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Teleology: Old Wine in New Skins

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On the Status of Teleological Discourse
A Confusing Fiction or a Description of Reality?*

> "*Teleology is like a mistress to a biologist: he cannot live without her but he's unwilling to be seen with her in public.*"
> J. B. S. Haldane

I. INTRODUCTION

There is a widely accepted view both in science and philosophy according to which teleological language is mainly a source of confusion and error as a description of nature. The view is held by many cognitive scientists (Kelemen 1999, see: De Smedt and DeCruz 2020) and also in much of metaphysics where teleological discourse is often depicted as the folk's way of systematically misrepresenting reality (Hartmann 1951, Rose and Schaffer 2017) and which is probably an unfortunate source of creationist intuitions at the same time (Kelemen 2004). In much of biology teleological language was viewed with suspicion from early on as it seemed to be a reminiscent of a misleading, pre-Darwinian way of understanding nature, therefore many biologists argued that this language should be replaced with proper evolutionary descriptions. To amend the situation, especially in the philosophy of biology a form of evolutionary teleonaturalism became popular, reinterpreting the teleological language of functions with direct reference to natural selection (Millikan 1984, Garson 2019).

This paper defends a different approach that allows for taking a large chunk of teleological discourse as veridical in a way that could be reconciled with naturalism. There are plausible theories on the table, according to which teleological statements can be systematically connected to the presence of certain type of complex physical systems, therefore teleological language could preserve its referential status by means of some form of reductive identification. This approach

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doesn't deny that the application of teleological discourse might be misleading in many cases concerning the nature of things, but it holds that it is definitely not as guilty as charged and has a fairly good reason to be.

The basic strategy for defending teleological discourse runs as follows: teleological intuitions and teleological discourse are a product of evolution and plausibly it has evolved to track the behaviour and presence of complex self-maintaining systems (basically organisms) in nature, the workings of which might involve tool use and also certain social structures or superorganisms. Such systems have an internal organization that makes sense why humans explain their activities in teleological terms. This view does not deny that humans might use teleological language to describe systems where its use is not justified, that they might overuse this tool, but as the cost of applying it in a too permissive way, the cost of erring on the safe side, isn't high we shouldn't be surprized about that. Naturally, starting from wrong assumptions concerning e.g. the broader context, teleological descriptions might be applied to systems that do not serve a purpose, do not have a function, however, such mistakes can be corrected. The suggestion will be that instead of concentrating on misfiring heuristic applications of teleological discourse, it would be more beneficial to treat teleology as a property of certain types of complex systems, reducible to some system level properties similarly to other macro properties such as temperature or mechanical hardness and other practically useful macro-physical properties.

The gist of the idea presented here is this: if some version of the reductive identification of teleological systems is attainable, we should treat teleological discourse as tracking real distinctions in nature. To be able to run the main train of thought in this paper the theoretical possibility of such identification would be sufficient in itself, but I will also suggest that it is more than a possibility, it is rational to think that it is a plausible option. It is widely known that such attempts were already pursued by early cybernetics from the middle of the 20^{th} century. Some philosophers and biologists tried to explain the apparent goal-directedness of certain systems on grounds of internal features like feedback-based organization (e.g. Braithwaite 1953, Sommerhoff 1969). In the beginning this attempt was also endorsed by mainstream biologists like Mayr (1974) who introduced the notion of 'teleonomy' to describe the apparent purposiveness of the living in need of explanation, but by the 1980's this project started by cybernetics was considered to be largely unsuccessful (see: Bedau 1992), largely because the normativity of teleological language seemed to be unexplainable by the theoretical means suggested. At the same time a somewhat different strand of theoretical biology, general systems theory created a holdout for analysing the organizational features of organic life introducing the concept of autopoetic systems (Maturana and Varela 1980). As I will explain below, a continuation of this tradition is what provides credibility, plausibility for reductive identification.

From the point of view of this tradition it is not implausible to think that teleological systems are real in the sense that they can be identified and differentiated from other types of systems based on their organizational features independently of folk teleological attribution. This provides a good enough basis for thinking that teleology is something that is reducible in an ontologically conservative manner, meaning that the higher-level property, as that construct does not turn out to be problematic, too imprecise or empty, is not eliminated by the reduction, but is conserved by its identification with some base properties (Savitt 1974), similarly to e.g., mechanical hardness (see Gilman 2009). In the cases of most macro-level physical properties micro-level reduction is not considered to be the elimination of the macro property even if substitution is made possible by the identification, instead it is considered to be matched onto more fundamental entities, properties and their configurations. Similarly, I will argue, that it is plausible to think that teleology is not an ontologically fundamental property, but it is a property of certain type of complexes organised from simpler elements.

II. THE ORGANIZATIONAL VIEW OF ORGANISMS – HISTORY SKETCH AND OUTLINE

According to a more and more influential new theory in the philosophy of biology, that is rooted in the tradition of the already mentioned general systems theory, to be a living entity is to be a self-determining system. In this section, I introduce this approach in some detail starting from a historical perspective (for a deeper discussion see Moreno and Mossio 2015, Mossio and Bich 2017).

Some broader context first. One might ask what brought the organism to the fore in recent biological theorizing? For a long time, the focus in the philosophy of biology was on conceptual issues surrounding evolutionary theory and some of its consequences. In the neo-Darwinian synthesis, the organism was reduced to the genes, they became the real agents of evolution (Hamilton 1964), a view made popular by Dawkins (1976). Organisms in this perspective were only the 'vehicles' or the 'interactors' of the real replicators, the genes. In this orthodox theory the focus was on two levels of analysis: on genes and on populations of genes. Organisms were omitted for convenience's sake. More recently, this trend started to dissolve, and the organism is having its renaissance. Walsh (2015) highlights that developmental biology, new research on ontogenetic developmental processes, a special interest in epigenesis, evo-devo theories and in the effects of niche construction created the need for a revaluation of the role of the concept of an organism in biology. And it is true that the models of the new evolutionary synthesis under construction, recently getting represented even in university level textbooks, are considering not only the mentioned two levels, in the new systematization the level of the organism became a level of analysis on its own right.

It is quite probable that this development is less surprizing for people interested in 20th century general systems theory originated by Bertalanffy (1951, 1968). That tradition had at least two strong arguments for highlighting the role of organisms from the outset. The first reiterates an old idea (1): prolification presupposes self-replication in time (Csányi 1982), or in other words, the evolutionary process presupposes the existence of self-maintaining systems. Replication in space, prolification can only appear if self-replication in time is already in place. Staying alive, maintaining organizational invariance in the face of constantly shifting environmental conditions, is the problem that has to be solved first before reproduction can become an issue at all. The second reason (2), the one that came to prominence more recently (McLaughlin 2001) is that evolutionary theories of biological function that identify function based on past selection history have a hard time with explaining the function of a biological trait created anew.

The other prominent teleonaturalist theory of biological functions, first advanced by Millikan (1984), bases everything on natural selection claiming that something has a function at present because it had a certain history, the function of a phenotypic trait we observe is what it was selected for. One important challenge to this view was the presence of vestiges, like the appendix. Suppose that it is true to say that it used to harbour gut bacteria, but it lost that function and at present it serves no function. The presence of the organ can still be explained on grounds of selection history, but it would be absurd to say that it has the function it was selected for in a bygone age. There are possible fixes to this problem. One could say that we should focus on the recent, or more immediate past of a trait (Godfrey-Smith 1994) and check whether it contributed to fitness in the period in question (Schwartz 1999).

However, even if those fixes work, we can also say that a functional description highlights a causal contribution to the workings of a particular living system at present whatever its history was. It might have a good pedigree in terms of its history, but what decides its fate and role is what is taking place at present. This is what gets highlighted by the already mentioned case of newly invented traits. This issue is usually discussed based on Davidson's well-known Swampman thought experiment. The Swampman is instantaneously created in some swamp through an improbable cosmic coincidence of quantum events, but still, it has the very same biological features as any human being. However, as it is not part of a lineage and therefore lacks a selection history, its organs cannot serve evolutionarily established functions. One might object, as some did, that this thought experiment is empirically highly implausible. To that I would answer, the example still clarifies the theoretical difficulty nicely and it describes a scenario that is quite close to the case of the appearance of new variations or mutations in the course of evolution. A useful, but evolutionarily new invention resulting from recombination or mutation functions beautifully in the talented young organism, even though it lacks any kind of selection history.

As I already said, the self-maintaining organisation of the individual organism is a prerequisite for selection processes, but it is also for the attribution of functions: a functioning part of a living system is good for that organism, however a dysfunctional part is bad, so purpose and function imply normativity at the level of the individual in a way that is not implied by other properties in nature. Which means that the ultimate ground for function ascription should belong to individual organisms themselves independently of their histories. However, histories are definitely not dispensable. Evolutionary explanations are important in themselves, but evolutionary histories don't exhaust the bases for function attribution and are not even the most important reference point for it.

A final note that might be surprizing for some readers. As Michael Ruse shows in his paper in this very volume, Darwin himself could be called to defend the view that organisms have some form of immanent teleology and it is exactly the origin of this adaptedness and adaptivity in organisms that gets explained by natural selection. A distinction should be made between Platonic teleology, where the source of telos can only be a Creator and Aristotelian teleology, where it is immanent to the being that has the telos. In the second case the function of the traits and behaviour belongs to the organism itself, not to its history, not to its maker, and the explanation of its presence is an altogether different issue (for a more detailed discussion of this distinction and its uses see Ariew 2007).

The *organizational view of organisms*, versions of which were already advanced by 20th century systems theorists, has a surprisingly long history. It is older than Darwinism. Let me give the reader a sketchy outline of that history. In the Aristotelian tradition organisms were defined by reference to features like self-motion, autonomous functioning, and separation from the environment (see Gelber 2021). These concepts describe organisms in terms of observable behavioral patterns contrasting them to purely physical entities. By focusing on the more general capacity of self-maintenance, one approaches organisms in terms of their distinctive internal organization that sets them apart from other types of complex physical systems. This more modern concept also has a prehistory in philosophy, most notably in Kant's work on purposiveness (cf. Moreno and Mossio 2015. xxiii-xxv). Kant held the view that only our limited cognitive capacities make us interpret living things as purposeful. However, at the same time he admitted that the reproductive and regenerative capacities of the living were inexplicable by the means of the physical science of his age. As a resolution to this tension, he coined the term 'self-organization' and described organisms as naturally purposive, characterized by a kind of immanent teleology, meaning that their internal mechanisms serve the purpose of maintaining the whole. However, we should note, that as he could not reconcile this picture with the science of his age, as he could not accommodate circular causation with the physics that was available, therefore for him teleology worked only as a regulative principle of reason and teleological descriptions of nature were considered to be ontologically non-consequential. For the modern view introduced below, circular or recursive causation creates no such puzzle, so self-organization features can be directly connected to lower-level dynamics.

Most contemporary conceptualizations of the living and of organisms in the philosophy of biology connect back to Kant's work on natural purposiveness via the second half of 20th century tradition of general systems theory (e.g. Bertalanffy 1968, Maturana and Varela 1980, Kampis 1991). Living systems are understood to be systems that self-maintain or self-replicate over time where this feature defines the fundamental goal of their activities. The parts of such systems actively contribute to the regeneration, recreation of other parts of the system. This creates a closed network of regenerative, functional connections between the different kinds of parts that, as I will show below based on work done by mainly former students of Maturana, amounts to a defining feature of these systems.

The organizational view introduced in this paper is a continuation of the systems theory tradition. To make the gist of it more intuitive, let us start with the idea of minimal self-maintenance, the proper understanding of which brings us closer to a definition of the kind of self-maintenance that defines organisms. All self-maintaining systems, including non-living ones, contribute to the maintenance of their own conditions of existence (see Mossio and Bich 2017). A candle flame self-maintains in the sense that the flame persists via maintaining a cycle: the heat it radiates by burning the vax melts the remaining wax that provides further fuel for radiating heat. At the same time hot combustion products are carried upwards, which creates a constant influx of oxygen rich air from the sides, also contributing to flame-persistence till the point when the vax runs out. What we observe as stability in such systems is a result of this cyclic flow. We all know that this system is fragile and the flame disappears swiftly without an external influx of energy. Candle flames are not in a stable internal state, like an atom sitting in a potential well, but in an instable, relatively high entropy state and exactly because of that their persistence hangs on running that cycle.

Candle flames are simple self-maintaining systems, which means that they are undifferentiated. They have no real parts, meaning that there is no internal division of causal labour inside. Any arbitrarily chosen proper part of the flame does the same kind of work, they melt and burn the vax. By contrast, living systems have functionally differentiated parts organized into a causal division of labour, each contributing differently to the maintenance of the whole (see Mossio and Bich 2017). All parts of such systems realize functions that serve the fundamental goal of self-maintenance at the level of the whole. When it comes to such systems the attribution of functions can be based solely on the identification of the role a part plays in self-maintenance, which also means that biological functions can be defined in an interest-independent manner and without reliance on the evolutionary history of organisms. This approach to function was first systematized by McLaughlin (2001).

Let us take a look at a section of such cycles. The repeated contractions of the heart in animals maintains blood flow and therefore oxygen and nutrient levels throughout the body, contributing to the persistence of the organism via maintaining other organs that, in turn, contribute to the maintenance of the heart. All parts of such systems 'work' for their continued existence by maintaining the right internal conditions and the influx of energy and building blocks for other parts and thereby for the whole. As two classic authors of systems theory put it (Maturana and Valera 1992), "being is doing" for self-maintaining systems that exist in far from thermodynamic equilibrium states. Without the constant regeneration cycle going on things would swiftly degrade.

From early on organisational views built heavily on the notion of a *boundary condition* (sometimes also called a *constraint*), a causal notion that is required to make real sense of the complex causal division of labour in organisms and with that of the notion of self-determination. Here I will explain this concept based on examples and only at a more intuitive level as it is not the main focus of the present paper.

The essence of the organizational view is that living systems are characterized by a circular causal regime that reproduces the *internal boundary conditions*[1] necessary for various processes in the causal cycle itself. But before things get conceptually too complicated let us see what is a boundary condition more generally and how is it different from an ordinary cause, a causal factor? In one sense it is just a causal factor, but it has some important features not considered by everyday causal talk, neither by received theories of causation (like interventionist theories (Woodward 2005), the INUS account (Mackie 1974), or process views (Dowe 2000)), that are important for physical explanations and calculations in the physical sciences. Take the case of blood circulation again. Its function is to deliver nutrients, oxygen and hormones to all parts of the body. The vein walls are indispensable constrains that channel our blood to its destinations. In the parlance of the organizational view, their presence is the most important *boundary condition* for the process of blood circulation to reach its end even if not the only one. However, in simple causal parlance their role cannot be differentiated from other *causal conditions* or causes of blood circulation, like the pumping of the heart. Blood circulation obviously has a lot of further causes, causal factors like external atmospheric pressure, internal body temperature range, etc., many

[1] By *internal* it is simply meant that the boundary condition in question is part of the causal cycle as it is created or regenerated by it, and it also regenerates or creates another boundary condition in the cycle. Many causal cycles are not like this. More on this later.

of which are not only causes, but also boundary conditions for circulation at the same time.

So how can we differentiate boundary conditions and other causal conditions in general? The best way is to think of boundary conditions as constraints the constant presence of which is required for some other process to be able to run its course. A constraint is such that it determines, shapes some dynamics, but the dynamics leaves it largely intact. This might be familiar from pure mechanics: the surface of the table constrains the movement of a ball rolling on it. The same initial momentum leads to different trajectories depending on the exact shape of the surface as a boundary condition. One can connect this concept back to causation by distinguishing between stable/constant and unstable/variable causal conditions. In most examples of causal processes, such as a house fire, many of the causal preconditions are used up. The fire consumes oxygen and combustibles leaving ash, cinder and CO_2 behind. By contrast, atmospheric pressure or the absence of firefighters are causal conditions that need to be constant for the combustion process to go through. As these examples show, the notion of a boundary condition is not inherently teleological. The same notion applies in the context of pure mechanics as in the biological examples discussed.

For some biological process to run its course most of its causal conditions need to remain constant while the process plays out. What makes the situation peculiar is that many of these constant conditions are the products of the organism itself. For example, protein synthesis requires both amino acids and enzymes as catalysts, with the former being transformed or used up in the process while the latter remains a constant throughout the process. The presence of amino acids and the presence of enzymes are both causal conditions of protein synthesis, but the enzymes are not used up by protein synthesis; rather, they channel the process toward a specific outcome. In turn, enzymes themselves are products of other processes of the self-maintaining cycle of the organism. This is what makes them internal boundary conditions of the cycle. they are both created by the cycle and are also indispensable enablers of further steps in the cycle. Unlike e.g., external atmospheric pressure.

Now we have all the required conceptual resources to formulate what is peculiar about biological systems and about biological self-maintenance. Any process that is carried out by an organism requires a host of boundary conditions. Many of them, like the enzymes, are internal to the system and internally produced by it and while naturally degrading they are always reproduced by other parts the system itself to serve their function as a constraint again, leading to a circular causal regime where the internal boundary conditions in the system are the causal conditions of each other's reproduction processes within the self-maintenance cycle. An enzyme makes possible a certain kind of protein synthesis process, but that very enzyme is synthetized with the patronage of another enzyme and so on. In general, the organizational view states that all internal boundary conditions in a living system are such that they are produced with patronage of some other internal boundary conditions in the system and the system is closed for this relation. Biological functions are nothing more than the roles of the internal boundary conditions in reproducing other boundary conditions.

After setting the stage I can also introduce the notion of self-determination. An organism determines its own fate, persistence into the future, by creating many of the boundary conditions, at least the internal ones, and built on that, in most organisms, even some of the external boundary conditions, circumstances that allow it to exist further. We are not talking about a lucky cycle for which the circumstances are just right accidentally, a self-determining cycle creates the conditions that allow it to persist, justifying the special name for the kind.

To sum up, all internal boundary conditions (BC) in an organism are produced by and within the system itself and this is what basically makes it into a self-determining system. This what Moreno and Mossio (2015) call the '*Closure of Constraints*':

- Every BC_i in the system is a BC for the regeneration of at least one other BC_j in the system
- Every BC_j in the system is subject to at least one other BC_i in the system

What a BC_1 does contributes to the existence of BC_1 itself and the living system itself by its contribution to the existence of other constraints BC_2, ..., BC_n. Note that such closure does not entail that there are no further external conditions for the existence of an organism or that the organism does not have some effect on its own external boundary conditions. The cycle itself runs only in the presence of certain external conditions (like e.g., gravity, atmosphere, etc.). However, this closure of boundary conditions in the self-maintenance cycle of living systems is what makes them special in terms of their internal relational organization according to the organizational view.

From this it should be clear that having a closure of boundary conditions is more than running a circular causal regime, that might also occur in inanimate nature. Consider the hydrological cycle: water evaporates from open waters, it forms clouds, then precipitation occurs, then rainwater follows the slope of the land and flows back into the oceans. The slope is a boundary condition of the cycle, but it is not caused by other processes that are part of the cycle. The evaporation, rainfall etc. are not boundary conditions for the slope. A cycle like the hydrological has no internal boundary conditions.

A more formal definition of organizational or biological closure can be created based on these ideas that does justice to the view of organisms as "unimaginably complex self-maintaining storm of atoms [that] moves across the surface of the world, drawing swirls and clots of atoms into it and expelling others, always maintaining its overall structure" (van Inwagen 1990: 87). *Organizational Closure* (def.):

> Some simples (e.g. physical building blocks), the *x*s, compose an organism if:
> The *x*s can be grouped into the x_1s, x_2s... x_ns such that (i) for any i ($1 \leq i \leq n$) there is a j such that the activity of the x_is is a boundary condition of the activity of the x_js, and (ii) for every i, the activity of the x_is is a boundary condition of the collective activity of the *x*s (that is, of the causal cycle as a whole). (for a more detailed discussion of the definition see: Kertész & Kodaj 2023)

The above definition allows for the fact that organisms change (1) their building blocks (*x*s) constantly and (2) their mode of self-determination in response to the environment, switching from one self-determining regime to another, changing behaviour, modes of feeding, digestion etc., all the while maintaining the internal cross-dependence defined by (i) and (ii). So, we have a definition that is a good start for more informative definitions of organisms, or living systems and should be enough for the purposes of this paper.

III. REFERENCE FOR TELOS AND FUNCTION ASCRIPTIONS

In this paper, I am not committing myself with respect to the validity of the organizational view. Even though I find it to be a promising research program, I only use it as the best available theory of organisms that attempts to define them as a type of complex physical system in contrast to other type of physical systems. I don't claim that the criteria developed by its proponents are correct, sufficient or easily justifiable in an empirical sense. Even though its proponents have already created more formal systematizations of this idea (Mossio et al. 2009) that bring it closer to computer simulation based tests and other more practical applications, at the moment this is first and foremost a promising theoretical construct. What I accept without critical discussion here, is that the criteria provide at least a necessary condition for the identification of organisms and maybe more than that with somewhat blurred boundaries of identification. Therefore, what I am interested in is the following question: if the organizational view were a successful theory of organisms what would be the consequence of that for the status of teleological discourse?

The short answer to this question is that it could provide a firm basis for the idea I proposed in the introduction. If we take self-determining systems and their parts to be the entities referred to by teleological statements, a lot about the uses of teleological discourse gets explained in a reductive sense and, on the other hand, we can also shed light on what happens in erroneous, or promiscuous applications and how could we correct those mistakes.

Let us sharpen our understanding of the referential bases of teleological, functional language. First, we said two things: (a) if the organizational view is true, then organisms are self-determining systems. (b) teleological attributions have the function of tracking the presence and explaining the behaviour of organisms, that are, according to (a), self-determining systems. In analysing the connections between teleological and systems language in more detail, I follow Moreno and Mossio (2015). First, what makes it justified to attribute purpose, a telos to organisms or their behaviour? Well, it is certainly not that they or their parts have minds or intentionality. Here, I need to make an important distinction. Intentions and intentionality only appear on the scene with the presence of a mind, cognition and representations and here I will use these terms in a way that respects this understanding (in contrast to e.g. Daniel Dennett). Having a telos is simpler, more basic feature than having a mind. When we search for the end of e.g. some anatomical feature, we certainly don't attribute a mind or intentionality to that feature. We try to situate it in a system and especially when that system is itself a mindless creature than the only plausible question is this: how does it help the creature to live, to stay alive? In the parlance of most system theorists the question is, how does it contribute to the self-maintenance of the organism?

This latter question is key for two reasons. First, it shows that biological teleology is independent of the attribution of mind and intentionality. Second, it makes it clear that something can only serve a function if it is situated in the right kind of context. The only approach that makes the attribution of function both objective and independent of the particular interests of an observer is based on the organizational view of organisms. In that perspective, the function of a trait (if it has or had any), e.g. an anatomical feature, can be identified by locating its causal contribution to the self-maintenance of a self-determining system it is (was) a part of. That is the right 'context' in which function can be attributed. Any activity/trait of a self-determining system has intrinsic relevance to itself, to its existence to the extent that its persistence depends on the contributions of those constraints that the activity in question maintains in the system. However, if something is (was) not part of such a system any attribution of function is only in the eye of the observer. So, self-maintenance can be identified as the fundamental telos of a living system to which all functions of its parts are subordinated. Notice that a function doesn't belong to a part, it is not intrinsic to the part. The same gene or neurotransmitter might serve different functions in different species. A function is a relational property, it identifies the role of a part in a self-determining system and the system as such cannot change into another system without a change in at least the contribution of some parts to self-maintenance and if a function changes the systems changes. So, the functions of the parts are intrinsic to the system in the same way as its basic telos.

Functions are also supposed to explain the existence of function bearers. E.g. the heart's activity of pumping blood explains its presence and persistence. Notice that self-determination allows such explanations to make good sense. The heart does contribute causally to its own persistence via the self-determination cycle of the whole system it is a part of. For the same reason, self-maintenance serves as the basis for the normativity of functions and teleology. We expect organic parts to function in certain ways, exactly because they stay present only if they do their work in the self-maintenance cycle. Interestingly, biology textbooks, even books on physiology are full of normative descriptions like: 'in order to', 'demand', 'need' and so on. There is a lot of discussion of control systems in biology. For example, in genetics textbooks they tell us that a cell can 'control' the proteins it makes by 'controlling' gene transcription. This language implies distinguishable states of a system from which some are preferred over others. In a self-determining system that is a meaningful evaluation if we take self-maintenance as the basic telos into consideration. So, 'control' is a teleological and normative notion, it is done for the sake of self-maintenance. It can be successful and it can fail from the internal perspective of self-maintenance. Biologists tend handle such language with distancing gestures and cautionary remarks about language use. However, in my view, when we accept that teleological idioms refer to self-determining systems and their parts, we accept that teleological language is basically innocent, requires no distancing gestures, as it has a respectable reference base in the physical realm.

IV. REDUCING OR ELIMINATING TELEOLOGY?

On grounds of the above I suggest that teleology and function are properties that are reducible in a similar sense as temperature or mechanical hardness is reducible. Maybe because of multiple realizability considerations identifications can only be created locally (see Kim 1992), but I suspect that the analogy with known cases of physical reduction are stronger than one would think. Let me start by introducing the classic case of reduction based on Nagel's conceptualisation. Starting from there I will show that organisational properties like being a self-determining system are sufficiently similar to aggregate properties like mean kinetic energy of gas molecules, or calculations based on the strength of chemical bonds in solid matter.

Usually Nagel's theory of theory reduction (Nagel 1961, 1970) is taken to be a theory of reductive explanation, not of ontological reduction and this might create some confusions, so let me shed some light on this issue. His bridge-laws do serve explanatory purposes because their function is to connect different theories using different descriptions of nature, allowing the derivation, the explanation of the reduced theory or terms of the reduced theory by the reducing theory. It is true that the possibility of derivations like that does not imply the necessity of full-blown inter-level identification. However, according to Nagel, in most cases bridge-laws also declare the identity of the properties, co-reference of the different terms or term constructs of the higher and lower-level theories (see: Fazekas 2009. 305–306).

The qualitative distinctness between the properties talked about in the two different theories is what makes reduction an interesting achievement. When temperature in a volume of gas is reduced to the mean kinetic energy of the gas molecules in the volume in question, the bridge-law connecting the two shows "that what are prima facie indisputably different traits of things are really identical" (Nagel 1961. 340). The two prima facie different terms refer to the very same thing. The qualitative distinctness is quite straightforward here: no lower-level gas molecule has a temperature, that term is meaningless in the realm of molecules. Those particles have a few basic properties like space and time location, charge and kinetic energy, but only the last is relevant for the reduction. In statistical thermodynamics the temperature of a volume of gas equals to the mean kinetic energy of the ensemble of particles that make up the volume of gas. The reduction achieved imply that the terms temperature and mean kinetic energy of molecules in the volume refer to the very same thing under different descriptions.

So, it is useful to differentiate two aspects of reduction (see: Crane 2001). First, explanatory reduction, when what is explained by a higher-level science also gets explained based on a lower-level science. Explanation expresses an asymmetric relation. The lower-level science explains a term of the higher-level science, but not the other way around. Explanatory reduction does not require inter-level identity between the entities assumed to exist, temperature could be reduced to a different theoretical construct in solid matter and in gases and according to some theorists this is the case (see: Sklar 2015).

Secondly, we can talk about ontological reduction, when it is shown that a term in the higher-level theory refers to the same entity that the lower-level reducing theory is talking about, just under a different name or complex description. This relation is symmetric. The two descriptions are ontologically reduced to each other as the terms co-refer. The identification of two entities does not eliminate either. Claiming that Charles Bronson is Charles Dennis Buchinsky does not imply that either is non-existent. So, although reductionists like to use the phrase that something is "nothing over and above" or "just is" this or that, reduction via bridge-laws is not the same as elimination.

Identity reduces the number of autonomous entities we should accept into our basic ontology but allows that there are different scientific categories in sciences at different levels that pick out the same real thing. In the case of temperature, we might say that only the particles, molecules with one of their basic properties are necessary to compute the temperature in the volume from lower-level information. This shows that the particles have ontological priority. However, we would not say that temperature is not a real property. It is real exactly because there is a procedure that show us how to connect it to more basic things in nature. The bridge-law allows for a substitution of terms between different languages, but it does not imply that the term temperature is useless or mistaken, like the term phlogiston for a model of combustion. In what follows I will argue that a similar situation holds for teleological discourse as for temperature.

Let's start with the case of the statistical mechanical reduction of temperature. The bridge-law connects the macro- level property temperature of a volume of gas (T) and an aggregate property constructed from the micro-level property of kinetic energy that characterizes each particle in the same volume and it is defined as the mean kinetic energy of molecules in the volume (MKE), a property of an ensemble. So [T is MKE]. This is a very imprecise qualitative formulation, but here it is enough to say that MKE explains T in lower level-terms. But the statement also implies that T and MKE refer to the very same thing and if they co-refer both terms refer to the same thing in reality.

How could this work in the case teleology? First, we need to connect the property 'teleological' (TE) to the term we defined as *Organizational Closure* (OC). What we mean by having teleology gets connected to the complex system property of *Organizational Closure*. The complex system property explains what we mean by being a teleological system as an intrinsic property. So [TE is OC]. So far so good. The difference really comes out when we realize that TE is a quality and we cannot give it a quantitative interpretation. Unlike in the case of temperature, we can only say that the system *does things for its own good*, which is generally true of teleological systems, and then we have to start detailing its behavioural capacities in service of itself. The same goes for OC, which is only a general organizational feature, but to give any further qualification to it we would need to start to spell out the component level organizational features of the system, the functions that the different parts play in self-maintenance and to show that the cycle is really closed. Such characterization would be too detailed and overly complex for proper treatment in a paper like this. I could only give partial, surface-level examples from the life sciences that only highlighted functions of particular anatomical features. Notice that the only thing that is relevant for the discussion of the reduction proposed here is proving that a particular system is really an instance of OC. OC as such is definitely a multiply realizable feature, different organisms have fairly different self-maintenance cycles, which is displayed in their different behavioural patterns, homeostasis, organs, etc., but those differences are irrelevant with respect to being a teleological system. According to the proposed view, teleology as such consists in being a self-determining system that is an instance of OC. Nothing more, nothing less than that.

At first sight this might sound too different from the case of temperature. The difference can be understood if one looks at the general differences between the underlying systems (see Kampis 1991. 207). A volume of gas exists in the range of disorganized complexity. In such systems the individual degrees of freedom of the constituent parts do not play a direct role in the behaviour of the whole, the parts are quite uniform, their properties can be easily averaged into some gross behaviour by simplifications along certain dimensions. In contrast, a biological system exists in the range called organized or inhomogeneous complexity where there are a wider variety of parts some of which contribute to the behaviour of the whole disproportionately. However, even though this difference is important for understanding the workings of these different kinds of systems more generally, this difference is no obstacle to the identification of the capacities of the organization as a whole and the component level organizational features of the system, the system of functional relationships between the parts (Fazekas–Kertész 2011, 2019). This is exactly what full-fledged 'mechanistic' explanations in the life sciences should ultimately aim for (Bich–Bechtel 2021) instead of just analysing such systems analogously to classical machines as much of the literature on mechanistic explanation in the life sciences in the last two decades did (e.g. Craver 2007).

V. ELIMINATIVISM, FICTIONALISM CONCERNING TELEOLOGY IN BIOLOGY

But before I delve into the discussion of the possibility of reduction more deeply, I should highlight that concerning teleology the eliminativist and the closely allied fictionalist attitudes rule supreme in biological theorizing and this is exactly what I would like to oppose in this paper. Although the context and the argumentation is different, in the philosophy of mind a parallel attitude became fashionable with the advent and development of neuroscience. In the view of the proponents of eliminative materialism (Chruchland 1981) as there are no mental states as depicted by folk psychology, both the identity theory and functionalism are trying to do something absurd, to reduce a non-existent to neural activity. This view presupposes that even though folk psychology is a theory of mind it is a useless, an outright wrong theory of the mind. Just as late 18th-century chemical theory did not try to save the concept of phlogiston in the context of molecular theory but simply dispensed with it and replaced it with oxygen theory, so the entire mentalistic vocabulary of folk psychology should be eliminated on behalf of the descriptions of advanced neuroscience. What I would like to point out below is that a similar approach to teleological language rests upon a mistaken attitude towards its uses in describing reality.

The eliminativist attitude in biological theorization has mostly to do with the dominance of evolutionary thinking and certain philosophical, metaphysical uses of Darwinism. The basic attitude is this: all apparent teleology was explained away by evolutionary theory, nothing remained and at the same time teleological language and explanation is unscientific so it should be dispensed with altogether. Darwin provided a mechanistic explanation for the changes observed in the history of life and so beliefs in the purposefulness of historical change in nature are mistaken, what really takes place is a combination of blind variation and selective retention of the fortunate forms that are more fitted to the environment. This view became important for scientists and philosophers alike as an argument for a monist, naturalist worldview as it was the Darwinian perspective that provided the best argument against natural theology and for dispensing with the idea of a Creator in the context of understanding biological nature. Historically the architects of the modern synthesis of evolutionary thinking interpreted Darwin's role in the debate over the place of teleology in biology, as providing the theoretical tools for "getting rid of teleology and replacing it with a new way of thinking about adaptation" (as Michael Ghiselin claims in his preface to a modern edition of Darwin's work on orchids, see Lennox 1993) and thereby making a huge step towards an integrated naturalistic worldview.

This eliminativist stance that considers teleology to be a false relic of pre-Darwinian thinking is closely allied with a form of fictionalism according to which teleological descriptions should be seen as metaphorical and only serve as replaceable abbreviations, shorthands for proper evolutionary accounts. E.g. Maddrell (1998) describes what even professional biologists do regularly "for the sake of saving space" this way: "the proper but cumbersome way of describing change by evolutionary adaptation substituted by shorter overtly teleological statements". Ghiselin (1994) argued against those who found that Darwin can be rightfully interpreted as someone who saw himself explaining the origins of the immanent teleology in organisms claiming that Darwin's thinking is not teleological, only his language is, he only uses teleology as a metaphor, a kind of 'as if' description. As Michael Ruse reminds us in his article in this volume, in earlier work Ghiselin even went as far as to claim that when Darwin uses teleological language in his book on orchids he is doing "metaphysical satire".

Why do we need such fictionalist accounts of teleology? The answer is obvious, the extensive use of teleological language by both layman, but also by knowledgeable experts requires some form of explanation if we firmly believe that this language is a misrepresentation of biological reality or that it is misleading. We are allowed to say that some organ serves a function, has a purpose only if we can replace that language with some scientifically respectable mechanistic parlance. But ultimately function and purpose should be considered eliminable items from our dictionary of reality, as things only seem to have a purpose, but they don't have a purpose really. This is where I would like to suggest, that it might be better to consider the option of taking teleological language more seriously.

There is a lot to agree with concerning the intentions behind the eliminativist/fictionalist conceptualization of teleological language, but one should also see that what is true about the process of evolution doesn't necessarily apply to organisms themselves. If one takes the caution against teleological language as a call to reject the idea that the adaptedness of organisms is a result of conscious design or some other intelligently guided process, etc., it is a fair point. But if it is about rejecting the idea that organisms in themselves, their parts and behaviour have purpose or function, the situation is much less straightforward. The reason why Mayr (1974) and some other prominent theoretical biologists favoured the introduction of the notion of teleonomy into the vocabulary of biology to replace teleology, the reason why they were interested in cybernetic accounts of apparently goal-directed behaviour (Sommerhof 1969) was exactly that the recognition that the properties of the organism should be handled separately from its history. I think it would be better to follow the path these theorists started to walk concerning teleology and that path leads to a system theoretic account of teleology.

Some contemporary Kantians provide a more constructive account of how and why teleological metaphors are useful (Breitenbach 2009). They argue that attributing teleology serves as a useful heuristic in the search for proper causal-mechanistic explanations of whatever organisms do. For a Kantian teleology can only serve as a regulative principle, our limited cognitive faculties are compelled to see organisms as purposeful, but teleology itself is what Kant calls a transcendental illusion. Therefore, for Kant, mechanistic science cannot explain teleology and therefore teleological descriptions have no ontological implications. At the same time, such descriptions create an analogy with purposeful human creation which provides a useful heuristic device for understanding how things really work, without committing the user to anything ontologically consequential.

This is a respectable view, which could also be categorized as a form of fictionalism simply because human planning and creation is not the real source of functionality in biological systems. However, one should also notice that Kant's inability to find a place in his system for the recursive kind of causation that characterizes organisms is problematic from the perspective of contemporary science. He saw them as causes of themselves, but such self-referential, recursive workings were incompatible with the linear view of causation that his idea of natural laws and scientific explanation implied. But we are not in Kant's position.

Contemporary science is well-equipped to handle both non-linearity and causal loops and this opens the door for taking teleological language seriously. Self-determining systems as described above are involved in non-linear dynamics and they are running energetically, thermodynamically open, but otherwise closed causal loops. Describing such systems as causes of themselves would be imprecise, but describing a cycle in self-maintenance as causing the next cycle and the functional parts of the system as causing the construction of a new token part of the same type that was instantiated before and thereby preserving a token of the type of organization that defines the organism in which the cycle is running, is feasible. This is the perspective of general systems theory advanced most prominently today by Moreno and Mossio (2015). But then taking teleology only as a heuristic that helps us with projecting our own teleological activities onto mechanisms is an unnecessary restriction. A different angle becomes possible concerning the task: understanding organisms on their own right and by doing that probably understanding the reason why they attract teleological descriptions so readily in contrast to objects of inanimate nature. This highlights one reason why the comeback of the notion of an organism in the last decade is a quite significant change for theories of teleology.

VI. SAVING TELEOLOGICAL INTUITIONS AND LANGUAGE

To close the previous thread let's get back to eliminativism. Is there still a good reason for eliminating teleological language? Answering the question, I will take it that teleological language is akin to mental discourse, folk psychology, in the sense that it is a kind of theory, it provides a more or less fitting model of a section of reality. As a theory it can be useful, predictive or not as any model or theory. I think it is arguable that this discourse is relied upon both in everyday life and in science and the second kind of application is a continuation of the first, the same framework utilized more systematically, methodically. I also think that the cognitive module responsible for teleological intuitions and language is a product of evolution itself and it was selected for its usefulness in tracking the presence of and in understanding the behaviour of self-determining teleological systems from predators to prey, possible allies and enemies from other humans to poisonous bugs. Research in cognitive psychology portrays our teleological cognitive module as a core part of our cognitive toolkit (Csibra–Gergely 2007) pointing towards similar uses. This line of research shows that goal attribution certainly has predictive reliability: "it carries direct information about likely future events (the expected outcome) and its context" (Csibra–Gergely 2013). There is also evidence for the occurrence of teleology attribution that does not involve the attribution of mental states for the understanding and computation of actions by organisms (Csibra–Gergely 2013).

So, in terms of predictive power our teleological module seems to perform well enough. In this respect it is unlike crystal spheres and phlogiston, which means that the best reason for elimination is out. However, I don't want to argue here that teleological language should be interpreted as literally true in all of its applications or that it is the best tool for the description of living systems. What it seems to do is tracking the presence of self-determining systems and it can also be used as a tool in analysing the ways in which the parts of such systems achieve the supposed end of the whole. The ability of tracking the presence of self-determining systems and predicting their ends does not imply that teleological language describes reality perfectly. Its applications can be faulty, and telos attributions can become unjustifiably loaded with e.g., anthropomorphic suppositions. However, any application can become subject of criticism and modified to match the features of a system more closely. The claim here is simply that, the function of teleological discourse is to track the presence of self-determining systems. Teleological discourse is not transparent in this respect, only science could tell us what are the underlying structural features that constitute such systems. This scientific language is more precise and should be considered more fundamental than teleological discourse. But the reduction suggested here still makes teleological discourse a respectable tool in describing reality, similarly to the use of the language of hardness or temperature.

But can't we still say that teleological discourse leads to a lot of confusion and misrepresentation? Let us start in the context of science and science education. According to many biologists it might create confusion by suggesting that evolution is a guided process, or by suggesting that organisms are designed by a creator, or by suggesting so-called Lamarckian mechanisms for evolution. To answer that worry let me point out this: teleological discourse, and our teleology seeking cognitive faculties are way older than our systematic accounts of the history of life, especially the theory of evolution. If we consider this faculty as a product of evolution, it must have had its uses in a context where humans didn't even consider the past more than a few generations before their own time. So, if teleological intuitions were selected for by evolution they were not selected for the capacity to grasp e.g. the mechanism of evolution, but probably for the capacity to track the behaviour of self-determining systems in the immediate environment. Therefore, it is not surprizing that they work fairly well for predicting the behaviour of other self-determining systems, but lead to misrepresentation when applied in a new context. So, there is a good reason to be cautious, but only for a restriction on the scope of application, not for eliminating the teleological module.

One should not forget that the same research quoted on the usefulness of teleological intuitions also shows, alongside other investigations into the subject, that humans have a strong tendency to overattribute teleology in other contexts as well (goals and functions alike). Teleology seems to work as a cognitive default heuristic. On the one hand, this means that infants and adults alike tend to attribute goals even to seemingly inanimate objects like rectangles, puppets, robots (Csibra 2008), basically if they behave in a sufficiently varied manner. On the other hand, especially young children, but also adults tend to choose teleological explanations even for purely physical occurences when they are asked to choose between purely physical-causal and teleological options (Kelemen 1999, Kelemen et al. 2012). Kelemen shows that children and, to a somewhat lesser extent, adults have a tendency to suppose even in the case of natural objects such as clouds, trees or mountains, that they serve a purpose. She named this tendency 'promiscuous teleology', and contrasts it with the ability to use teleological reasoning in appropriate domains, what she calls 'selective teleology'. Humans are obsessed with goals from an early age, they look for them everywhere most probably because this facilitates social learning about instrumental action and problem solving (Csibra–Gergely 2013).

Is this a problem for someone who aims to show that teleology is a respectable property of natural systems? Not necessarily. In the literature on cognitive processing and decision-making there is differentiation between heuristic and systematic processing (Kahneman (2011) calls them system 1 and system 2). Heuristic processing is fast, and automatic whereas systematic processing is slow and effortful. The distinction is a result of idealization, and it is accepted that in many cases processing takes place in an in between manner, partly heuristic, partly systematic. Heuristics are useful simplifications that are helpful in the right kind of context, but systematically mislead in other contexts[2]. However, choosing systematic processing and gathering more information, we can correct heuristic biases. Kelemen et al. (2012) showed that time pressure, which increases the tendency to use simple heuristics, increases the occurrence of promiscuous teleology in test subjects. But it was also demonstrated that education reduces the occurrence of promiscuous teleology and the only factor that seemed to count was the level of education. It did not matter whether the subject had a PhD in literature or physics. Most probably the result is a consequence of more systematic processing and information seeking. Therefore, it is plausible to think, even if we are usually too obsessed with goals and overly reliant on one clue for identifying goal-directed, teleological behaviour (Csibra 2008), we have the means to correct ourselves and 'selective teleology' can be at least approximated.

Approaching the same issue from a different angle, even if there is a systematic bias in our teleological cognitive module towards false positives, that doesn't mean that the entity the module is searching for is a non-existent. So, the identification of a systematic bias is not a good enough reason for the elimination of teleological discourse. Still, the best explanation for the existence of the module is that it helps the organism to find or to avoid the entities modelled, described by it reliably, if not always correctly. Also, the fact that a cognitive module produces many false positives, without producing false negatives, is not an evolutionary disadvantage as long as the cost of false positives is low. Obviously, it is much less problematic to recognize a boulder as bear than the other way around. This is a well-recognized pattern in evolutionary psychology with respect to many cognitive categories. To save energy organisms manage errors

[2] For example, the ease of remembering is a good heuristic regarding the distribution of different weeds in my own garden, supposing that I know weeds and I visit my garden daily. The same heuristic is bad guide with respect to the frequency of suicides in my country.

only when those are costly enough, that is why this principle is called error management theory (see Buss 2016). To sum up, the ability to identify organisms, self-determining systems is a highly adaptive trait and the inability to do so is mostly a maladaptive one, regardless of the numerous low-cost false positives that are generated in the process (for a more detailed discussion of this topic see: Kertész–Kodaj 2023).

Before closing this paper, it might worth mentioning one further advantage of accepting the perspective argued for here. Namely, that teleological intuitions and language are mostly fair descriptions of reality and teleology (TE) as a property term can be reduced to the systemic property I called Organizational Closure (OC). As Kelemen, Csibra and others also recognized people tend to attribute teleology, over and above organisms, to things like social organizations, in some cases to groups. From an organizational point of view, I suspect that not all of these are cases of misattribution. The notion of organizational closure probably can be reasonably extended to include systems that are not organisms in the ordinary sense. Maybe the most obvious intuitive example would be the case of superorganisms, the large, well-organized colonies of social insects. But let's just take a look at artefact functions here which is usually taken to be unproblematic. But there is extensive tool use in the animal kingdom, the exquisite palaces of termites are a prime example. How could we handle them conceptually? According to received wisdom artefact function depends on the intentions of the maker. Do termites have intentions? Quite probably not.

Let's approach the case differently. The self-regulatory capacities of many organisms involve agential capacities, movement and in many cases the more or less complex manipulation of the environment. Following Moreno (2018), agency can be defined as changing one's environment in such a way that the change is beneficial or even indispensable from the point of view of the self-maintenance cycle of the agent. To use another example, a beaver cannot fulfil many of its basic needs without building its dam, it sounds plausible to say that the dam is a constraint constantly renewed by cycle that maintains the beaver and seems to serve as constraint that is important for cycle. If the dam can become part of the self-determination cycle of the beaver than in that cycle the dam serves an intrinsic function. Whether it does become part of it is a harder question to answer, the only thing I want to say here that this is not implausible. And this thought might open an interesting perspective on artefact functions. As in the case of termites we probably want to say that beavers don't have intentions. And think about this: you find and abandoned beaver dam or termite hill. Does it have a function? Well, according to the organizational perspective it might have had one, but at present it doesn't as it is not part of a self-determination cycle. These examples are mentioned to raise awareness, that the organizational account of teleology might be able to surprize us with unexpected solutions to old problems or even to unexpected problems connected to old problems.

In conclusion, we have good reasons to take teleological intuitions and teleological language seriously, giving teleological descriptions a realist reading. And the best way of taking them seriously is to suppose that these descriptions track the presence of self-determining systems, their behaviour and functioning.

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