

USING RANDOMNESS AND HISTORY DARWIN BREAKS ARISTOTLE'S CONCEPTUAL PILLARS ABOUT NATURAL WORLD

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A Review of the Book

From Aristotle's Teleology to Darwin's Genealogy: The Stamp of Inutility

By Marco Solinas. 2015.

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It was an adventure to read Marco Solinas' newest book, a journey through history that encompasses twenty-four centuries of the study of living beings. Quite originally, it offers a bird's eye view of this long period, focusing on three philosophical pillars sustaining Aristotle's conception of natural world: fixism, essentialism, and teleology. Aristotle's fixism is related to the immutability of species, its lack of history. His essentialism is related to the uniformity of species, its lack of random variation. His teleology is related to the motto 'nature does nothing in vain', everything has a function to preserve the species. Hence, the book creates the feeling that it is a biography of each member in this conceptual family. In this sense, the reader is offered the birth, infancy, turbulent adolescence, adult life climax, and finally, elderly decline and death of each basic pillar. The first part of the book covers the first four 'life history' phases and the second part covers the last two phases. By focusing on the core concepts, the author makes the long history comprehensible, and helps the reader make sense of the direction taken by modern science in a broader context. Thus, overall, this book presents a didactic union between historic and philosophic approaches that will be of interest to

biologists, historians, philosophers, psychologists, anthropologists, and general public. Besides that, this book is important for ethologists in light of recent attempts (Hogan, 2015) to reframe Tinbergen's questions into Aristotle's material, formal, efficient, and final causes (see also Hladký & Havlíček, 2013).

Inspired by the strong Aristotelian presence throughout the book, this review will analyze Solinas' book with respect to Aristotle's classification of four causes. First, I will deal with the formal and efficient causes, that is, how the book is organized and constructed, and then consider the book's material and finality, that is, explore its content and applications.

Formal Cause

Solinas' book is well organized. In the first part entitled "The Aristotelian Teleological Tradition", the author presents the tripod of core concepts (fixism, essentialism, and teleology). The original Aristotelian pillars go through Christianization, Medieval/Renaissance reinterpretation, experimental updating in the seventeenth-century, collapse in the eighteenth-century and its nineteenth-century dissolution by Darwin.

The tripod form of Solinas' book is not entirely new. For instance, Shanahan (2009) also approaches the historical evolution of Darwinism in three central concepts. However, Shanahan focuses on the nature of selection, the scope of adaptation and evolutionary progress in three separate sections, and offers historical analysis mostly focused on the period starting from Darwin to the present. On the other hand, Solinas' book deals with the core philosophical concepts in its full historical depth, starting in ancient Greece and finishing after Darwin.

The book is six chapters long, three for each part, and contains summary sections throughout the chapters that help to fully understand the content. It presents quotations from many scholars dealing in an implicit or explicit manner with the three Aristotelian cornerstones throughout history, and it also contains many explanatory notes that further deepen the understanding of how each conceptual pillar was changing during historical time.

Arguably, anthropocentrism—human superiority—could be the fourth pillar, transforming the 'tripod' into a 'tetrapod' of the Aristotelian framework. Solinas mentions anthropocentrism at least seven times throughout the book, and gives the impression that Aristotle strongly embraced this concept because of his famous *scala naturae*. In contrast, Darwin had also to abandon it to become the first full evolutionist. For instance, Darwin (1837) wrote in his notebook B that "It is absurd to talk of one animal being higher than another. We consider those, when the intellectual faculties/cerebral structure most developed, as highest. A bee doubtless would when the instincts were", From an historian's perspective, maybe it would seem too easy to criticize Aristotle on anthropocentric grounds, but from the perspective of someone trying to understand how and why everyday people get evolution wrong so often and easily (see, Varella, Santos, Ferreira, & Bussab, 2013), I still find it necessary to make anthropocentrism an explicit pillar of pre-evolutionary thinking as are Aristotle's fixism, teleology and essentialism. This would help to resolve, or even prevent, many

misunderstandings about evolution because the first step for understanding evolution is to recognize the common mistakes in order to be able to self-correct.

Efficient Cause

Solinas does “not share the classic historiographical thesis that tends to consider the dogma of creation the most important element in the (...) fixist vision.” (p. 5). In contrast to Michel Ruse's (2003) approach, which is more focused on the argument of design and creationism as the background to explain the history of Darwinian revolution, in order to answer whether evolution has a purpose, Solinas shows that “it was primarily on the (...) conceptual structure (teleology, essentialism, fixism, and so on), on the analytical (...) apparatus (empirical observations, classifications, dissections, and so on), and on the categorical equipment (notions of ‘species’, the form/material dichotomy, and so on) of the life sciences forged by Aristotle that the multiple variants of (...) creationist doctrines (...) were projected” (p. 5). Thus, the book shows that the background against which Darwin would become victorious is not much that of a divine creation, but that of an eternal, immutable, typological, perfectly functional and anthropocentric universe. In this sense, the book offers a promising approach for those who want to avoid direct conflict with religiously-oriented individuals, but also want them to better understand evolution.

By comparison to similar books, I see Cronin's approach (1993) as an intermediate between Shanahan's (2004), Ruse's (2003) and Solinas' (2015). Like Shanahan, she traces the history of adaptationism from just before Darwin on to modern days. Like Ruse, she stresses the design argument as the background before the Darwinian revolution. Like Solinas, she focuses on underlying concepts, e.g., utilitarianism—related to teleology—, and idealism—related to essentialism—as the main characters in the history of Darwinism.

Material cause

Regarding the book's substance, it has its strengths and weaknesses as everything does. I will first touch upon some of its weaknesses to stimulate a critical debate, and then I will focus on its strengths to encourage people to read and debate it. On the down side, instead of making a dissection of the plurality of meanings of teleology (see, Mahner & Bunge, 1997; Mayr, 2004), Solinas sticks to Aristotle's original meaning. Thus, instead of teleology *per se*, he talks about a mix of panadaptationism—everything is adapted; and perfectionism—the highest form-function/ecological efficiency. He risks falling into the genetic fallacy in which the original version is taken to be the one true definition/use of it. Solinas admits that different meanings may exist only on page 100: “Darwin's interpretation of the action of sifting the hundred thousand wedges in terms of ‘final cause’ approaches the Herschelian acceptance inasmuch as it distances itself from the Aristotelian meaning in the strictest sense” (p. 100). Solinas thus almost gives historical reasons for promoting the rejection of every teleological use in biology. For Mayr (2004), treating teleology unitarily “ignores the fact that [it] has been applied to different natural phenomena [therefore] the search for a unitary explanation of teleology has been entirely futile” (p. 48).

Despite Mahner and Bunge (1997) and Mayr (2004) being on opposite sides of the teleological tolerance/acceptance in biological discourse, they both, in contrast to Solinas, opted for a philosophical dissection of the term before dealing with it. Mahner and Bunge (1997) followed previous authors, and divided teleology into internal and external depending on whether the *telos* is taken to be an immanent property of an object, or whether it is attributed to the outside. Then they divided each branch into cosmic (panteleology) and regional (hemiteleology) depending on whether finality is a property attributed to all or some things. They did the same with teleonomy. By this approach, the meaning of the terms become clear, and also the universe of usage for the terms are organized. Mayr (2004) distinguished five different processes, or phenomena, for which the word teleological has been used: Teleomatic processes (inorganic processes that have an endpoint), Teleonomic processes (implies goal-directedness of a process or activity under the influence of an evolved program), Purposive behavior (intentional acts of individuals, mostly mammals and birds), Adapted features (adaptation and selective pressures) and Cosmic teleology (tendency toward progress and to ever-greater perfection). According to Mayr, only Cosmic teleology has been refuted in science. By reducing teleology to panadaptationism and perfectionism, Solinas, in fact, reaches almost the same conclusion as Mayr (2004) by claiming that Darwin rejected perfection in nature, but at the same time gives the strong impression that he reaches an opposite conclusion from Mayr, that teleology is dead in modern biology, which is certainly not true.

Another advantage of the nuanced view would be to crossbreed the core concepts e.g., immutable functions and essential functions, and see how many gradual versions one can get (see table 1). Ironically, Solinas appears to deal with his concepts in an essentialist way, judging by how he refers to them in terms of solid objects: “pillar”, “cornerstone”. This limits us from conceiving them in a gradualist/continuous manner, in which they form a coherent framework because they intermix easily. He amalgamates them only once: “immutable essences” (p. 22).

On the up side, the chosen tripod view is very heuristic for understanding other small-scale historical facts about evolution. For instance, one may explain why Darwin's theory of inheritance was not based on particles as it was for Mendel, but rather of the mixture of inherited factors, since he has already broken up with essentialism. The pervasive essentialist thinking might even help to understand the Eclipse of Darwinism, or the strong criticism after Darwin passed away. Interestingly, the biggest opponents were actually the first geneticists who proposed that mutation, not natural selection, was the important evolutionary mechanism.

Solinas' approach is very much aligned with recent lines of research in psychology focusing on how folk theories and cognitive constraints make evolutionary concepts difficult to grasp, thus being a real challenge for those teaching evolution. For instance, Gelman and Rhodes (2012) have argued that psychological essentialism is a highly accessible mode of thought that has five related components: stability, boundary intensification, within-category homogeneity, causes inherent in individuals, and existence of category ideal. Therefore, essentialism poses a profound obstacle for evolutionary understanding from childhood onward. Kelemen (2012), backed up by

psychological studies, also shows that our natural intuitions about agency and purpose, seen here as a general teleological bias that develops from infancy, provide one of the major instructional challenges to science teachers. This confluence of focus stemming from disparate fields, such as history and psychology, shows that intuitive bias and folk biology can explain part of the persistence and the explanatory appeal of the pillars throughout the centuries.

Table 1: Two by two combination of the core concepts about the natural world derived from Aristotle

	Fixism	Essentialism	Panadaptationism	Perfectionism	Anthropocentrism
Fixism	Everything is fixed. No historical contingency	Immutable essences	Everything has an immutable function, reason, aim, design	Immutable perfection	Immutable human superiority
Essentialism		Uniformity, no continuity, no random variation	Everything has a qualitatively discontinued function, reason, aim, design	Perfect uniformity	Humans qualitatively separated from animals
Panadaptationism			Everything has a purpose, function and reason. No random useless trait neither coincidence.	Everything has a perfect function, aim, reason; Perfect balance.	Everything is made for humans, humans deserve it
Perfectionism				Perfection everywhere	Humans are perfect beings
Anthropocentrism					Humans are the best, the superior animal

Moreover, Solinas' approach is complementary to that of Mayr (2004) who traced back the history of Darwin's five Theories of Evolution: transmutation of species, common descent, gradualism, speciation, and natural selection, showing that the acceptance of each one occurred in a different historical period, and that many evolutionists differed in regard to how many of those theories they accepted. Fixism was broken by the transmutation of species. Essentialism was dissolved by gradualism/population thinking and the similarities were explained by convergence and common descent/speciation—tree/genealogical thinking. The impressive, but not perfect nor pervasive, adaptation could be explained by natural selection, the stamp of inutility and common descent and not in Aristotle's teleological terms. Finally, anthropocentrism was dismantled by the stamp of inutility and genealogical thinking. Solinas' own resolution can be summed as

follows: "(1) The descent with modifications thesis is set against the ahistorical thesis of the fixity of species. (2) The appreciation of individual variations is set against anti-random essentialism. (3) The recourse to natural selection, and so to extinction, is set against immanent functionalist organs/ends teleology and its systemics." (p. 4). Thus, for Solinas, while Galileo abandoned Aristotelian matrix using mathematization, Darwin did it by stressing history and randomness.

Final cause

Because of all its formal, efficient, and material qualities, this book is also suitable for organizing the syllabus of undergraduate courses of history and philosophy of science and biology, evolutionary biology, and also of basic and high school science/biology courses. Besides being an excellent tool for making sense of the history of the Darwinian revolution and to help teachers develop new educational strategies, the book makes a substantial contribution to connecting history, philosophy, and the psychology of evolutionary thinking.

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