Western University

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Aristotle and the Unity and Diversity of Life (project description)

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Detailed Description

I. Objectives

When it comes to physics, Aristotle's influence on the development of Western science is well documented. By contrast, his role in the development of the life sciences remains under-explored. My project intends to remedy this. My goal is not the more ambitious one of tracing the influence of Aristotle's work through the history of biology. Instead, I plan to focus on understanding Aristotle's biology on its own terms with the aim of laying bare its philosophical foundations. My project is focused around Aristotle's solutions to three of the most enduring puzzles in the study of life: its diversity, its unity, and its adaptations.

Diversity. The first thing that immediately strikes anyone who considers life on this planet is its astounding diversity. Upon stepping outside, one's visual field is instantly filled with different kinds of bird, insect, plant, and countless other organisms. The number of different species is bewildering. On some estimates there are over 20,000 different species of fish, 9,000 species of birds, 6,000 species of reptiles, 1,000 species of amphibians, 5,000 species of mammals, and over a million species of known insects. This striking fact immediately raises a puzzle. If the world is governed by universal laws of nature operating on homogeneous matter, as physics tells us, why are there are so many different kinds of living thing? What is it that produces this incredible diversity? For Aristotle, explaining diversity is the central problem of the science of biology. And the first step in solving this problem is the discovery and arrangement of the differences between living things, which provides the foundation for an investigation of their causes: "We must first grasp the differences that belong to all animals as well as their proper attributes, and then attempt to discover their causes; for to proceed in this way with respect to inquiry, beginning with an investigation into the differences between things, is in accordance with nature." (*History of Animals* [*HA*] I 6, 491a7-10) This statement, which occurs in an important programmatic passage near the beginning of the *HA*, sets the agenda for Aristotle's whole biological enterprise.

Aristotle's interest in diversity has not generally been appreciated by scholars who either deny that he recognized variation at all or else take him to have attributed it to a breakdown of the natural mechanisms whose function is to perpetuate form. This is due in part to the perception of Aristotle as a staunch essentialist who emphasized sameness and downplayed difference, and partly to the fact that it has become standard to see Aristotle as having associated sameness with the regularity of form and difference with the indeterminacy of matter and thus not a candidate for scientific knowledge. One of the main goals of my project is to correct this oversimplification by focusing on Aristotle's biological works where variation is treated as an object of scientific inquiry in its own right.

Unity. Despite its immense diversity, life also reflects an underlying unity and order. What explains this order? And what is the best way to organize living things so that it becomes most salient? In order to deal with the diversity of life and uncover its unity, biologists have historically attempted to generate sound classifications. Whether or not Aristotle had a deep interest in classification as such remains controversial. A second goal of my project is thus to answer this question. In several places Aristotle attempts to systematically arrange animals into a hierarchy of kinds (e.g. *HA* I 1-6; *Generation of*

Animals [*GA*] II 1, 732a-733b1). In this sense he can surely be said to "classify" animals. However, exactly what this entails needs to be worked out carefully. One thing is reasonably clear. Classification is never pursued by Aristotle as an end in itself. Instead it is used to achieve other goals, such as constructing definitions (*Posterior Analytics* [*APo.*] II 13, *Parts of Animals* [*PA*] I 2-3) or generating scientific problems (*APo.* II 14), both of which are related to the primary goal of explanation.

Adaptation. The unity and diversity of life are connected with the third major puzzle confronting the biologist. Living things not only come in a wide array of different forms; each one of those forms is adapted to its particular environment. Fish, for example, have specially modified parts to suit their unique environment: their bodies have a fusiform shape that reduces drag and requires minimal energy for efficient swimming; they have gills instead of lungs for extracting oxygen from the water; and they have a lateral line for detecting vibrations, which is useful when hunting underwater. Adaptations like these are perhaps the most distinctive feature of life. But what is the cause of adaptation? What is responsible for producing the good 'fit' between an organism and its environment? For Aristotle, this good fit is produced by an organism's "formal nature", which is a goal-directed principle inside the organism that equips it with the tools necessary for its particular way of life. Aristotelian formal natures are optimizing agents whose "design space" is determined in part by the functional needs of the creature and in part by the material constraints imposed on its development (*Progression of Animals* [*IA*] II, 704b14-17; *PA* III 2). A third goal of the project is to explore Aristotle's concept of organismal "natures" and the role they play in accounting for biological adaptations.

II. Context

Interest in Aristotle's philosophy of biology is a relatively recent phenomenon. Unlike work on his *Categories*, *Metaphysics*, or *Ethics*, the main scholarship on Aristotle's biological works goes back only as far as the 1960s. The initial spark came from David Balme, whose 1962 paper challenged the long-standing tradition of reading Aristotle's *History of Animals* as a failed attempt to set up a taxonomy of animals along the lines developed by Linnaeus in the 18th Century. Balme challenged this interpretation by showing that Aristotle's twin concepts of *genos* and *eidos*, traditionally translated as "genus" and "species", do not designate fixed ranks (as they do in the Linnaean system), and by exposing the lack of intermediate kinds that would serve as sub-genera in a taxonomy of animals. While some took this as evidence that Aristotle was simply inconsistent in how he ranked animals, Balme saw it as incontrovertible evidence that Aristotle was not interested in taxonomy at all (see also Pellegrin 1986). Balme's work gave rise to new questions about the aims of Aristotle's biological enterprise, which has continued to be a major theme in the literature today. The work by Gotthelf (1988) and Lennox (2001a, Ch. 1-2) on this issue has contributed significantly to our understanding of how Aristotle studied biological diversity.

A second major trend in the literature was inspired by a series of papers by Jonathan Barnes (e.g. 1975, 1981), who argued that when it comes to Aristotle's natural science there is a considerable gap between theory and practice. Part of his evidence came from the biological works, which (Barnes claimed) failed to live up to the scientific ideals laid out in the *Analytics*. This motivated several scholars to examine the ways in

which the basic concepts, methods, and principles of Aristotle's general philosophy of science are employed in his writings on biology (Bolton 1987; Charles 2000; Gotthelf 1987, 1988, 1997; Lennox 1990, 2001a, 2001b, 2004). As a result of their pioneering work, the debate is no longer over whether Aristotle's biological treatises reflect ideas about scientific inquiry and explanation developed in the *Analytics* but the extent to which they do (Lennox 2001a, 1). This literature has been essential in laying the groundwork for all future research on Aristotle's biology.

Another trend in the literature that is particularly germane to my project is the discussion of Aristotle's teleology, which is connected with the problem of adaptation. Most of the literature on Aristotle's teleology has been focused on the theoretical defense of final causation in *Physics* II (Cooper 1982, Furely 1985, Sedely 1991, Sauvé Meyer 1992, Judson 2005). What has received much less attention is the extent to which Aristotle's biological treatises help us understand how he thinks teleology actually works in nature. Recent scholarship has begun to shift the focus in this direction, including Johnson (2005) and Leunissen (2010). Both of these draw heavily on the use of teleological explanations in Aristotle's biology and will be important for my project. In addition, the papers by Gotthelf (1987) and Lennox (1995) will be instrumental in understanding how Aristotle's use teleology underwrites his solution to the problem of adaptation.

My work will make several important contributions to the growing literature on Aristotle's biological works. First, there are currently no books that offer a sustained exposition of the themes and problems that form the scope of my project, including the causes of diversity, Aristotle's account of natural kinds, and the influence of Aristotle's predecessors on the development of his biology. Moreover, scholarship on Aristotle's biology has prematurely closed the door on a number of issues that are central to my project. One of the most significant is the issue of classification. The literature on this topic has been dominated by Allan Gotthelf and James Lennox, who both followed Balme in thinking that Aristotle was simply not interested in classification. This conclusion, I believe, is too hasty. It arises from a confusion between "classification" – the arranging of organisms into groups based of shared similarities and differences – and "Linnaean taxonomy" – which involves placing organisms into a series of fixed ranks (species, genus, family, etc.). Balme's arguments that Aristotle was not interested in the latter are compatible with the idea that Aristotle employed a *rank-free* approach to classification (as argued in Henry [forthcoming B]). Once we see that Aristotle was engaged in classification, we can begin to ask questions that could not have arisen within the framework of the dominant interpretation: Is Aristotle a realist or an anti-realist about the groups identified by our classifications? Does he think the job of science is to come up with a single, unified system of natural classifications (monism) or did he believe there are many equally legitimate ways of dividing the objects in a given domain into natural kinds, which may cross-classify one another in indefinitely complex ways (pluralism)? Such question are important for understanding Aristotle's approach to the study of biological diversity.

Second, my project will bring a new approach to the study of Aristotle's biology. Much of the pioneering work by Lennox and Gotthelf arose from trying to understand how Aristotle's biological writings reflected the ideals of his philosophy of science as outlined in the *Analytics*. This significantly influenced the kinds of questions they asked

and the type of data they considered relevant. While their approach has produced many fruitful results, my alternative methodology (which focuses instead on a set of enduring problems in the history of biology and seeks to locate Aristotle within the broader philosophical landscape shaped by those problems) can generate new questions leading to novel lines of interpretation beyond those that were tied to the question of whether or not there is a gap between Aristotle's theory and practice.

Finally, the importance of the translation projects to the field cannot be overstated. There has not been a complete translation of Aristotle's *GA* since the 1940s (Peck's 1942 Loeb edition), and that work was more of a paraphrase of Aristotle's text than an accurate translation. There are also no modern full-length commentaries of the treatise.[1] Translations of Aristotle's major works are a staple of classical scholarship, and philosophical commentaries often become canonized as the standard interpretation of a work (e.g. many of the orthodox readings of Aristotle arose out of W.D. Ross' commentaries on the *Metaphysics* and *Physics*). An up-to-date translation and commentary on the *GA* promises to be an essential text in the burgeoning study of Aristotle's philosophy of biology.

III. Methodology

There are several ways to approach the history of science. One might trace the specific historical events leading up to important scientific discoveries or focus on the lives of the leading scientists involved in those discoveries. Alternatively, one might focus on the particular cultural and sociological context in which scientific discoveries are made on the assumption that scientific theories cannot be understood apart from that context. Because science is essentially a problem-solving enterprise, a fruitful approach is often to examine the history of science by examining the history of its problems and their attempted solutions as well as the development of new concepts, methods, and principles for dealing with those problems (Mayr 1982, 2). The current project will apply this methodology to the study of Aristotle's biology.

I shall combine this problem-oriented methodology with a contextualist approach, which seeks to understand Aristotle as a philosopher writing from within a particular historical tradition. Scholars who have worked on Aristotle's biology in the past have tended to ignore the intellectual ancestry of his ideas. In some ways this context-free approach is justified, since Aristotle was a major innovator in the science and philosophy of biology. Before Aristotle there was nothing approaching a systematic study of life that could be seen as an attempt to mark off biology as a special field of natural science. But philosophy and science do not develop in a vacuum, and Aristotle's work in the philosophy and science of biology is no exception. Aristotle himself devotes major sections of his biological writings to reviewing the theories of his predecessors, sometimes to refute them, but often to mine them for ideas he thinks advance our understanding of life. To date there has been no systematic attempt to determine just how much of Aristotle's own work was shaped by the prevailing theories of his time. I plan to remedy this by devoting part of the project to exploring the influence of the Presocratics, Plato, and the Hippocratic doctors on the development of Aristotle's biology. A full

[1] The more recent Balme (1972) edition is only a partial translation and commentary, covering Book I (of five) and selections of Book II.

appreciation of Aristotle's innovation in this area cannot be achieved without paying due attention to this.

The proposed project consists of three primary components: a single-authored monograph, entitled "Aristotle on the Unity and Diversity of Life"; an English translation of Aristotle's *GA* accompanied by a philosophical commentary: and translations of Michael of Ephesus' two Byzantine commentaries, one on Aristotle's *GA* and one on the *PA*. The data for the monograph will be gathered from a close reading of Aristotle's biological works together with an extensive review of the scholarly literature. The translation projects will require consulting Greek texts. The Greek text of Michael of Ephesus' commentaries can be found either in *Commentaria in Aristotelem Graeca*, which is readily available from the university library, or from the electronic resource *Thesaurus Linguae Graecae*. There are a number of editions of the Greek text for Aristotle's *Generation of Animals* (e.g. Arthur Peck's 1942 edition, the *Oxford Classical Text*). Each has incorporated a substantial number of emendations on the basis of textual irregularities and suspected interpolations offering an array of variations. Yet in many cases these emendations have not been adequately justified, and many passages remain where no adequate rendering has been offered. In such cases it will be necessary to consult original manuscripts. While there are several manuscripts of Aristotle's original text in existence, the principal ones (including Michael Scott's translation) are housed in the British Library (London, England) and at various libraries of Oxford University. The important "Z" ms. of the *GA* is held at Corpus Christi College, Oxford, while the two mss. of Michael Scott's translation are held at the British Library, London, and Balliol College, Oxford.

IV. Communication of Results

The results of the project will be communicated to academic audiences in the form of workshops/conferences, peer-reviewed journal articles, translations with philosophical commentaries, and ultimately a single-authored monograph on the topic.

Component 1 (Year 1-2). The ultimate goal of the project is to produce a single-authored monograph, entitled <u>Aristotle on the Unity and Diversity of Life</u>. The monograph will be organized into three parts focused on the main research questions outlined above: part one will deal with methodological questions concerning the study of diversity; part two will focus on questions about classification and natural kinds, which have to do with exposing the unity and order behind that diversity; and part three will deal with the causes of diversity, both at the level of kinds (which is bound up with the question of adaptation) and at the individual level (which is related to questions about inheritance). While preparing the manuscript for publication, the main outlets for presenting material will be professional philosophy workshops and conferences. I co-organize an annual workshop on Aristotle's philosophy of biology with Allan Gotthelf, which has included several well-established scholars working in the field (e.g. James Lennox, Alan Code, Robert Bolton). The purpose of the workshop is to bring together internationally-recognized scholars working on Aristotle's biology with the aim of presenting work-in-progress dealing with a series of well-defined problems. In May 2010 we held the fifth meeting of the workshop at the University of Western Ontario (sponsored by a SSHRC workshop grant), focused on the theme of science and method in Aristotle's *Generation of Animals*. (Michael Sharp, chief editor of Classics and Byzantine

Studies at Cambridge University Press, has expressed interest in publishing a collection of papers arising from this workshop.) These workshops will continue to provide me with the opportunity to present ongoing research related to my project in an interactive setting. I will also be presenting a paper on Aristotle's teleology at a conference at the University of Patras (Greece) in collaboration with the Norwegian classical Institute at Athens (June 2011). Finally, I plan to submit work relating to the project in the form of peer-reviewed articles to top-tier journals. I have very recently had two papers accepted for publication, "Aristotle's Pluralistic Realism" (*The Monist*) and "A Sharp Eye for Kinds" (*Oxford Studies in Ancient Philosophy*), and a third paper in draft form on the concept of difference in Aristotle's *Metaphysics* Iota, each of which will be included as chapters in the monograph. Potential venues for publishing the monograph itself include Cambridge University Press, Oxford University Press, and Brill Academic Publishers.

Component 2 (Year 2-3). The second outcome of the project is a new translation of Aristotle's *Generation of Animals* from Greek into English accompanied by a philosophical commentary, which will be done in collaboration with Allan Gotthelf (University of Pittsburgh). The *GA* is the third in a series of texts considered to be Aristotle main biological writings. With the recent publication of a new translation and commentary of the *PA* and a forthcoming translation of the *HA*, our edition will complete the trilogy. The Clarendon Aristotle Series (Oxford University Press) and Cambridge University Press are two potential publishers for this work.

Component 3 (Year 1-2). The third and final outcome will be two translations of Michael of Ephesus' Byzantine commentaries on Aristotle's *GA* and *PA*. Since the end of the Hellenistic period and into Late Antiquity the standard way of doing philosophy was to write close commentaries on the works of Plato and Aristotle. The results were not simply an exposition of the ideas of these two authorities; the Commentators often used their commentaries as vehicles for expounding their own philosophical views. With the inception of Richard Sorabji's Ancient Commentators Project in 1987 interest in these works has grown, generating an increased demand for English translations. Michael of Ephesus produced the only extant commentaries on Aristotle's *GA* and *PA* in the historical record, and no English translations currently exist. The value of having a translation of his works, both for my project and for its own sake, cannot be overstated. Not only do his commentaries have the potential to tell us something about the reception of Aristotle's biology in the 12th Century, they will provide insights into Aristotle's work that reflect a perspective which is much closer to his own than our post-Darwinian eyes can offer. I fully expect that Michael's commentaries will prove to be vital to my research for the monograph and for the translation and commentary on Aristotle's *GA*. (Preliminary work on various sections of his text by a Graduate Research Assistant has already begun to bear fruit in this regard.) The natural outlet for this component would be Richard Sorabji's Ancient Commentators Project. I have been in contact with Sorabji, who has expressed interest in including translations of Michael's commentaries in his series.

Each of these vehicles for disseminating the results of the project is designed to draw attention to the richness of scholarship taking place in Canada and to consolidate the international reputation of The University Western Ontario as a centre for research into the history and philosophy science. I am confident that, with the funding provided by SSHRC, I will be able to accomplish these goals.