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Leiden
The Netherlands

Explanation and teleology in Aristotle's Philosophy of Nature

Leunissen, M.E.M.P.J.

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INTRODUCTION

Why do organisms reproduce? Why do birds have wings? Why do neither snakes nor stars have feet? Why do most of the hoofed life-bearing animals have horns (but not all of them)? Why do human beings build houses, or walk after dinner?

For Aristotle, questions such as these go to the heart of natural philosophy, which is the study of the coming to be and presence of beings that have their own internal principle of change and rest. Throughout his lifetime, Aristotle was deeply committed to investigating and explaining natural phenomena, which is reflected in the large amount of natural treatises we possess today. Among these treatises, Aristotle's *Physics* is most fundamental. In this treatise, Aristotle lays out the general theoretical framework for his natural philosophy, defining notions such as nature, motion, causation, place, and time. In the other treatises, Aristotle explores more specific problems related to the study of natural beings, like coming to be and passing away (in *De Generatione et Corruptione*), the nature and motion of the elements (in *De Generatione et Corruptione* and the second part of *De Caelo*), the motions and features of the heavenly bodies (in the first part of *De Caelo*), atmospheric causes and changes (in *Meteorologica*), the notion of soul and its dependence on natural bodies (in *De Anima*), and finally, the causes of the coming to be and presence of living beings and of their parts and motions (in the biological works).

What unites the questions explored in these natural treatises, exemplified by the questions above, is that they are predominantly questions asking for the reason why, or, as Aristotle puts it, questions asking 'for the sake of which'. By posing this specific kind of why-question, Aristotle is inquiring after the *function* served by the presence, absence, or material differentiation of a certain natural feature, or after the *goal* for the sake of which some animal motion or natural process takes place. According to Aristotle's understanding of scientific knowledge, the answers to these questions constitute teleological explanations, because they pick out the final cause (in the form of a function or goal) for the sake of which something has come to be or is present (or absent, etc.). These teleological explanations are a central feature of Aristotle's investigation of nature, and reflect the importance he attributes to final causality in the coming to be and presence of regular natural

phenomena. According to Aristotle, everything that exists or comes to be ‘by nature’ comes to be or changes, unless prevented, for a purpose and towards an end, and is present for the sake of that purpose or end. Final causality thus operates among all natural beings, from the level of the inanimate elements, through that of living beings, and on to the eternal realm of the heavenly bodies.

Although the importance of teleology for Aristotle (and in the ancient world in general)¹ has been acknowledged widely,² its nature and scope have consistently been the focus of much debate.³ These debates have progressively led to a better understanding of Aristotle’s notion of teleology. This is especially the case with regard to teleology as a descriptive principle of nature entailing the internal goal-directed tendency of natural processes (which is to be contrasted with processes due to spontaneity or necessity).⁴ What I have found to be lacking in the literature, however, is an understanding of the role Aristotle attributes to teleology in *explaining* natural phenomena. Setting aside the other issues that remain concerning the nature and scope of teleology, the question that this dissertation sets out to resolve is how – granted that Aristotle has established teleology as a cause of natural phenomena – he then *uses* (e.g. refers to, draws inferences from, builds premises upon, rejects other possible explanations on the basis of) this teleology as a principle of scientific explanation.

I believe that this gap in our current understanding of the role of teleology within Aristotle’s theory of science is unfortunate for the following four reasons.

First, Aristotle argues at several instances throughout the corpus that final causes possess some kind of priority over his other three types of causes, and that

¹ Hankinson (1998), 6.

² E.g. Caston (2006), 341; Gotthelf & Lennox (1987), 199; Gotthelf (1997b), 82; Johnson (2005), 1-2.

³ Cf. Quarantotto (2005), 17. For an historical overview of the trends and circumstances that shaped the earlier interpretations of Aristotle, see Johnson (2005), 15-39. On the nature of Aristotle’s teleology, see in particular Bradie & Miller (1999); Cameron (2002); Charles (1988); Cooper (1982; 1985; 1987); Gotthelf (1987); Irwin (1988); Johnson (2005); Lennox (2001a; 2001b); Nussbaum (1978); Sauvé Meyer (1992); Sorabji (1980); and Wieland (1975). On the metaphysics of Aristotle’s teleology, see in particular Charles (1994); Mirus (2004); Pavloupoulos (2003); and Witt (1998). On the scope of Aristotle’s teleology, see in particular Cooper (1982); Furley (1985); Matthen (2001) and (2007); Owens (1968); Sedley (1991); and Wardy (1993).

⁴ See especially Johnson (2005), who brings together many of the recent new insights in Aristotle’s notion of teleology as a principle of nature in his monograph, and explicitly addresses and eliminates some of the most persistent ‘popular misconceptions’ about Aristotle’s teleology. See also Cooper (1982; 1985; 1987) and Lennox (2001a), 225; 251.

the task of the natural philosopher is foremost (although not exclusively) to provide teleological explanations. This suggests that Aristotle assigns special explanatory power to explanations that pick out final causes. However, studies have not made sufficiently clear yet what this explanatory power exactly amounts to in each of the various types of teleological explanations used, nor how teleological explanations actually explain each of the specific kinds of natural phenomena they are supposed to explain.⁵

Secondly, the wide range of teleological explanations found in Aristotle's works is often taken as one homogeneous category, unified by the fact that they all refer in some way or another to teleology. The existing literature hardly differentiates between, for instance, explanations that refer directly to final causes and explanations that operate through the supposition of teleological principles (such as 'nature does nothing in vain').⁶ It often fails to take the different explanatory contexts into account.⁷ The unifying approach to teleology overly simplifies several questions: What types of answers can constitute teleological explanations according to Aristotle, how other types of causes can be integrated in a teleological explanation, and especially how the various types of teleological explanations are applied in practice.⁸

A third question pertains to the understanding of references to necessity *as part of* (instead of 'as opposed to') explanations that also contain references to teleology. Scholars have often tried to reconstruct the nature of Aristotle's teleology by contrasting it to forces such as material necessity and spontaneity. In doing so, however, they have either overlooked or misunderstood those teleological explanations that refer to both final causes and material necessity to explain the same

⁵ These questions have been addressed on a general level by Code (1997) and by Bolton (2004; unpublished) within the context of Aristotle's methodological remarks in *Ph*II and *PA*I; the analysis called for here is one that addresses this question at the level of Aristotle's actual teleological explanations in the varieties of contexts in which they are applied.

⁶ Johnson (2005), for instance, does not distinguish between these two types of explanations.

⁷ Although Lennox's work on the principle that nature does nothing in vain (2001a, 205-222) suggests that Aristotle uses all his teleological principles in a very specific way to explain very specific explananda, scholars still seem to think that they are just 'didactic mantras', reminding his students that he believes nature is goal-directed. See, for instance, Quarantotto (2005), 13.

⁸ Sorabji (1980, 155-174) offers an account of how according to him the various kinds of teleological explanations work, but I believe his distinctions are not subtle enough to cover Aristotle's actual practice of explaining natural phenomena in a teleological way.

natural phenomenon.⁹ What is lacking is an account of Aristotle's use of teleological explanations that integrates these references to material necessity instead of explaining them away.

A fourth question concerning the use of teleology in explanations of natural phenomena arises from a research program initiated relatively recently by scholars such as Lennox and Lloyd.¹⁰ This program has set out to explore the interplay between Aristotle's philosophy of science and his practice in the sciences themselves. Although there have been some studies on Aristotle's (teleological) explanations within the context of the first book of the *Parts of Animals* and the second book of the *Physics*,¹¹ with a few exceptions,¹² Aristotle's theoretical remarks on the structure of teleological explanations in the *Analytica Posteriora* (*APo*.II.11) have been ignored. So have many other passages in the Aristotelian corpus that bear on these issues.¹³ Consequently, there have only been a few attempts to give a more comprehensive view of Aristotle's practice of providing teleological explanations including some of the other key treatises in Aristotle's natural philosophy, such as *De Anima* and *De Caelo*.¹⁴

⁹ I mainly disagree with scholars who have either explained away the role of material necessity in teleological explanations (Balme, 1987c); reduced it to conditional necessity (Cooper, 1987; Johnson, 2005); or assigned only a negative role to it in constraining the realizations of function (Lennox, 2001a).

¹⁰ Lennox, who focuses on the similarities between theory and practice, summarizes his main views on the relation between Aristotle's theory and practice in the sciences in (2001a), 1-6; see also Lennox (1997a), (2004a), (2006). Lloyd, who focuses on the dissimilarities between theory and practice, formulates his main views on this issue in (1990) and (1996), 7-37.

¹¹ Next to the aforementioned literature by Lennox and Lloyd, see especially Balme (1987b); Bolton (1987; 1997); Charles (1997; 1999); Detel (1997; 1999); Gotthelf (1987; 1997); Pellegrin (1986); note, however, that not all of these works deal specifically with teleological explanations.

¹² Bolton (1997), Detel (1997), and Johnson (2005).

¹³ Cf. Quarantotto (2005), 27: "Le interpretazioni del concetto aristotelico di 'causa finale' avanzate negli ultimi decenni, come si è già osservato, si basano spesso su passi differenti o su brani divesi di uno stesso testo. E tale selezione del materiale documentario è, almeno in parte, la causa della loro difformità e molteplicità." Quarantotto points to *Pb*.II.8-9 and *PA*.I.1 as the key texts on which most scholars have based their interpretation of Aristotle's notion of teleology; in her own work, she studies teleology from a more comprehensive perspective, including the whole of *Pb*.II, the whole of *PA*, a few passages from *DA*, and *Meta*.I.3-10.

¹⁴ With the exception of Quarantotto (2005). Johnson (2005, 1 and 7) introduces his investigations into Aristotle's teleology as an investigation of "how ends are used by Aristotle as explanations in natural philosophy" (2005, 1). However, the core of his monograph contains a discussion of the sorts of things that according to Aristotle behave in a goal-directed way, and of the reasons for why these things behave that way (and are thus explainable by reference to teleology). I have found no analysis of the different types of teleological explanations Aristotle uses, or any reflections upon why Aristotle uses the types of teleological explanations he uses, or what he thinks these explanations amount to, which is the sort of reflection I intend to offer in this dissertation.

The present dissertation intends to fill these gaps in our understanding of Aristotle's use of teleology as a principle of explanation, especially as it is used in the natural treatises.

Its main purposes are, first, to determine the function, structure, and explanatory power of teleological explanations in four of Aristotle's natural treatises, that is, in *Physica* (book II), *De Anima*, *De Partibus Animalium* (including the practice in books II-IV), and *De Caelo* (book II). These are the treatises that I believe to be most relevant to the present investigation.

Its second purpose is to confront these findings about Aristotle's practice in the natural treatises with the theoretical picture of the structure of teleological explanations gained from Aristotle's theory of scientific demonstration. For this purpose I will present a new interpretation of *APo.*II.11, a notoriously difficult chapter in which Aristotle introduces his theory of four causes into the syllogistic framework of scientific demonstration. This study thereby contributes to recent scholarship on the relation between Aristotle's philosophy of science and philosophy of nature, while at the same time adding to our knowledge of Aristotle's notion of teleology in terms of its explanatory merits and limits.

Although this dissertation attempts to explore Aristotle's theory and practice of providing teleological explanations as broadly as possible, due the limits of space and time I have narrowed down this study to Aristotle's *science of living nature*. The ethical and political works of Aristotle fall outside the scope of this dissertation. My central tenet is that Aristotle's notion of teleology has been developed primarily and applied most successfully in the context of Aristotle's investigations of living nature; a further study of the use, function, and explanatory power of teleological explanations in, among others, his ethics or politics, would have to start from and build upon the more 'basic' uses in the natural treatises.

This dissertation comprises five separate, but interrelated studies into the function, structure, and explanatory power of teleological explanations in Aristotle's philosophy of nature.

The core of my dissertation, consisting of chapters one to four, is devoted to an analysis of actual teleological explanations provided by Aristotle in the

selection of his natural treatises stated above. In these chapters, I do not intend to provide a comprehensive picture of Aristotle's views on the nature and scope of teleology in the natural world (although it must be understood that any study dealing with Aristotle's teleology will have to discuss these issues somewhat), but rather focus on exploring the function, structure, and explanatory power of the teleological explanations used.

In the final chapter, chapter five, I will relate these findings concerning Aristotle's practice to the theory of scientific demonstrations described in *APo*.II.11. in order to determine the relationships between them and the extent to which his theory is reflected in his practice. Let me conclude by briefly introducing the main subject matter and the lines of argument set out in the five chapters of this dissertation.

In chapter one, I will examine Aristotle's defense of natural teleology in the second book of the *Physica*, and discuss its consequences for Aristotle's views on the use and function of teleological explanations in natural philosophy. Aristotle introduces his theory of causal explanation in the context of his general project of trying to gain knowledge of natural phenomena. He then singles out teleological explanations for further discussion in the light of potential objections raised by his materialist predecessors. The purpose of this chapter is, first, to illuminate the place of final causes in Aristotle's theory of causal explanation. This constitutes an analysis of: (a) the relation of final causes to the other three types of causes (here the formal identity between formal, efficient, and final causes will turn out to be important); (b) the different notions of final cause that Aristotle seems to employ (i.e. 'structural' versus 'generative' ends); and also includes (c) an attempt to answer the question why and in what sense Aristotle attributes priority to final causes over the other three types of causes. Secondly, I will analyze the causal patterns underlying the three major domains of teleological explanations from which Aristotle draws his examples in the *Physics* (i.e. artistic production, deliberative action, and natural generation), and assess how he uses the analogy between nature and art. An important part of my argument will be that art and nature are used as analogies by Aristotle *because* of the absence of deliberation in either domain. Thirdly, I will turn to Aristotle's defense of teleology

itself. For Aristotle, the for-the-most-part character of natural processes and the regularity of their outcomes offer empirical evidence that they cannot be due to spontaneity but must have intrinsic causes. The operation of final causality must then be assumed to be an inference to the best explanation of our perception of the regular coming to be and presence of natural phenomena. Here it will be necessary to distinguish between the operations of two types of teleology (i.e. ‘primary teleology’ and ‘secondary teleology’) and hence of two – structurally different – types of teleological explanations in order to be able to determine more precisely the domain of things to which teleological explanations are to be applied if we want to gain knowledge of it.

Next, in chapter two, I will provide an analysis of Aristotle’s bio-functional notion of the soul and the soul-functions, and their relationship to the body, as described in *De Anima*. The main purpose of this chapter is to show how in this treatise Aristotle lays the foundations for the teleological explanations of living nature in the biological works by differentiating the various life-functions and then grounding them teleologically. That is, living beings have the functions they have for a natural purpose. For Aristotle, the soul is not only the principle of life in an ontological sense; it is also the explanatory principle of living beings and their features in an epistemological sense. Thus, while in the *Physica* Aristotle grounds the existence of natural teleology itself, in the *De Anima* he rather grounds the possibility of providing teleological explanations for the domain of living nature: the life-functions will form the starting-points of the explanation of the realized living being with its kind specific parts and features. Two issues will receive my main attention in this chapter. First, I explore the function, structure, and explanatory power of the teleological explanations Aristotle uses in his account of the nature of the soul and of its functions. Here it will be important to recognize Aristotle’s use of the teleological notion of conditional necessity to describe the relationship between functions and the natural body in which they are realized. Further, I will differentiate between necessary and non-necessary functions of the soul. Secondly, I will analyze Aristotle’s teleological model of human and animal locomotion. In an appendix, I will discuss the role of intentionality in this model, while distinguishing between ‘objective’ and ‘subjective’ teleology; the causal framework provided in *De Anima* will

thus be shown to ground the paradigm of action used for didactic purposes in the *Physica*.

In chapter three, the heart of this dissertation, I will examine the rich material of actual teleological explanations found in *De Partibus Animalium*. It is in the biological works that Aristotle builds upon the foundations laid out in his *De Anima* and employs final causes and teleological principles most successfully to explain the presence, absence, and material differentiation of living beings. The purpose of this chapter is to get a clearer understanding of the various types of explanations, and especially of the teleological ones, that Aristotle offers for biological phenomena. In particular, I will clarify their structure, the roles played by the various types of causes picked out in the explanations, and their explanatory power. I will set the stage by introducing Aristotle's explanatory project in *De Partibus Animalium* as a demonstrative science of living nature. Next, I will discuss the types of explanations provided by Aristotle that refer directly to causes, while paying special attention to the interrelatedness of the different causes picked out in one and the same explanation, and to the issue of causal versus epistemological priority. Third, I will turn to those explanations that make use of teleological principles, and argue how they are used heuristically as a framework for explanation in those cases where final causes are not immediately discernable. A final issue to be addressed in this chapter is the relation between teleology and necessity, both in theory and in practice. Here I hope to show that Aristotle does not deny any causal role for material necessity in the coming to be of sublunary natural generations, but rather attributes a positive role to it in the formation of non-necessary, luxurious parts. The distinction between primary and secondary teleology, and between the explanation of the coming to be of natural phenomena and the explanation of their presence, will prove to be crucial in this context.

In chapter four, I will reveal the limits of Aristotle's use of teleology as a principle of explanation in *De Caelo*. In this treatise, Aristotle tries to gain scientific understanding of otherwise incomprehensible cosmological phenomena almost exclusively through mathematical reasoning. The only exceptions are formed by seven teleological explanations. It is striking that these latter explanations, which are the only 'physical' explanations given, all make use of teleological principles. I will

argue that Aristotle uses teleological principles to explain the presence and absence of heavenly phenomena, on the assumption that they are part of the realm of nature, and that they therefore have to be explained in terms of the four causes. The principles Aristotle uses are well-established in biology, and by applying them to the heavenly domain Aristotle hopes to make as much sense of the heavenly phenomena as possible. I will first discuss the teleological explanations offered for the *presence* of heavenly phenomena and next the explanations that are set out to account for the *absence* of heavenly phenomena. The purpose of this chapter is to show that although the *use* of teleological principles in the heavenly realm is similar to that in biology (in both cases they are used because the final causes are not immediately discernable), their explanatory power in biology is much stronger than in cosmology. As I will show, the lack of empirical evidence in the heavenly domain weakens the inferences Aristotle draws within his cosmology: as he himself points out repeatedly, the teleological explanations presented are plausible, but do not reach the same level of detail as the ones presented in biology.

In chapter five, I finally turn to Aristotle's theoretical account in the *Posterior Analytics* of how the four causes, and in particular the final cause, are to be picked out within the syllogistic structure of explanations in order for those explanations to qualify as 'demonstrations of the reason why', and thereby to generate scientific knowledge. The main part of the chapter consists of a careful reinterpretation of *APo*.II.11 in which Aristotle discusses these vexed issues. The aim of this chapter is to show how comprehensive and flexible Aristotle's theory of scientific demonstration truly is. Of particular interest, is how in teleological demonstrations, material, formal, and efficient causes can all play an explanatorily basic role in establishing a teleological relation between two states of affairs. On the other hand, the final cause itself, so I will argue, never plays such a role, but is always demonstrated to hold of something else. The scientific value of final causes is primarily one of explanatory priority: final causes are picked out first in explanations, but have no causal priority in the world. Once the theoretical picture has become clear, I will relate this picture to my findings concerning Aristotle's practice of providing teleological explanations in the previous chapters, and in particular to the findings from the biology discussed in chapter three. This will show how the

‘theoretical format’ as presented in *APo*.II.11 can easily accommodate the variety of types of teleological explanations that are found in practice, and how closely the two domains are related.

In the conclusion, I will bring together the various findings and distinctions drawn concerning the practice and theory of providing teleological explanations in Aristotle’s philosophy of nature, so as to lay out the merits and limits of the use of teleology as a principle of explanation.