Science et Esprit

Science et Esprit

CAN ARISTOTLE HELP THOMAS NAGEL?

Klaus Brinkmann

Volume 72, Number 1-2, January–August 2020

Aristotle and the Peripatetic Tradition
Aristote et la tradition péripatéticienne

URI: https://id.erudit.org/iderudit/1067576ar
DOI: https://doi.org/10.7202/1067576ar

See table of contents

Publisher(s)

Collège universitaire dominicain, Ottawa

ISSN

0316-5345 (print)
2562-9905 (digital)

Explore this journal

Cite this article

Brinkmann, K. (2020). CAN ARISTOTLE HELP THOMAS NAGEL? *Science et Esprit*, *72*(1-2), 13–30. https://doi.org/10.7202/1067576ar

Article abstract

Aristotle's teleological principles work inside the individual organism, not as a cosmic principle transcending the boundaries of the species-specific development of individuals. Holding on to the irreducibility of the form, he identifies the mechanisms of efficient causality that give the immaterial final cause a grip on the material substratum. Moreover, his account of biological reproduction in terms of actuality and potentiality does not amount to a scientific theory in our sense, since neither factors are quantifiable. However, Thomas Nagel's probability requirement, while empirically verifiable, seems not to be a significant advance over Aristotle's act-potency doctrine, for we still lack the efficient cause. On the whole, then, as far as his biology is concerned, Aristotle seems more like a visionary of modern science than a metaphysician. It is Nagel who seems to have burdened his teleology with a lot of metaphysical commitments that do not harmonize with his intention to preserve the scientific nature of his teleology. A closer look at Aristotle's analysis of teleological processes in general and his embryology in particular might help us develop a better understanding of how teleology as teleonomy might be a useful scientific hypothesis today.

Science et Esprit, 72/1-2 (2020) 13-30

CAN ARISTOTLE HELP THOMAS NAGEL?

Klaus Brinkmann

A couple of years back, Thomas Nagel published *Mind and Cosmos,* so far his latest book.[1] In it, he voices skepticism about the ability of today's standard materialist version of evolutionary biology to explain important aspects of reality as we know it. In particular, he criticizes the failure of materialist neo-Darwinian evolutionary theory to account for the existence of life and consciousness. This kind of theory is based on molecular biology and its findings. If it is correct to say, as Nagel does, that no merely chemical theory of evolution can account for even the emergence of self-reproducing cells from a purely physical environment (cf. p. 123[2]), then our scientifically based picture of the world is marked by a huge gap. In this situation, it is incumbent on the philosopher to ask whether there are any alternative theories that would enable us to construct a more inclusive account of what there is. It would need to explain not only the nature and origin of life and the emergence, in some life-forms, of mind or consciousness, but also the reality of reason, in particular our ability to achieve objective knowledge, and the existence of moral values. Life, consciousness, reason and values are realities, Nagel argues, and they are not accounted for, nor can they be, by the reigning reductionist materialism. But neither can they be explained away. They are genuine *pièces de résistance* for current materialist naturalism, phenomena that cannot be reduced to purely physical elements. As a result, alternative reconstructions of these phenomena need to be explored. Interestingly, what Nagel calls "natural teleology" (92) emerges as the most promising candidate for replacing current materialist reductionist theories (cf. 121). Moreover, natural teleology is explicitly linked to, even if not directly derived from, the Aristotelian conception of teleology (cf. 66).

How exactly Nagel's idea of natural teleology compares to Aristotle's teleological interpretation of nature will be the main focus of this paper. First,

1. Nagel 2012. One will find in the final bibliography the complete reference under the name of the author and the date of publication.

2. Hereafter the number will indicate the reference to the pagination of Nagel's book without the indication p.

however, I would like to make two preliminary remarks. To begin, let me clarify a potentially misleading point. A misunderstanding of Nagel's project might be encouraged by the subtitle of his book which is "Why the materialist neo-Darwinian conception of nature is almost certainly false." This may suggest a thesis that is not confirmed by the book's argument. As it turns out, it is not Nagel's aim to refute neo-Darwinian evolutionary biology by demonstrating its falsity (cf. 123). Rather, Nagel is out to dispute the alleged claim of neo-Darwinian evolutionary theorists that their kind of biology can be a "theory of everything," in other words, that it, and it alone, can give us a picture of what nature really is. And by nature Nagel here means our world, insofar as it includes life, consciousness, reason and moral values. So it is the absoluteness of this alleged assertion that Nagel wants to rebuff in order to create room for alternative theories. Now I believe we do not go far wrong, if we suspect that such absolute claims are rarely, if ever, advanced by evolutionary biologists. Instead, such claims are philosophical in nature, and so Nagel's critique should not be laid at the door of evolutionary biologists but should rather be directed at those philosophers who argue that materialist reductionism, including neo-Darwinian evolutionary theory, is the only scientifically viable method of explaining the existence and evolution of life, consciousness, and even reason and value.

This brings me to my second preliminary point. Nagel's book should not merely be read as a critique of current reductionist theories in evolutionary biology. This would be far too narrow an interpretation of its philosophical significance. As I see it, the book has the great merit of reaffirming the perennial and truly philosophical concern with the possibility of a comprehensive account of what there is, traditionally known as the question concerning being. In this respect, there is another Aristotelian background to the book, one that is not necessarily acknowledged by Nagel himself, viz. the Aristotelian idea that the need for philosophy arises precisely because there are questions that are not, and arguably cannot, be asked, let alone answered, by the individual sciences. In my view, Nagel's book is so intriguing (a) because it insists on the diversity and non-uniformity of sensible reality and (b) because it raises anew the Aristotelian question of what being is, in particular how we are to analyze and describe the basic constituents of the natural world. So I look at Nagel's book not only as a critique of contemporary reductionism, but also as an exercise in regional ontology. Also note that in good Aristotelian fashion those regional ontologies are supposed to define the limitations of, and provide the ontological basis for, the individual empirical sciences such as physics, biology, and psychology. In this way, Nagel's book can also be understood as a contribution to a philosophy of science that critically examines the ontological foundations of the empirical sciences, a task that admittedly is left unfulfilled by those sciences themselves.

Nagel proposes a rather abstract but complex schema of six possible alternatives to reductionist theories of life and consciousness. He uses it for vetting the most likely candidates for a more comprehensive "postmaterialist theory" (46) capable of explaining the nature and existence of life, consciousness, reason and moral values. It is largely by a process of elimination that he arrives at his defense of natural teleology. I will not go into the detail of all the theories, but I will give an idea of how the schema is set up. I will then focus on Nagel's discussion of teleology and in a next step outline what we may be able to learn from a comparison of Nagel's natural teleology with Aristotle's teleological theory of nature, and of generation and growth in particular.

I.

Simply put, Nagel's arguments against materialist reductionism in evolutionary biology are inspired by the belief that it is impossible to reduce mind and consciousness to physico-chemical events in the brain. Such a reduction would eliminate the perspective of subjective experience not only in humans but presumably in all forms of life that have evolved a central nervous system. The perspective of subjective experience, Nagel argues, is irreducibly real and cannot be explained away by material behaviorism or eliminated by some form of physicalism. Note, however, that Nagel also includes life itself among the phenomena that resist materialist (or "psychophysical") reduction. As for myself, I fully endorse Nagel's critique of materialist reductionism. It remains to be seen whether his account of alternative explanations of the nature and existence of life and mind is persuasive.

Nagel's claim that subjective experience is irreducibly real is so well-known that I do not need to repeat his reasoning here. His arguments were first developed in the famous article titled "What is it like to be a bat?" of 1974. However, in *Mind and Cosmos* Nagel adds an interesting new argument as to why neo-Darwinian evolutionary theory is implausible. Not only can it not account for the existence of life and consciousness, it also makes these phenomena the result of mere chance developments or of a biochemical accident. For Nagel, this is to shortchange reason's demand for the intelligibility of things (cf. 16-17). This seems to me to be a fair point to make. What are theories for, if they do not make things intelligible to us? Theories are supposed to be explanatory of something, but to explain is equivalent to making something intelligible in a particular way. Aristotle summarizes the intelligibility requirement nicely in his definition of knowledge. We know something, he says, when we know its cause, not only *that* something is the case but also *why* it is the case. The cause supplies not only intelligibility but also necessity, since it lets us understand why something could not be

otherwise.[3] Nagel does not go so far as to claim necessity for the relationship between what is the case and its cause, but apart from that he does seem to share Aristotle's intelligibility requirement in important respects. In order for an evolutionary theory to be explanatory of life and mind, Nagel argues, it would need to make the emergence of these phenomena at least probable in a non-trivial sense (32, 93). Without a non-trivial degree of probability, these phenomena must remain a blind spot in any evolutionary theory.

Nagel's probability requirement has important consequences for his further argument. It is precisely because he believes that chemistry or physics have failed and will likely continue to fail to lend a "significant likelihood" (32) to the emergence of life and consciousness that he concludes that "biology cannot be a purely physical science" (32). Life and consciousness are not "physically reducible," and yet they are "an integral part of nature" (15). This means that an explanation of all natural phenomena, including life and consciousness, will have to be based on an "expanded but still naturalistic understanding that avoids psychophysical reductionism" (32), and will "not be explainable by physics and chemistry alone" (33, cf. 49-50). Indeed, Nagel suspects, such an explanation "will have to include teleological elements" (33). In this way, "mind, meaning, and value" would become "as fundamental as matter and space-time in an account of what there is" (20).

Nagel is aware of the fact that this last conclusion raises another problem, namely, that of radical dualism such as substance dualism. He points out that substance dualism would imply "that biology has no responsibility at all for the existence of minds" (49). That would leave us with a radical ontological difference between mind and body, a hiatus that would constitute another roadblock on the path towards intelligibility. Later in the book he seems to rule out properly dualism as well on the grounds that we have no empirical evidence at all of non-physical proto-psychical properties (cf. 61-62).[4] Nagel is drawn towards some kind of monism, but he is skeptical of the monism of panpsychism and rejects any kind of idealistic monism, not to mention the monism of eliminative materialism. This may explain why he prefers to describe the alternative theory he is trying to identify as a "comprehensive," "inclusive," "integrative" or "unified" theory.[5] Nagel's programmatic formulation of the task of such a comprehensive and unified theory is as follows:

This, then, is what a theory of everything has to explain: not only the emergence from a lifeless universe of reproducing organisms and their development by evolution to greater and greater functional complexity; not only

3. Cf. *An. post.* I 2.

4. These properties "are completely indescribable and have no predictable local effects, in contrast to the physical properties of electrons and protons…" (62).

5. For instance: "…in contrast to classical dualism, I suggest that we should not renounce the aim of finding an integrated naturalistic explanation of a new kind." (68-69)

the consciousness of some of those organisms and its central role in their lives; but also the development of consciousness into an instrument of transcendence that can grasp objective reality and objective value (85).

Let us now look at the options that according to Nagel might satisfy this description.

II.

Given Nagel's rejection of materialist reductionism, it will come as no surprise that the alternative theories will all have a dual ontological basis: life and consciousness "must be part of our conception of the basic constituents of reality" (43) just as much as physical matter. The fact that the mental cannot be reduced to the physical means "that the elementary constituents of which we are composed are not merely physical" (54).[6] Nagel variously refers to these non-physical constituents as "proto-psychic" and "proto-mental" or "mental." He leaves it open how exactly we are to construe the relationship of these elements. In particular, it is unclear whether he assumes the existence of some mental substratum in addition to the physical substrate or just two different kinds of properties attaching to a single substratum. *Prima facie,* the dual nature of the constituents could be a challenge to Nagel's conception of a unified non-reductionist theory.

Nagel calls the account of the constituents "ahistorical" and "constitutive" (54). We could also call it a structural account, since it represents an analysis of the ontological structure of the basic constituents of reality. The constitutive account is further subdivided into a "reductive" and an "emergent" approach (54). Nagel warns us that we not confuse "reductive" and "reductionist." The reductive account is anti-reductionist, since it is an analysis of the substrate into its basic two components, the physical and the mental or proto-mental.

Now in addition to a dual ontological basis, any non-reductionist account must also include a temporal perspective in order to capture the evolutionary history of our world. At this point, it is important to notice that Nagel is far more interested in the question of the origin of life and consciousness than in that of their ontological status. Indeed, it is fair to say that he is strongly preoccupied by the question of *how* and *why* life and consciousness emerged from an apparently lifeless universe.[7] To the ahistorical analysis we therefore need

6. Also: "A teleological account will hold that in addition to the laws governing the behavior of the elements in every circumstance, there are also principles of self-organization or of the development of complexity over time that are not explained by those elemental laws." (59)

7. Among the many formulations throughout the book that express Nagel's interest in questions of origin I refer the reader to the one on p. 92: "The teleology I want to consider would be an explanation not only of the appearance of physical organisms but of the development of consciousness and ultimately of reason in those organisms." Or again: "An understanding of the universe as basically prone to generate life and mind will probably require a much more

to add an historical (or genetic) account of how and why life and mind evolved on earth. Furthermore, Nagel proposes a three-fold division of the historical approach. It can be causal, teleological, or intentional (58-59). The latter variety is meant to refer to theories of intelligent design that have recourse to the idea of an interventionist power such as a divine designer.

With these distinctions in place, Nagel now asks us to pair the two structural accounts (reductive and emergent) with the three historical or genetic accounts (causal, teleological, and intentionalistic) (59). These combinations yield six potential candidates to replace the reductionist account of contemporary evolutionary biology (reductive causal, emergent causal; reductive teleological, emergent teleological; reductive intentionalistic, emergent intentionalistic). Nagel discards all accounts that appeal to emergentism. An emergent account would merely establish a correlation between physical and mental states which, while systematic, would remain causally opaque or enigmatic.[8] He likewise rejects both the reductive and the emergent intentionalistic accounts, not only because he is an atheist, as he confesses at one point (95), but also because intentionalistic approaches require the acceptance of interventions of a causally miraculous nature. Finally, neither the emergent nor the reductive causal accounts really satisfy Nagel's intelligibility requirements. We have already noted the dismissal of emergentism. The reductive causal account fails on the grounds that it would need to be able to explain the concrescence of mental wholes such as an individual mind or state of mind out of mental or proto-mental states or events, and we have "no […] clear idea of a part-whole relation for mental reality" nor an idea of "how mental states at the level of organisms could be composed out of the properties of microelements" (62). I note in passing that Nagel's discussion of these six variants is not always very detailed. It is interrupted by critical reviews of other similar proposals such as panpsychism and often somewhat sketchy. In any case, Nagel is content to offer rough outlines rather than detailed descriptions of the six positions.

Having eliminated four possible contenders for a comprehensive non-reductionist theory, we are essentially left with the two teleological accounts, reductive and emergent. Since Nagel's reservations about emergentism also apply in the case of his teleological approach, we are eventually left with only one candidate, reductive teleology. I will return to this remaining option in a minute. First, however, consider that in Nagel's schema the teleological approach represents a *historical* account, since it is supposed to explain, not the development and growth of given individuals but the origination of life

radical departure from familiar forms of naturalistic explanation than I am at present able to conceive." (127)

8. Emergence is a "brute fact" that is "not explainable in terms of anything more basic, and therefore essentially mysterious" (60-61).

and consciousness from a combination of physical and proto-mental elements as well as the molecular mutations in already existing organisms that lead to evolution. To link this historical approach to Aristotelian teleology comes rather as a surprise, especially since Nagel knows very well that Aristotle "did not have our conception of the world's historical evolution over time" (66, cf. 19). It is perhaps not redundant to add that Aristotle not only did not have "our" conception of evolution, but that he had no conception of evolution at all, if that means transformation of species over time and an account of the origins of life and mind. As I hope to show later on, there is some wisdom in taking such a position.

How, then, does Nagel describe his version of natural teleology? First of all, he believes that the idea of teleological laws or principles makes sense. He has been "persuaded," he tells the reader (without divulging by whom or what), that "the idea of teleological laws is coherent" (66), although he also thinks that "the teleological option is in many ways obscure" (67) and that we are far from any empirical theory that might be able to identify such laws. Second, he affirms that his natural teleology would be non-purposive or non-intentional (cf. 67), and here he is in full agreement with Aristotle who, as we know, likewise rejects the idea that natural teleology would require intentionality on the part of the developing organism. According to Aristotle's inverse argument, if we were to endow spiders and ants with an intelligent mind in order to explain their apparently intelligent behavior, we'd soon be driven to accept that plants, too, must possess a mind, since their development also seems to exhibit traces of intelligent behavior.[9] Since this is absurd, to attribute a rational mind to insects or animals generally is at least unnecessary. I find it puzzling, however, that Nagel at one point voices doubts about this kind of teleology. He is not "confident" he says, that "this Aristotelian idea of teleology without intention makes sense" (93). As I shall argue below, non-purposive teleology, if interpreted in a certain way, is a perfectly acceptable scientific concept.

The third characteristic of natural teleology as Nagel understands it is its tendency to produce certain outcomes rather than others. Teleological principles are "principles of change over time tending towards certain types of outcomes…" (66), Nagel says. Here again, he is in perfect agreement with Aristotle as we can see from Aristotle's standard definition of teleological development. According to this definition, something is, in Aristotle's terminology, "due to nature" or "for the sake of something," "if it arrives, by a continuous process of change, starting from some principle in itself, at some end. Each principle gives rise, not to the same thing in all cases, nor to any

9. See *Phys*. II 8, 199a 20ff.

chance thing, but always to something proceeding towards the same thing, if there is no impediment" (*Phys*. II 8, 199b 16ff.).

Nagel even goes a step further to include an aspect of Aristotle's teleology that one would not readily call scientific in the usual sense. For he allows teleological principles to aim at some good or to influence outcomes in such a way that "the natural world would have a propensity to give rise to beings of the kind that have a good – beings for which things can be good or bad" (121). And, a few lines further on, Nagel continues:

> We recognize that evolution has given rise to multiple organisms that *have* a good, so that things can go well or badly for them, and that in some of those organisms there has appeared the additional capacity to aim consciously at their own good, and ultimately at what is good in itself. From a realist perspective this cannot be merely an accidental side effect of natural selection, and a teleological explanation satisfies this condition. On a teleological account, the existence of value is not an accident, because that is part of the explanation of why there is such a thing as life… (122-123)

Some may have a strong feeling that, in this passage, Nagel is very much going out on a limb, and that the position he takes here is riskier than Aristotle's. We understand that it would allow Nagel to integrate ethics and the existence of objective values into a naturalistic account. But this comes at the cost of having to endow the entire universe with a tendency towards the eventual production of objective value and, ultimately, happiness.[10] In Aristotle, by contrast, we find no such claim. There is striving towards happiness in humans, of course, but not as a result of a cosmic principle. Further, the goal of teleological development is indeed also a good for each individual according to Aristotle[11], but the universe does not have a tendency to produce such ends (since they always already exist), nor would Aristotle say that life exists *in order to* create value in the world. Life does not exist for the sake of the good for Aristotle, rather, life exists for the sake of itself, and such self-referential existence *is* a form of happiness and enjoyment, the realization of something good.[12] I may be overinterpreting part of what Nagel says here; his intention may in fact be to say exactly what I just now attributed to Aristotle.[13] But it is

10. See p. 121: "…once we recognize that an explanation of the appearance of life must at the same time be an explanation of the appearance and development of value, a teleological explanation comes to seem more eligible. This would mean that what explains the appearance of life is in part the fact that life is a necessary condition of the instantiation of value, and ultimately of its recognition."

11. Cf. *Phys*. II 2, 194a 32: "…the end should not be just any last thing, but the best."

12. See Aristotle's definition of happiness as something self-sufficient (*autarkes*) in *Nicomachean Ethics* I 7, 1097b 8ff.

13. See, however, p. 93: "The existence of teleology requires that successor states […] have a significantly higher probability than is entailed by the laws of physics alone – simply because they are on a path towards a certain outcome."

perhaps not unimportant to note the difference between saying, on the one hand, that life exists for the sake of the good and saying, on the other, that life exists for the sake of life, which latter is a good in itself.

This brings me to another divergence between Nagel's and Aristotle's natural teleology. Nagel wants his teleological principles to be "genuinely universal," that is to say, he wants them to be operative throughout nature and "at much lower levels" than that of individual plants and animals. It seems clear why Nagel must introduce this stipulation: If teleological principles weren't at work at the level of the physical and non-physical elements, the appearance of life on earth and elsewhere in the universe would remain a mere chance event, which would call the entire explanatory project into question.[14] So we see again that the historical or genetic perspective so important to Nagel's conception of teleology pushes him to envision a hierarchical sequence of conditions – the formation of RNA and DNA as a condition for the emergence of self-replicating organisms, the emergence in self-replicating organisms of consciousness so that in some of them reason can eventually arise etc. There is no doubt that this is scientifically sound, but the question is, whether the explanatory project can only succeed, if it is defined as developing a hierarchical sequence of conditions. If it turns out that the initial condition cannot be fulfilled because, for instance, no teleological principles that would explain the appearance of RNA can be found, the whole project is in jeopardy. As we can see in Aristotle, no such requirements are necessary for his teleology, and yet it arguable possesses a high degree of explanatory value, as I hope to show below.

As several scholars have pointed out, there is no hierarchical or holistic teleology in Aristotle.[15] The nutrients in the soil do not exist for the sake of the plants, plants do not exist for the sake of animals, nor plants and animals for the sake of humans, nor humans for the sake of a higher being. Their bodies exist for the sake of their souls: their nutritive souls, to be precise, so that they may be able to nurture themselves and reproduce.[16] Aristotle's conception of teleology is circular, not transcendent. The complete individual is the beneficiary of its normal bodily functions; it is the end of its own development and growth. *Its* end is reproduction, and in the case of humans it is happiness. And the end of reproduction is participation in the divine, according to a famous passage in *De anima*.[17] Still, the self-referential teleological circle is not really broken even in this case. Sensible organisms are incapable of participating in the divine directly, so they do so vicariously through their offspring.

14. Hence, Nagel's statement that, if teleology were not truly universal, it would be unable "to genuinely explain anything" (67).

15. See, among others, Kullmann 1998, p. 263; Johnson 2005, pp. 11, 247-248.

16. *De an*. II 4, 415a 30ff.

17. *De an*. II 4, 415a 30ff.

But neither do they reproduce for the sake of the divine, nor is the divine the beneficiary of their reproduction. Rather, they themselves and their offspring are the beneficiaries of the act of reproduction, since they reproduce the kind of life they themselves already share in, if only temporarily.

I would like to mention one other point on which Nagel's conception of natural teleology is broadly in agreement with Aristotle's but not entirely analogous to it. Nagel stipulates that teleology can only be made to work, if the laws of physics are "not fully deterministic" (92, cf. 66-67). In other words, determinism must leave room for teleology. In Aristotle, the situation is somewhat different. Instead of determinism making room for teleology, teleology leaves room for both determinism and chance events. Aristotle seems to have a richer set of categories with which to capture both teleological and non-teleological processes as well as exceptions to, or interferences with, teleological processes. Generally, teleology works *in tandem* with determinism. Teleology is not pervasive in that not all processes are teleological according to Aristotle.[18] While there exists a teleological cycle of rain and heat throughout the seasons (a lot of heat in the summer, a lot of rain in the winter), the fact that rainfall makes the corn grow does not represent a teleological linkage, but is instead the result of deterministic efficient causation.[19] On the other hand, teleological processes can abort or be derailed by a combination of teleological principles, deterministic connections and the interference of chance. Aristotle is thus able to explain why, if teleology generally works *in tandem* with determinism, the teleological process may occasionally be derailed.

The element of chance in particular would seem to be an important addition to Nagel's picture, since he needs to make teleology be compatible with the evolutionary process. Successful adaptation or the failure thereof might best be explained by explicitly adding the element of chance to the teleological and deterministic account. What I mean to say is: Might not evolutionary fitness be precisely such a case of teleology and determinism working together with chance to produce a teleological result (i.e., a fit)? Or, conversely, might not teleology working together with determinism generate an outcome that coincidentally represents a failure to adapt, because the environment is not suitable?

18. In addition to the so-called four causes there is also chance and spontaneous causation as well as a differentiation between absolute and hypothetical necessity.

19. See *Phys.* II 8, 198b 16ff. – For the teleological cycle of the elements see Johnson 2005, pp. 140-149.

III.

Let me now summarize the result of my comparison between Nagel's and Aristotle's natural teleology, before I turn to an illustration of the explanatory merits of Aristotle's teleology.

As we know, Aristotle makes a crucial decision when, in *Metaph.* VII 8, he argues that neither matter nor form are created.[20] Creation of matter or form would imply an infinite regress, since for anything to be created, it must be created out of a substratum and a form, and so a substratum and a form would be necessary for the creation each of form and matter. Nor can anything be created from nothing, as he says in *Metaph.* VII 7.[21] These determinations taken together lead Aristotle to accept the eternal existence not only of matter and form generally, but also of species-forms and of the entire cosmos. In other words, Nagel's historical perspective, evolution included, falls completely away in Aristotle. I suggested earlier that there may be wisdom in discarding the historical perspective. Let me now explain why. First, however, note that not all temporal parameters disappear from the picture in Aristotle. Teleological growth and development still occur on a temporal axis, from the proverbial seed to the mature plant or animal. Second, it is certainly a weakness of Aristotle's account that due to the eternal nature of the species-form he is unable to accommodate evolution and the attendant development of new species. Nagel is right to want to include evolutionary change in his version of teleology, and I don't see how this should be possible for Aristotle given the invariability of the species-form. To be sure, Aristotle is very well able to allow for the presence of a variety of potential organic forms inherent in matter that is potentially alive. However, the seed or semen would likewise have to carry more than one potential form within it, and it is difficult to see how that might be possible.

The problem I really see with Nagel's historical interpretation of teleology is his unfaltering commitment to the explanation of the *origin* of life, consciousness, reason and value from an initially lifeless universe. The question about the how and why of origins is the overriding concern of the book and it is justified by Nagel's appeal to an intelligibility that will not take chance or brute fact for an answer. In itself, this requirement is quite reasonable. But if so, then why start teleological explanation with the appearance of life? Why not start earlier and include the origin of the lifeless universe? *Its* existence is a brute fact, if ever there was one. So why restrict the intelligibility requirement to life and consciousness, why not extend it to the existence of the universe itself? There is no defense of this restriction in Nagel's book, and I don't see how such a defense might be possible. But if intelligibility is impaired

20. See *Metaph.* VII 8, 1033a 24ff.
21. See *Metaph.* VII 7, 1032b 30ff.

at the very beginning of the explanatory chain, then the whole chain loses its anchoring.

So Nagel has to exempt the existence of the universe itself from his intelligibility requirement, and that to my mind constitutes a breach in the logic of his argument. This is why I suggested that there may be some wisdom in Aristotle's decision not to undertake an explanation of the origin of matter and form, of the universe or of life and reason. Questions of radical origin do not come under the purview of the intelligibility requirement for Aristotle, because for him there can be no answer to them. I would add that, if there can be an answer, then it would have to come from empirical research rather than from philosophy. Until science finds an answer to these questions, the phenomena mentioned will simply have to remain so-called singularities. Philosophy, for Aristotle no less than for Hegel, for example, is the explanation of what is. It is structural or reconstructive, not historical or genetic. I propose that to characterize matter, form, and the universe as eternal is just another way of saying that their origin does not fall under the kind of intelligibility requirements to be upheld by the philosopher.

We can now see the differences between Nagel's and Aristotle's conception of natural teleology more clearly. Nagel's version is partly structural or reconstructive, and partly historical or genetic. It is universal in its application in that it extends all the way down to the basic elements of the physical and the mental. The historical account is structured in the form of a temporal sequence of hierarchical conditions, from the existence of life to the existence of value (cf. 121). Nagel's teleology transcends lower level ends in order to make their attainment a necessary condition for the existence of higher level ends. In this sense, his teleology is transcendent. By contrast, Aristotle's teleology is purely structural and so to speak local. By structural I mean that Aristotle identifies two components, matter and form, and interprets their relationship in terms of the act-potency doctrine. Developments are circular and self-referential, not transcendent.[22] Man generates man. The teleological cycle is complete when one individual produces another individual of the same species. In other words, teleological principles are non-hierarchical and species-specific, they do not transcend the ends of a given species. In other words, according to Aristotle things that are ends in themselves are not subservient to other ends except incidentally.[23] Teleological cycles are separable from one another – rain,

22. Kullmann 1998, pp. 263-267 in particular has rejected the "pan-teleological" interpretation of Aristotle's teleology and insisted on the non-transcendent nature of Aristotle's final cause and the fact that the *telos* is internal to the individual.

23. Note that this is not contradicted by the fact that Aristotle defends a hierarchy of values such that living is better than non-living, the soul more valuable than the body, the primary *ousia* more truly *ousia* than the *synolon*, the contemplative life preferable to the practical life, etc. To take the latter case, neither the life of the individual human being nor his reason is strictly speaking a necessary condition for the contemplative life, the *polis* is. And it is questionable, if

which partakes of a teleological cycle of its own, is a condition of plant life, but is not part of the teleology of plant life. In Nagel's teleology, there is no telling which conditions of human activity, say, are or are not part of the teleology of human life, starting with the existence of the universe. For Aristotle, necessary conditions do make teleological development possible, but their production is not part of the teleological cycle itself. In short, my proposal would be to view Aristotle's teleology as a species-specific teleology, i.e., a *teleonomy,* as opposed to Nagel's transcendent universal teleology. The reason why scholars introduced the term teleonomy not only generally in biology but also as a characterization of Aristotle's teleology is precisely in order to differentiate it from the kind of pan-teleology proposed by Nagel.

IV.

Earlier, I suggested that Aristotle's non-intentionalistic teleology of the natural world represents a scientifically sound concept. I would now like to lend some textual support to this suggestion. The special theories to consult in this respect are Aristotle's account of the generation of animals and in particular his embryology.[24] But first I would like to remind us of one fundamental principle of Aristotle's thought that has the status of an axiom and is valid and operative throughout his work. This axiom runs: "Matter will surely not move itself." It appears in this formulation in *Metaph.* XII 6. I quote the short passage in full: "Matter will surely not move itself – the carpenter's art must act on it; nor will the menstrual fluids nor the earth set themselves in motion, but the seeds and the semen must act on them." (*Metaph.* XII 6, 1071b 30ff.)

Aristotle makes this statement in the context of an argument that insists on the priority of actuality over potentiality and, since matter is paired with potentiality and form with actuality, this is simultaneously an argument in favor of the priority of form over matter. It is likewise an argument in favor of the priority of soul over body.[25] As is well known, form is prior also in terms of definition and knowledge. And *qua* form in an individual sensible substance, it is prior also in time. I quote:

> Those who suppose, as the Pythagoreans and Speusippus do, that supreme beauty and goodness are not present in the beginning […], are wrong in their opinion. For the seed comes from other individuals which are prior and complete, and the first thing is not the seed but the complete being, e.g., we must say that before the

---

one can say that the practical life is a necessary condition for the contemplative life, even though Aristotle describes it as a stage in the citizen's life that chronological precedes the contemplative life.

24. See GA Books I and II, esp. I 2, 17, 19-22, II 1-3, and the detailed analysis by Gotthelf 2012, in particular chs. I 1 and I 4.

25. *Metaph.* XII 6, 1071b 30.

> seed there is a man, – not the man produced from the seed, but another from whom the seed comes (*Metaph.* XII 7, 1072b 30ff.).

Next, form is also irreducible to matter for Aristotle, just as matter cannot be fully transformed into or absorbed by form. (The Unmoved Mover is separate from matter, not matter transfigured into pure form.) There is such a thing as a form in potentiality (not an easy concept!), but there is no purely potential form as there is no purely potential matter (*prôtè hylè* is a limiting concept, not something that could exist).

So form is prior to matter also, if not only, in a causal sense. If there it to be any movement, generation, growth or development, form must move matter as an efficient cause. And this must have been so from the beginning. But remember, the beginning is already a state of completion. This might be just another way of saying that form and matter are eternal.

If the form, as final cause, moves like an efficient cause, how does it do so? Aristotle likes to offer the analogy of the process of production in the arts: The carpenter uses his hands that use his tools to shape the material in accordance with an idea or image in his soul. The carpenter's hands and his tools are the efficient causes operative in the process of production, but it is crucial that he have a plan or some blueprint in his mind for the work to get anywhere. Incidentally, this may not be the most suitable analogy for all types of generation (e.g., where would the tools be in the case of the acorn that grows into an oak tree?), but it is quite helpful as a guide to understanding the process of reproduction.

Much scholarly work has been done over the last decades to analyze and interpret in detail how Aristotle understood the process of animal reproduction. A thumbnail sketch will have to do for our purposes. The semen consisting of heated air (*pneuma*) and foamy water produces movements due to its vital heat, which movements shape the female residue (*katamene*) in accordance with the form that exists in the *pneuma*. Note that no material component of the semen is being added to the female substrate. Indeed, the semen does not possess a genuine substrate. Consequently, the heat of the semen is not a quality of some matter (as Aristotle points out explicitly), but merely the medium or vehicle for the transcription of the form into the movements that shape the nascent embryo. This is important for the argument I am now going to make. For I want to say that the *pneuma* is the complete species-form, but without a substratum of its own. Nor, on my interpretation, could it logically possess its own substratum, for the semen would in that case already be the complete individual, if the full species-form is to be present in the *pneuma* from the beginning.

Let me address a concern one might have here. Aristotle sometimes says that the form is not actually but potentially present in the embryo or that the form possesses a potentiality to become the fully developed individual. I must

say that I have difficulty making sense of the notion that the form itself should *be* a potentiality. For according to the argument outlined above, there always needs to be an actuality present to trigger the potential of the potentiality. So I am inclined to say that there is nothing potential about the form, only that the form as actuality possesses the potentiality to unlock the potential in the substratum. When Aristotle speaks of a potentiality of the soul, for instance,[26] I suggest that we should read that as the power of the soul as an actuality to express itself successively in a continuous process in the substratum, until it is fully realized in the substratum, at which point we have reached the mature individual. The eventual coincidence of the form and its expression is the form in *entelecheia*.

One other point is worth mentioning. I do not see how we can avoid the problem of so-called backwards causation, unless the full species-form is present from the beginning, albeit virtually only. For, if only part of that form or an underdeveloped version of it were to initiate the process of shaping the substratum, where would the rest of the form come from to guide the process to its completion? This does not necessarily conflict with Aristotle's statement, at GA II 3, that "the end is developed last." I take this to mean that the full embodiment of the form is developed last.

To avoid a possible misunderstanding, I should say that I am not attributing a pangenetic theory to Aristotle here, that is, I do not mean to say that the species-form that is co-present from the beginning together with the substratum is already a miniature adult. I believe Wolfgang Kullmann is right, when he argues that Aristotle's embryology is epigenetic, that is to say, the development of the embryo is a continuous process of successive differentiation. In modern parlance, the cells of the embryo are initially omni- or pluripotent, before they undergo the process of specification. Kullmann supports this interpretation by pointing to Aristotle's analogy of the marionettes whose prolonged movement is triggered by one initial impulse.[27]

The parallels of Aristotle's account with modern molecular biology have been pointed out before.[28] Here is how I would interpret that analogy. In contemporary biology, the whole process of reproduction and cell replication is understood as the "expression" of genes in a cellular substrate. The information contained in the DNA is "transcribed" in the synthesis of RNA, and RNA in turn "translates" that information into the synthesis of proteins. In Kullmann's description: The transcription that leads to the production of nucleic acids guarantees genetic invariance, while the translation that guides the production of the proteins is responsible for the teleonomic structures of the nascent

26. As at *De an*. II 4, 415a 25.
27. See Kullmann 1998, p. 292. The passage in Aristotle comes from GA II 1, 734b 9ff.
28. Notably by Kullmann 1998, pp. 32, 301-302.

individual.[29] This parallels Aristotle's account in that the movement of the semen can be seen as analogous to a transcription of the species-form (DNA) into an efficient cause (RNA), while the efficient cause then translates movement into growth of the embryo in conformity with the species-form. In fact, it has become quite commonplace to compare Aristotle's final cause to a genetic program in studies of Aristotle's biology.[30]

Where I disagree with Kullmann is with his almost exclusive focus on the aspect of efficient causation in reproduction, to the extent that the form seems to be completely absorbed into the activity of the efficient cause. This near elimination of the form goes together with a rejection of its immateriality. For Kullmann, to characterize the form as immaterial would mean to make it transcendent, whereby its triggering of the process of efficient causation would become mysterious and enigmatic.[31] By contrast, I would suggest that the form is indeed immaterial, and yet immanent to the organism. Modern genetics quite naturally speaks of DNA as coded information, as a program. In other contexts, we talk about the difference between software and hardware. But how should we describe coded information, a genetic program or software other than as immaterial? After all, in gene expression the DNA is not simply reproduced – and even if it were, reproduction would still have to based on a set of instructions; instead the information contained in the DNA is transcribed into something other than DNA. Information, however, is not a molecule. It is a blueprint, a template, a plan, or a set of instructions, something like a thought or the meaning of a sentence. So to my mind, the immateriality of the form does not make it a mysterious transcendent cause. If a thought can move me, then so can a genetic program cause the process of gene expression. In short, I subscribe to the "ontological irreducibility," as it has been called, "of the teleological to the non-teleological in Aristotle."[32]

V.

In conclusion: After what has been said, we will not be surprised to learn that Aristotle has been called the "father of teleonomy."[33] Aristotle sees teleological principles at work inside the individual organism, not as a cosmic principle transcending the boundaries of the species-specific development of individuals. And while holding on to the irreducibility of the form, he is astonishingly meticulous in identifying the mechanisms of efficient causality that give the

29. Cf. Kullmann 1998, p. 302.

30. See the relevant publications by Ernst Mayr, Montgomery Furth, Wolfgang Kullmann, Monte R. Johnson among others.

31. See Kullmann's critique of transcendent forms in Kullmann 1998, p. 32.

32. See Gotthelf and Lennox 1987, p. 200. This also means that I disagree with functionalist explanations of Aristotle's final causation as proposed by Nussbaum 1978, p. 72 and others.

33. Kullmann 1998, p. 303 here refers to Hassenstein 1981, pp. 60-71.

immaterial final cause a grip on the material substratum. To be sure, he had no inkling of modern molecular biology, and how could he have? And one must also concede, it seems to me, that his account of biological reproduction in terms of actuality and potentiality does not amount to a scientific theory in our sense, since neither factors are quantifiable. On the other hand, however, Nagel's probability requirement, while empirically verifiable, seems not to be a significant advance over Aristotle's act-potency doctrine. If probability just means the measurement of a statistical distribution, then we still don't know what is responsible for the distribution, i.e. we still lack the efficient cause. On the whole, then, as far as his biology is concerned Aristotle seems more like a visionary of modern science than a metaphysician. It is Thomas Nagel who, by comparison, seems to have burdened his teleology with a lot of metaphysical commitments that do not harmonize with his intention to preserve the scientific nature of his teleology. A closer look at Aristotle's analysis of teleological processes in general and his embryology in particular might help us develop a better understanding of how teleology as teleonomy might be a useful scientific hypothesis today.

Department of philosophy
Boston University
Boston MA

BIBLIOGRAPHY

Furth, Montgomery 1987, "Aristotle's Biological Universe: An Overview," in Allan Gotthelf and James G. Lennox (ed.), *Philosophical Issues in Aristotle's Biology*, Cambridge, Cambridge University Press, pp. 21-52.

Gotthelf, Allan and James G. Lennox (ed.) 1987, *Philosophical Issues in Aristotle's Biology,* Cambridge, Cambridge University Press.

Gotthelf, Allan 2012, *Teleology, First Principles, and Scientific Method in Aristotle's Biology* (Oxford Aristotle Studies)*,* Oxford, Oxford University Press.

Hankinson, Robert J. 1998, *Cause and Explanation in Ancient Greek Thought,* Oxford, Clarendon.

Hassenstein, Bernhard 1981, "Biologische Teleonomie," *Neue Hefte für Philosophie,* 20, pp. 60-71.

Johnson, Monte R. 2005, *Aristotle on Teleology,* Oxford, Clarendon.

Kullmann, Wolfgang 1998, *Aristoteles und die moderne Wissenschaft,* Stuttgart, Franz Steiner.

Nagel, Thomas 2012, *Mind and Cosmos. Why the Materialist Neo-Darwinian Conception of Nature is Almost Certainly False,* Oxford, Oxford University Press.

Nussbaum, Martha Craven 1978, *Aristotle's* De Motu Animalium. *Text with Translation, Commentary, and Interpretive Essays,* Princeton NJ, Princeton University Press.

SUMMARY

Aristotle's teleological principles work inside the individual organism, not as a cosmic principle transcending the boundaries of the species-specific development of individuals. Holding on to the irreducibility of the form, he identifies the mechanisms of efficient causality that give the immaterial final cause a grip on the material substratum. Moreover, his account of biological reproduction in terms of actuality and potentiality does not amount to a scientific theory in our sense, since neither factors are quantifiable. However, Thomas Nagel's probability requirement, while empirically verifiable, seems not to be a significant advance over Aristotle's act-potency doctrine, for we still lack the efficient cause. On the whole, then, as far as his biology is concerned, Aristotle seems more like a visionary of modern science than a metaphysician. It is Nagel who seems to have burdened his teleology with a lot of metaphysical commitments that do not harmonize with his intention to preserve the scientific nature of his teleology. A closer look at Aristotle's analysis of teleological processes in general and his embryology in particular might help us develop a better understanding of how teleology as teleonomy might be a useful scientific hypothesis today.

SOMMAIRE

Les principes téléologiques aristotéliciens sont à l'œuvre dans les organismes individuels, et non à titre de principe cosmique transcendant les limites du développement spécifique des individus. Considérant l'irréductibilité de la forme, le philosophe identifie les mécanismes de la causalité efficiente donnant à la cause finale, immatérielle, une prise sur le substrat matériel. Par ailleurs, son explication de la reproduction biologique en termes d'acte et de puissance ne compte pas comme une théorie scientifique telle qu'on l'entend aujourd'hui étant donné qu'aucun de ces éléments n'est quantifiable. Pourtant, l'exigence de probabilité posée par Thomas Nagel, bien que vérifiable de manière empirique, ne semble pas représenter une avancée significative par rapport à la doctrine aristotélicienne de l'acte et de la puissance, dans la mesure où il lui manque la causalité efficiente. Globalement donc, en ce qui concerne sa biologie, Aristote fait davantage figure d'un visionnaire de la science moderne que d'un métaphysicien. C'est Nagel qui semble avoir encombré sa téléologie de nombreuses affirmations ne s'accordant pas avec sa volonté de maintenir la nature scientifique de cette téléologie. Un examen attentif de l'analyse aristotélicienne des processus téléologiques en général et de son embryologie en particulier contribuera à mieux expliquer en quoi la téléologie en tant que téléonomie peut s'avérer une hypothèse scientifique utile aujourd'hui.