Review of *Explanation and Teleology in Aristotle's Science of Nature* by Mariska Leunissen

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Many of those studying Aristotle’s philosophy of science during the last twenty five years have focused on determining the extent to which the model of scientific inquiry and explanation developed in the *Posterior Analytics* is reflected in the record of Aristotle’s own researches in the physical sciences. There have been two main challenges. First, the biological and other physical treatises are put forward in a meandering way, offering an apparently disorganized mix of observations, consideration of opposing theories, classifications, and partial explanations that is far from the orderly array of principles, premises derived from principles, and demonstrative syllogisms, which one might expect from *APo*. Second, many of the explanations that are offered in these treatises are teleological, explaining regularities in nature on the basis of how they serve or are necessitated by the good of various natural kinds. But such explanations do not seem to be easily cast in demonstrative form. Aristotle’s one attempt at making sense of how this would work, in *APo*. 2.11 has been roundly criticized as unclear at best and an incoherent failure at worst.

Gotthelf, Lennox, and others have shown how the first problem is less formidable than first appears. Aristotle can be seen working his way to definitions, from which the basic explanatory principles can be derived; he does so by developing fragmentary explanations, which allow him to determine and isolate certain core explanatory facts; the completion and integration of these, and the facts they explain, within the context of a whole science, remains an incomplete project. It is the second project that has
proven more recalcitrant, and is Leunessen’s focus in the present study. There are two major aspects to the project. The first is to isolate and clarify the various explanatory principles concerning the workings of final causation in regard to the structure and activities of natural beings. The second is to clarify what Aristotle means when he says that, even in regard to teleological explanations, the explanation (aition) is revealed through the middle term (APo. 2.11 94a20-94a23).

Leunissen begins with the defense given in Phys. 2.8 of the general applicability to the natural realm of teleological explanations. She offers preliminary distinctions that will feature prominently in what follows. Primary teleology “involves the realization of a preexisting potential for form through stages shaped by conditional necessity, where the fully realized form constitutes the final cause of the process” (18). In this case, a nature serves as an efficient cause that is responsible for certain features of that which has the nature, which features are necessary preconditions for the existence of that form. Thus, the nature of a bird requires the existence of wings; a bird’s possession of wings is due to an instance of primary teleology. In a case of secondary teleology, what is explained is not a necessary condition for form; it is rather the existence of certain features that aid or facilitate the performance of certain functions that are determined by the natural form. The efficient cause of these features is something external to that natural form; they often arise through “material necessity.” But, given the existence of these features, they are employed or adapted in a way that is conducive to the accomplishment of the natural good appropriate to that kind. In both cases, Leunissen argues, we are dealing with temporal processes in which earlier stages cause and thereby lead to later stages. It is the later stage that is the goal, and thus the final cause of the process. Accordingly, the cause that leads to and is responsible for the goal will be a formal or efficient cause, not the final cause which is the goal itself. It will be this formal or efficient cause that will appear in a demonstration as a middle term; the final cause will feature as the major term.

The distinction between primary and secondary teleology allows Leunissen to account for what many have taken to be a puzzling aspect of Aristotle’s argument in Phys. 2.8 that regular connections cannot be the result of chance: only teleological causation can account for them. His example of a regular connection is how the rains come in winter, the time (in Greece) at which the crops grow. This suggests that Aristotle holds that the rain is for the sake of the crops. This has struck many as a very difficult result, as it suggests either an un-Aristotelian holism or his attributing some sort of causal pull of the crops on the rain, which would mean that the physical
processes internal to evaporation and condensation are insufficient to account for the rainfall. Leunissen instead suggests that this is a case in which a certain teleological activity (that of the human art of agriculture) takes advantage of a process occurring through material causation in order to facilitate a goal that is not that of the material process per se: it is a case of secondary causation. In this way, she is able to account for the clear implication of the text (the growing of the crops is indeed a final cause of the rain) without attributing to Aristotle the view that facilitating the crops is an essential aspect of the rainwater or its descent.

Chapter 2 clarifies the teleological role that Aristotle gives to soul. The soul of a certain kind of living being is a formal cause that determines the natural goals that it has as a matter of primary teleology. The ensouled body is geared towards the performance of those goals in a way that displays both primary and secondary teleology. The biological works build on this understanding of soul.

The third chapter presents evidence concerning the distinction between primary and secondary teleology from within Aristotle’s own biological writings. Leunissen is not the first to point out that Aristotle takes biological explanations that identify a certain feature as crucially necessary for a goal to differ in kind from those that indicate that certain features are “for the better” and that the latter often involve the use of materials that are generated at the level of material necessity (which do not themselves always necessitate the parts and functions that they necessarily presuppose), but the distinction has never been laid out so clearly before. One of her contributions is to point out that those biological features that are not necessary but contribute to an organism’s good can be further subdivided into those that make a contribution to necessary functions (“subsidiary parts”) and those (which she calls “luxury parts”) that do not benefit the organism in this way, but rather “contribute to the well being of animals in some other way” (92). An example is the horns of a goat; a goat can live without horns, but it lives better with horns, as it is then better able to defend itself. The distinction between contributions to necessary functions and contributions to well being has a certain intuitive plausibility, but exactly what it amounts to is unclear to me. Presumably, self-protection makes a contribution to vital functions: an animal unable to defend itself against predators would presumably not be able to engage in basic life functions like nutrition or reproduction. Perhaps Leunissen wants to say that, unlike luxury parts, subsidiary parts themselves are directly involved in the performance of basic life functions. But if the role they play is merely contributory, how exactly is it the case that it is they that are directly involved in these
functions? Among the subsidiary parts are kidneys, which assist the bladder in the collection of residues by providing extra storage space. But how is this different from how horns assist in the rearing of young by providing protection for them? The lines between the different sorts of teleology seem to me to be blurry enough to call into question the cogency of the distinction.

The fourth chapter surveys the use of teleological principles in the biological works, primarily *PA* 2-4. These principles are not specific to the individual physical sciences; they are rather “heuristic principles” that provide the basic framework for finding what the discovered explanations would look like, and accordingly guide the investigation into what the relevant demonstrative principles are. Leunissen surveys the various forms that the superordinate methodological principle “nature does nothing in vain” might take and the various patterns of explanation that might be used in making sense of living things by appeal to such a principle. She shows how a teleological principle of this kind allows one to engage in thought experiments that determine the advantage or necessity of regular features of certain biological kinds.

Ch. 5 explores the extent to which the results of the previous chapters can be applied to Aristotelian cosmology, which, like biology, makes ample use of teleological explanation. She shows how the cosmological explanations are extensions of the explanatory strategies that had been so successful in regard to biological kinds at the terrestrial level, and how Aristotle offers such explanations in full awareness of their more limited suitability, in light of how little is empirically known about the heavens.

The final chapter (apart from a summarizing conclusion) turns to the main issue that has plagued efforts to understand teleological explanations in conformity with the strictures of the *Posterior Analytics*: how can the final cause serve as middle term? Leunissen’s answer is that it doesn’t. Readers have been misled by Aristotle’s assertion that for all varieties of causation the *aitia* is revealed by the middle term, thinking that here, as elsewhere in Aristotle, *aitia* is synonymous with *aition*. Leunissen argues that here, *aitia* means “explanation,” not “cause.” Aristotle’s point, then, is that the middle term is crucial in revealing that whole explanation of the goal that serves as final cause; it does not itself express that final cause (though it does express the formal or efficient cause that serves to explain the final cause). I am dubious of this move, for within the *Posterior Analytics*, the term *aitia* is on two occasions used to refer not to the whole demonstration that serves to explain and allow one to understand something, but to the cause that such an explanation identifies. Thus at 71b9-12, the *aitia* is explicitly identified as that through which the fact (*pragma*) is. At 85b21-22, Aristotle uses the term *aitia* to refer, not to the *logos* that reveals the source of error, but to the cause
of the error itself. One could say that these passages are aberrations in a book that otherwise consistently employs a term in a way that is aberrant from the rest of the corpus, but for me the most likely account of *APo*. 2.11 is still that which is widely accepted: Aristotle goofed.

Even if it does not win general acceptance, the account of the syllogistic structure of teleological explanations presented in the sixth chapter is one to be reckoned with. The preceding chapters can be recommended unconditionally. They offer a clear and wonderfully helpful schematic presentation of the explanatory and methodological structure of the various teleological explanations offered in the physical treatises; future readers of these treatises would be well advised to make ample use of them.

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