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Biological Neo-Teleologism and Aristotle's Teleology: A Whiteheadian Perspective

Spyridon KOUTROFINIS (Berlin / Germany)

Abstract

In the last few decades, several biologists and philosophers of biology have claimed that organisms may be considered teleological entities, spurring on a movement that is often celebrated as the renaissance of teleological thinking and that I describe as 'neo-teleologism'. Neo-teleological approaches have been provided by cyberneticists, neo-Darwinists, theorists of self-organization, and some philosophers of biology. In Aristotle's work *Physics* the term 'telos' has a double meaning: final state on the one hand and purpose, aim, or goal on the other. In all neo-teleological approaches the concept of 'telos' is understood as final-state-directedness, but here the final state of a material process is considered to be achieved by blind, deterministic, non-mental factors alone. Philosophy of biology gives to all neo-teleological approaches great credit for providing interpretations of 'purpose' and 'aim' without any reference to mental or psychical factors. According to Aristotle, in contrast, organismic final-state-directedness is the result of striving factors. This does not, however, mean that Aristotle ascribes a human-like conscious mentality to biological processes. Aristotle's concept of striving may be interpreted in terms of non-conscious proto-experiential agency, as it was introduced by Alfred North Whitehead. I will claim that his metaphysics offers to biophilosophy a modern basis for a re-conception of genuine Aristotelian insights concerning 'telos' and biological organism.

Key words: Teleology, biophilosophy, Aristotle, A. N. Whitehead

1. On Different Approaches to Teleology in the Philosophy of Biology

In the first half of the 20th century the attempt was made to banish all teleological thinking from biology. In the last few decades, however, several biologists and philosophers of biology have claimed that organisms may be considered teleological entities, spurring a movement that is often celebrated as the renaissance of teleological thinking and that could be called 'neo-teleologism'.¹ Though neo-teleological explanations often treat natural selection as sufficient to explain teleology, I will apply the term in a broader sense that includes three different approaches introduced in succession since the 1940's.² However, the issue of teleology in contemporary biology is a very contentious and complicated subject. It is doubtful whether opponents are arguing over the same thing.³

Aristotle is the thinker most often cited by philosophers of biology. The interpretation, and subsequent acceptance or rejection of Aristotle's treatment of teleology is a reliable landmark for recognizing the metaphysical foundation of different authors' understandings of teleology. Philosophers of biology tend to reject all forms of universal teleology or pan-teleology, the Aristotelian, Platonic, or Leibnizian consideration of the cosmos as a finally aligned totality. Neo-teleologism is confined to a specific biological variety of teleological reasoning – the 'special' or 'regional' teleology which merely refers to single living bodies and not to global phenomena like the evolution of species or of the cosmos. Special teleology can also be subdivided into 'inner' and 'external' teleology, the former focused on the growth of the entire organism, its organs and other elements, and their functional role, and the latter ascribing "utility for something else"⁴ to the organism as a whole. Contemporary philosophy of biology recognizes only special, inner teleology.

¹ Millikan 1984, Neander 1991, Griffiths 1993, Kitcher 1993, Godfrey-Smith 1994, Allen & Beckoff 1995.

² Cummins 2002, 162.

³ Costa 2008, 183–188.

⁴ Toepfer 2005, 36.

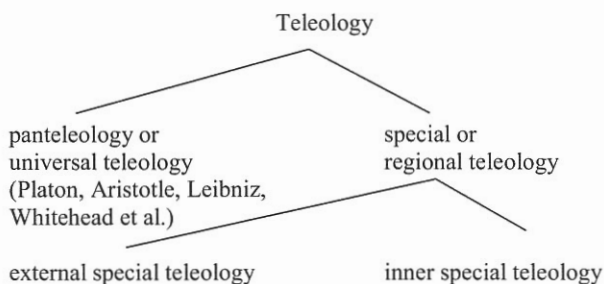


Figure 1: Different kinds of teleology.⁵

In the long history of philosophy of organism, a great deal of attention has been paid to inner special teleology, however, without considering it to be the only kind of natural teleology. In occidental philosophy of organism, for more than two millennia, the term '*telos*' kept its double meaning of both 'final-state,' on the one hand, and 'purpose,' 'aim,' or 'goal' on the other.

In neo-teleological approaches to the philosophy of biology, the concept of *telos* is understood exclusively as final-state-directedness of a material process that has been achieved by blind, deterministic, non-mental factors alone. Growth, embryogenesis, physiological processes, the search for food, achieving a certain geographic position (e.g., in the case of migratory birds) and final acts of behavior (e.g., in the case of mating) are considered to be typical examples of final-state-directed processes.⁶

Researchers in neo-teleology carry forward an impression of Aristotelian *telos* as both final state and purpose. This impression is a major source of confusion in contemporary debates. The relevant literature is teeming with expressions like 'purpose,' 'aim,' and 'goal,' and less frequently, 'purposiveness.' Sorting out the confusion requires careful examination of the meaning of the terms 'purpose' and 'aim' in neo-teleology, an issue that leads us to three milestones in the twentieth century neo-teleology renaissance.

⁵ This diagram is mainly based on ideas of Toepfer and Mahner and Bunge (Toepfer 2004, 36f; Mahner & Bunge 2000, 348).

⁶ Mayr 1991, 61.

1.1. Cybernetics

First, in 1943, the founders of cybernetics – Wiener, Rosenblueth, and Bigelow – published the article “Behavior, Purpose and Teleology,” in which they argued for the rehabilitation of teleology. They used the term ‘purposeful’ to denote an act where “the act or behavior may be interpreted as directed to the attainment of a goal, namely, to a final condition in which the behaving object reaches a definite correlation in time or in space with respect to another object or event.”⁷ In this definition, the term ‘purpose’ is coextensive with a special understanding of the expression ‘final condition,’ which in this context means ‘final-state.’ In cybernetics, the term ‘aim’ means ‘final-state,’ that is, the encounter between a behaving object (e.g., a missile) with a certain external object (e.g., a ship) – and this is merely a spatiotemporal event. On the basis of this concept of purpose that excludes every conceivable kind of first-person perspective – the behaving object does not have an *aim of its own*, as Hans Jonas correctly states⁸ – cyberneticists define teleologic behavior as the variety of purposeful behavior which reaches a final-state by means of a mechanism of *negative* feedback:

“We have restricted the connotation of teleological behavior by applying this designation only to purposeful reactions which are controlled by the error of the reaction – i.e., by the difference between the state of the behaving object at any time and the final state interpreted as the purpose. *Teleological behavior thus becomes synonymous with behavior controlled by negative feedback*, and gains therefore in precision by a sufficiently restricted connotation.” (Rosenblueth et al. 1943, 23–24, italics added.)

There is an intrinsic relation between this understanding of teleology and the cybernetic concept of *information*: Wiener thinks of information as something employed by a “behaving object” that is controlled by negative feedback that steers it towards a predefined goal. Wiener developed his concept of information almost contemporaneously with Claude Shannon in the 1940s. Both authors employ the same formalism and connect the notion of information with the concept of statistical entropy which is a measure of a physical system’s disorder.⁹ By doing so they identify information with the physical features of a material or energetic system (e.g. an electromagnetic signal) thus ignoring meaning and refer-

⁷ Rosenblueth, Wiener, Bigelow 1943, 18.

⁸ Jonas 1997, 202.

⁹ Wiener 1961, 62, 11.

ence of the message that this system potentially carries. The operations of cybernetic and information processing devices do not have meaning and value for the automata themselves, but only for human beings who determine the 'goals' and 'purposes' of the devices. Therefore, both renderings of the term 'information' have only a syntactic aspect and thus void of semantics (meaning and reference): although a missile can process the electromagnetic signal of its radar in such a way that enables it to encounter a ship, the signal is void of meaning for the missile itself and so does the telos or purpose that it attains by processing the information of this signal. In cybernetics (Wiener) and information-theory (Shannon) teleology encompasses a concept of information that is not able to count for the semantic aspects which underlie the design of cybernetic and information processing automata. These theories do not make any claims about the causality of the processes involved in creating, expecting, or evaluating the usefulness of information.

1.2. Neo-Darwinism

Second, some neo-Darwinists welcomed the non-metaphysical conception of purpose and telos that was provided by the cyberneticists. They adopted and developed cybernetic teleology further. The well-known biologist Ernst Mayr added that the mechanisms which orientate the negative feedbacks towards a final-state and activate them are programs. Mayr, Jakob, and Monod are the best-known proponents of the program metaphor in biology.¹⁰ They consider programs as genetic or behavioral algorithms that were generated in evolution and brought *selective advantages* to the organisms carrying them out. Normally, *neo-Darwinist theoreticians of teleology interpret purpose as function*. They do not attempt to explain, for example, how the wing of a bird embryo develops step by step by molecular mechanisms, but rather content themselves with stating that wings develop in order to perform a function, leading to a positive selection of all its bearers which were progenitors of the bird embryo in question.¹¹ The "what for" questions and the "in order to" replies typical of teleological language were retained. They refer, however, only to natural selection:

¹⁰ Mayr 1991, 61; Jakob 1993, 1–17; Monod 1971.

¹¹ Ariew 2007, 179; Mayr 1991, 75, 61.

“The sense in which what-for questions and their answers are teleological can now be clarified. Put cryptically, we explain A’s existence in terms of A’s function. More fully, A’s existence is explained in terms of effects of past instances of A; but not just any effects: we cite only those effects relevant to the adaptedness of possessors of A.”¹²

Griffith described this kind of neo-Darwinist teleological reasoning as follows: “where there is [natural] selection there is teleology.”¹³ The neo-Darwinist idea of the genetic program or genetic information is based on the concept of information as it is introduced in cybernetics and information theory; in part, this makes it difficult to ascribe semantic aspects to this idea. Nevertheless this should be possible, since survival, reproduction, or death cannot be conceived of, without any reference to their meaning and value for the organisms, in question, themselves.

Despite the problematic conception of a ‘program,’ the lack of even a simple concept of organism remains a decisive weakness of neo-Darwinism. Neo-Darwinistic teleologism only considers single functions. But in evolution a whole phenotype is selected, that is, a complex structure of mutually conditioning functions and elements. Two hundred years ago, Immanuel Kant emphasized this most essential aspect of the organism with his concept of the ‘self-organizing being.’¹⁴

1.3. Theory of Self-Organization

Third, because of the inability of neo-Darwinism to consider whole organisms, an organismic turn is currently taking place in the philosophy of biology in which dynamic systems theory (or the theory of self-organization) plays an essential role. The directedness of growth and other processes towards a certain final-state is understood as the outcome of the *self-organized* complex molecular dynamics of organisms. The proponents of this conception consider the organism as a self-organized dynamical physico-chemical system, the dynamics of which results in virtue of an extremely complex structure of interdependent

¹² Brandon 1990, 188.

¹³ Griffiths 1993, 420 (addition by S.K.).

¹⁴ *Critique of Judgment*, §65.

positive and negative feedbacks.¹⁵ Dynamic systems theory and theory of self-organization build the theoretical foundation of the third and most recent kind of biological neo-teleologism. From this perspective, the non-linear deterministic interactions between the organism's molecules constrain their own dynamics and thus give rise to a deterministic material phenomenon that is directed to a certain final state. Theorists of self-organized physicochemical systems illustrate the dynamics of biological and organismic processes, such as metabolism and growth, by using an abstract space called a 'state space'.

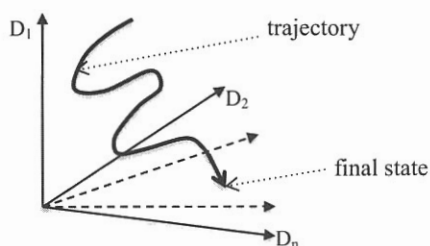


Fig. 2: The trajectory of a biological process in a state space.

The dimensions D_1 to D_n of the state space represent the different sorts of molecules out of which the organism is made. The course of the process is represented by a curve called a 'trajectory.' Thus each one of the points on a trajectory through the state space provides a complete qualitative and quantitative description of the material composition that is physically present as the organism at a particular point in time. Thus, the trajectory represents the succession of the states that the organism occupies in different points in time. In the theory of self-organization, the dynamics of a growth process is considered to be entirely determined by the material constellation of both the growing organism and the part of its environment with which the organism interacts. The final state of growth is reduced to what is physically present inside the organism as well as around it in the relevant part of its environment. In a nutshell: The final state of a biological process, is considered to be entirely reducible to something physically present, the material constellation of the organism and its environment.

¹⁵ Christensen 1996, 308f; Rosen 1985, 173f.; Goodwin 1989, 49–61.

Philosophy of biology gives all three neo-teleological approaches great credit for providing interpretations of the concepts of ‘purpose,’ ‘aim,’ and ‘telos’ without any reference to mental factors. Philosophers of biology differentiate sharply between versions of inner special teleology divested of all psychological or mental connotations and others which assume mental factors. According to contemporary philosophers of biology, only *non-mental inner special teleology* comes into question for biology, thereby distancing themselves from many philosophers. All three approaches serve the development of a new form of teleologism, allowing biology to use teleological language without neglecting contemporary scientific metaphysics which remains essentially materialistic. The common denominator of all three neo-teleological approaches is that *they consider the final state of a process, to be determined by something physically present: negative feedback, genetic program, self-organized material structure.*

2. Teleology in the works of Aristotle

The philosopher and scientist Mark Bedau rightly noted that “we are unsure whether teleological notions apply in roughly the same cases as those in which we are unsure whether value notions apply.”¹⁶ This statement relating teleology with value is fully applicable to Aristotelian and Kantian considerations of organismic teleology.

The second book of the *Physics* occupies a crucial position in Aristotle’s theory of biological teleology that, from a present-day perspective, can be assigned to inner special teleology. In this text, Aristotle makes clear that the concepts ‘final state’ and ‘purpose’ – the Greek expression for ‘purpose’ is ‘*ou heneka*’ (οὐ ἕνεκα) which means ‘for the sake of which’ – are mutually related and inseparable. The key query, however, is whether the Aristotelian term ‘purpose’ refers to an experiencing unity that strives to attain its aims. Neo-teleologically-minded biologists and philosophers tend strongly to interpret the Aristotelian concept of purpose in a functionalist manner¹⁷ by overestimating the importance of certain passages in the second book of the *Physics* wherein Aristotle explains the final-state-directedness of certain biologic processes by their functions in the

¹⁶ Bedau 1998, 272–273.

¹⁷ Ariew 2007, 173.

organism: "roots extend downwards [...] for the sake of nourishment"¹⁸ and "sharp teeth are located in the front of the mouth for the sake of tearing."¹⁹ Appropriately, Hans Jonas criticized this myopic restriction of Aristotle's thinking to functionality by reminding us that his teleology is only "in the second place a fact of structure or physical organization, as exemplified in the relation of organic parts to the whole and in the functional fitness of organism generally."²⁰ Indeed, something beyond neo-Darwinian functionalism is much more important to Aristotle's teleology: his worldview simply *forbids* considering a natural process controlled by blind, i.e., non-mental forces, as being able to achieve the kind of ordered result attained by an appropriately formed organic structure that serves the purpose of staying alive, like an organism or an organ, rather than degenerating into chaotic malformation.²¹ Aristotle applies to blind mechanistic processes the term 'automaton' (αὐτόματον), which may be translated as 'senseless in itself,' since 'maten' (μάτην) means 'in vain.'²² He refers to all processes that are not grounded in any kind of mental purpose as 'automata.' Therefore, he would subsume all processes which we today consider to be regulated only by physico-chemical interactions under the category of 'automaton.' Accordingly, from his point of view, all phenomena of material self-organization constituting the third type of contemporary neo-teleologism would be cases of 'automatic' becoming. Automatic processes may sometimes look *as if* there were a purpose behind their movement: the roof tile that falls on somebody's head could have been thrown at him purposefully by someone else. From Aristotle's anti-mechanistic perspective only very rarely do blind forces lead to a final-state that could be considered a purposefully generated one. In contrast to modern physics, Aristotle thinks that in most cases automatic processes lead to chaotically disorganized final states. He would never assume that the non-mental processes of self-organization would be able to determine something as ordered as the growth of a plant or animal.

¹⁸ *Physics* II, 8, 199 a28–29.

¹⁹ *Physics* II, 8, 198 b24–25.

²⁰ Jonas 1997, 163 (my translation).

²¹ *Physics* II, 8, 198 b33–199 a28.

²² *Physics* II, 6, 197 b22–31.

In Aristotelian hylomorphism, the final-state of living processes is something both aimed at and purposed. As Hans Jonas has shown, Aristotle made a distinction between the “mere ending and internal ‘end’ of a movement.”²³ As stated above this does not mean that Aristotle ascribes a human- or animal-like mentality to biological processes. In the first clearly formulated theory of teleology, as presented in the works *Physics* and *On the Soul*, the concepts of ‘aim’ or ‘goal,’ ‘end’ and ‘purpose’ denote inseparable aspects of one and the same thing: they designate essential elements of the ‘*eidos*’ (εἶδος), or the form or the biological species to which a single living being belongs. In Aristotelian metaphysics ‘*eidos*’ is considered to be formal causality that is a non-material causal factor. In his seminal work *De Anima* (*On the Soul*) Aristotle says both that all processes occurring in a living being are determined by its *soul* (psyche) and that the soul is the ‘*eidos*’ or the formal cause of a “natural body having in it the capacity of life” (II, 1, 412 a 19–21). By ‘life’ Aristotle means “the power of self-nourishment, independent growth and decay” (ibid. a 14–15). Accordingly, the growth of an organism is not determined by its material constitution but by its soul, particularly by the part of its soul that Aristotle calls the ‘vegetative soul’ (threptikon) (III, 11, 434 a 22–25). As Aristotle says in *Physics*, the formal cause of a being is intrinsically connected with its efficient and final causes (II, 7, 198 a 24–27). It is the vegetative soul of a growing organism that directs growth towards a particular final state. In other words, in Aristotle’s biology the agent of growth (and nourishment), the *vegetative soul*, is not reducible to something physically present such as the material constellation of the growing organism. Thus, in sharp contrast to contemporary materialistic neo-teleologism, *the most essential feature of Aristotelian teleology is that teleological becoming is determined by a causal factor that is not reducible to what is physically present.*

²³ Jonas 1997, 203 (my translation).

3. *Biological Neo-Teleologism and Aristotle's Teleology from a Whiteheadian Perspective*

Against the background of the last great metaphysical systems – created in the early 20th century by W. James, C. S. Peirce, A. N. Whitehead, H. Bergson, et al. – Aristotle's understanding of vegetative soul may be interpreted in terms of *proto-mental* or *proto-experiencing* agency. According Whitehead's panexperientialistic metaphysics entities at all levels of complexity are able to enjoy some degree of subjective experience. This is often misunderstood since we usually ascribe experience only to conscious beings. But, as Whitehead says, "consciousness presupposes experience, and not experience consciousness"²⁴ (and by 'consciousness' he means human and animal consciousness). In other words, not all experience is conscious. Whitehead's explanations harmonize well with an important position in Aristotle's *Physics* which clearly argues that a purposefully acting entity is only rarely conscious of its acting. He states, "it is absurd to suppose that purpose is not present because we do not observe the agent deliberating. Art does not deliberate. If the ship-building art were in the wood, it would produce the same results by nature. If, therefore, purpose is present in art, it is present also in nature" (II, 8, 199 b26–30). Of course, in all arts purpose is present because the agent acts towards an aim. In other words, conscious action is only a seldom special case of purposeful end-directed action. This interpretation of Aristotle's understanding of teleology confirms Thomas Nagel's and Mark Bedau's position that one may talk of teleology only in connection with entities to which one can ascribe *values*, since an experiencing being is only directed towards something if that something is experienced as something valuable.²⁵

If, as I suggest, Aristotle's understanding of the soul's agency be re-interpreted in panexperientialistic terms of Whitehead's process philosophy, his concept of 'telos' may be extended to include the idea that achieving a certain final state requires that an experiencing being, even a proto-mental one, *desires* to achieve this final state. In other words, the final state has an intrinsic value that is experienced by an acting being, such as the vegetative soul.

²⁴ Whitehead 1978, 53.

²⁵ Nagel 2012, 97; Bedau 1998, 272–273.

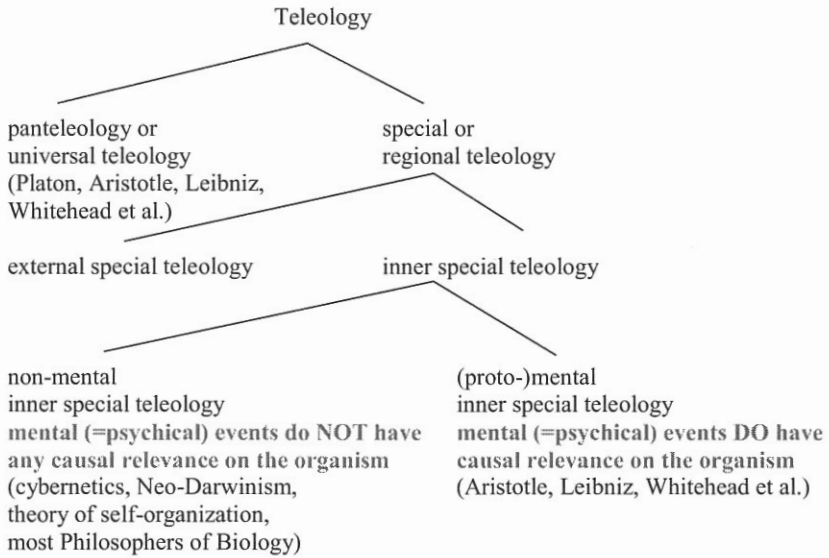


Figure 3: The different kinds of teleology from a Whiteheadian perspective.

From a Whiteheadian perspective there is a clear distinction and even a competition between Aristotle's teleology and contemporary biological neo-teleology, as Fig. 3 shows.

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