants will help us advance our research agenda. It is worth recalling that there are two main items on our agenda at this point. First, we want to know why the Peripatetic study of perishable life is approached through separate studies of animals and plants rather than a common study of perishable living beings. Second, we want to understand why the study of perishable living beings begins with the study of animals rather than the study of plants. *HP I* provides circumstantial evidence that helps us make significant progress on both fronts.

<sup>8</sup> An idea of the contents of the lost essay *On Wine and Olive Oil* can be gathered from the few ancient testimonies collected and translated in FHS&G 427–429.

<sup>9</sup> Two more titles concerned with plants are transmitted in the *Life of Theophrastus*: a work *On Fruits* (one book) and a work *On Honey* (one book). This last work was still accessible to Photius (tenth century AD), who has left a summary of its contents (FHS&G 435).

## 2 The Opening Lines of *HP*

Theophrastus introduces his task at the outset of *HP*. He does so without fanfare:

The differences in plants and the rest of their nature are to be understood with respect to their parts and their qualities, as well as their modes of generations and modes of life; for they do not have character traits and activities as *animals* do.<sup>10</sup>

It is striking how little Theophrastus says by way of introduction to motivate the investigation he is about to launch. To be sure, a similar point can be made in connection with Aristotle's *HA*. There too there seems to be hardly any need to motivate the reader to read on. And yet a few things are obvious enough from this passage. To begin with, Theophrastus conceives of his study of plants as a contribution to a research project that is already underway. This research project includes a study of animals as one of its two main components. Moreover, from the way Theophrastus refers to animals, we can safely infer that the study of animals comes before that of plants in the order of inquiry. Finally, Theophrastus appears to be confident that his reader is familiar with the study of animals since he takes the conceptual schema adopted for the collection and organization of animal differences as a starting point that does not require elaboration, let alone justification.

I will elaborate on this conceptual schema momentarily. First, however, I would like to venture a guess as to where the importance of engaging in a systematic study of both animals and plants is defended and motivated. To my mind, the most obvious candidate is the exhortation to the study of animals and plants offered at the end of the first book of Aristotle's *PA*. We have good reasons to consider this exhortation to be a relatively independent and self-sufficient protreptic piece.<sup>11</sup> Aristotle takes it for granted that the natural world is constituted by a celestial and a sublunary part and argues that the study of each of these two parts has its own appeal. Aristotle contrasts the study of the heavenly objects with the study of plants and animals: while there are serious limitations to what can be known by us about the heavenly objects because of their remoteness, we live next to plants and animals, and the wealth of knowledge gained by engaging in

<sup>10</sup> Theophrastus, *HP* I 1.1.

<sup>11</sup> See BALME 1992: 69, 122–123; PELLEGRIN 1995: 25–26; LENNOX 2001b: 172. The view that *PA* I is a protreptic piece is defended in JOHNSON 2021: 12–29.

their close study more than compensates for the fact that they are arguably an inferior object of study:

we are better provided in relation to knowledge about *perishable plants and animals* because we live among them.<sup>12</sup>

Plants are listed before animals in this passage. Is this a problem for my claim that we ought to study *first* animals, *then* plants? I do not think so. We need to remain mindful of the larger context in which this claim is made. Aristotle is not immediately concerned with the structure of his science of nature in this protreptic piece. By contrast, this structure becomes a primary concern when he offers us a conceptual map of how his science of nature is organized at the beginning of his *Meteorology*. Hence, we should not expect Aristotle to employ the same words, let alone employ them in the same order, every time he makes a reference to his larger explanatory aims.

Still, Aristotle has chosen his words carefully. The knowledge of the divine (*sc.* celestial) objects is described as *philosophy* (φιλοσοφία). Although animals and plants are a lesser object of study, they can supply extraordinary pleasures to those who are by nature *philosophers* (φιλοσοφοί). Aristotle's emphasis is placed on "philosophy" and "philosophers." Of course, the philosophy in question is natural philosophy (alias second philosophy). Aristotle has in mind the philosophical knowledge that can be gained from a systematic study of the natural world. Many, if not most, in antiquity may have been tempted to think of the study of plants and animals as an expendable coda to such a project. Aristotle is resisting this thought. His considered view is that the results reached in this study contribute, directly and immediately, to the highest form of knowledge, namely philosophical knowledge. In other words, explanations and theories advanced in the context of the study of animals and plants are regarded by him as an integral part of a single and coherent attempt to arrive at a full account of the natural world. What makes the student of animals and plants a philosopher rather than merely a possessor of expert knowledge is the fact that the relevant knowledge is inscribed within a comprehensive explanation of the natural world.

The theoretical orientation of the Peripatetic study of animals and plants is too often taken for granted. It is worth stressing that a few in antiquity felt that this was a weakness rather than a strength of the Peripatetic project. As a result, they also criticized Aristotle and

<sup>12</sup> Aristotle, *PA I* 5, 644b24–35.

Theophrastus on the basis that their works were of little or no practical use. In Varro's *De re rustica*, for instance, Stolo criticizes Theophrastus because "his books [on plants] are of use not to those who want to cultivate the land but [only] to those who want to spend time in the schools of philosophers."<sup>13</sup>

We cannot be certain that Theophrastus is relying on what Aristotle says in *PA* I 5 at the outset of his study of plants. We can only say that he makes explicit contact with the study of animals. As Allan Gotthelf noted in a seminal paper on the shared explanatory strategies adopted in the early Peripatos,<sup>14</sup> the opening statement of *HP* presents striking similarities, both in language and content, with the following programmatic passage taken from *HA*:

The differences in animals are with respect to their modes of life and their activities and their characters as well as their parts. Let us first speak in outline about them, and then with attention to each kind.<sup>15</sup>

We have seen that *HA* is a pre-explanatory collection of zoological data. In *HA* Aristotle is concerned with finding out and grouping all the ways in which animals differ from one another – namely, all their differences.<sup>16</sup> In the above passage, Aristotle tells us that these differences are organized around the following categories: modes of life, activities, characters, and bodily parts. The relevant activities are those that are constitutive of a given mode of life (βίος).<sup>17</sup> When, therefore, we study the characteristic activities in which an animal is engaged, we study its distinctive way of life (and vice versa). By "character" Aristotle means whether an animal is good-tempered or ferocious, whether it is courageous or timid, and so on. A review of all the ways in which animals differ from one another with respect to their character is advanced in *HA* VIII (IX). The data on their distinctive way of life and characteristic activities are collected in *HA* V–VII (VIII).<sup>18</sup> Finally, the data about their bodily parts are to be found in *HA* I–IV.

<sup>13</sup> Varro, *De re rustica* I 5.2: *libri non tam ideonei iis qui agrum colere volunt quam qui scholas philosophorum* (= FHS&G 387). In this case *philosophi* appears to be used as a disparaging term. On the Roman use of the term *philosophus* to describe a professional philosopher, see HINE 2016: 15–31.

<sup>14</sup> GOTTHELF 1988: 100–133 (reprinted in GOTTHELF 2012a: 390–314). The existence of shared explanatory strategies in Aristotle's study of animals and Theophrastus's study of plants is already discussed in STRÖMBERG 1937: 23–37.

<sup>15</sup> Aristotle, *HA* I 1, 487a11–14. <sup>16</sup> Chapter 3, Section 2.

<sup>17</sup> The conceptual link between *activities* (πράξεις) and *modes of life* (βίοι) is explored in LENNOX 2010a: 239–258 and LENNOX 2010b: 329–355. See Chapter 6, Section 1 for more on the Peripatetic conception of a βίος.

<sup>18</sup> *HA* V–VI are concerned with the activities that can be subsumed under the label "animal reproduction." The activities concerned with character and food are studied in *HA* VII. What the Greek

When we compare the opening lines of *HP* with the programmatic statement found in *HA* I, we immediately see that Theophrastus not only adopts the theoretical framework developed for the collection and organization of the zoological data but also adapts it to what is specific about his subject matter. Theophrastus tells us that we should not expect to find a complete correspondence between animals and plants. For one thing, we have nothing in plants that corresponds to activities and characters in animals. For another, the study of the parts of plants poses special challenges to the investigator. As we will see shortly, these challenges have to do with how we should think about the bodily parts that are regarded as constitutive of a plant. For the time being, I would like to elaborate on the following observation: *Theophrastus builds his whole theoretical edifice on the results achieved in the study of animals*. I have chosen my words carefully. More directly, I refrained from speaking of *Aristotle's* study of animals. Theophrastus never mentions Aristotle by name when he refers to the study of animals, so we should not jump to the conclusion that Theophrastus is referring to Aristotle's *HA*, or think that Theophrastus has our *HA* on his desk when he writes *HP*. Allan Gotthelf may have succumbed to the temptation to see a cross-reference to our *HA* in the opening statement of *HP*. While his original thesis is that there is "theoretical affinity" between the two works, he subsequently claims that "the parallels, in short, are overwhelming, and there cannot be any question but that Theophrastus had *HA* before him as a model for his work so far as his distinct subject matter permitted it."<sup>19</sup> But we can never be certain that Theophrastus is referring to our *HA* even when he is explicitly referring to an *ιστορία* of animals as in *CP* II 17.9. The reason is that all his references to a study of animals are self-consciously impersonal. They never take the form of a reference to any of the works written by Aristotle.

A similar point can be made in connection with the references to plants in the Aristotelian corpus. Let us return, briefly, to the short essay on longevity examined. In Chapter 2 I argued that the few remarks that Aristotle makes on the topic of the relative longevity of animals and plants do not constitute a complete discussion of longevity in plants. Aristotle ends the section on the relative longevity of animals and plants by referring his reader to a separate discussion of longevity in plants.<sup>20</sup> Are we entitled

manuscript traditions transmits as *HA* VII has become *HA* VIII after Gaza's edition and translation of *HA*. For more on this, see footnote 43 in Chapter 1.

<sup>19</sup> GOTTHELF 2012a: 327.

<sup>20</sup> Aristotle, *Long.* 6, 467b5–6: "It will be determined about these things also separately by themselves in the study of plants [περὶ μὲν τούτων καὶ καθ' αὐτὰ ἐν τοῖς περὶ φυτῶν διορισθήσεται]."

to conclude that Aristotle wrote (or planned to write) a work on longevity in plants? Upon reflection, this question can only be answered in the negative. The future tense in this reference need not be an indication that Aristotle took it upon himself to write a separate work on longevity in plants. It can be taken to be a reference to a *research slot in the Peripatetic study of perishable life*. This slot could be filled out either by Aristotle himself or by another researcher. Can this researcher be identified with Theophrastus? I do not think so. No separate essay on longevity in plants has been transmitted to us as part of the Peripatetic study of animals and plants. While Theophrastus deals with the topic of longevity in *HP* IV 13 and *CP* II 11, it is not easy to connect his discussion with what is accomplished by Aristotle. In *HP* IV 13, Theophrastus collects data about wild and domesticated trees and argues (among other things) that wild trees and plants live longer than domesticated ones. In *CP* II 11, he establishes a correlation between being fruitless and being long-lived, and a correlation between bearing many fruits and being short-lived. For Theophrastus, fruiting “takes away a great deal of the nature of the plant, and indeed the most important part” (*CP* II 11.1). He also notes that this is analogous to what happens in animals (*CP* II 11.1 and 4). The link with what Aristotle accomplishes in his discussion of longevity is, to say the least, tenuous.<sup>21</sup>

More instances of the same phenomenon can be found. Perhaps most striking is a passage from Aristotle’s *Sens.* 4 where we are told that what we read there on the topic of flavors has to be supplemented with what we read on the same topic in “*the part of the study of nature concerned with plants*” (τῇ φυσιολογίᾳ ἐν τῇ περὶ τῶν φυτῶν).<sup>22</sup> This is the only occurrence of the term “φυσιολογία” in the Aristotelian corpus.<sup>23</sup> By employing this expression, Aristotle signals that the study of flavors offered in *Sens.* 4 and the study of flavored juices offered in the context of the study of plants must be integrated into a single account. He also indicates that this account contributes to, and is inscribed in, the larger study of nature. Scholars tend to read into this passage a reference to the study of flavored juices and

<sup>21</sup> So I disagree with Luciana Repici when she tries to connect the discussion of longevity by Aristotle with what Theophrastus says on the same topic in *HP* and *CP* (REPICI 2000: 188–192).

<sup>22</sup> Aristotle, *Sens.* 4, 442b24–26. See Appendix II.

<sup>23</sup> This abstract noun is derived from φυσιολόγος. Aristotle uses this second term in connection with the ancient (by his lights, old-fashioned) student of nature. For instance, Aristotle tells us that it is more appropriate to call Empedocles a φυσιολόγος rather than a poet even if the latter writes in hexameters like Homer (*Poet.* 1, 1447b19). The reason is that Empedocles writes about nature in a certain style. This is also the style adopted by Plato in the *Timaeus*, and Aristotle tells us that, in the *Timaeus*, Plato engaged in φυσιολογεῖν about the soul of the cosmos (*DA* I 3, 406b26).

odors offered in the sixth book of Theophrastus's *Causes of Plants* (CP VI).<sup>24</sup> To be sure, CP VI begins with a definition of flavored juices and odors that agrees with what Aristotle says in *Sens.* 4:

*Now, the nature of flavored juices and odors, what each of the two is, was defined elsewhere* [ἡ μὲν οὖν φύσις ποῖα ἐκατέρου τοῦ γένους ἐν ἄλλοις ἀφώρισται], [when it was stated] that both somehow result from compounds of some definite proportions. On the one hand, a flavored juice is a mixture of dry and earthy components in a liquid, or it is produced when heat draws and filters the moist through the dry. Perhaps there is no difference between these two processes. Odor, on the other hand, is produced by the dry component of the liquid flavor in that which is transparent, which is a property of air as well as water. (Thompson's translation, slightly modified)<sup>25</sup>

I highlighted in italics the putative reference to Aristotle. When Theophrastus tells us that he is relying on what is said elsewhere, it becomes almost irresistible for us to see in this passage a reference to the treatment of flavors and odors offered in *Sens.* 4. In this scenario, Aristotle would be referring to Theophrastus in *Sens.* 4, and Theophrastus to Aristotle in his essay *On Juices and Odors* (CP VI 1).<sup>26</sup> If confirmed, these cross-references would be a prime example of the existence of a shared research agenda in the Peripatos. Unfortunately, they cannot be substantiated beyond any reasonable doubt. They cannot precisely because both Aristotle and Theophrastus have chosen to express themselves in an impersonal way.

### 3 How to Build on the Study of Animals

The foregoing reflections on the elusive nature of the cross-references in Aristotle and Theophrastus help us appreciate the limits of any attempt to use them as positive evidence for the existence of a joint effort in the Peripatos to produce separate but coordinated studies of animals and plants. I am nevertheless confident that we can still secure this important result by taking a longer route. This alternative route consists in looking in some detail at how Theophrastus proceeds in his actual study of plants. Let us return to the opening statement of *HP*. What matters is not whether

<sup>24</sup> We have already seen that this book is a self-contained and relatively independent work transmitted under the title *On Juices and Odors*.

<sup>25</sup> Theophrastus, CP VI 1.1.

<sup>26</sup> For example, EINARSON-LINK 1976: 201n3. For more on how Theophrastus opens his account of juices and odors and the possible reference to Aristotle's *Sens.* 4, see THOMPSON 1941: 72–74, 224.

Theophrastus is referring to *HA* (or to any other extant or lost work by Aristotle). What really matters is that *Theophrastus is relying on the study of animals as something that is already in place when he is about to embark on his study of plants*. At the very least, we can say that Theophrastus expects his reader to have already mastered the results reached in the study of animals. This expectation depends on the assumption that the study of animals comes before the study of plants in the order of inquiry. This overall approach to the topic of perishable life confirms what we have seen in previous chapters. *In the early Peripatos, the relevant order of study is first animals, then plants*. In his extant writings on animals, Aristotle generally looks ahead to a study of plants.<sup>27</sup> Once more, this kind of references need not be given a chronological meaning. Even if it is very likely that Theophrastus wrote on plants after Aristotle wrote on animals and wrote his works several years after the death of Aristotle, his references to the study of animals are best understood as evidence that the study of plants follows that of animals in the order of investigation.<sup>28</sup>

The study of plants follows the study of animals in the order of inquiry, so Theophrastus is allowed to start his own investigation from certain results achieved in the study of animals. However, this does not mean that he can mechanically transpose those results. Right from the beginning of his inquiry, Theophrastus is quite forthcoming on the existence of specific or even unique challenges that the study of plants poses to the investigator. It is worth quoting the opening paragraph of *HP I* in full:

The differences in plants and the rest of their nature are to be understood with respect to their parts and their qualities, as well as their modes of generations and modes of life; for they do not have characters and actions as animals do. *While their differences with respect to generation, qualities, and modes of life are more discernible and easier to study, those that have to do with*

<sup>27</sup> See, for example, Aristotle, *PA II* 10, 656a2; *Long.* 6, 467b4; *Juv.* 2, 468b1; *GA I* 1, 716a1; *GA V* 3, 783b20. There are exceptions to the rule. In *GA I* 23, 731a29, Aristotle appears to refer to a study of plants as something that is already in place as he writes on the topic of animal generation. Compare also *HA V* 1, 539a15–20. These passages are collected in Appendix I.

<sup>28</sup> I will not venture into chronological speculations even though the wealth of information reported in *HP IV* (where the focus is on plants indigenous to the various regions of the known world) became available only after the conquest of Alexander the Great in Asia. Alexander himself is evoked several times in this context (see *HP IV* 4.4). This information derives mostly from the literature generated by his military expedition. A well-informed and balanced attempt to evaluate the scanty evidence for the sources as well as the absolute date of *HP* is offered in AMIGUES 1988: xx–xxx. Compare REGENBOGEN 1950: 1455–1466. *HP IV* 8.4 also contains a reference to a historical event that can be dated after the death of Alexander: Antigonos the One-Eyed and his use of the papyrus grown in Syria to make the ropes for his fleet of Phoenician ships (c. 315 BC). The reference is in the past, which suggests that by the time Theophrastus reports this information Antigonos is presumably dead.

*their parts display a great variety. To begin with, this very thing is not sufficiently determined but rather is a source of some difficulty – namely, what are and are not to be called parts* [εἰσι δ' αἱ μὲν κατὰ τὴν γένεσιν καὶ τὰ πάθη καὶ τοὺς βίους εὐθεωρητότεραι καὶ ῥαγούς, αἱ δὲ κατὰ τὰ μέρη πλείους ἔχουσιν ποικιλίας. αὐτὸ γὰρ τοῦτο πρῶτον οὐχ ἱκανῶς ἀφώρισται τὰ ποῖα δεῖ μέρη καὶ μὴ μέρη καλεῖν, ἀλλ' ἔχει τινὰ ἀπορίαν].<sup>29</sup>

I highlighted in italics the section that is immediately relevant to our purposes. Theophrastus thinks that the parts of plants present special challenges to the student of nature. The first and most serious one is that it is not clear what counts as a constitutive part of a plant. Theophrastus elaborates on this front in the stretch of text immediately following the one quoted above. Unlike animals, plants appear to have a variable number of parts to the extent that some of those parts are annual. For example, leaves are annual. Moreover, everything else that has to do with the production of the fruit is annual. Finally, the new growths in the area above the ground as well as around the roots are also to be counted among the parts of a plant. This situation creates the following dilemma. If we take the seasonal parts to be constitutive of the plant, then we must conclude that the latter has a variable, and indeed indeterminate, number of parts. But if we refuse to consider those parts as constitutive of the plant, we end up saying that the parts that contribute most to making the plant what it is at its bloom are not really its parts. Neither option is theoretically attractive.

It does not take long to realize that the dilemma is especially difficult for someone who expects the study of plants to follow the study of animals very closely. We have seen that this is the implicit assumption made at the outset of *HP*. And yet Theophrastus gets out of this difficulty by arguing that we should not look for a complete correspondence between animals and plants after all.<sup>30</sup> His remarks on this front create the theoretical space for an investigation of plants that does not follow what has been achieved in the study of animals in a slavish or unthinking manner. At the same time, Theophrastus tries to bridge this gap as soon as he has created it. He notes that the shedding of annual parts is not unique to plants. He recalls the shedding of horns in deer and the shedding of feathers and hair in birds and four-footed animals that hibernate.<sup>31</sup> He makes a similar point in connection with the bodily parts involved in the reproduction of animals and plants. It is true that in plants the parts that are involved in the

<sup>29</sup> Theophrastus, *HP* I 1.1.      <sup>30</sup> Theophrastus, *HP* I 1.3.

<sup>31</sup> We can expand on Theophrastus's examples by recalling that snakes shed their old skin and insects cast off the outer layer of their bodies.

production of the fruit are annual. But in animals too some parts are separated from the parents when the offspring is born, while others are cleansed away.<sup>32</sup>

The discussion of the perceived similarities between parts in animals and plants may seem at first to blur any sharp distinction between animals and plants. But the point Theophrastus would like to take away from this discussion is that plants and animals are different kinds of perishable living beings, so we should not try to assimilate plants to animals; rather, we should focus on what is specific about each of the two kinds of perishable living beings. Consider the passage that immediately follows in the text and brings the whole discussion to a natural conclusion:

*In general, just as we said, it should not be assumed that there is a complete correspondence with animals* [ὅλως, καθάπερ εἶπομεν, οὐδὲ πάντα ὁμοίως καὶ ἐπὶ τῶν ζώων]. That is why the number of parts is indeterminate: *a plant has the capacity to sprout everywhere because it is alive everywhere* [πανταχῇ γὰρ βλαστικόν, ἅτε καὶ πανταχῇ ζῶν]. As a result, we should assume that things are in this way not only with respect to what is being discussed now but also with a view to what we are going to discuss later. *To try to assimilate what cannot be assimilated is futile in order that we not lose sight of what is the proper object of study* [ὅσα γὰρ μὴ οἶον τε ἀφομοιοῦν, περίεργον τὸ γλίχεσθαι πάντως. ἵνα μὴ καὶ τὴν οἰκείαν ἀποβάλωμεν θεωρίαν].<sup>33</sup>

The final words in this passage are best understood as implying that we should not try to assimilate plants to animals. If we tried to do so, we would end up losing sight of what is specific about plants. This passage is often taken to be evidence that, right from the start of his study of plants, Theophrastus wants to distance himself from Aristotle.<sup>34</sup> But I do not see any compelling reason for thinking that Aristotle is a critical target in this passage, let alone for concluding that Theophrastus is trying to distance himself from what Aristotle has achieved in his study of animals. Firstly, Aristotle is not even mentioned in this stretch of text. Theophrastus refers to the study of animals in a rather impersonal way. He refers to this study as something that can be appropriated and considered scientific background for the investigation he is about to launch. Secondly, and more importantly, this passage implements a key Aristotelian insight Theophrastus endorses and makes his own: scientific progress requires attention to

<sup>32</sup> Theophrastus, *HP* I 1.3.      <sup>33</sup> Theophrastus, *HP* I 1.4.

<sup>34</sup> See AMIGUES 2010a: 61–70 and AMIGUES 2010b: 4n2. But it is important to stress that she is here giving voice to a firmly entrenched view that goes back at least to SENN 1930: 113.

what is specific to the object of study. What Theophrastus tells us can be restated as follows: if we do not pay attention to what is specific to our present subject matter, we are bound to fail as scientists.

What is specific to the subject matter under examination can be traced back to the fact that plants are a distinct form of perishable life. Theophrastus is very clear on this point: when he refers to the fact that a plant has life everywhere, he refers to the fact that there is no single center of life in plants as there is in animals. Evidence that this is the case is the ability of a plant to grow everywhere. This is a view that Aristotle shares with Theophrastus. Let me recall the passage from the essay on the length and shortness of life where Aristotle argues that some plants live longer than all animals because “they have potentially life everywhere” (i.e., “they have potentially a root and a stem everywhere”):

Plants are like insects as we said earlier. The reason is that when they are cut, they continue to live and become two or more than two from one. But insects, although they manage to live, cannot do so for long. The reason is that they do not have organs and the source of life that is present in them cannot produce them [*sc.* the organs]. But the source [of life] present in plants can: the reason is that *plants have potentially a root and a stem everywhere* [πανταχῇ γὰρ ἔχει καὶ ρίζαν καὶ καυλὸν δυνάμει]. So it is from this source that the new and the old [in the plant] grow, with the new parts cut from the plant having little difference in terms of longevity. Indeed one might say that in a way the same happens in the case of propagation by slip, since the shoot cut off is a part [of the plant]. Thus, in the case of propagation by a slip this happens because the slip is separated from the plant, whereas in the other case [this happens] in virtue of its continuity. The reason is that *the source [of life] is everywhere, being present potentially* [ἐνυπάρχει πάντῃ ἢ ἀρχὴ δυνάμει ἐνοῦσα].<sup>35</sup>

At this point, we have reached the most obvious strength of the Peripatetic approach to study of perishable life. We can restate this strength in the following terms: as soon as we realize that there is no single thing called perishable life, but rather there are different forms (or levels) of perishable life, we have no option but to engage in the study of the various forms (or levels) of perishable life without overlooking what is specific to, or even unique about, each of them. In other words, our prospects of making progress in the study of animals and plants depends, crucially, on our ability to develop an appropriate strategy to approach what is specific, or even unique, about each of them. It is very telling that Theophrastus

<sup>35</sup> Aristotle, *Long.* 6, 467a18–30. See the full discussion in Chapter 2, Section 3.

reminds us of this important insight right at the start of *HP*. We have now to see how Theophrastus remains true to this insight in dealing with the question that is at the heart of his whole discussion in *HP* 1 – namely, how to study the parts of plants.

#### 4 How to Study the Parts of Plants

In the opening statement of *HP* Theophrastus tells us that he is interested in collecting and presenting all the relevant differences (διαφοραί).<sup>36</sup> We have already seen that διαφορά is a technical term in the early Peripatos. It refers to any way in which *X* may differ from *Y*.<sup>37</sup> Plants may differ from one another because of the presence or absence of certain bodily parts. When the same parts are present, those parts may still differ with respect to their appearance, size, or arrangement. For instance, plants may or may not have leaves and fruit. But when they have leaves or fruit, the latter may differ in shape, color, and texture. Differences in juices are also relevant. Finally, leaves and fruits may be arranged in different ways: for instance, some plants may have their fruits located below the leaves, while others may have them above the leaves. Theophrastus makes it clear that his example is meant to be nothing more than an outline.<sup>38</sup> His strategy is reminiscent of the one Aristotle adopts at the outset of *HA*. Like Theophrastus, Aristotle begins his collection and presentation of all the ways in which animals differ from one another with an outline that has the stated goal of giving us a foretaste of the task that is ahead of us.<sup>39</sup> In both cases, the key word is “outline.” To speak in outline (εἰπεῖν ἐν τύπῳ) is to provide an initial sketch; when the investigators have grasped this initial sketch (ἐν τύπῳ λαβεῖν), they are ready to turn to their actual investigation. Both Aristotle and Theophrastus want the investigators to embark on the study of either animals or plants with an initial grasp of the task that lies ahead of them.<sup>40</sup>

The task of collecting and presenting all the ways in which plants differ is truly daunting. How can we possibly accomplish this feat? It is time to look a bit more closely at the explanatory strategies Theophrastus adopts in

<sup>36</sup> Theophrastus, *HP* I 1.1.    <sup>37</sup> More on this in Chapter 3, Section 2.

<sup>38</sup> Theophrastus, *HP* I 1.6. I come back to this interesting phrase, which is a piece of Peripatetic jargon, in Chapter 5, Section 2.

<sup>39</sup> Aristotle, *HA* I 6, 491a6–7: “we have stated these things in this way now – *in outline* – *to provide a taste of the range and sorts of things we must study* [ταῦτα μὲν οὖν τοῦτον τὸν τρόπον εἰρηται νῦν ὡς ἐν τύπῳ, γεύματος χάριν περὶ ὧν καὶ ὅσα θεωρητέον].”

<sup>40</sup> More on the use of outlines and sketches in the Peripatetic practice of science in Chapter 5, Section 2.

his study of plants. What he says immediately before giving his initial outline is quite important:

(a) The research into plants, to speak generally, is either about their external parts and their whole form or about their internal parts, *just like the data from dissections in the case of animals* [ὥσπερ ἐπὶ τῶν ζώων τὰ ἐκ τῶν ἀνατομῶν]. We must consider which parts are the same in all plants alike, which parts are proper to each kind, and which of them are similar – I mean, for instance, leaves, roots, and bark.

(b) This too must not be overlooked if something ought to be studied by means of analogy: just as in the case of animals [we must] trace it back to the clearest and the most perfect thing. And, in general, *things in plants are to be assimilated to the corresponding things in animals, to the extent that one can assimilate what is analogous* [καὶ ἀπλῶς δὲ ὅσα τῶν ἐν τοῖς φυτοῖς ἀφομοιωτέον τῷ ἐν τοῖς ζῴοις, ὡς ἂν τις τὸ ἀνάλογον ἀφομοιοῖ].<sup>41</sup>

I divided this programmatic passage into two parts. In the first, marked as (a), Theophrastus recalls the division into *internal* and *external* parts already employed in the study of animals. This time, however, he does not refer generically to the study of animals but he makes a specific reference to the data available to him from the dissections of animals. We have seen that dissections are required for the study of the internal parts of animals.<sup>42</sup> We cannot rule out that Theophrastus refers to a formal presentation of data like the lost *Dissections* that Aristotle himself mentions several times in his extant works on animals.<sup>43</sup>

What matters, however, is not whether we have here an allusion to a book by Aristotle (or by someone else), but rather that Theophrastus relies on a pre-existing familiarity with the study of animals for his basic distinction between internal and external parts. The study of animals is in the background as something that can provide us with a helpful platform for our research into plants. As in the case of animals, the task of the investigator consists in collecting and presenting all the ways in which the plants differ from one another. This may entail recourse to dissections. This task entails registering the features that are common to all plants as

<sup>41</sup> Theophrastus, *HP* I 1.4–5. <sup>42</sup> See Chapter 3, Section 2.

<sup>43</sup> In his catalogue of Aristotle's writings, Diogenes Laertius lists eight books of *Dissections* and a *Selection from Dissections* (V 25). Similar but not identical information is found in the so-called *Vitae Hesychii*: six books of *Dissections*. These *Dissections* are now lost, so we can only guess about the role Aristotle envisions for them in his explanatory project. In a few places Aristotle jointly refers to the *Dissections* and the *HA*. An educated guess is that the *Dissections* are meant to serve as an auxiliary support to the collection and organization of the relevant zoological data advanced in the *HA*. A full list of the Aristotelian references to the *Dissections* with an in-depth discussion of each of them can be found in LENNOX 2017: 249–272.

well as those that make them different kinds of plants. If we adopt the language that has been introduced to describe the aims that Aristotle sets for himself in *HA*, we can say that Theophrastus is concerned with “laying out the differences” as well as finding out “the relevant groupings of differences.”<sup>44</sup>

In the second part of our passage, marked as (b), Theophrastus recalls a rule of inquiry that appears to control his entire study of plants. This rule should guide the investigators in their attempt to offer an account as complete as possible of all the parts present in all the different kinds of plants. At the most general level, this rule mandates that, as we have already done in the study of animals, we employ analogy as a tool for the collection and explanation of the botanical data. This requires us to single out a kind that may serve as standard of reference in the study of all kinds of plants. In what looks like a natural development stemming from the rule of inquiry, Theophrastus adds the following piece of advice: assimilate plants to animals only to the extent that analogous things allow for it. This piece of advice works together with the recommendation that we should not look for a complete correspondence in animals and plants, but rather we should consider what is specific to each of the two kinds of living beings. Clearly, animals and plants are regarded as distinct investigative domains; as such, they are the objects of separate studies; however, it turns out that there exist structural similarities which can be exploited as we move from the first field of study (animals) to the second (plants). Hence, these two separate studies can (indeed, should) be coordinated in some way.

## 5 Steps in the Study of the Parts of Plants

What Theophrastus says in the second part of the passage, marked as (b), outlines two main steps in any scientific attempt to study the parts of plants. The first step goes something like this: we ought to study the parts of plants by singling out a kind we can use as a standard of reference as we proceed in the examination of the other kinds of plants. To perform the function of a standard of reference, this kind must be the clearest and the most perfect one.<sup>45</sup> I take Theophrastus to mean that the kind we choose must display all the natural articulations present in the other plants and must display them in the clearest possible way. This paradigmatic case will

<sup>44</sup> I adopt the language employed by Allan Gotthelf (in GOTTHELF 2012b: 261–292) to characterize the aims of Aristotle’s *HA*. See Chapter 3, Section 2 for the reasons behind the use of this language.

<sup>45</sup> The Greek is τὰ ἐμπερέστατα καὶ τελειότατα.

serve as our model as we proceed in our subsequent inquiry, so we will employ the results achieved in the study of the model as we turn to the other, less perfect, kinds of plants. These kinds are less perfect either because they do not possess all the natural articulations present in the paradigmatic case or because they display them in a less distinct way.

Like Aristotle, Theophrastus does not shy away from using the language of perfection. Some of us may be uncomfortable with this language because we take it to involve an unwarranted projection of normative values onto the natural world. By now, however, it should be clear that we can rework the reference to perfection in terms of relative organization and structure. Recall that, at least for Aristotle, to be a living body is to display a certain level of organization and structure. The level of organization is different in animals and plants. Animals exhibit a higher level of bodily organization and structure because they are minimally organized into an upper and a lower part, a front part, and a back part. Animals that can displace themselves show an even higher level of organization and structure because they also display a right and a left side in their bodies. Since plants are stationary and, at least according to Aristotle, cannot perceive, they only display the distinction into an upper and a lower part, which is the distinction that can be traced back to the basic activity of nutrition shared by animals and plants. Moreover, since the roots are the entry point of nutrition, they are the upper part of plants. As a result, branches, leaves, and flowers appear to us to be the upper part of plants, but they are in fact their lower part. This is an important theoretical insight. Aristotle recalls it several times in his zoological works.<sup>46</sup> Although this catchy image is never used by Theophrastus, it surely captures an important truth: life as encountered here on earth (i.e., perishable life) entails organization and structure.<sup>47</sup>

Theophrastus is not as explicit as Aristotle on the basic truth that a living body is an organized body. But his references to perfection can be cashed out as claims entailing the existence of different levels of bodily complexity in plants. In particular, the kind of body that we plan to employ as our paradigmatic case must display the highest level of organization and structure among plants. Furthermore, the organization and structure in this kind must be transparent for us to be able to apply it as we progress in the study of various kinds of plants. So our first and arguably most

<sup>46</sup> For example, Aristotle, *IA* 4, 705a26–28. The image of plants as upside-down animals is quite suggestive. It has been used in the title of the most recent and most comprehensive survey of ancient Greek ideas on plants (REPICI 2000).

<sup>47</sup> According to Aristotle, this truth cannot be extended to the celestial world.

important decision in the study of plants is to establish a model, for which we must then develop an exhaustive description of its bodily organization and structure. I will return to this point shortly.

For the time being, however, let us turn to the second step in a truly scientific study of parts of plants. This step can be introduced as follows: we ought to launch our study of plants, including the study of our paradigmatic case, on the assumption that plants are analogous to animals, at least in some respects. The qualification is important: *Theophrastus is not envisioning a complete assimilation of plants to animals*. On the contrary, he is forthcoming that we are expected to exercise our judgment as to when, and to what extent, the insights gained in the study of animals can be used to make progress in the study of plants. Proceeding in any other way would amount to an outright violation of the Peripatetic insight that animals and plants are separate domains of investigations.

At this stage of our inquiry, the two rules outlined above are still quite abstract. Before trying to be a bit more concrete by looking at how Theophrastus implements them, I would like to return briefly to Aristotle. These two rules are at work in his study of animals as well. At the most general level they are spelled out in a passage from the lost *Protrepticus* where we are told that the natural way to proceed in any inquiry is from what is more knowable by nature, and we are told that our investigation must proceed from what is most organized and most determinate to what is less organized and less determinate.<sup>48</sup> We have seen that this is how Aristotle proceeds at the pre-explanatory and also at the explanatory stage of inquiry.<sup>49</sup> In both cases Aristotle begins his investigation from blooded animals with a concentration on the case of the human being. As a result of this overall strategy, Aristotle first develops an account for blooded animals and then extends it to the study of bloodless animals. The transition from the first to the second group of animals is made on the assumption that bloodless animals are *analogous* to blooded animals. All blooded animals have a heart. Aristotle takes this observation as his starting point to infer that all bloodless animals must possess a body part *analogous* to the heart. This example illustrates how analogy can be used to make new discoveries in any given field of study. Aristotle extends what he has learned about one group of animals – the group he takes to be his model and standard of reference – and applies it to another group of animals.

<sup>48</sup> Aristotle, *Protr.* B 33 Düring (= Iamblichus, *Protr.* 38.7–8 and *De comm. math. sc.* 81.7–11).

<sup>49</sup> Chapter 3, Section 2 (concerned the pre-explanatory stage of inquiry) and Chapter 3, Section 3 (dealing with the explanatory stage of inquiry).

Like Aristotle, Theophrastus begins his inquiry into plants from what he takes to be the clearest and most perfect kind of plant. He makes the study of this kind a suitable platform from which to launch a study of all the other kinds of plants. For Theophrastus, this kind of plant is *the tree* (τὸ δένδρον). At least two observations can be made in connection with this momentous choice. The first is that Theophrastus begins his investigation from what may be regarded as a very large kind. The second is that this very large kind is isolated by an everyday word. Theophrastus is emphatically not the first to employ the Greek name “δένδρον” in his scientific discourse. Empedocles used this term in his poem on nature. The latter famously compared seeds to eggs: “*the tall trees lay their eggs, olives, first.*” This comparison is recalled by both Aristotle (*GA* I 23, 731a5) and Theophrastus (*CP* I 7.1–3). We will see in due course that Theophrastus criticizes this comparison.<sup>50</sup> Here I am content to stress that while Theophrastus appropriates the same popular designation as Empedocles, he uses it in a different way. Unlike Empedocles, Theophrastus does not employ the term “tree” as a *pars pro toto*; rather, he uses it to refer to the large kind he takes to be his core case. Starting from this core case, Theophrastus develops a scientific discourse about plants that goes emphatically beyond his initial case. Part of our task in the rest of this chapter is to see how this explanatory feat is achieved.

To make progress on this front, let us see, first, how Theophrastus introduces his very large kinds of plants. Next to the tree, the other kinds are *shrub* (τὸ θάμνος), *under-shrub* (τὸ φρύγανον), and *herbaceous plant* (ἡ πτόα).<sup>51</sup> For each of them, Theophrastus offers an initial definition that, by his own admission, grasps in outline what the name signifies. In all these cases, the definition is given by relying on the *morphology* of plants, namely their visible characteristics:

A *tree* is a plant that rises from the root with a single stem, having many branches and knots, and it is not easy to uproot (for instance, olive-tree, fig-tree, and vine). A *shrub* is a plant that rises from the root with many branches (for instance, bramble, and the jujube). An *under-shrub* is a plant that grows from the root with many stems and many branches (for instance, savory and rue). An *herbaceous plant* is a plant that rises from the root with leaves and has no stem; the seed is borne on the branch (for instance, corn and vegetables).<sup>52</sup>

At least two observations can be made in connection with this passage. The first is that Theophrastus begins his study of plants with a *diairesis* that

<sup>50</sup> Chapter 5, Section 2.2.    <sup>51</sup> Theophrastus, *HP* I 3.1.    <sup>52</sup> Theophrastus, *HP* I 3.2.

divides the domain under investigation. He justifies this initial move by saying that our object of study becomes clearer as soon as it is divided into kinds and that we should adopt this procedure to the extent that it is possible.<sup>53</sup> It has long been noted that the division employed in this stretch of text reminds us of how Aristotle introduces his largest kinds in *HA* I 6.<sup>54</sup> Admittedly, we do not find equivalent terminology in Theophrastus; and yet the parallels between the two texts are striking. Note, however, the following important difference: unlike animals, plants show considerable variation. Depending on domestication or the impact of their surrounding habitat, the same plant may display considerable variation. The same plant, depending on whether it is wild or domesticated, or whether it grows in a sunny or a shady place, may bear fruit or be fruitless, may have flowers or be flowerless, and so on and so forth. So our division into large kinds, including their initial characterization, is only a first approximation. Theophrastus signals what is peculiar about his subject matter when he says that we should divide our subject matter “to the extent that it is possible.” He returns to this point when he says that these definitions must be taken to apply “in general and on the whole.”<sup>55</sup> Finally, toward the end of his discussion, he reiterates that these “distinctions [are] made in outline.”<sup>56</sup> Further evidence that Theophrastus rejects any hard and fast classification of plants is that he does not rule out that a few plants may remain outside his initial *diairesis*. At the very least, we can say that Theophrastus is not motivated, or at least not primarily, by taxonomic concerns. Rather, his first and foremost concern is to supply us with a useful framework to organize and present the botanical data rather than providing an exhaustive, hierarchic classification of plants.<sup>57</sup>

The second observation is that our initial definitions of the four very large kinds of plants are best understood as *nominal definitions*. These definitions give us nothing more than a first orientation, indeed a first grasp, of the phenomena to study. Armed with this first grasp, we are in a position to begin our research. At this early stage of our investigation, our cognitive state is not unlike the one that Aristotle ascribes to those

<sup>53</sup> Theophrastus, *HP* I 3.1.

<sup>54</sup> GOTTHELF 1988: 100–133 (reprinted as GOTTHELF 2012a: 390–314). For an insightful discussion of *HA* I 6, including its role in laying out the animal differences in *HA*, I refer the reader to GOTTHELF 2012d: 293–306.

<sup>55</sup> Theophrastus, *HP* I 3.2. <sup>56</sup> Theophrastus, *HP* I 3.5.

<sup>57</sup> The same point can be made in connection with the study of animals offered in *HA*. Aristotle is emphatically not motivated by classificatory concerns. See GOTTHELF 2012b: 261–292 for a useful summary of the scholarly consensus reached on this front.

investigators who have *non-accidental knowledge of the existence of the relevant thing*. Consider the following passage from *Posterior Analytics* II:

It is impossible to know what a thing is when we are ignorant that it exists. Sometimes we grasp that something exists in an accidental way, and sometimes by grasping something of the thing itself (for instance, that thunder is a certain kind of noise in the clouds, that eclipse is a certain kind of loss of light, that the human being is a certain kind of animal, or that the soul is that which moves itself). . . . To search for what something is without grasping that it exists is to search for nothing. But when we grasp something [of the thing itself] it is easy to search. Thus, as we are aware that something exists, so is our awareness directed toward what it is.<sup>58</sup>

Aristotle argues that we can try to offer a definition of what something is only when we are aware of its existence.<sup>59</sup> In addition, he claims that when we know in a non-accidental way that a thing exists, we grasp something of the thing itself and our awareness is directed toward what the thing is. In this case, our non-accidental knowledge that the thing exists comes with some provisional understanding of what it is. This understanding is conveyed by a preliminary account. Aristotle's examples are that thunder is a certain kind of noise in the clouds, eclipse is a certain kind of loss of light, and the human being is a certain kind of animal.<sup>60</sup> The definitions of the very large kinds of plants Theophrastus offers at the beginning of his presentation of the botanical data meet these epistemic requirements.

## 6 Non-Uniform, Uniform, and Annual Parts of Plants

It is time to look at how Theophrastus proceeds in establishing which bodily parts are relevant to the study of plants. Theophrastus tells us that the primary and most important parts, which are also those common to most plants, are the following four: root, stem, branch, and twig.<sup>61</sup> He regards these parts as the most widely shared *non-uniform* parts of plants and compares them to the *limbs* (μέλη) of animals. In both cases, the part is a non-uniform one and the whole, either the animal or the plant, is a composite body made out of these parts.<sup>62</sup> The reader who is interested in exploring the systematic connections between the study of plants and the study of animals should return to the opening paragraph of *HA*, which

<sup>58</sup> Aristotle, *APo* II 8, 93a20–29.

<sup>59</sup> The seminal papers on this passage, and its implications for Aristotle's scientific method, are BOLTON 1976: 514–544 and BOLTON 1987: 120–166. See also SORABJI 1981: 213–219; DEMOSS-DEVEREUX 1988: 133–154; and CHARLES 2000: 23–56.

<sup>60</sup> Aristotle, *APo* II 8, 93a23–24. <sup>61</sup> Theophrastus, *HP* I 1.9. <sup>62</sup> Theophrastus, *HP* I 1.9.

offers a definition of uniform and non-uniform parts, with a focus on the so-called limbs. The latter are described as wholes that are themselves constituted of non-uniform parts. Aristotle's examples are the head, the hand, and the whole arm.<sup>63</sup>

Theophrastus offers an initial definition for each of these four non-uniform parts.<sup>64</sup> *The root* is the part by which the plant draws its nourishment, whereas *the stem* is the one that grows above the ground and is single. *The branch* is the part that splits off from the single one that we call stem, whereas *the twig* is growth that springs from the branch regarded as a single whole.<sup>65</sup> After these brief definitions, which at this stage of the investigation can only be taken to serve the function of interim definitions, Theophrastus states that these parts, which are constitutive of the nature of a plant, belong especially to trees in the sense that this partition is most appropriate and most apparent in their case. This is why we ought to make trees our standard of study and to begin our investigation of plants by investigating trees: they display the structure and complexity of plant life in the fullest and clearest way. We will have to use whatever we have found out in the study of trees as we turn to the study of the other kinds of plants.

Although the above parts are commonly shared by plants, they are not present in all of them. In connection with this observation, Theophrastus adds the following, general remark:

As a rule, the kinds of plants are manifold, various, and difficult to study in general terms. Evidence of this is that we cannot grasp anything that belongs in common to all plants, *just like mouth and stomach in animals* [καθάπερ τοῖς ζῴοις στόμα καὶ κοιλία].<sup>66</sup>

The comparison with animals invokes a zoological fact that Aristotle registers in *HA* I 1 and discusses at the outset of *PA* II 10.<sup>67</sup> In both passages, Aristotle tells us that animals have a body part they use to take in the nourishment and another body part they employ to process the nourishment. “Mouth” and “stomach” are names borrowed from our everyday language; they become technical terms as they are appropriated for the Peripatetic study of perishable living beings. Our passage confirms this picture. It also supplies an additional reason why we should start our

<sup>63</sup> Aristotle, *HA* I 1, 486a9–14.    <sup>64</sup> Theophrastus, *HP* I 1.10.    <sup>65</sup> Theophrastus, *HP* I 1.9.

<sup>66</sup> Theophrastus, *HP* I 1.10. The claim that the world of plants exhibits not only more complexity but also specific challenges is repeated in *HP* I 2.3. More on this later in this chapter.

<sup>67</sup> For *HA* I 1, see Chapter 3, Section 2; for a discussion of *PA* II 10, see the interim conclusion offered in Chapter 2, Section 5.

study of life with animals rather than plants: as a subject matter, plants are considerably more difficult to study than animals.

After the non-uniform parts, Theophrastus lists what he takes to be the *uniform* parts of plants: bark, wood, and core. He adds that there are bodily parts that are even prior to these and from which these parts are composed: sap, fiber, vein, and flesh. Bodily parts that belong to this second group are common to all plants. These parts are common to all because they are their first principles.<sup>68</sup>

Along with non-uniform and uniform parts, Theophrastus lists *annual* parts. Theophrastus has already referred to these parts at the outset of *HP I*, where he has stressed that plants have annual parts. For instance, deciduous plants shed their leaves. The question raised but not answered at the outset of *HP I* is whether the study of annual parts is an integral component of the study of plants. By now this question has been answered in the affirmative. Here Theophrastus takes it for granted that the study of parts must comprise a discussion of the annual parts, which are all related to the production of the fruit: leaves, flower, stalk, tendril, and the fruit itself. By “fruit,” Theophrastus means the compound of the seed and the surrounding covering that contains the seed.<sup>69</sup> He also makes a final point that clarifies his overall strategy: the tripartition into non-uniform, uniform, and annual parts is made in relation to trees rather than annual plants because in the latter all the parts last for only one year. As a result, this distinction would not apply.

Theophrastus ends his review of the three kinds of parts – non-uniform, uniform, and annual – by stating that the task of the investigator is to look for a first definition of each of these parts. I speak of a “first definition” because this definition will tell us what these parts are only in outline.<sup>70</sup> Evidently, our investigation is still at a preliminary stage. What is important at this early stage is to provide the investigators with a first orientation and an initial sketch before they turn to the actual investigation. The reader who is familiar with how the argument unfolds in *HA I* will notice that there is here a similarity with how Aristotle proceeds in the first six chapters of *HA I* (*HA I* 1–6, all the way to 491a14).

There is at least one other passage that sheds considerable light on the explanatory strategy Theophrastus employs in his study of plants:

Not all plants have root, stem, twig, branch, leaf, flower, or fruit; or again bark, core, fibers, or veins (e.g., mushrooms and truffles [do not have

<sup>68</sup> Theophrastus, *HP I* 2.1.

<sup>69</sup> See Chapter 5, Section 3.2 for more on this distinction.

<sup>70</sup> Theophrastus, *HP I* 2.1.

them]). And yet, the substance of a plant is in these parts (or in such like parts). *But, as we have already stated,*<sup>71</sup> *these parts are present above all in trees, and this partition is more appropriate in them, and it is right to trace the parts of the other plants back to them* [ἀλλὰ μάλιστα ταῦτα ὑπάρχει, καθάπερ εἴρηται, τοῖς δένδροις κάκεινων οἰκειότερος ὁ μερισμός, πρὸς ἃ καὶ τὴν ἀναφορὰν τῶν ἄλλων ποιεῖσθαι δίκαιον].<sup>72</sup>

We can restate the point Theophrastus makes here by saying that, in addition to non-uniform parts (roots, a single stem, branches, and twigs), we are required to study annual parts (leaves, flowers, and fruit), as well as uniform parts (bark, core, fiber, and vein). The reason is that the substantial being (οὐσία) of a plant consists of all these parts. This does not mean, I hasten to say, that all plants must display all the above parts. Theophrastus mentions mushrooms and truffles because he takes them to be an especially difficult case as they do not show most of the above parts.

Both mushrooms and truffles remain at the margin of the Peripatetic study of plants. While Theophrastus mentions mushrooms twice more (*HP* III 7.6 and *HP* IV 7.2), he never returns to the topic of truffles. Here we can feel the limits of the Peripatetic approach to the study of animals and plants. Of course, Theophrastus does not have the option to treat mushrooms and truffles as a class of perishable living beings distinct from both animals and plants since he approaches perishable life starting from the basic distinction between animals and plants. Like Aristotle, he does not think there is room for an intermediate class of perishable living beings. But there is at least one other point that is worth stressing in connection with mushroom and truffles. Beginning a systematic study of plants from these creatures would be a complete non-starter. Even if Theophrastus does not say so, we can venture to say that starting a study of plants from mushrooms and truffles would have been equivalent to engaging in a study of animals starting from alien creatures such as the octopus and the cuttlefish. His view is that we must begin our study from those plants that display all the relevant bodily parts and display them in an especially clear way. So we must begin our study of plants from trees. To be a tree is to have roots, a single stem, many branches, and twigs (non-uniform parts). A tree also displays the partition into bark, core, fibers, and veins (uniform parts). Finally, most trees have leaves, flowers, and fruit (annual parts). In short, all three kinds of parts we are required to study are “present *above all* [μάλιστα]

<sup>71</sup> The reference is to *HP* I 1.9.

<sup>72</sup> Theophrastus, *HP* I 1.11.

in trees.”<sup>73</sup> We can try to capture the force of this statement by saying that this tripartition is not only most appropriate but also most evident in trees.<sup>74</sup> Hence, we must focus *first* on how these body parts are realized in trees. We will turn to the study of the other kinds of plants that either do not display this tripartition or display it in a less clear and less perfect way *only at a later stage*. We will find out our account of these other kinds of plants by relying on the results achieved in the study of trees.

## 7 Analogy in the Study of Plants

Analogy is the explanatory tool that enables Theophrastus to make progress in his study of plants. A couple of passages taken from the discussion of *uniform parts* illustrate how he makes his transition from the study of animals to the study of plants by means of analogy:

Fibers and veins have no special names in relation to plants, *but they are known in virtue of the resemblance they share with the parts in animals* [τῇ δὲ ὁμοιότητι μεταλαμβάνουσι τῶν ἐν τοῖς ζώοις μορίων].<sup>75</sup>

The wet and the hot are the primary things: *every plant has some amount of innate moisture and heat, just like [every] animal* [ἅπαν γὰρ φυτὸν ἔχει τινὰ ὑγρότητα καὶ θερμότητα σύμφυτον, ὥσπερ καὶ ζῶον]. When their moisture or heat fall short, then age and decay ensue; when they fail altogether, death and withering. *Now, while in most plants the moisture is without a name, in some it has a name, as we have said. The same thing happens in the case of animals. The moisture of blooded animals alone has a name. This is why they are also divided with respect to this by privation: some animals are called blooded while others [are called] bloodless* [ἐν μὲν οὖν τοῖς πλείστοις ἀνώνυμος ἡ ὑγρότης, ἐν ἐνίοις δὲ ὠνομασμένη ὥσπερ εἴρηται. τὸ αὐτὸ δὲ τοῦτο καὶ ἐπὶ τῶν ζῶων ὑπάρχει. μόνη γὰρ ἡ τῶν ἐναίμων ὑγρότης ὠνόμασται. διὸ καὶ διήρηται πρὸς τοῦτο στερήσει. τὰ μὲν γὰρ ἄναιμα τὰ δὲ ἐναιμα λέγεται].<sup>76</sup>

Let us begin our discussion from the second passage. We have already seen that, very early on in *HA*, Aristotle claims that all animals are supplied with

<sup>73</sup> The main division adopted here is not between external and internal parts but rather between uniform and non-uniform parts. Compare Theophrastus, *HP* I 1.12.

<sup>74</sup> Theophrastus seems to make a comparative claim with each of the other large kinds taken one by one. In other words, the partition into uniform and non-uniform parts is more appropriate (and more evident) in trees than in shrubs; it is more appropriate (and more evident) in trees than in under-shrubs; it is more appropriate (and more evident) in trees than in herbaceous plants.

<sup>75</sup> Theophrastus, *HP* I 2.3. <sup>76</sup> Theophrastus, *HP* I 2.4–5.

some inner moisture, the privation of which results in death.<sup>77</sup> We have also seen that Aristotle regards aging and decaying as processes that involve loss of inner moisture and loss of vital heat. For Aristotle, becoming old amounts to becoming increasingly dry and cold. Finally, death is equated by him with the complete loss of vital heat and moisture.<sup>78</sup> In light of all this, it is not surprising to discover that Theophrastus adopts the same theoretical framework in his study of plants. Note, however, that Theophrastus introduces the notion of innate heat and innate moisture with reference to animals: every plant has some connate moisture and heat, *just like [every] animal* (ὡσπερ καὶ ζῷον). At first sight, one might be tempted to think that Theophrastus is making a generic reference to a more familiar case (animals) without any reference to a specific truth established in the study of animals. What follows in our passage, however, suggests a different, indeed more interesting, scenario. Theophrastus has in mind a precise distinction. This is the distinction between *blooded* and *bloodless animals*. Moreover, he adopts the way in which this distinction is established in the study of animals to suggest that a similar procedure should be employed in the study of plants. More directly, we have a name for the most common moisture in animals: *blood*. The presence of blood (and what we would call a cardiovascular system) can be used to distinguish blooded animals from the other animals collectively known by means of a privative term: “bloodless animals.” Theophrastus is self-consciously invoking the adoption of a similar procedure for the study of plants. In a few cases, we have a name for the moisture present in plants. But whenever the name is not available, we should make recourse to a privative term as we do in the case of bloodless animals.

There is no need to see a reference to any specific passage in the zoological corpus by Aristotle. What we have here is something more interesting and at the same time more meaningful, namely the reference to a scientific procedure that is regarded as common practice in the early Peripatos. This procedure has been fully worked out for the study of animals and is now adopted for the study of plants. As we move from the study of animals to the study of plants, we ought to remain mindful of the fact that we are dealing with a different subject matter. At most, we can expect to find a few resemblances. Of course, they should not be taken to be resemblances we find in things that belong to the same kind (either

<sup>77</sup> Aristotle, *HA* I 4, 489a20–21. More on this in Chapter 3, Section 2.

<sup>78</sup> Chapter 2, Sections 4 and 5.

specific or generic resemblances); rather, they are the sort of resemblances we find in *analogous* cases.

It is time to turn to the first passage cited above, where we are told that fibers and veins have no special names in relation to plants and are also invited to adopt the designations used for the equivalent parts in animals. The mention of animals gives Theophrastus the opportunity to return to the claim that plants present special challenges to the investigator because the kind taken is manifold (πολύχουν). What follows is another methodological statement emphasizing the importance of analogy:

Since it is by means of what is better known that we ought to pursue the unknown, and better known are the things that are larger and more obvious to sense-perception, it is clear we must speak about these things in the way indicated: *we will trace the other things back to these* [*sc. the better known*] *to the extent and in the manner in which each of them participates in likeness* [ἐπαναφορὰν γὰρ ἔξομεν τῶν ὁλλῶν πρὸς ταῦτα μέχρι πόσου καὶ πῶς ἕκαστα μετέχει τῆς ὁμοιότητος].<sup>79</sup>

This methodological principle is formulated in very general terms: we need to start from what is better known, which is also what is more easily accessible and more obvious to sense-perception. We will use what is better known as our model and standard of inquiry as we turn to the things that are not known. We will do so by exploiting the similarities that exist between the two kinds of things. Note, however, that the reference to similarity is carefully qualified: “to the extent and in the manner in which each participate in likeness.” Given the context, the things that are still unknown must be the bodily parts *in plants*, whereas the things that are better known and clearer to sense-perception must be the equivalent bodily parts *in animals*. Once more, we cannot (indeed, should not) expect that plants can be completely mapped onto animals even though the study of the latter can provide us with some of the conceptual resources we employ in the study of the former.

At this point, it should be clear that for both Aristotle and Theophrastus the study of animals is prior to the study of plants in the way in which the study of blooded animals is prior to the study of bloodless animals. Moreover, it should also be clear that analogy is the tool that Aristotle employs to engage in a study of the less perfect and less complete kinds of animals (bloodless animals); his study is conducted in light, and indeed on the basis, of the results reached in the study of the more perfect or more

<sup>79</sup> Theophrastus, *HP* I 2.3–4.

complete kinds of animals (blooded animals). Finally, it should be obvious that Theophrastus too make use of analogy to deal with a less perfect and less complete kind of living beings (plants) in light, and indeed on the basis, of a more perfect and more complete one (animals). Aristotle and Theophrastus are committed to biological gradualism. Both acknowledge that there is some important continuity in nature.<sup>80</sup> Still, they consider this continuity to be fully compatible with the view that animals and plants are different kinds of perishable living beings. They are different kinds of perishable living beings because they constitute different levels of perishable life. As a result, they agree that animals and plants ought to be studied separately.

Analogy is the tool that enables Aristotle and Theophrastus not only to make progress in the context of their separate studies of animals and plants but also to go beyond those separate studies. Let us concentrate on the case of Theophrastus. His use of analogy in *HP* I does not eliminate the differences that exist between animals and plants and does not obscure the fact that we are dealing with two separate subject matters, namely animals and plants. In other words, analogy does not entail the reduction, let alone the elimination, of the existing differences between animals and plants. On the contrary, the whole point of using analogy is to recognize these differences. Animals and plants remain distinct domains of investigation, but there is nonetheless something that holds the same place or plays the same functional role in each of them. We are quite distant from the mindset adopted by the Hippocratic author of the work *On the Nature of the Child*.<sup>81</sup> While scholars have often credited this unknown author with analogical thinking, his account of the formation and development of the human embryo does not suggest a self-conscious use of analogy. By contrast, in the *HP* we find not only a self-conscious use but also a fully developed theory of analogy. This is no coincidence: analogy is an explanatory tool specifically designed to deal with reality without reducing or eliminating its complexity.

## 8 Plants As Ensouled Beings

I would like to conclude this chapter by addressing a concern a perceptive reader may have about the reading I have developed so far. This concern

<sup>80</sup> The famous dictum *natura non facit saltus* can be traced back, ultimately, to the Peripatetic study of living beings.

<sup>81</sup> See Chapter I, Section 1.

can be presented in the following terms: a commitment to the existence of different forms of life is registered in Aristotle's *De anima*; by contrast, we do not find an explicit commitment to this effect in Theophrastus. The latter never says *expressis verbis* that plants are a different kind of ensouled beings, let alone that they are ensouled beings. Moreover, there are no explicit references to Aristotle's *De anima* in his whole botanical corpus. This silence is quite remarkable for someone who is supposed to be working within the theoretical framework established by Aristotle. Shouldn't we take this silence as circumstantial evidence that Theophrastus is in fact trying to mark his distance from Aristotle?<sup>82</sup>

To begin with, I would like to recall that the absence of any explicit reference to Aristotle's *De anima* is in line with the self-consciously impersonal style that Theophrastus adopts in his own writings on plants. We have already seen that there is no explicit reference to any of the writings by Aristotle in his whole corpus of writings on plants. And yet we have seen that we cannot make sense of Theophrastus's overall approach to the study of plants without assuming that Aristotle's *De anima* is a foundational text for him as well. Consider, once more, the brief reference to mushrooms and truffles.<sup>83</sup> Theophrastus regards them as a difficult or odd case. They are mentioned to point out how unwise it would be to study plants starting from there. Our best hope is to deal with mushrooms and truffles by employing some of the resources developed for the study of the other plants. If we develop a powerful enough set of tools, we should be able to make sense of difficult cases. Dealing with these cases may even turn out to be an indirect vindication of the overall approach to the study of plants. What is especially interesting is that Theophrastus does not even consider the option of placing mushrooms and truffles in a group of their own, distinct from both animals and plants. This theoretical option is simply not available to him. From the very start of his study Theophrastus appears to operate with the distinction between animals and plants. However, without the study of the soul offered in Aristotle's *De anima* as theoretical background, this distinction would be far from a compelling one. In fact, there would be no theoretical need to conduct separate studies of animals and plants.

<sup>82</sup> This striking silence is often registered in the secondary literature as implying, if not open disagreement, at least some distance from Aristotle. See, for example, HARDY-TOTELIN 2016: 67. For an attempt to answer my question in the negative with arguments that only in part overlap with those I offer in this section, see REPICI 2000: 200–211.

<sup>83</sup> Theophrastus, *HP* I 1.11.

One may still object to this conclusion by noting that Theophrastus never says that plants are *ensouled*. Theophrastus credits plants with *the nutritive power* (τὸ θρεπτικόν), but he does so without crediting them with a soul.<sup>84</sup> On this reading, Theophrastus ends up occupying a position that is not too far from the one subsequently adopted by the Stoics (among others), who claimed that plants have a nature (φύσις) but they do not have a soul (ψυχή).<sup>85</sup>

I take this objection very seriously. While I cannot rule out that Theophrastus may be able to ascribe a nutritive power to plants without ascribing them a soul, two passages offer circumstantial evidence that this is not the case. While this textual evidence is not as clear as we would like it to be, it goes some way toward addressing the concern prompted by Theophrastus's silence on the topic of the soul of plants. The first passage is from the short but difficult essay traditionally known as Theophrastus's *Metaphysics* (I note, in passing, that a better title for this text would be *On the First Principles*). There, Theophrastus lists animals, plants, and *things without a soul* (ἄψυχα) in this very order.<sup>86</sup> This is emphatically not a random list of things; rather, it is a list in which the relevant items are ordered in accordance with their distance from the first principle. It is natural to read into this list a *scala naturae* ending with inanimate things. Animals and plants are on this list as separate kinds of *ensouled* beings; as such, they are to be contrasted with *things without a soul*. The second passage is found in his writings on plants. In connection with the study of flavors, Theophrastus tells us that we should begin our investigation with those that appear in *things without a soul* (ἄψυχα) and only then continue with those found in plants and fruits.<sup>87</sup> Again, the implicit contrast is between ensouled things and things that have no soul (soulless things), with plants as one kind of living being.

I would like to end by noting that we do not have to take Theophrastus's silence as evidence that he is trying to mark his distance from Aristotle. It is open to us to read into this silence a sign that *Aristotle and Theophrastus not only share the same research program but they also work within the same*

<sup>84</sup> Theophrastus, *CP* I 12.5. I offer a full discussion of this passage in Chapter 5, Section 3.

<sup>85</sup> The debate on whether plants are ensouled was very much alive not only before but also after Aristotle. Recall the view registered in Aëtius, *Placita* V 26.1–3 (= *Dox. gr.* 438.4–20):

The Stoics and the Epicureans [hold that] plants are not ensouled: some creatures partake in the impulsive and appetitive soul, others also in the rational soul, but plants move spontaneously and not on account of the soul.

For more on the context in which this testimony is embedded, see Chapter 1, Section 1.

<sup>86</sup> Theophrastus, *Metaph.* 9a10–15. <sup>87</sup> Theophrastus, *CP* VI 3.3.

*theoretical framework.* On this reading, the fundamental truth that plants are ensouled beings is a given that need not be recalled; rather, this biological truth performs for Theophrastus the function of an implicit starting point that is at work in his writings while remaining in the theoretical background.