

Theophrastus on the Generation of Plants (Causes of Plants I)

1 Introduction

In Chapter 4, I argued that beyond their shared decision to study animals and plants separately, and to study them in this order, Aristotle and Theophrastus adopt a few common rules of inquiry in their investigations of animals and plants. With a concentration on *HP* I, I argued that Theophrastus develops an account of what he takes to be the paradigmatic case of plants and then uses that account as his starting point for a study of what he takes to be more difficult cases. In Chapter 3, I showed that Aristotle employs a similar strategy in the context of his study of animals, and that he does so both at the pre-explanatory and the explanatory stage of inquiry.

The rationale for this shared strategy is found in a fragment from Aristotle's lost *Protrepticus*:

Prior things are always more knowable than posterior things, what is better in nature [is more knowable] than what is worse: *there is knowledge more of what is organized and determinate than of their opposites*.¹

There are two ways in which things can be prior and more knowable: either by nature or relative to us.² Aristotle is concerned with what is prior and more knowable by nature. Such things are identified with those that have a higher level of internal organization. It is because these things are more organized that they are also more intelligible by nature. The idea formulated in this fragment is very general and is meant to apply to everything that can be an object of knowledge. So it is not immediately clear how this idea can be applied to the study of perishable living beings. My suggestion is that the more organized and more determinate perishable living beings

¹ Aristotle, *Protr.* B 33 Düring (Iamblichus *Protr.* 38.7–8 and *De comm math sc.* 81.7–11).

² For example, Aristotle, *APo* I 2, 72a1–5; *Phys.* I 1, 184a16–20; *Metaph.* VII 3, 1029a3–5; *NE* I 3, 1095a2–4.

are those that display a higher level of organic unity. In other words, Aristotle and Theophrastus begin their separate studies of animals and plants from biological systems that display a higher level of organic unity. If this suggestion is accepted, we can use the terminology offered in this fragment to make the following claims:

1. Animals display a higher level of organic unity than plants, so they are better by nature than plants; as a result, they are also more knowable by nature than plants.
2. Certain kinds of animals display a higher level of organic unity than other kinds of animals, so they are better by nature; as a result, they are also more knowable by nature than these other kinds of animals.
3. Certain kinds of plants display a higher level of organic unity than other kinds of plants, so they are better by nature; as a result, they are also more knowable by nature than these other kinds of plants.

These claims do not only establish a definite *scala naturae* among perishable living beings; they also determine an order of inquiry that we are required to follow as we engage in a systematic investigation of the phenomenon (or rather phenomena) of perishable life. We are required to begin our investigation of perishable living beings with the study of animals rather than plants, and the study of animals with the study of blooded rather than bloodless animals, with a focus on live-bearing rather than egg-laying animals, and in particular on the human animal; last but not least, we are required to begin our study of plants with the study of trees rather than less perfected forms of plant life such as shrubs, under-shrubs, and herbaceous plants.

In Chapter 4, I argued that Theophrastus follows a common Peripatetic practice when he organizes the complexity of the botanical data by dividing plants into large kinds. I suggested that he embarks on the study of plants with the help of a few nominal definitions based on the visible characteristics of plants. He warns us to take those definitions with a grain of salt because of the plasticity of plants. In fact, because of their remarkable variability in appearance, plants resist any hard and fast classification based on morphology. Hence, our division into large kinds, as well as our initial definitions of those kinds, represent at most a first approximation to the complexity of the natural world. In brief, they are distinctions made in outline.³ Still, by starting his investigation with a few nominal definitions and an outline of the task that lies ahead of us, Theophrastus gives us a first

³ Theophrastus, *HPI* 3.5.

orientation, as well as an initial conceptual framework, to engage in an intelligent and fruitful study of the complexity of the world of plants. By doing so, he embraces a key methodological insight advanced in Aristotle's *Posterior Analytics*. According to the theory of inquiry outlined in this work, we cannot search for an explanation or a definition of *X* unless we have an initial grasp of *X*.⁴ If I am right, the inquiry into plants is largely controlled by the theory advanced in Aristotle's *Posterior Analytics*. In this chapter, I would like to continue my search for procedures of inquiry that are shared in the early Peripatos. I will do so by turning to the investigation that Theophrastus offers in *Causes of Plants* (*CP*). I will focus on the first book, with a concentration on the explanatory strategies Theophrastus deploys in his attempt to account for the different modes of plant propagation.

A few preliminary words on the project of *CP* are in order before embarking on such a project. To begin with, the Greek manuscript tradition has transmitted us a *CP* in six books.⁵ Since this treatise is explicitly concerned with the search of the causes of plants, it belongs to the *διότι*-stage of inquiry. Taken together, *CP* I and *CP* II offer explanations of facts about plants that can be traced back to their nature. What matters is not only the specific nature of plants but also the nature of the habitat in which they live. This ecological approach is prominent in *CP* II, where we are introduced to the idea that plants have a fitness for a certain location.⁶ In this context, the concept of a proper place becomes central. Constitutive of a proper place are causal factors such as the nature of the soil, the presence or absence of moisture, and the exposure to winds and to the sun. The discussion of how these causal factors interact with the nature of the plant includes a brief discussion of adaptation to a particular location.⁷ What Theophrastus says at the very end of *CP* II reveals how *CP* I and *CP* II contribute to a single explanatory project:

With respect to other properties of trees, and [in general] plants, we should try to pursue their study starting from trees, considering the essence of each of them and the nature of the region [in which each of them lives] [ὑπὲρ δὲ τῶν ἄλλων ὅσα

⁴ See Chapter 4, Section 4.

⁵ I refer the reader to Chapter 4, Section 2 for how our *CP* in six books may relate to the lost Hellenistic edition of *CP* in eight books documented in the catalog of Theophrastus's writings preserved by Diogenes Laertius.

⁶ On Theophrastus as a forerunner of ecological thought, see HUGHES 1985: 296–306 (reprinted in FORTENBAUGH-SHARPLES 1998: 67–75).

⁷ Theophrastus, *CP* II 13.1–2. Theophrastus notes that adaptation to the surrounding environment can be observed in plants as well as in animals.

συμβαίνει τοῖς δένδροις ἢ φυτοῖς πειρατέον ἐκ τῶν δένδρων μετιέναι καὶ θεωρεῖν τὴν ἰδίαν οὐσίαν ἐκάστου λαμβάνοντας καὶ τὴν τῆς χώρας φύσιν]. In this way, the common attributes, the variations according to the different kinds, and what is convenient and proper to each [of them] become clear. But we also ought to be able to study what is similar and identical [across different plants], since many different plants do not seem [after all] to be different, just like in other domains.⁸

To fully appreciate what we are told in this passage, we should keep in mind one of the main results achieved in Chapter 4 – namely, that our systematic study of plants begins with a study of trees. The results reached in the study of this large kind can be adopted, and indeed adapted, as we turn to less developed forms of plant life. While *CP I* is concerned with the nature of plants, *CP II* is about the impact of the habitat on plants. Human intervention becomes the object of study in *CP III* and *CP IV*. In these books, Theophrastus concerns himself with cultivation, plantation, and in general how domestication alters the nature of a plant. The complementary nature of *CP I–II* and *CP III–IV* is made explicit at the outset of *CP III*, where we are told that the study of plants consists of two complementary investigations: while the first has its starting point in nature, the second focuses on human ingenuity and contrivance.⁹ *CP V* completes the project in two ways. *CP V 1–7* deal with anomalous phenomena whose explanation can be traced back either to the nature of the plant, even though they represent a deviation from its natural behavior, or to the effects of an art that aims at producing fruit of a special and extraordinary character (e.g., growing a grape cluster that has no stones). *CP V 8–18* complement the discussion with a treatment of diseases in plants and the causes of death. We are left with *CP VI*. This book is announced as a systematic study of natural juices and odors. By “natural juices and odors,” Theophrastus means juices and odors that can be traced back to the properties of plants. To understand why Theophrastus discusses juices and odors together, we must keep in mind how he explains their respective generation. A juice is a mixture of a dry and earthy components in a liquid. It is naturally generated when some water is filtered through dry and earthy components. When those dry and earthy components present in the juice are diffused in the transparency of air, they give rise to an odor.¹⁰ In other words, juices and odors share the same dry and earthy components, which make

⁸ Theophrastus, *CP II* 19.6.

⁹ Theophrastus, *CP III* 1.1. The same idea is repeated in *CP II* 1.1 and *CP V* 1.1.

¹⁰ Theophrastus, *CP VI* 1.1.

themselves felt to us either through water or air. *CP* VI and the essay *On Odors* are two extant pieces of a large-scale investigation of juices and odors.¹¹

2 Theophrastus on the Propagation of Plants in *CP* I

At the outset of *CP* I, Theophrastus states his overall explanatory goal:

We have spoken earlier *in the historiai* [ἐν ταῖς ἱστορίαις] about the *modes of generation in plants* [τῶν φυτῶν αἱ γενέσεις], [stating] that they are more than one, how many they are, and what they are. However, since these modes of generation are not present in all plants alike, *it is appropriate [for us] to distinguish which modes occur in what kinds of plants and on account of what causes, employing principles that are appropriate to the essential nature of each of them* [οἰκείως ἔχει διελεῖν τίνες ἐκάστοις καὶ διὰ πόιᾱς αἰτίας, ἀρχαῖς χρωμένους ταῖς κατὰ τὰς ἰδίας οὐσίαις], for our [explanatory] accounts ought to agree directly with the stated facts.¹²

There is a great deal that is interesting in this passage. To begin with, Theophrastus announces a study of modes of generation. The plural is significant because plants can propagate in more than one way. It is not unusual for the same kind of plant to propagate in several ways, so part of the task that Theophrastus sets for himself in *CP* I is to explain which modes of generation occur in which kinds of plants and why. Moreover, Theophrastus refers to the results reached earlier in his ἱστορίαι. The plural is a reference to the data collected rather than to the activity of collecting them. Those data can be found in *HP* II 1–4 (domesticated trees and, more generally, domesticated plants) and *HP* III 1 (wild trees). I do not capitalize the word “ἱστορίαι” because I see no compelling reason to take this word to be a reference to the traditional title of the work. Finally, we should resist the temptation to give a merely chronological meaning to the adverb “earlier” (πρότερον). Instead, we should apply the Peripatetic insight that the scientific enterprise proceeds in stages and the collection and organization of the relevant data come before their explanation.¹³ This methodological insight is subordinated to an even more fundamental one: a proper study of perishable living beings must be approached via separate studies of animals and plants. It is because of this second insight that the Peripatetic tradition has left us two scientific enterprises rather than one: a study of animals and a study of plants, both organized into a ὅτι- and

¹¹ I refer the reader to Chapter 4, Section 2. ¹² Theophrastus, *CP* I 1.1.

¹³ See Chapter 3, Section 2.

a διότι-stage of inquiry. At the outset of *CP*, we are about to approach the διότι-stage of the Peripatetic study of plants.

The task that lies ahead of us is looking for causal explanations – namely, explanations that single out the relevant causes (αἰτίαι). We are told that these explanations must agree with the facts. I take this statement to be equivalent to saying that our explanations must do justice to the complexity of the data collected in *HP* II 1–4 and *HP* III 1. This goal can be achieved only by finding out causes that are specific to the different kinds of plants. This entails, in turn, looking for explanations starting from the essential natures – the Greek term is οὐσίαι – of the different kinds of plants. Theophrastus considers the various οὐσίαι to be explanatorily primary. In other words, the essential natures of the different kinds of plants are his starting points in the explanation of their various modes of generation. It does not take long to see that Theophrastus is endorsing *explanatory essentialism* – namely, the view that essences understood as basic, necessary, and universal features play the role of first principles in the explanation of the per se accidents (that is to say, the other necessary and universal features) of the relevant things. Explanatory essentialism is at the heart of the Peripatetic theory of scientific explanation. At this early stage of our inquiry we do not know what goes into the essence of a given plant. But we should think, for a start, about morphology – namely, the organization of the various parts of plants, including the presence or absence of a given part. In due course, however, we will discover that there is more than morphology to the essence of a plant.

After this opening statement, Theophrastus outlines three modes of generation in plants:

- (1) generation from seed
- (2) spontaneous generation
- (3) generation from a part.

This tripartition should not be taken to be exclusive. Theophrastus does not mean to say that if a plant is generated from seed, it cannot be generated spontaneously or from a part. There are plants that appear to be generated from seed as well as spontaneously. This should not trouble us, Theophrastus adds, because we observe the same phenomenon in animals. Like plants, some animals come to be from other animals as well as from the earth.¹⁴ In connection with this last claim by Theophrastus, the reader will find a note in their preferred translations

¹⁴ Theophrastus, *CP* I 1.2.

of *CP*, with a reference to what Aristotle says in the context of his account of spontaneous generation.¹⁵ In *GA* III 11, which is the official treatment of spontaneous generation, Aristotle tells us that some hard-shelled animals come to be spontaneously as well as from the spermatic fluid they emit:

the nature of some hard-shelled animals is constituted spontaneously, while others emit some power from themselves. However, these animals too often come to be from a spontaneous constitution. [*To understand this phenomenon we must grasp the modes of coming to be of plants* [δεῖ δὲ λαβεῖν τὰς γενέσεις τὰς τῶν φυτῶν]. While some plants come to be from seed, others come to be from slips that are planted out, and still others come to be by side-shoots (e.g., the kind of onions). Now, mussels come to be in this way, since small ones keep growing by the side next to their source. Whelks, purpuras, and those creatures that are said to honeycomb emit a slimy fluid as if it were originating from a spermatic nature.¹⁶ However, *none of this is to be thought to be seed, but it bears resemblance with plants in the manner stated above* [σπέρμα δ' οὐθὲν τούτων δεῖ νομίζειν ἀλλὰ κατὰ τὸν εἰρημένον τρόπον μετέχειν τῆς ὁμοιότητος τοῖς φυτοῖς]. That is why a multitude of such animals come to be once one has come to be.¹⁷

To fully appreciate the remarks made in this passage, we must keep in mind that, according to Aristotle, hard-shelled animals are creatures that occupy an intermediate position between animals and plants.¹⁸ It is, therefore, not surprising to see that Aristotle tries to account for the way (or rather ways) in which these creatures reproduce by recalling the different modes in which plants propagate. He claims that some plants reproduce from seed, while others do so from a slip or by side-shoots. Moreover, he uses this last remark to explain how mussels reproduce: small ones keep growing by the side next to their original source in a way that resembles the propagation of plants by side-shoots.

In Chapter 4, I argued that for Theophrastus the analogy between plants and animals is essential to get his study of plants off the ground. I added that Theophrastus adopts some of the results achieved in the study of animals not only to lay out the task ahead of him but also to speak about plants. In fact, it is difficult to imagine how Theophrastus could have proceeded in his investigation of plants without relying on those results. This passage from *GA* III 11 enriches our understanding of the relation between the separate studies of plants and animals envisioned in the early

¹⁵ EINARSON-LINK 1976: I 6nd; AMIGUES 2012: 130n7.

¹⁶ The verb κηριάζειν is formed from κηρίον (honeycomb). According to Aristotle, these animals secrete a slimy mucous substance displaying a structure like that of a honeycomb.

¹⁷ Aristotle, *GA* III 11, 761b23–762a2. ¹⁸ Aristotle, *GA* I 23, 731b8–15.

Peripatos. It suggests that the analogy between animals and plants can play an explanatory role not only as we progress from the study of animals to the study of plants but also when we are concerned with borderline cases such as that of hard-shelled animals, the propagation of which seems to bear some resemblance to the way plants propagate. In connection with this claim, it is worth stressing that these intermediate cases do not occupy a gray area between the study of animals and plants. In other words, we should not approach this text with the idea that there are three kinds of perishable creatures: animals, plants, and intermediate living beings. Rather, for both Aristotle and Theophrastus, there are only two kinds of perishable living beings, namely animals and plants, with borderline cases such as hard-shelled animals falling on the animal side of the border. In this scenario, analogy understood as an explanatory tool can work both ways – not only from animals to plants but also from plants to animals.¹⁹

Still, it remains true that, as a rule, the order of investigation is from animals to plants rather than vice versa. It is significant that in *CP* Theophrastus begins his account by saying that, just like plants, some animals come to be from other animals as well as from the earth. Something analogous happens at the outset of *HP*, where Theophrastus adopts (and adapts) the theoretical framework that Aristotle outlines for the collection and organization of the relevant zoological data. In both cases, we should refrain from reading actual cross-references in his statements. Theophrastus is not interested in referring us to a particular treatise, let alone to a particular passage in a particular treatise, by Aristotle. His references are self-consciously impersonal. They are primarily meant to activate knowledge that his reader is expected to have acquired *before* embarking on the study of plants. Furthermore, these references need not have chronological significance. Even if it is very likely that Theophrastus wrote on plants after Aristotle wrote on animals, his references to the study of animals are better understood as evidence that the study of plants follows the study of animals in the order of investigation. Following a certain order of investigation does not imply any claims as to when the treatises reporting the results reached in those investigations were written. It is this order of investigation that makes it possible for Theophrastus to appropriate what is established in the account of the generation of animals. When Theophrastus says that some animals reproduce from seed as well as spontaneously, he can reasonably expect his

¹⁹ But I hasten to say that this is the exception rather than the rule. Analogy is for the most part asymmetrical. I will return to this issue in Chapter 6, Section 5.

reader to be familiar with the case of the hard-shelled animals that come to be in more than one way. He can also expect his reader to see in the modes of generation of these animals an instance of the Peripatetic insight that nature proceeds in a succession of steps without gaps, to the point that in certain borderline cases it may be difficult for us to tell whether the living thing is a plant or an animal.²⁰

2.1 *Plant Propagation in Outline*

The main challenge Theophrastus faces as he turns to the explanation of how plants are generated is that plants propagate in more than one way. Right from the start of *CP*, he speaks of modes of generation (plural) rather than generation (singular).²¹ The three modes of generation outlined in the previous section are discussed separately, beginning with generation from seed. This mode of generation is discussed first because it is the most common. While short, this discussion is not without interest because Theophrastus invokes the teleological principle that nature does nothing in vain.²² We have encountered the most precise formulation of this teleological principle in connection with Aristotle's explanation of animal locomotion.²³ In all probability, this explanatory principle originated in the context of the study of animals. However, its methodological significance goes emphatically beyond the narrow boundaries of zoology. Already in Aristotle we find the claim that this is a general principle for the study of nature rather than a special principle that holds for the study of animals. Consider, in particular, how Aristotle introduces three explanatory principles to be used in the explanation of animal locomotion (one of them is the principle that nature does nothing in vain):

We begin our investigation by positing those [principles] that we are accustomed to employing often in natural investigation *assuming that things*

²⁰ Aristotle, *HA* VII (VIII) 1, 588b4–30. Virtually the same point is repeated in *PA* IV 5, 681a10–15. More on this passage and its theoretical implications in Chapter 1, Section 2.

²¹ Aristotle does the same in the passage when he invokes the modes of generation (γενέσεις) in plants to explain how some hard-shelled animals propagate. I refer the reader to the passage quoted earlier in this section.

²² Theophrastus, *CP* I 1.1: “nature does nothing in vain.” See also *CP* II 1.2, where Theophrastus says that “nature does nothing in vain and thought aims to help nature [ἡ φύσις οὐδὲν ποιεῖν ματὴν, ἥ τε δίδονα βοηθεῖν θέλει τῇ φύσει].” In this context, it is worth recalling another, closely related, teleological principle: “nature has always an impulse toward the production of the best.” For this principle, see Theophrastus, *CP* I 16.11: ἡ δὲ [φύσις] ἀεὶ πρὸς τὸ βέλτιστον ὁρμᾷ.

²³ Chapter 3, Section 4.

occur in the same manner in all nature's works [λαβόντες τὰ τοῦτον ἔχοντα τὸν τρόπον ἐν πᾶσι τοῖς τῆς φύσεως ἔργοις].²⁴

What we read in Theophrastus confirms that the principle that nature does nothing in vain has a more general application. It also suggests that this principle is best understood as a Peripatetic rather than Aristotelian principle of inquiry. While the principle takes a general form, it must be understood with reference to a certain nature or other. When a plant produces a seed, we must expect that the seed has the power to produce another plant of the same kind. If not, the nature of that plant would have done something in vain.²⁵

Let us turn now to generation from a part, which is unique to plants in the sense that plants alone can be generated from one of their parts (a branch, a twig, a side-shoot, or a root). This mode of generation must be traced back to the specific nature of plants: unlike animals, plants have life everywhere. This is a refrain we hear many times in Aristotle.²⁶ It is also a view shared by Theophrastus. He mentions it right at the outset of his research to demarcate the study of plants from the study of animals.

To speak in general, as we have said, we should not assume that [the growth of plants] is in all respects the same as in the case of animals. This is why the number of their parts is indeterminate: [*a plant*] *has the power to sprout everywhere because it is alive everywhere* [πανταχῇ γὰρ βλαστικόν, ἅτε καὶ πανταχῇ ζῶν].²⁷

The statement highlighted in italics may suggest that all plants are generated from a part. In fact, we should resist such a generalization since not all plants are generated from a branch, a twig, or a side-shoot. There are plants that can be generated from a twig or a side-shoot but not from a branch.

²⁴ Aristotle, *IA* 2, 704b12–14. What Aristotle tells us in this passage is fully compatible with the fact that the explanatory principles he is about to introduce find their clearest application in the study of animals. It is very likely that these principles were first discovered and formulated in the context of the study of animals and then extended to other areas of natural philosophy on the crucial assumption that “things occur in the same manner in all nature’s works.” See LEUNISSEN 2010: 119–134 and FALCON 2021a: 1–18.

²⁵ The literature on how the principle that nature does nothing in vain should be understood is very large. In addition to LENNOX 1997: 199–214 (reprinted in LENNOX 2001a: 205–223), see LEUNISSEN 2010: 115–135; HENRY 2013: 225–263; GOTTLIEB-SOBER 2017: 246–271; STAVRIANES 2021: 165–193; and RANGOS 2021: 233–265. For the application by Theophrastus of this teleological principle to the study of plants, see WÖHRLE 1985: 84–94.

²⁶ Aristotle, *Long.* 6, 467a18–30; *Juv.* 2, 468b5–9; *PA* IV 6, 682b30–32. The first passage is discussed in Chapter 2, Section 4. For the second, see Chapter 2, Section 5.

²⁷ Theophrastus, *HP* I 1.3.

In this context, Theophrastus reiterates his commitment to explanatory essentialism: the different modes of generation ought to be traced back to the specific essences of the different kinds of plants.²⁸ This time, however, he gives us an outline of the relevant explanation: none of the plants that have a dry nature and are single stemmed admit of propagation either from a side-shoot or a twig or a branch. More to the point: those that have a single stem do not admit of propagation from a side-shoot, whereas those that have a dry nature do not admit of propagation by either a branch or a twig. The Greek text is difficult and possibly corrupt. If we accept the text printed by the most recent editor of *CP*, the next sentence adds the following thought: it is the lack of proportion in the amount of innate heat and innate moisture that explains why single-stemmed plants and plants that do not have side-shoots cannot propagate by means of a part. These plants cannot propagate in this way because of a lack of balance in the amount of connate heat and connate moisture.²⁹ The implication is that those plants that display the right amount of innate heat and innate moisture can propagate because they can preserve this right balance of heat and moisture in all their parts. This explains why some of them can grow even from a detached part (e.g., the fig tree). At the very least, we can say that the innate moisture of a plant is taken to be an essential feature of the plant to the effect that a scientific explanation of how the plant propagates should be derived from there.

I have spoken of an “outline of the relevant explanation” because Theophrastus is very clear that he has given us a general account and has delineated the main lines of his account.³⁰ I take “general” (καθόλου) and “in outline” (ἐν τύπῳ) to work together. The account offered so far does justice to the facts observed and collected in the *HP*. Furthermore, this account establishes the role of seeds in generation and acknowledges that some plants are generated spontaneously. Finally, it explains why certain plants can be generated from a part (either a side-shoot, a twig, or a branch). In sum, there is

²⁸ Theophrastus, *CP* I 1.3.

²⁹ Theophrastus, *CP* I 1.4: καὶ ταῦτα μὲν διὰ τὰς εἰρημένους αἰτίας, τὰ δὲ ἀπαράβλαστα καὶ μονουφῇ ἀσυμμετρίᾳ τινὶ τοῦ θερμοῦ καὶ ὑγροῦ. δέχεται [δὲ] τὰς ἄλλας [ἂ] δύναται τηρεῖν τὴν ὑγρότητα καὶ θερμότητα τὴν ζύνφυτον. In addition to supplying two words, Amigues (following Wimmer) prints ἀσυμμετρίᾳ instead of συμμετρίᾳ, which is the reading transmitted by the manuscript tradition. The alternative reading – printed by Benedict Einarson, who follows Theodore Gaza and Julius Scaliger – retains the reading συμμετρίᾳ but considers the words ἀπαράβλαστα and μονουφῇ to be an intrusive gloss. Here is the text printed by Einarson: καὶ ταῦτα μὲν διὰ τὰς εἰρημένους αἰτίας, τὰ δὲ [ἀπαράβλαστα] συμμετρίᾳ τινὶ τοῦ θερμοῦ καὶ ὑγροῦ [καὶ μονουφῇ] δέχεται καὶ τὰς ἄλλας [sc. γενέσεις].

³⁰ *CP* I 1.3: “let this be defined in this manner in general [καθόλου] and in outline [τύπῳ].”

nothing provisional or tentative in the explanatory work done in *CP I* 1–3. And yet a great deal of detailed information is still missing. In this sense, we have been given only a “general” (καθόλου) account. But insofar as it delineates the main lines of an explanation – that is, insofar as it is ἐν τύπῳ – this account is as complete as it can possibly be at this early stage of our inquiry.³¹

Theophrastus contrasts the expressions λέγειν ἐν τύπῳ and ἀκριβολογεῖσθαι.³² Since ἀκριβολογεῖσθαι is equivalent to “speaking with precision,” one may be tempted to take λέγειν ἐν τύπῳ as equivalent to “speaking without precision.” Recall, however, that a general account (a καθόλου account) is as precise as it can possibly be without dealing with what is specific about the specific cases. At the level of generality at which we are now, there is nothing tentative or provisional about this account. The only way to achieve more precision is by adding details. But the relevant details become available only when we go beyond the καθόλου account to discuss what is specific about the particular cases (τὰ καθ’ ἕκαστα).³³

Let us take stock: an explanation in outline, or a general account, gives a first and necessary orientation toward the final explanation. As such, it is a first and necessary stage in the δίοτι-stage of explanation. All this confirms, indeed refines, the Peripatetic insight that the scientific enterprise unfolds in stages. In addition to a ὅτι- and a δίοτι-stage of inquiry, we now see that the scientific enterprise admits of further articulation within the δίοτι-stage of inquiry. The scientific enterprise not only advances from a ὅτι- to a δίοτι-stage of inquiry but also progresses in stages within the δίοτι-stage of inquiry. As will become fully apparent in a moment, reaching the final explanation, which is based on the ultimate essence of the thing, as required by explanatory essentialism, is a complex business requiring recourse to a combination of explanatory procedures.³⁴

2.2 *Plant Propagation in Detail*

The details that are missing in our outline are supplied in *CP I* 2–7. To begin with, a notable exception to the rule is discussed: the date-palm. This tree has a single stem, a dry nature, and no side-shoots; it can nevertheless

³¹ For the use of expressions such as λέγειν (or εἰπεῖν) ἐν τύπῳ and λαμβάνειν (or λαβεῖν) ἐν τύπῳ in the early stages of Theophrastus’s study of plants, see *HP I* 1.6; *HP I* 2.2; *HP I* 3.2; *HP II* 6.12.

³² Theophrastus, *HP I* 3.5; *HP I* 4.3.

³³ For a clear instance of speaking first in general (λέγειν καθόλου) and in common (κοινῶς) and then speaking about particular cases (λέγειν κατὰ μέρος/καθ’ ἕκαστον), see the opening statement of *HP I* 5.1.

³⁴ For a brief but helpful introduction to the stages of scientific inquiry in Aristotle (with reference to the theory of theory of science outlined in the *Posterior Analytics*), see GOTTHELF 2012C: 371–398.

propagate in ways other than by seed.³⁵ The explanatory procedure adopted in this case is reminiscent of how Aristotle proceeds in his study of animals. Like Aristotle, Theophrastus deals with exceptional or difficult cases as soon as an explanation is in place. His goal is to show how they fit within the explanatory framework provided for the other cases. Theophrastus has outlined an explanation for trees that have a single stem, a dry nature, and no side-shoots. He now deals with a *prima facie* exception, and indeed a potential challenge, to his general explanation. He shows how this apparent exception to the rule can be explained once a few additional facts that are unique to the date-palm are considered. What seems to be relevant in this case is the habitat in which this kind of plant grows, which is described as rich in food and tending to promote sprouting.

Although brief, this discussion is instructive for at least two reasons. First, it shows that a plant is not studied in isolation from its habitat. Quite the opposite: the habitat – the Greek term is *χώρα* – is taken to be a primary explanatory factor as Theophrastus tries to account for what is distinctive, or even unique, about a given plant. What is taken to be explanatorily primary is traced back to the essence of the plant, so we must conclude that a reference to the habitat features in the essential nature of the plant. Admittedly, this expansive understanding of what counts as the essence of a plant is surprising. To mitigate this surprise, it is worth stressing that a similar explanatory procedure is already in place in Aristotle's study of animals. Like Theophrastus, Aristotle at times takes the habitat of the animal to be a primitive fact and a starting point for his explanations.³⁶ Second, this discussion helps us see how dealing with an exceptional case (and dealing with it immediately after outlining his general explanation) is not a digression but an important part of the main task, which is to account for the complexity of the world of plants. By showing how a difficult case can fit the outline of the explanation, Theophrastus is able to strengthen the case for this explanation.³⁷

³⁵ Theophrastus, *CPI* 2.1–4.

³⁶ Here is one example taken from the theory of animal locomotion: egg-laying four-footed animals like lizards bend their legs obliquely and away from their body because they are hole-dwellers (*IA* 15, 713a16–25). In this case, the *explanandum* is the unique way in which a group of animals bends their legs. The explanation is given by taking the way of life – what Aristotle calls the *βίος* – as the starting point of the explanation. For a discussion of this aspect of Aristotle's explanatory strategy, I refer the reader to LENNOX 2010a: 239–258 and GELBER 2015: 267–293. For an in-depth discussion of *IA* 15, see JANSEN 2021: 266–281.

³⁷ Let us return, once more, to the explanation of animal locomotion for an instance of the same strategy in Aristotle's study of animals. Crabs appear to be a notable exception to the general rule

As soon as the discussion of a *prima facie* exception to the general explanation is in place, Theophrastus turns to a detailed account of which plants are generated from which parts. In this stretch of text Theophrastus applies the explanatory strategy already adopted in the context of his general account. He explains the specific mode of propagation, starting from what he takes to be explanatorily primary. What is taken to be explanatorily primary is traced back to the substance or essence of a plant. For example, the fig tree can propagate by a twig because its extremities are by nature tender and moist. These extremities preserve the *living principle* (ζωτική ἀρχή), which has to do with their innate moisture and heat. By contrast, propagation by a twig is rare in the case of the almond tree because of its overall dry nature. Finally, this mode of generation is outright impossible in the case of the bay tree because of a combination of two features that are specific to this plant: the dryness of its nature and the open texture of its wood. The latter feature does not help preserve the limited internal moisture present in the bay tree. By contrast, the combination of a moist nature and a close texture in a plant is ideal for its propagation by a part other than seed. The olive tree is mentioned in this context because its close texture and oily nature explains why its extremities remain tender when they are cut. Having an oily nature, the cuttings of an olive tree do not dry out quickly. However, the olive tree cannot propagate by a branch.³⁸

As a rule, trees propagate by means of side-shoots when the roots are shallow and do not penetrate deep in the ground, or when, in their root system, there is a combination of deep and shallow roots. In addition, there must be an accumulation of moisture in the root system, which is concocted by the sun. What is set up by the sun results in a κύημα, which eventually sends out a new growth.³⁹ To understand how Theophrastus envisions this process, we must recall what Aristotle says in *GA* on the topic of κύημα. In a recent, helpful essay, Ignatio de Ribeira Martín has shown that Aristotle uses the term σπέρμα to refer to the first mixture (the first κύημα) that contains the generative contributions coming from the male and the female.⁴⁰ While this passage has often been regarded as a possible

that animals progress *forward*. In fact, they seem to progress *diagonally* (*IA* 14, 712b16–712b21). Aristotle explains this apparent anomaly away by pointing out that the eyes of crabs are implanted on their two sides. In other words, crabs move obliquely with respect to us but forward relative to themselves. They move forward relative to themselves because their eyes are implanted on the parts that functionally operate as the front of the animal. Upon reflection, what appeared to be a *prima facie* challenge to the general rule ends up strengthening it. For an explanation of how crabs displace themselves and what this explanation means for the general theory, see JANSEN 2021: 266–281.

³⁸ Theophrastus, *CPI* 3.1–3. ³⁹ Theophrastus, *CPI* 3.4. ⁴⁰ Aristotle, *GA* I 18, 724b12–19.

interpolation, De Ribeira defends its authenticity.⁴¹ Far from creating a textual problem, this apparently anomalous use of σπέρμα suggests that there is a genuine Aristotelian notion of seed, and indeed of κύημα, that is common to both animals and plants regardless of their mode of reproduction.

In the theory of animal reproduction, the κύημα is the first mixture of the female and the male: that which is first set up and is ready to grow.⁴² Moreover, depending on the mode of generation, this mixture is either an embryo, a fertilized egg,⁴³ or a grub. Like animals, plants have a κύημα, and this is their seed (σπέρμα). This conclusion is confirmed by what Aristotle says in the following passage:

In plants too these potentials are mixed, and the female and the male principles are not separate. As a result, they generate from themselves and emit not semen [γονή] but rather a κύημα – what we call seeds [σπέρματα].⁴⁴

Immediately after our passage, Aristotle goes on to recall the following line from the lost poem of Empedocles: “*the tall trees lay their eggs, olives, first.*” Aristotle cites this line with approval because fertilized eggs are an instance of κύημα. In his view, fertilized eggs are analogous to seeds in plants, so there is more than a grain of truth in the Empedoclean claim that trees lay eggs. Far from taking a poetic license, Empedocles points to the existence of an important analogy in nature between plants and animals – or so Aristotle would like to read Empedocles. In a moment, we will see that Theophrastus recalls the same Empedoclean fragment in *CPI*. For the time being, what is immediately relevant is that “κύημα” is a technical term in the Peripatetic study of perishable living beings. When they speak of κύημα, Aristotle and Theophrastus mean that which is first set up and can grow. The side-shoots are an instance of κύημα because they have the power to send out a new growth. They grow in the root system of the plant whenever the right conditions are in place. Once more, the roots are to be close to the surface, and there is to be enough moisture coming together at the right time. Theophrastus goes on to say that there is nothing fixed about the place where a side-shoot appears in the root system because the

⁴¹ DE RIBEIRA 2019: 87–124. For the view that the passage is not authentic, see PECK 1942: 76. Drossaart Luif prints the text in square brackets in his edition of Aristotle’s *GA*. In the *apparatus criticus* he indicates that he follows Peck (“*secl. Peck*”). BALME 1992: 145 defends the authenticity of the transmitted text but does not explain how this passage contributes to Aristotle’s argument.

⁴² Aristotle, *GA* I 20, 728b32–34.

⁴³ Wind-eggs are an instance of imperfect κύημα because they can grow only up to a point. Full discussion in DE RIBEIRA 2019: 105–107.

⁴⁴ Aristotle, *GA* I 23, 731a1–4.

right conditions for the formation of a κύημα obtain randomly. Plants such as the pear tree and the pomegranate tree have a large root system, so they can send up shoots not only close to their trunk but also at some distance from it – wherever the right conditions are present.

For Theophrastus, the explanation of how plants propagate must be given separately – namely, by considering the different modes of propagation. Still, the complexity of this task should not be underestimated. Within each mode of propagation there is a great deal of variation. Dealing with this variation requires the application of the explanatory strategy that Theophrastus has outlined in *HP*. A perceptive reader may have already noticed that Theophrastus offers his outline of the explanation for *trees* (δένδρα). This kind of plant is the primary focus when Theophrastus begins to fill out the relevant details because the relevant articulation is present in trees in the clearest possible way. However, as Theophrastus explains the various modes of generation beyond the paradigmatic case of trees, he no longer adopts any of the large groups of plants introduced in *HP* I 1.5. Rather, he speaks of “woody and herbaceous plants.”⁴⁵ Theophrastus is not as forthcoming as we would like him to be about his reasons for what looks like a change in strategy. We need to bear in mind, however, that the theory of scientific inquiry outlined in Aristotle’s *Posterior Analytics* requires the investigator to give explanations at the right level of generality. Presumably, the articulation of plants into shrubs, under-shrubs, and herbaceous plants is no longer useful in the context of the explanation of plant propagation. Hence, Theophrastus adopts the following, alternative procedure: he begins his explanatory work by focusing on the case of trees and subsequently extends some of the results achieved in the study of trees to the class of woody and herbaceous plants understood as a more convenient grouping for the sake of his explanatory concerns.⁴⁶

In the transition from the study of trees to that of woody and herbaceous plants, Theophrastus is quite explicit about his overall strategy:

The other trees cannot do this [*sc.* fill out the space around them with shoots] to the same extent, but this phenomenon happens in certain woody and herbaceous plants. Since we have said enough on the topic of trees, our discussion must turn to these plants. *The modes of generation in these plants*

⁴⁵ This is not one of the largest kinds outlined at the outset of *HP*. For a close but not identical expression, see “woody plants and vegetables” at *HP* I 6.7.

⁴⁶ One might worry that this procedure creates a tension with the pre-explanatory stage of inquiry, which is supposed to prepare the ground for the explanatory work. This worry can be addressed if we keep in mind that the largest kinds of plants only provide a first orientation to the subsequent study. At the very least we can say that this division is not binding for Theophrastus.

must be studied from the same considerations as before – namely by positing that the most common mode of generation, common to all, is generation from seed. But there is more than one mode of generation also in these plants. Each of them must be distinguished in so far as they have points of contact with what has been previously discussed [τούτων δὲ τὰς μὲν γενέσεις ἐκ τῶν αὐτῶν θεωρητέον, κοινοτάτην πᾶσι τὴν ἀπὸ σπερμάτος τιθέντας. οὐ μὴν ἀλλὰ πλείους εἰσὶ καὶ τούτων, ἥ δὲ ἕκαστα τῶν προειρημένων ἐφάπτεται, ταύτῃ διαιρετέον].⁴⁷

As Theophrastus moves away from trees, he extends the strategy adopted for the study of trees to the study of the remaining kinds of plants. Since there are several modes of propagation beyond that which is common to all plants – generation from seed – the focus will be on what is specific about the different modes of propagation in woody and herbaceous plants. There is a great deal of variety in the way in which these kinds of plants propagate: some woody and herbaceous plants propagate from their roots, others from a side-shoot, still others from a detached extremity. Theophrastus does not repeat himself as he deals with these kinds of plants. Rather, he offers a separate explanation of the various modes of generation with a focus on what is specific, if not even unique, about each of them. By so doing, he progressively fills out the general outline by accounting for how different kinds of plants are generated.

I will not engage in a detailed study of what Theophrastus accomplishes in this stretch of text. Instead, I would like to turn to his discussion of spontaneous generation, which is mentioned as one of the modes of generation at the outset of *CP* I. Theophrastus returns to it only when he has completed his discussion of generation from a seed or by a part other than the seed. By so doing, Theophrastus adopts an explanatory strategy that reminds us of one that Aristotle employs in his study of animal generation. Recall that Aristotle begins his account of animal generation by focusing on sexual generation. For Aristotle, this is the central case of animal generation. He turns to the study of spontaneous generation only when his account of sexual generation for live-bearing, egg-laying, and grub-producing animals is in place. This means that he deals with spontaneous generation only at the very end of *GA* III. Moreover, Aristotle approaches spontaneous generation by employing the theoretical framework developed for the study of sexual generation. It is worth recalling a key methodological passage taken from the beginning of *GA*:

As for the generation of the other animals [*sc.* those that do not reproduce sexually] we must speak about each of them according to the ongoing

⁴⁷ Theophrastus, *CP* I 3.5–4.1.

argument, *building it from what has been said* [ἀπὸ τῶν εἰρημένων συνείποντος].⁴⁸

Theophrastus employs a similar strategy in his discussion of spontaneous generation in plants. He turns to this mode of generation only after he has completed his study of the other modes of generation. He too treats this mode of generation as an eccentric phenomenon. Right from the start, as he tries to make sense of this phenomenon, Theophrastus refers to the account of spontaneous generation given for animals:

To speak in general, [spontaneous generation] occurs when the earth is thoroughly warmed and the collected mixture is altered by the sun, *as we see also in the case of animals* [καθάπερ ὁρώμεν καὶ τὰς τῶν ζώων].⁴⁹

The first-person plural in the words highlighted in italics is open to more than one reading. It may be taken to mean that spontaneous generation is in plain sight, and we all can observe this phenomenon in the case of animals. I am not persuaded by this reading. While it is true that ancient Greek zoogonies were committed to the spontaneous emergence of life from earth and water, spontaneous generation was emphatically not an obvious phenomenon.⁵⁰ Furthermore, Theophrastus describes it as beyond the reach of our senses.⁵¹ *Spontaneous generation is something we see only when we are equipped with a certain theoretical framework.* Theophrastus seems to be gesturing at this theoretical framework when he mentions the sun as the proximate moving cause and the earth as the relevant material cause. This language reminds us of what we read in *GA* III 11. This does not mean, I hasten to add, that Theophrastus is referring his reader to *GA* III 11. Nor does it mean that he is blindly transferring results achieved in one field of study (animals) to another (plants). Theophrastus remains mindful of what is specific about plants and animals, which he considers from the outset to be two separate fields of study.

In his discussion of spontaneous propagation, Theophrastus seems to be largely concerned with *restricting* the genuine cases of spontaneous generation. Theophrastus reminds us that wind or water can import unseen seeds that can then grow under the appropriate circumstances. Far from being spontaneous, this propagation is analogous to sowing seeds and planting.⁵² He also notes that there are many cases, especially among

⁴⁸ Aristotle, *GA* I 1, 716a2–4. ⁴⁹ Compare Theophrastus, *CP* I 5.2.

⁵⁰ For more on the ancient Greek zoogonies in connection with the view that life emerges spontaneously from earth and water, see CAMPBELL 2014: 233–247.

⁵¹ For this claim, see Theophrastus, *HP* III 3.1.5. ⁵² Theophrastus, *CP* I 5.3.

herbaceous plants, in which seeds are not evident to the naked eye but they become manifest in their subsequent effects (e.g., the growth of flowers). But even in large trees seeds may be difficult to observe, even by the expert eye. In the case of the cypress, for instance, this is not the round-shaped fruit but rather the thin and unsubstantial bran-like flake that is found in it.⁵³ Finally, in addition to propagation from unnoticed seed there is also propagation from a root, which is especially evident when the plants are very close to one another as in a wood.

Theophrastus ends his review of the putative cases of spontaneous propagation with the claim that additional data are needed.⁵⁴ At the very least, we can say that the corpus of writings that has been transmitted to us is not meant to be his last word on the topic of plants. Theophrastus acknowledges that more work is needed both at the *ᾠτι*- and the *διῶτι*-stage of inquiry to fully account for the complexity of the world of plants. In particular, the Greek verb *ἀνιστορῆσαι* (“to make an additional inquiry”) points to the need for a fresh collection of data with a focus on the putative cases of spontaneous generation. Additional data are needed for at least two reasons. To begin with, plants are a separate domain of investigation, so we cannot rely too heavily on what we know about spontaneous generation in animals. But there is also a tendency to rely too much on the phenomenon of spontaneous generation when it comes to how plants propagate. Theophrastus is critical of this overreliance. Scholars often read into his criticism an attack on Aristotle. I do not agree with them. First, his stance appears to be quite general, and I see no reason to read into it a criticism, let alone a revision, of what Aristotle says on the topic of spontaneous generation.⁵⁵ Second, Aristotle is concerned with spontaneous generation in animals. There is no evidence that Aristotle thinks that we can mechanically transpose what we have learned about spontaneous generation in one field of study to another. Third, like Theophrastus, Aristotle operates with the general rule of inquiry that all investigations should be tailored to their specific domain. At the very least, he must be ready to adapt his theory of spontaneous generation to fit the case of plants. More to the point: the first, and indeed crucial, step in this direction is the one that Theophrastus calls for – namely, a fresh collection of data. In sum, there is no textual evidence for the view that Theophrastus is targeting Aristotle’s theory of spontaneous generation in this stretch of text. One possibility is that Theophrastus is reacting to the special role assigned to spontaneous generation in the

⁵³ Theophrastus, *CPI* 5.4.

⁵⁴ Theophrastus, *CPI* 5.5.

⁵⁵ Pace AMIGUES 2012: 126.

early zoogonic accounts, where the emergence of life is often explained via the emergence of plants from mud.⁵⁶

The account of the various modes of generation does not bring the discussion of plant propagation to a conclusion. Theophrastus continues with a long and rather technical discussion of grafting.⁵⁷ We are not told why grafting is discussed here rather than elsewhere. An educated guess is that grafting is an instance in which craft complements, indeed completes, nature. This is an insight that goes back to Aristotle.⁵⁸ After grafting, the treatment of generation in plants ends with a discussion of the seed of plants.⁵⁹ The seed of all plants contains within itself a certain amount of nutriment, which is generated together with the principle. Presumably, the principle in question is the vital principle (ζωτική ἀρχή). In this respect, the seed is just like a fertilized egg.⁶⁰ We have already seen that for Aristotle the seed is analogous to a fertilized egg – namely, the first thing that is set up (κύημα) and that from which a new living being grows. Like Aristotle, Theophrastus recalls the Empedoclean line where trees are compared to egg-laying animals: “*the tall trees lay their eggs*.” Theophrastus finds more than a grain of truth in this claim. Like Aristotle, Theophrastus takes Empedocles to offer an *analogy* that allows us to move from the study of animals to the study of plants.⁶¹ Unlike Aristotle, however, he finds reasons for a criticism. It is the criticism of a student of nature who is engaged in a systematic study of plants and is concerned with making a statement that is as accurate and as general as possible. For Theophrastus, Empedocles is wrong because he has arbitrarily confined himself to the case of trees:

Empedocles has not put it badly by saying “*the tall trees lay their eggs*” [ῥοτοκεῖν μακρὰ δένδρα]. The nature of seeds is like that of eggs, *but he should have spoken about all plants and not only about trees* [πλὴν ἔδει περὶ πάντων εἰπεῖν καὶ μὴ μόνον τῶν δένδρων].⁶²

Theophrastus complains that Empedocles spoke about trees rather than plants. This is a remark made from the perspective of a student of nature engaged in a systematic study of plants and concerned with making statements that are as accurate and as general as possible. But we can safely say that the noun δένδρα does not have the same meaning for Empedocles and Theophrastus. For Theophrastus, this noun refers to a certain kind of

⁵⁶ More on this in Chapter 1, Section 1. ⁵⁷ Theophrastus, CP I 6.1–10.

⁵⁸ For this claim, see Aristotle, *Phys.* II 8, 199a15–17. ⁵⁹ Theophrastus, CP I 7.1–3.

⁶⁰ Theophrastus, CP I 7.1.

⁶¹ But it is far from clear that Empedocles meant to offer an analogy. See Chapter 1, Section 1.

⁶² Theophrastus, CP I 7.1.

plants as defined at the outset of *HP*. His definition offers us a first outline of the kind of plant that plays a special role in the collection, organization, and explanation of the botanical data.⁶³ When, therefore, Theophrastus says that Empedocles should have extended his discussion beyond the case of trees, he means to say that Empedocles should have extended the account developed for the paradigmatic case of plants to all kinds of plants. Put differently, Theophrastus reminds his reader that the ultimate scientific goal is to give a full account of the complexity of the botanical data to be approached via an application of the account developed for the paradigmatic case (trees). Stopping at the account of trees would be falling short of delivering on that front. But there is absolutely no reason to think that Empedocles was committed to this sort of principle. He appears to be innocent with respect to the explanatory concerns motivating the Peripatetic study of perishable life. It is difficult, if not impossible, to reconstruct the original context of his fragment. In all probability, Empedocles chose the word δένδρεα for metrical reasons and used it as a *pars pro toto*.⁶⁴

Although brief and selective, the foregoing discussion highlights the existence not only of a set of explanatory strategies but also of a network of concepts shared by Aristotle and Theophrastus. The application of these explanatory strategies and the employment of these concepts, remarkable as it is, is no substitute for separate studies of generation in plants and in animals. Aristotle and Theophrastus agree that there is no way to arrive at a scientific understanding of the phenomenon of generation in animals and plants except by engaging in a study of what is specific about each of them. Contrary to what one might initially think, the main challenge faced in the study of generation in plants is not that plants lack the distinction between male and female.⁶⁵ This absence could be easily circumvented by invoking the Aristotelian observation that the seed is the first mixture of the male and the female – namely, the first κύημα.⁶⁶ The main challenge is rather that plants, unlike animals, propagate in a number of ways, and that they do so as a direct consequence of what is specific to their own form of life.

⁶³ I refer the reader to Chapter 4, Section 3.

⁶⁴ The word δένδρεα consists of one long syllable followed by two short vowels (–υυ). This works well for dactylic hexameter, the meter of didactic poetry. Both δένδρον and δένδρεα (coming from the Ionic form δένδρεον) are already well-attested Homeric terms. See also Chapter 1, Section 1.

⁶⁵ For this claim, see Aristotle, *GA* I 23, 731a1–2; *GA* II 4, 741a3–5; *GA* III 10, 759b30–31; *GA* IV 1, 763b21–25. For the claim that whenever possible it is better for the male and the female *qua* principles of generation to be separated, see *GA* II 1, 732a6–11.

⁶⁶ Aristotle, *GA* I 23, 731a1–5.

Both Aristotle and Theophrastus agree that plants have life everywhere, so they can grow everywhere.

It is very telling that, from the beginning to the end of his account of the generation of plants, Theophrastus consistently speaks of *modes of generation*.⁶⁷ It is difficult to see how, by approaching generation on the working hypothesis that this phenomenon is to be studied in common for animals and plants, we could do justice to this aspect of plant life. The Peripatetic decision to deal separately, first with animals and then with plants, not only does justice to what is specific about generation in animals and plants; it also gives us a theoretical framework to deal with propagation in plants based on the results achieved in the study of reproduction in animals. At this point, we can fully appreciate the implications of the decision Aristotle makes at the outset of the theory of animal generation offered in his *Generation of Animals* when he tells us that plants must be studied separately by themselves.⁶⁸

3 Growth, Sprouting, and Fructification

The systematic account of the various modes of generation in plants comes to a natural end with a discussion of the nature of seed. By the end of *CP* I 7, Theophrastus is confident that he has fulfilled the promises made at the outset of the book:

The *modes of generation* [γενέσεις] – how they occur, how many they are, and what modes are proper to what kind of plants – are clear from what we have said.⁶⁹

What follows in the rest of *CP* I is a systematic treatment of growth, sprouting, and fructification. It does not take long to realize that a study of these processes is a natural, indeed inevitable, continuation of the study of generation (γένεσις). To see why, it may be helpful to return to Aristotle and his theory of animal generation.

Recall that Aristotle does not stop his account of animal generation at birth but treats generation as a single continuous process from a fully developed animal to another fully developed animal of the same kind.⁷⁰ The Aristotelian slogan that it takes a human being to generate a human

⁶⁷ Aristotle adopts the same language in *GA* III II, 761b26–27. ⁶⁸ Aristotle, *GA* I I, 716a1.

⁶⁹ Theophrastus, *CP* I 7.5.

⁷⁰ Chapter 3, Section 4. Additional information on Aristotle's explanatory strategy in *GA* is in GOTTHELF-FALCON 2017: 15–34. Compare LEUNISSEN-GOTTHELF 2010: 325–356 (reprinted as chapter 5 in GOTTHELF 2012a: 117–141).

being fixes not only the starting point but also the end point of the study of animal generation.⁷¹ The study of the generative process starts from the parents and their particular nature and is not over until the generative process is also over. However, the generative process is over only when another fully developed animal of the same kind is in place. Theophrastus adopts a similar approach. Like Aristotle, he begins his investigation of plant propagation by taking the substantial being (οὐσία) of a fully developed plant as his starting point. As a result, the generation (γένεσις) of the plant is explained starting from its οὐσία rather than vice versa. Furthermore, like Aristotle, Theophrastus takes γένεσις to include all the natural processes that lead from one fully developed plant to another fully developed plant of the same kind. This explains why sprouting, flowering, and fructification are suitable topics of discussion in the context of *CP* I. Quite tellingly, Theophrastus speaks of sprouting as “second (as opposed to first) generation [γένεσις].”⁷²

3.1 Growth and Sprouting

The first topic discussed in the second part of *CP* I is growth, with a focus on the remarkable variation that plants display in their relative speed of growth.⁷³ Two phenomena call for an explanation in connection with this: (1) within the same kind of plant, a plant grows faster from a slip or a root than from a seed, and (2) across different kinds of plants, some plants grow faster than others. The explanation of the first phenomenon is offered as reasonable (εὐλόγως): all the parts of the plant are already present in a slip, so these parts only need to grow; by contrast, the seed must first send out these parts. A similar point is made with respect to propagation from the roots as it happens in the case of bulbous plants. Bulbous plants already have large roots with a strong impulse toward sprouting. Hence, it is reasonable (εὐλόγως) that these plants grow faster and more efficiently from their roots than from a seed.

The explanation of the first phenomenon does not invoke the specific nature of the plant. This is not surprising because Theophrastus is trying to account for a variation within the same kind. Since all the plants within the

⁷¹ I note, in passing, that Aristotle is happy to extend this important insight to plants. See Aristotle, *PA* II 1, 646b34: “it takes a human being to generate a human being, and it takes a [certain kind of] plant to generate a [certain kind of] plant.”

⁷² For sprouting as second generation, see *CP* I 10.1. The expression “first generation” is used again in *CP* I 12.1 and *CP* I 12.4.

⁷³ Theophrastus, *CP* I 8.1–4.

same kind share the same nature, the difference in their relative speed of growth cannot be traced back to the nature of the plant. But as soon as Theophrastus compares the rate of growth across different kinds, he turns to the specific nature of the plant, which he treats as the primary explanatory factor. At the most general level, two ingredients are invoked as primary in the explanation of different rates of growth: openness of texture and innate moisture. Plants that are more open in texture and have more innate moisture grow faster. For instance, the pomegranate tree and the fig tree are rapid growers. By contrast, the date-palm, the cypress, and the olive tree are slow growers. These plants are slow growers because they have a close texture and a dry nature. The discussion of growth ends with the observation that growth from seed not only takes longer but is also not as efficient in the case of trees.⁷⁴

Sprouting is the next topic on Theophrastus's agenda.⁷⁵ We are told that both early and late sprouting within the same kind and across different kinds call for an explanation. In some cases, early sprouting is due to the amount of nutriment. But we also know of early sprouting due to the weakness of the plants. For instance, herbaceous plants – and more generally, annual plants – sprout early. As in the case of growth, the variation in behavior in sprouting can be traced back to the specific nature of the different kinds of plants. Abundant moisture and an open texture give rise to early sprouting, whereas a dry nature and a close texture are found among late sprouters. Clidemus's view that the relative coldness or heat has an impact on the time of sprouting is recalled. According to the latter, plants with a colder nature sprout in summer, whereas those that exhibit a hot nature do so in winter. Theophrastus does not reject this claim, but his considered position is that early or late sprouting depends on a combination of factors: the relative heat and moisture of the plant, as well as its open or close texture. The weakness of the plant, the amount of nourishment available, and other conditions that can be traced back to the environment play the role of auxiliary causes (συνάιτια).⁷⁶ The case of evergreen plants is discussed at the end. These plants constitute a well-demarcated group whose behavior can be explained in general terms (καθόλου). All the plants that belong to this group sprout and bear fruit later than all other plants because they have a dry nature and a close texture, and they do not shed leaves. Since they do not shed their leaves, they are required to distribute nutriment to their leaves all year round. As a result, no extra nutriment is left for early sprouting.

⁷⁴ Theophrastus, *CP I* 9.1–3.

⁷⁵ Theophrastus, *CP I* 10.1–7.

⁷⁶ Theophrastus, *CP I* 10.3.

What follows in the text is a discussion of plants that sprout and bear fruit all year round.⁷⁷ Theophrastus deals with an *aporia*, which he solves in three steps. First, Theophrastus traces the phenomenon of sprouting back to an essential feature shared by all plants: all plants have life everywhere, which explains why they can sprout everywhere.⁷⁸ Second, he notes that each sprout is like a plant in the sense that it has the power to grow in the tree just as the plant grows in the ground. Although all sprouts have the power to grow, they do not have the same power; rather, some grow faster than others. As a result, sprouting is not a simultaneous phenomenon.⁷⁹ Up to this point, Theophrastus has made a reference to facts that are common to all kinds of plants. The third and final step consists in invoking a feature that is uniquely possessed by ever-sprouting plants. This feature can be traced back to their specific nature. Like evergreen plants, these plants bring nutriment to their leaves all year around; unlike evergreen plants, their supply is so rich and continuous that, in addition to retaining their leaves, they can also generate new parts. Hence, they can generate new sprouts and bear fruit all year round.⁸⁰

Establishing whether growth above and below ground takes place at the same time or rather at different times comes next in the order of explanation.⁸¹ After reporting the reasons of those who argue that the roots grow in autumn and winter whereas the trunk and branches grow in spring and summer, Theophrastus reviews the arguments for a simultaneous growth of the upper and lower part of the plant. This is one of the most interesting stretches of text in *CP* I. Here Theophrastus invokes ideas and concepts that are familiar from reading Aristotle. He distinguishes the initial stage of generation from later stages of the same process. While in the *first generation* one part grows before the other in a definite sequence (the roots grow before the shoot), in the *second generation* the entire bulk of the plant not only feeds but also develops simultaneously and continuously everywhere. The analogy with animals is invoked to corroborate this point: in animals, too, the heart and the

⁷⁷ Theophrastus, *CP* I II.1–8.

⁷⁸ Theophrastus, *CP* I II.4. Theophrastus says that this is a feature that belongs to the οὐσία of all plants. We have seen that this is what makes plants another kind of perishable living being different from animals.

⁷⁹ Theophrastus, *CP* I II.4. ⁸⁰ Theophrastus, *CP* I II.6–7.

⁸¹ It is not immediately clear why this question is not addressed in the context of the discussion of growth, but it is postponed until after the treatment of sprouting. An educated guess is that since Theophrastus refers to sprouting in his attempt to answer this question, he considers the present order of study to be the optimal one for his overall argument.

parts around the heart are generated first but then the growth of the animal happens continuously and simultaneously.⁸² As always, there is no explicit reference in Theophrastus to any text or claim made by Aristotle. But we do know that the order in which the different body parts are generated is a major concern in Aristotle's theory of animal generation. According to the account offered in *GA* II 6, the heart is generated first in blooded animals (and whatever is analogous to the heart in bloodless animals).⁸³ Right after the heart, the blood vessels extend from the heart and the upper part of the body in outline.⁸⁴ We can see here a reliance on results reached in the study of animals. These results offer a first orientation as we turn from animals to plants; they are also used to develop a set of tools that can be used to speak of the generative processes in animals and plants in analogous terms.

To be sure, there is an analogy between first generation in plants and first generation in animals. In both cases we are dealing with a generative process taking place in a definite sequence of steps. The same analogy holds when we move beyond what Theophrastus calls the first generation: just like animals, plants grow simultaneously everywhere. It would be absurd, Theophrastus says, if the nutritive power responsible for forming the plant should be active in some parts but not in others, or if the bodily instrument that it uses, either *pneuma* or the fire, should not reach all the parts of the plant alike. It is worth recalling the passage in its entirety:

Since it is also absurd if *the nutritive power* [τὸ θρεπτικόν], which forms [the plant] and gives nutriment [to what is formed] should divide its activity in accordance with the various part; or again, [it is also absurd] if that which carries out this activity, which is something bodily (either *pneuma* or fire) should do it, for it is unlikely that these [bodily things] should operate in this way either. But whenever they are jointly stirred by the season, they pervade all the plants alike.⁸⁵

⁸² Theophrastus, *CP* I 12.4. The Greek τὰ περὶ τὴν καρδίαν is a generic designation for the parts around the heart. Based on what we read in Aristotle's *GA*, we can be more precise: the blood vessels that extend from the heart.

⁸³ Aristotle, *GA* II 6, 742b35–743a1. Compare what Aristotle says on generation from the center of the living body in common for animals and plants (*Juv.* 3).

⁸⁴ Aristotle, *GA* II 6, 743a1–3: “the blood-vessels extend from the heart, as when artists sketch out preliminary figures on the walls. The reason is that the parts are arranged around the blood-vessels because they come to be from them.”

⁸⁵ Theophrastus, *CP* I 12.5: ἐπεὶ καὶ ἄτοπον εἰ τὸ θρεπτικόν, ὃ δὴ διαπλάττει καὶ δίδωσι τροφάς, διαίρεται κατὰ μέρη τὴν ἐνέργειαν, ἢ πάλιν εἰ τῶν σωματικῶν τὸ ἐνεργεῖν, οἷον πνεῦμα ἢ πῦρ, οὐδὲ γὰρ ταῦτα εἰκός. ἀλλ' ὅταν ἅμα ταῖς ὥραις κινήθωσιν, ὁμοίως δι' ὅλων διήκειν τῶν φυτῶν. In

Expressions such as “τὸ θρεπτικόν,” “τὸ φανταστικόν,” and “τὸ ὀρεκτικόν” are familiar from reading Aristotle, who uses them to refer to specific powers of the soul.⁸⁶ For Aristotle, the nutritive capacity (τὸ θρεπτικόν) is the most common power shared by all perishable living things insofar as they are ensouled beings.⁸⁷ The exercise of such a power requires a bodily instrument. Aristotle makes it clear that the nutritive power employs heat as an instrument for the concoction of food.⁸⁸ What matters most to him in this context is to be as clear as possible on the following crucial point: this bodily instrument alone cannot explain the phenomenon of nutrition and growth. His polemical targets are all those theories that explain nutrition and growth in a purely material way with reference to fire. For Aristotle, the efficient and final cause (αἴτιον) of nutrition and growth is an incorporeal power of the soul, while fire is at most a co-cause (συναίτιον).⁸⁹ While fire is required for processing food, the mere presence of heat does not suffice on its own to explain the phenomena of nutrition and growth.⁹⁰

In the context of his study of animals, Aristotle is more specific about the bodily instrument used by the soul. For instance, toward the end of *GA* V 8, and in the context of his criticism of Democritus and his materialist explanation of the formation of teeth, he identifies this bodily instrument with *pneuma*, which he describes as an instrument (an ὄργανον) useful for many functions in natural processes like the hammer and anvil in the art of the smith.⁹¹ One may wonder whether there are other functions that *pneuma* performs in Aristotle’s zoological theory beyond contributing to the explanation of the process of generation, nutrition, and growth. Consider Aristotle’s theory of animal motion, where *pneuma* is introduced as the instrument of animal

this exceptional case, I give the full Greek text. I follow the punctuation offered by Benedict Einarson. I also follow his translation (with only minor modifications). Suzanne Amigues appears to have a different understanding of our passage since she places a full stop after πῦρ (rather than after εἰκός). On her reading, Theophrastus is envisioning two *alternative* scenarios. In the first scenario, the nutritive power of the plant is responsible for the simultaneous growth of all its parts. In the second scenario, either fire or *pneuma* is the bodily principle responsible for the simultaneous growth of the plant. On this reading, our passage would establish a contrast between the incorporeal and the corporeal principle of life rather than positing the need for both for an adequate explanation of the growth of the plant.

⁸⁶ But note that these powers are not all on a par for Aristotle. For more on this point, I refer the reader to Chapter 2, Section 2.

⁸⁷ Aristotle, *DA* II 4, 415a23–26. ⁸⁸ Aristotle, *DA* II 4, 416b26–29.

⁸⁹ Aristotle, *DA* II 4, 416a13–14. ⁹⁰ SHIELDS 2016: 206–207.

⁹¹ Aristotle, *GA* V 8, 799b9–12: “it is also likely that the operation of *pneuma* is like an instrument for many things. As some instruments are of many uses to those involved in the arts (e.g., the hammer and the anvil in the art of the smith), so too is *pneuma* in those things that are naturally constituted.”

motion.⁹² A full discussion of how Aristotle explains a single episode of animal motion goes emphatically beyond the scope of this book.⁹³ What matters most now is that the mechanism Aristotle envisions requires, in addition to a power of the soul, also the presence of a bodily instrument. The latter is *pneuma*, which is regarded as a non-expendable moved mover that works along with an unmoved mover (the relevant power of the soul) in each single episode of animal motion.⁹⁴

It is against this background that we should read what Theophrastus says when he mentions the nutritive power along with fire and *pneuma*. Theophrastus is not envisioning two competing explanations of nutrition and growth without choosing between them – namely, one that invokes an incorporeal capacity (the threptic or nutritive power of the soul) and another that invokes a corporeal cause (either fire or *pneuma*). Rather, he is integrating the incorporeal capacity and the corporeal instrument into a single explanation. The nutritive (or threptic) power works together with the bodily instrument in the explanation of how nutrition and growth take place. Theophrastus does not decide whether this bodily instrument is *pneuma* or fire. Both are regarded as plausible candidates to carry out the relevant activity. His main concern is to stress that the threptic power along with its dedicated bodily instrument (whether it is fire or *pneuma* does not really matter to him) are not likely to perform their activity by taking one part of the plant at a time. When the right time comes – presumably, when springtime comes – they are jointly stirred into activity; as a result, they pervade the plant and act upon the whole of it in like manner.

Immediately after our passage, Theophrastus adds a criticism directed at Empedocles, who reportedly argued that earth is responsible for the growth of the roots and *aither* (which is equivalent to air in Empedocles's theory) for the growth of the shoots. Theophrastus rejects this explanation and argues that the growth of the plant requires a single matter and a single cause.⁹⁵ While it remains true that the weather has an impact on the growth of a plant (cold weather stops the growth of the plant while good weather triggers it), the plant grows everywhere because it has the

⁹² Aristotle, *MA* 10, 703a5–28. For the claim that *pneuma* is an instrument of animal motion, see 703a20.

⁹³ For more on this topic, see CORCILIUS-GREGORIC 2013: 52–97.

⁹⁴ I note, in passing, that thinking of *pneuma* as a non-expendable moved mover in a causal chain of motion may help us give some content to the anodyne term “co-cause” (συναίτιον) that Aristotle employs in *DA* II 4.

⁹⁵ Theophrastus, *CP* I 12.5.

principle of life everywhere. The connection between the principle of life, principle of growth, and principle of nutrition is made in the following passage:

All that is alive nourishes itself, and what has an impulse to grow grows as well: plants, both new and old, have an impulse to grow everywhere.⁹⁶

Theophrastus's considered position seems to be something like this: plants grow all year round even though their growth may be held back by cold weather. When the mild season comes, plants not only grow but also put out shoots. His explanation of this behavior is that the twigs and branches contain sources of life (ἀρχαὶ ζωτικαί). The upper part of the plant is pregnant in winter, but it is the wet and warm weather that triggers these sources or principles of life to put out the shoots.⁹⁷

This observation invites a question that is based on a comparison with animals. Theophrastus wonders whether what happens in plants is analogous to the fixed times of gestation and delivery observed in animals, or whether the behavior of plants is entirely controlled by the cycles of the seasons. Considering what happens to ever-sprouting plants in favorable climates, Theophrastus refrains from accepting the analogy with animals. There does not seem to be a fixed time of gestation in plants. Theophrastus goes on to offer the following, interesting, remark: "In our present cycle of seasons, trees are emptied in summer because of sprouting and fruiting, and then they are replenished again,"⁹⁸ so as to be able, because of this *antiperistasis*, to bring forth fruit and to sprout at the right times, having somehow a gestation both in their parts and in their whole plant."⁹⁹ The term *antiperistasis* is known to us from Aristotle.¹⁰⁰ Aristotle criticizes Plato for explaining breathing and projectile motion by means of *antiperistasis*.¹⁰¹

In the *Timaeus*, Plato explains a number of biological and physical phenomena in terms of *antiperistasis*.¹⁰² In addition to breathing and projectile motion, Plato lists acoustics, water currents, the descent of thunderbolts, and the alleged attraction exercised by amber and the lodestone.¹⁰³ Clearly, Aristotle wants to narrow down the acceptable uses

⁹⁶ Theophrastus, *CP* I 12.8. ⁹⁷ Theophrastus, *CP* I 12.9.

⁹⁸ Replenished with what? Recall that it is the nutritive power, via its bodily tools (either *pneuma* or fire), that controls growth, sprouting, and fruiting. Whatever is distributed to the extremities of the plant – let us call it nutriment – is entirely used up during sprouting and fruiting. As a result, the plant remains "empty." The plant is replenished once sprouting and fruiting are finally over.

⁹⁹ Theophrastus, *CP* I 13.3. ¹⁰⁰ Aristotle did not coin this term. See *Phys.* VIII 10, 267a15–16.

¹⁰¹ Aristotle, *Resp.* 6, 472b6–31 and *Phys.* IV 8, 215a14–15.

¹⁰² But Plato speaks of *περίωσις* (pushing around) rather than *ἀντιπερίστασις*.

¹⁰³ Plato, *Tim.* 79 A–80 C.

of *antiperistasis*. Still, he invokes it to explain meteorological phenomena such as winds.¹⁰⁴ He also employs it to explain how episodes of sleep occur in animals.¹⁰⁵ While Aristotle explain the alternation of periods of sleep and waking teleologically (sleep is for the sake of the preservation of the animals), he explains single episodes of sleep in non-teleological terms.¹⁰⁶ Something analogous happens in our passage. Sprouting and fructification are surely amenable to a teleological explanation. In *CP* I, Theophrastus speaks about these processes in terms that are unmistakably teleological. For instance, he is able to say that the fruit proper, namely the seed, is for the sake of the generation and perpetuation of the plants, or that the goal common to all plants is the production of the seed, since the end is the generation of another plant of the same kind.¹⁰⁷ He is also able to say that the outer covering that surrounds and protects the seed – the pericarp – is for the sake of the seed.¹⁰⁸ At the same time, however, he explains the cyclical occurrence of these processes in non-teleological terms by invoking *antiperistasis*. We do have the conceptual resources to combine the teleological and the *antiperistatistical* descriptions into a single coherent account: certain processes explicable in terms of *antiperistasis* must obtain if a given goal is to be reached.

3.2 Fructification

The discussion of fructification begins with the observation that there is a lack of correspondence between sprouting and fruiting: while most plants sprout at times very close to one another, and in the same season, they take longer to grow their fruit. Indeed, the ripening of the fruit happens at different times in different plants. Theophrastus explains this fact with reference to the matter involved in sprouting and fruiting: the

¹⁰⁴ Aristotle, *Meteor.* II 4, 360b22–26. ¹⁰⁵ Aristotle, *Somn.* 3, 458a25–28.

¹⁰⁶ See the definition of sleep that Aristotle gives at the end of the work *On Sleep*. This is not only the final but also the most precise definition of sleep: “sleep is the paralysis of the first sense-organ preventing it from operating, and it occurs on the one hand [μὲν] of necessity – for it is not possible for the animal to exist should the conditions that produce it not obtain – and on the other hand [δὲ] for the preservation of the animal” (*Somn.* 3, 458a28–32). *Antiperistasis* appears to be the crucial mechanism for the explanation of how an episode of sleep occurs when the conditions that produce it obtain. More on this in FALCON 2019: 516–543.

¹⁰⁷ Theophrastus, *CP* I 16.1: “fruit and seed are for the sake of [χάριν] generation and perpetuation of the trees.” Compare Theophrastus, *CP* I 16.3: “the seed is the common goal [τέλος] of all plants since the end is the generation of the like.” See Aristotle, *DA* II 4, 414a28: the goal of reproduction is “the production of another like itself.” Compare *GA* I 4, 717a21–22. Finally, *GA* I 23, 731a24–26: “there is no function or activity in the being of plants other than the coming to be of the seed.”

¹⁰⁸ Theophrastus, *CP* I 21.1: “the seed is the goal [τέλος] and what is for the sake of something else [*sc.* the pericarp] must exist before that [*sc.* the seed].”

matter employed for their fruit is purer, especially that used for the juices in the fruit. As a result, the ripening of the fruit takes not only more work but also more time. Furthermore, the great variation in the time of ripening is a function of the different nature of the fruit: a fruit that has a woody, earthy, dry, or oily nature takes longer to ripen. For instance, the almond tree flowers early but keeps its fruit for a long time because it has a woody nature. Having a woody nature, its fruit is hard to detach from the tree.¹⁰⁹

The discussion of the different behavior in sprouting, flowering, and fruiting continues with an explanation of the differences we observe when we compare domesticated and wild trees. Wild trees sprout earlier for a combination of causes: they retain more heat than domesticated trees because their soil is not dug up and the roots are not exposed to cold weather; moreover, unlike domesticated trees, their branches are not subject to pruning and thinning, so their generative principles are more numerous and more widely distributed even though they are smaller. And yet they fail to ripen their fruit, which creates an *aporia* because they are clearly stronger than domesticated trees. The solution is given by invoking, once more, a combination of causes. To begin with, the superabundance of fruit compensates for the superior strength of wild trees compared to domesticated trees. Moreover, the denser and drier nature of the moisture present in wild trees does not favor the ripening of their fruit. Theophrastus ends his discussion of the *aporia* by stating that, in general, it is not the case that the stronger organism, whether an animal or a plant, is also the more fertile, since the power and the strength that leads to the production of fruit, or to the generation of an offspring, is of a different kind.¹¹⁰

In connection with this statement, the editors of Theophrastus refer to a passage in *GA* I where Aristotle notes a difference even within the same kind of animals or plants: some have much seed while others have little seed, and still others have no seed at all, not because of illness but for the opposite reason – namely, because they are too healthy and too strong.¹¹¹ To make sense of this remark, we must keep in mind that for Aristotle the seed is a useful residue of nutrition. If most, or even all, nutriment is used up toward building a strong body, there is very little, or even nothing, left for the seed. It is not possible to establish whether

¹⁰⁹ Theophrastus, *CP* I 14.3–4. ¹¹⁰ Theophrastus, *CP* I 15.3–4. Compare 16.5.

¹¹¹ Aristotle, *GA* I 18, 725b25–726a6. Both Einarson and Amigues refer to this Aristotelian passage in their vastly different editions of Theophrastus's *CP*.

Aristotle's ideas are in the background of *CP* I. Still, there is no doubt that the nutritive and the generative power are one and the same capacity for both Aristotle and Theophrastus. If, therefore, the nutriment is used for the body, it cannot be used for reproduction and vice versa.¹¹² In *GA*, for example, this truth is invoked to explain why small birds such as the fowls lay more eggs than the crooked-taloned birds. While in the latter kinds of birds the nutriment is used up for building strong wings, long feathers, thick legs, and a bulky body, in the former the nutriment is available for laying more eggs and laying them more often. In Aristotle's own words, "what nature takes from one place it gives to another place."¹¹³

Theophrastus appears to be committed to a similar principle when he claims:

It is not the case that the strongest animals are the most fertile; it is perhaps the opposite, since the power of the nutriment is diverted to either one result or the other, which is what happens also in plants, and it happens reasonably. We ought to take the analogy in the following way: whichever of the two results the animal or the plant sets out to do, there will be a deficiency in the other, since the animal or the plant cannot reach both. This is agreed perhaps in all cases.¹¹⁴

Aristotle and Theophrastus agree that nature operates in an analogous way in animals and plants. In both kinds of perishable beings, there is a limited amount of nutriment that must be used for different goals. There is, however, an important disanalogy. Theophrastus discusses it because it is immediately relevant to understanding the different behavior in fructification among wild and domesticated plants. In animals, the nutriment is used either to build the body or to produce the seed; in plants, the nutriment that is diverted to the fruit goes either to the fruit proper, which is the seed, or to the outer covering that surrounds it. Aristotle and Theophrastus coined a technical name for this covering: the pericarp (literally "what surrounds the fruit").¹¹⁵ Theophrastus notes that the ripening of the fruit proper, namely the seed, and the ripening of the outer covering are contrary to one another: a bigger and juicier pericarp entails a smaller seed, whereas a bigger seed entails a smaller, harder, and

¹¹² Aristotle, *GA* III 1, 749b34–750a10. ¹¹³ Aristotle, *GA* III 1, 750a3–4.

¹¹⁴ Theophrastus, *CP* I 16.4.

¹¹⁵ From Aristotle we learn that the pericarp (περικάρπιον) exists for the sake of the seed as it is its shelter (*DA* II 1, 412b1–4; *Phys.* II 8, 199a25–30). Theophrastus comes close to making a similar statement in *CP* I 19.3: "the pericarp [περικάρπιον] is for the preservation of the fruit in view of reproduction."

ill-flavored pericarp.¹¹⁶ In wild trees, the nutriment goes to the seed, which is for the reproduction of another plant, at the expense of the pericarp. But in domesticated trees, husbandry diverts the nutriment from the seed to obtain a fleshier and juicier pericarp. The fleshy and juicy part that surrounds the seed is for human consumption.¹¹⁷

The treatment of fructification continues with a discussion of early and late bearers. Whenever the fruit is moist and surrounded by a thin membrane, the plant is an early bearer. Theophrastus illustrates this point with the help of the mulberry, which has a naked fruit and requires little help from the sun to ripen. The fruit of vine and fig trees ripens later than the fruit of the mulberry because it has a covering, and its fluid is greater in amount and thicker.¹¹⁸ The discussion of early and late bearers continues with a general statement followed by a discussion of the relevant cases. This is in line with the Peripatetic strategy of offering a καθόλου explanation followed by a discussion of the relevant καθ'ἕκαστα. It is only the integration of the καθόλου and the καθ'ἕκαστα that gives us proper (*sc.* scientific) knowledge. A καθόλου explanation that is not followed by a discussion of the καθ'ἕκαστα is empty; by contrast, a discussion of the καθ'ἕκαστα that is not combined with a καθόλου explanation fails to do justice to the Peripatetic requirement that a scientific explanation must be given at the proper level of generality. In other words, the general or καθόλου account not only provides a theoretical framework for the discussion of the καθ'ἕκαστα but also highlights what the latter have in common.

At the most general level, early bearers are found among plants that produce a fruit that is neither cold nor fluid, is naked or wrapped in a thin covering, and has juices that, on ripening, are watery and not thick. By contrast, late bearers are found among plants that are full of cold fluids and that produce a woody or hard fruit that has juices that, on ripening, become oily. All these features slow down the concoction of the fruit. When we look at the particular cases, we find a confirmation of the general rule. All evergreen plants bear late fruit. For instance, the fruit of the pine tree or the cypress is dry and oily. If the fruit is not oily, it is viscous as in the case of the cedar tree. In all these cases, the fruit is hard to concoct because the viscosity and oiliness of its juices hinder concoction.

¹¹⁶ Theophrastus, *CP* I 16.1.

¹¹⁷ For more on the relation between the pericarp and the fruit proper, see Theophrastus, *CP* I 21.1–3.

¹¹⁸ Theophrastus, *CP* I 17.1–3. Theophrastus does not mean the seed but rather the pericarp plus the seed, which is also called fruit.

Additionally, the hard texture of the tree makes the influx of nutriment to the fruit small. Among deciduous plants, the late bearers produce a fruit that is full of cold fluids. If the fruit is hard or woody, as in the case of acorns, it takes longer to concoct.¹¹⁹ There exist exceptions to the rules: plants that should be early bearers turn out to be late bearers. These exceptional cases ought to be explained by taking into account what is specific about their nature. The smilax is offered as an example. This plant produces naked fruit, but it is a late bearer. This has to do with the specific nature of the smilax, which is naturally cold. As a result, the smilax is not only a late sprouter but also a late bearer.¹²⁰

The discussion of early and late bearers continues with the impact of the age of the plant on fruiting. As a rule, young trees fruit late because of the abundance of inner moisture and fluid. However, there are also plants that are late bearers because of their advanced age. Moreover, too much moisture is not only a cause of late fruiting but, in a few plants, is also responsible for their failure to ripen the fruit. The case of the sycamore fig, which owing to the abundance of inner moisture cannot ripen its fruit unless the plant is scratched and smeared with oil, is recalled.¹²¹ A discussion of the behavior of wild trees that fail to ripen their fruit (e.g., the wild figs and the so-called mad vine) follows in the text.¹²² Theophrastus recommends that they be treated as different kinds of plants from their domesticated counterparts.

Toward the end of *CP I*, Theophrastus returns to the relation between the pericarp and the seed. Since the pericarp is for human consumption, it has a time limit that does not apply to the fruit proper (i.e., the seed).¹²³ Moreover, in all fruiting plants, the pericarp is produced before the fruit proper (the seed). A first reason for this differing timetable is that the seed is woody and takes longer to form. A second reason is that the pericarp is for the sake of the seed and so it comes to completion before the seed. The teleological relation that Theophrastus establishes between the seed and its outer covering is not new. We have already found it in Aristotle. We have seen that Theophrastus opens *CP I* with the claim that nature does nothing in vain and the seed is for the sake of the production of another plant of the same kind.¹²⁴ He comes back to this topic in our chapter with the claim that the relation between the pericarp and the fruit is to be

¹¹⁹ Theophrastus, *CP I* 17.4–7. ¹²⁰ Theophrastus, *CP I* 17.8. ¹²¹ Theophrastus, *CP I* 17.9–10.

¹²² Theophrastus, *CP I* 18.3–4. ¹²³ Theophrastus, *CP I* 19.1–5.

¹²⁴ Theophrastus, *CP I* 1 combined with *CP* 16.1.

understood teleologically. Furthermore, while the ripening of the pericarp is easier because the sun and the air contribute to it, the ripening of the seed is the sole work of the nature of the plant. To the extent that it is possible, the nature of the plant aims at giving equal development to the pericarp and the seed, but whenever one develops more, the other develops less.¹²⁵

¹²⁵ Theophrastus, *CP* I 21.1–2.