

## [Aristotle], On Plants

## I Problems of Authorship and Dating

A full study of the complex and fascinating history of the transmission of this text can be found in DROSSAART LULOFS-POORTMAN 1989. Here are the bare bones of the story. The original Greek of this work is not extant, but this work enjoyed great success in the Aristotelian tradition since it was translated into Syriac, Arabic, Hebrew, and Latin. A Greek retroversion based on the Latin version was made in the second half of the thirteenth century AD. This retroversion is the text printed in the Bekker edition of Aristotle.<sup>1</sup> The historical and philological relevance of the extant Greek text is negligible.<sup>2</sup> Far more important is the Arabic translation made by Isâq ibn Hunayn (ca. 900 AD) – most likely after the lost Syriac translation. This Arabic translation was the basis for both the Latin translation produced by Alfred Sarashel (ca. 1200 AD) and the Hebrew translation prepared by Qalonymos ben Qalonymos (1314 AD).

The Arabic tradition ascribes our text to “Nicolaus,” who is said to have explained (i.e., commented on) the lost work on plants by Aristotle.<sup>3</sup> I have already indicated that the relation between our extant text and the lost work by Aristotle on plants is, to say the least, poorly understood.<sup>4</sup> H. J. Drossaart Lulofs, who is also the last editor of our work, believes

<sup>1</sup> BEKKER 1831: 815a10–830b4.

<sup>2</sup> DROSSAART LULOFS 1957: 75. Compare DROSSAART LULOFS-POORTMAN 1989: “On the whole, it must be admitted that [the Greek translation] is even less reliable than Alfred’s Latin version. The ‘law’ that in each subsequent translation the text deteriorates appears to be inexorable, and the naïve expectation of the Greek [translator] that he could restore a lost work of Aristotle for his compatriots was not realized” (575).

<sup>3</sup> Haġgi Khalifa (died in 1658 AD), *Lexicon bibliographicum* V, p. 16 nr. 10564: “The book on plants of Aristotle in two treatises which Nicolaus explained and Ishâq ibn Hunayn translated with correction by Tâbit ibn Qurra.” The book on plants is attributed to Nicolaus by Ibn al-Nadîm (254.1–4 Flügel) and Ibn al Qifî (336.5–12 Lippert).

<sup>4</sup> See the Introduction.

that vestiges of the lost work on plants by Aristotle can still be found in our text.<sup>5</sup> He also believes that Nicolaus, the author of the work on plants, is the same person as Nicolaus of Damascus, the author of a compendium of Aristotelian philosophy. He also defends the traditional identification of Nicolaus, the author of the compendium of Aristotelian philosophy, with the advisor and friend of King Herod of Judea and Emperor Augustus, as well as preceptor of the twin children of Cleopatra and Antonius. If this identification is accepted, both our extant work on plants in two books and the compendium of Aristotelian philosophy must be dated to the end of the first century BC.

Drossaart Lulofs addresses the question of the relation between the compendium of philosophy and the work on plants. His main results can be summarized as follows: this relation remains difficult to ascertain, but it is not likely that the work on plants was originally part of the compendium.<sup>6</sup> And yet, the *modus operandi* might have to be the same in both works. In fact, the way in which Nicolaus condensed and abbreviated Aristotle's philosophy in the compendium may help us understand how Nicolaus operated in the work on plants. Arguably, the most original feature of the compendium is the attempt to complete the Aristotelian project with results reached in fields of study left untouched, or only briefly touched, by Aristotle. In those cases, Nicolaus availed himself of the results reached by Theophrastus.<sup>7</sup> In light of this, the compendium is best described as a summary of *Peripatetic* philosophy. And yet it is presented as a summary of *Aristotle's* philosophy.<sup>8</sup> Following this, it is hard to resist the following conclusion: Nicolaus considered Theophrastus a loyal pupil of Aristotle and regarded his research output as a straightforward contribution to Aristotle's philosophy.

<sup>5</sup> For more on how Drossaart Lulofs sees the complicated relation between the extant versions of this summary and the lost work on plants by Aristotle, I refer the reader to the diagram printed at the outset of the wonderful edition of the five extant versions of this summary that Drossaart Lulofs jointly produced with E. L. J. Poortman (DROSSAART LULOFS-POORTMAN 1989: xiv).

<sup>6</sup> H. J. Drossaart Lulofs describes the relation between the extant work on plants and the compendium as follows: "all things considered, the question whether *De plantis* was part of Nicolaus' *Compendium* does not admit of a definite answer, but the odds are against its being positive" (DROSSAART LULOFS-POORTMAN 1989: 20–21).

<sup>7</sup> Hidemi Takahashi (in TAKAHASHI 2002: 189–224) goes a long way toward explaining how Nicolaus operated in connection with the extant fragments from book 7. In his words, this book "was devoted to a summary presentation of those sciences left untouched by Aristotle and developed by Theophrastus (mineralogy, botany, and hydrology, along with some new elements of zoology)."

<sup>8</sup> The transmitted title of the compendium is *On the Philosophy of Aristotle*. See the evidence collected in DROSSAART LULOFS-POORTMAN 1965: 9–11.

The complicated edifice I outlined above rests on a double identification – namely, the identification of Nicolaus the author of the work on plants with Nicolaus of Damascus and the identification of Nicolaus of Damascus with the author of compendium of Aristotelian philosophy. But how solid is this foundation? Silvia Fazzo has challenged the second identification on the ground that the Aristotelian compendium betrays knowledge of a *Metaphysics* that includes the second book (*Alpha elatton*).<sup>9</sup> In brief, she does not believe that a *Metaphysics* that included this book could circulate before Alexander of Aphrodisias (end of second century to beginning of third century AD). If she is right, the author of the Aristotelian compendium should be dated after Alexander of Aphrodisias. I will not follow her argument in any detail. What matters is her conclusion: Nicolaus the author of the compendium of Aristotelian philosophy should be identified with Nicolaus of Leodicea in Syria (fourth century AD). Bernhard Herzhoff, in an article specifically concerned with the extant work on plants attributed to Aristotle, has accepted this conclusion.<sup>10</sup> He has also built on the suggestion made by Fazzo to read the activity of Nicolaus of Leodicea in connection what was attempted around the same time by Themistius. This connection has led Herzhoff to venture the following suggestion: we should abandon the patchwork hypothesis that has dominated scholarship on and around the work on plants attributed to Aristotle in favor of the alternative hypothesis that this treatise is largely based on the lost work on plants written by Aristotle. While we cannot exclude an infusion of materials from the Peripatetic tradition, and in particular from Theophrastus, we should operate on the assumption that the extant work is a condensation of the original arguments and claims made by Aristotle rather than an amalgam of Peripatetic ideas.

In the almost complete absence of independent evidence about the lost work on plants by Aristotle, it remains difficult, if not impossible, to isolate what is by Aristotle from what is not. One example will clarify this point. The work opens with a doxographical section that has no parallel in the extant writings by Aristotle. While it is quite possible that this section goes back to his lost work on plants, this cannot be confirmed in the absence of any other source of information.

<sup>9</sup> FAZZO 2008: 99–126. Further evidence for a later dating of Nicolaus the author of the compendium is offered in a joint article by Silvia Fazzo and Mauro Zonta (FAZZO-ZONTA 2008: 681–690).

<sup>10</sup> HERZHOFF 2016: 135–187.

## 2 Outline of the Contents

What follows is a review of the work on plants transmitted under the name of Aristotle. The goal is to provide the reader with an idea of its contents. A full analysis of the claims made, or a complete discussion of their putative source (or sources), goes beyond the scope of this appendix.<sup>11</sup>

The work begins with the statement that life is found in animals and plants, but it is patent and obvious in animals whereas it is hidden and not clear at all in plants (815a10–13). The text goes on to announce a preliminary inquiry into whether plants have soul, capacity for desire and pleasure, and power of discrimination (815a13–15).<sup>12</sup> The ensuing review of reputable opinions on the topic of plants has no parallel in the extant writings by Aristotle. However, it has one in the doxographical tradition.<sup>13</sup> A look at this tradition suggests that the debate on whether plants are ensouled beings remained very much alive after Aristotle both in Hellenistic and post-Hellenistic times. This may explain why Nicolaus felt the need to open his work on plants with a review of this debate. His diagnosis of the source of this disagreement is the inability of philosophers to find any intermediate between life and its privation (815a35–816a1). His solution consists in carving out the theoretical space for a kind of life that does not require cognition in the form of sense-perception or the capacity to feel pleasure and pain. None of this is terribly original.

Next, Nicolaus turns to the topic of the presence or absence of sexes in plants. This investigation is motivated by recalling Empedocles and his view that the male and the female are mixed in plants (816b30–817a3, 817a9–11). Nicolaus objects that for two things to mix, they have first to exist separately. Nicolaus replaces the Empedoclean view with the Aristotelian claim that the two sexes are not separate in plants. He explains this claim by recalling that the seed (σπέρμα) is *analogous* to the first κύημα in animals. In other words, the seed of a plant is *analogous* to the first mixture of the generative contributions coming from the male and the female principles of animal life (817a28–36). What we read in this stretch of text seems to be an intelligent reworking of what we find in *GA* I 23.<sup>14</sup>

<sup>11</sup> A more in-depth review of the contents of this work is offered in MORAUX 1973: 487–514. FERRINI 2012 contains a rich apparatus of endnotes helping the reader to navigate the work.

<sup>12</sup> At least at this early stage of the inquiry, we should not presuppose any specific view on how the power of discrimination may be related to the capacity to feel pleasure and pain and the capacity to desire.

<sup>13</sup> Aëtius, *Placita* V 26.1–4 (= *Dox. gr.* 440.4–20). For more on the doxographical tradition going back to Aëtius, see Chapter 1, Section 1.

<sup>14</sup> The relevant passage is printed as text [F] in Appendix 1. For more on the Aristotelian solution and its theoretical implications, see Chapter 5, Section 2.2.

The rest of the first book is an abridgment of what Theophrastus says on the topic of plants in *HP I* and *HP II*. The original topics and their order of discussion are still detectable even though the work by Nicolaus has been considerably abbreviated by its translators to the point that it is at times hard to follow his original train of thought. A discussion of the bodily parts in plants, with a concentration on the difficulties that the investigator has to face in deciding what counts as a genuine part, is offered (818a36–b27).<sup>15</sup> The largest kinds of plants Theophrastus gives as a first orientation to the study of plants are also found in our text (819a41–b3).<sup>16</sup> An attempt at their definition is followed by a review of the way (or rather ways) in which plants differ from one another, with an emphasis on the distinction between domesticated and wild plants (819b27–39) and on the relation between plants and their habitat (819b39–820a10).<sup>17</sup> After a review of how plants differ with respect to their juices and fruit, the focus shifts to the modes of generation. The rest of the first book appears to be a condensed version of what we find in *HP II* 1–7.

The second book begins with an account of nutrition and growth in plants. The details of the discussion are difficult to follow because of the lack of the original source combined with the fact that this source has been abbreviated and condensed to an extreme point. The translation from the Greek to the Syriac and from the Syriac to the Arabic has yielded a text that is garbled in a few places.

Concoction (πέψις) appears to be the key natural process that explains how the moisture taken from the soil is assimilated by the plant. We are told that concoction requires the interaction of three powers that can be traced back respectively to earth, water, and fire (822a12–14). This interaction is most clearly at work in the production of pottery. To make pottery, we need clay, water as a kind of glue, and fire. When wet clay is baked, the moisture is dispersed, and the particles of clay cohere together (822a16–24).

The explanation of what happens when a compound of earth and water is solidified by the agency of fire is discussed at the most general level for the formation of stones and metals as well as the generation of the bodily parts of animals and plants. It is only when this common account is in place that the focus shifts to what is specific to the case of plants. What we are told at the start of the second book can be described as an attempt to give

<sup>15</sup> The original discussion is found in Theophrastus, *HP I* 1.1. <sup>16</sup> See Theophrastus, *HP I* 1.3.

<sup>17</sup> The section on the habitat is an abridgment of Theophrastus, *HP I* 4.2–4.

a common account of the formation of organic and inorganic bodies. It reminds us of what Aristotle says in *Meteorology* IV.

What is specific about concoction in plants is described in the following terms: the dryness of the plant draws moisture from the soil; as this moisture moves up in the plant, it is also warmed up (822b1–6).<sup>18</sup> We are not told what agent is responsible for warming up the moisture drawn from the soil, but this agent can only be the innate heat of the plant that is associated with fire. Growth is understood as the outcome of a straightforward process of solidification: once heated, the moisture drawn from the soil becomes solid and is added to the body of the plant. Since plants are relatively simple living bodies, they can grow quickly. For instance, small herbaceous plants grow in a single day (822b5–6). This is not true for animals because their bodies are more articulated; in addition, their nutriment requires further processing to be assimilated by animals (822b6–8).<sup>19</sup>

What is drawn from the soil is distributed to the entire body of the plant and whatever is in excess flows out (822b18–20). The explanation of how the moisture can move from the roots up to the rest of the plants is a major concern in this stretch of text. An analogy is offered with the formation of springs and rivers in the mountains. Whenever an excess of water is forced into a narrow channel, the excess of steam rising from them seeks an exit on the surface. The reader is also referred to the *Meteorology* for a fuller discussion of this phenomenon (822b32–34).<sup>20</sup>

After a long and tortuous discussion of a few meteorological phenomena, the focus shifts to the role that the habitat plays in the growth of the plant. We are told that a plant needs two things: proper nutrition and a position suitable to its nature (824a36–39). What follows is a review of the

<sup>18</sup> At 822b1, I am following the Arabic version, which reads (in Drossaart Lulofs's translation) as follows: "within plants movement is easy because dryness, which is one of the powers of earth, draws moisture." We are not told why the dryness of the plant draws the moisture from the soil. Recall, however, that Theophrastus invokes *antiperistasis* for the explanation of why an "empty" plant draws its nutriment from the soil (see Chapter 5, Section 3).

<sup>19</sup> At least for Aristotle, animals take in *unconcocted* nutriment. As a result, their nutriment requires further work before it can be assimilated and added up to their bodies. This further work is not needed in the case of plants because they draw *concocted* moisture from the earth. The moisture in the soil is concocted by the agency of the sun and the surrounding air. See the main text for more on this point.

<sup>20</sup> This reference gives rise to an excursus on a few meteorological phenomena such as the cause of earthquakes, the formation of sand by the sea, and the formation of salt water. In addition to Aristotle's *Meteorology*, Nicolaus must have used Theophrastus's *Meteorology*. It has long been noted that the source of the explanation of the saltiness of water agrees with what we know about Theophrastus's views on the topic. See MORAUX 1973: 509 and DROSSAART LULOFS-POORTMAN 1989: 318.

effects of exceedingly cold or hot places, sandy and salty places, on the growth of the plants, as well as a discussion of plants that grow on the surface of water, or in a wet or rocky soil. The impact of the soil, the presence or absence of water, as well as the quality of the surrounding air are discussed. Reference to concoction is made a few times. This appears to be reference to a process taking place in the soil rather than within the plant; moreover, this is a process that is due to the action of the sun and the surrounding air.<sup>21</sup> Upon reflection, it becomes clear that the concoction that takes place in the soil and the one that happens in the plant work together in the explanation of how a plant grows. An educated guess is that the nutriment concocted in the soil is distributed to the entire body of the plant, where it undergoes a second concoction. This second concoction amounts to a straightforward solidification of the moisture drawn from the soil, which is added to the body of the plant.

Fruiting follows growth in the order of inquiry.<sup>22</sup> Depending on the nature of the plant, the fruit can appear before, after, or at the same time as the leaves. When the plant has a considerable amount of viscous juice, the inner heat of the plant is responsible for its concoction producing the fruit before the leaves. By contrast, when the plant has a considerable amount of moisture, the production of the fruit is delayed; as a result, leaves will appear before the fruit. When the plant has a considerable amount of both moisture and viscous juice, the fruit and the leaves may appear at the same time. But how is the growth of leaves to be explained? When the moisture is abundant and is not fully concocted by the combined agency of the inner heat and the sun, we obtain leaves rather than the fruit (827a24–33). Leaves are for the protection of the fruit from the intensity of the sun (827a33–35).<sup>23</sup>

Perhaps it is still possible to see an overall argument in the next stretch of text, which at first sight appears to be concerned with a random list of topics. Dealing with the predominantly green coloration of the surface of plants can be seen as a logical continuation on the topic of leaves. Their green color is explained as the effect of concoction on the inner moisture. The concoction in question is the one that happens in the plant, not in the soil. It is due to the action of the innate heat of the plant and the sun.<sup>24</sup> Discussing the

<sup>21</sup> References to concoction are made at 825a32, 825b20, 826a28, and 826b37.

<sup>22</sup> The same order of explanation can be observed in *CP* I. See Chapter 5, Section 3.

<sup>23</sup> Compare Aristotle, *DA* II 1, 412b1–2.

<sup>24</sup> This excerpt can be usefully compared with what is said in the work on colors attributed to Aristotle, where we find similar claims regarding coloration in plants. [Aristotle] *Color*. 5, 794b19–22: “the original color is green in all plants: shoots, leaves, and the fruit are green at first.” *Color*. 5, 795a12–20:

directions in which plants grow (whether upward or downward) becomes the occasion for a few additional remarks on the topic of the two concoctions that are characteristic of plants – namely, the one taking place in the soil and the one occurring in the plant. In this context, we learn that plants do not undergo a third concoction, which is limited to animals. This further concoction is needed for the articulation of the bodies of animals and the divergence in their nature (828a6–13).<sup>25</sup> The explanation of why trees shed their leaves is a natural complement to this discussion. The channels that bring the moisture to the leaves narrow down and eventually close up. As a result, the leaves do not receive nutriment and dry up (828a32–39).

The focus returns to fruiting and the factors controlling fructification in the next section. If water predominates in the plant (presumably if the inner moisture in the plant is not viscous enough), the plant hardly bears fruits for the combination of three factors: because the concoction that happens in the plant cannot solidify the inner moisture, the inner channels in which the moisture flows are too wide, and the root system is too weak.<sup>26</sup> This is true for all herbaceous plants as well as for some vegetables (828b8–14). Flowers are produced by using the finer portion of the nutriment at the start of the process of concoction and for this reason the flower comes before the fruit. The color of the fruit ranges between a deep blue and white with yellow in between (828b34–40).

The exudation of a milky juice in some trees is traced back to the nature of their inner moisture, which is concocted until it becomes viscous, like milk, which is then attracted to the extremities of the plant. All milky juices have a tendency toward coagulation, so that if the outside of the tree is cold, the milk coagulates; the outcome of that process is the formation of gum, and the ability or inability of the plant to concoct it (829a4–15).

Toward the end of the work, attention turns to the nature of the juices in the fruit, which can range between bitter or sweet. As a rule, the fruit is bitter when the process of concoction is not complete. A discussion of how the surrounding environment and the nature of the soil may impact the quality of the juices in the fruit is offered. We are told that trees grown by acidic waters tend to produce sweet fruit (829b2–10) and that trees that bear fruit for the first time tend to produce bitter fruit (829b23–25).

“in those shoots that remain unmixed with the rays of the sun the white color remains . . . in all plants the parts above the earth are green at first but beneath the earth stalks and roots are white.” In this context, green is seen as the first color between white and black.

<sup>25</sup> This confirms what we read at 822b6–8.

<sup>26</sup> Presumably, it does not draw enough concocted moisture from the soil.

When we look at our work as a whole, we see a prolegomenon to the study of plants that, at least in part, is based on Aristotle's *DA* and *GA* followed by a condensed version of the ὄτι-stage of the research on plants largely based on the data collected in Theophrastus's *HP* I and *HP* II 1–7. The inquiry should continue with an attempt to explain the phenomena at the διότι-stage of research. It is no surprise that growth and fructification emerge as the two main explananda. This is exactly how Theophrastus proceeds in *CP* I and *CP* II. And yet what we read in our text does not appear to be based on Theophrastus. It is quite possible that the second book goes back, *in toto* or in part, to the lost work on plants by Aristotle. Unfortunately, we have no way to substantiate this hypothesis.

What is specific about plants remains the focus throughout the second book, but this focus requires recalling results reached in the study of animals. It is only when those results are available that a full appreciation of plants as a distinct form of life is possible.