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Article

Is natural selection a chimera?

Reflections on the 'survival' of a principle

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Abstract

My objective is to discuss the persistence of the notion of natural selection in the biological sciences, exploring the fact that: (1) this notion, just like the term culture in anthropology, is historically an inaugural concept in its particular scientific field, and, insofar as both possess a value of heuristic delimitation, both thus came to be considered as explanatory concepts, although today they may be more widely accepted as descriptive in kind; (2) this persistence seems to be equally linked to the fact that the term combines randomness and teleology, but without foregrounding the inherent contradiction; (3) the anthropomorphic metaphors generally used in the description of biological processes, by attributing intentionality to beings lacking in self-determination, presume the existence of a nature defined by processes oriented towards precise ends, endorsing the finalism that, I believe, underlies the idea of natural selection; (4) and, finally, I think that 'culture' and 'natural selection' correspond to disciplinary labels – for social anthropology and biology respectively – that arose in Victorian Britain, as defined by the Great Divide, but they no longer have explanatory power.
Keywords: natural selection; biology; randomness and teleology.

Seria a seleção natural uma quimera?

Reflexões sobre a "sobrevivência" de um princípio

Resumo

Meu objetivo é discutir a permanência do conceito de seleção natural nas ciências biológicas considerando que: (1) este, bem como o termo 'cultura', sendo conceitos historicamente inaugurais em seus respectivos campos científicos, e tendo assim valor de delimitação heurística, passam a ser considerados como conceitos explicativos, embora atualmente possam ser mais aceitos como conceitos descritivos; (2) a permanência parece estar ligada igualmente ao fato de o conceito conjugar aleatoriedade e teleologia, sem que seja ressaltada a inerente contradição; (3) considero que as metáforas antropomorfizadoras, usuais na descrição de processos biológicos, ao emprestarem intencionalidade a seres desprovidos de autodeterminação, pressupõem a existência de uma natureza de processos que se orientam para finalidades precisas, endossando o finalismo que acredito estar subjacente ao conceito de seleção natural; (4) e, finalmente, avento que 'cultura' e 'seleção natural' correspondam antes a seus epítetos disciplinares – antropologia social e biologia – surgidos na Grã-Bretanha vitoriana, conforme limites estabelecidos pelo grande divisor, do que propriamente revelem poder explanatório.
Palavras-chave: seleção natural; antropologia e biologia; acaso e teleologia; adaptacionismo e finalismo; natureza e cultura

Quant aux sciences, elles poseraient une seule question proprement historique:
pourquoi ne se sont-elles pas développées plus tôt,
pourquoi la raison humaine a-t-elle été si longtemps obscurcie pas les opinions irrationnelles?
Isabelle Stengers

For José Roberto

Introduction

The biological sciences, until recently solidly based on Darwinist foundations, have been experiencing some profound changes. One such change, endorsed by the scientists Jablonka and Lamb (2010), proposes – albeit through the adoption of innovative approaches – the revival of a fairly old conception, today known as neo-Lamarckist. Yet however radical these questionings of contemporary Darwinism may be, they always leave

unscathed its distinctive concept, namely the principle of natural selection. The aim of this article is to provide a panorama of these critiques and suggest an explanation for the persistence of the concept of natural selection. My intention is not, therefore, to interrogate its scientificity, given that this could only be questioned from the viewpoint of (political) epistemology) (Latour 2004: 354). Rather I wish to engage in an anthropologically-informed reflection on why the scientificity of this concept/principle continues to be reaffirmed even when its theoretical framework is thrown into question. Consequently, the present article is greatly influenced by the anthropology of Tim Ingold, which Carvalho and Steil (2013: 64) very aptly characterize as "immersed in life."

In examining why the principle of natural selection still remains a scientific principle of practically hegemonic heuristic value in the biological sciences even today, despite the huge transformations seen in the field biology, I have in mind that the background to the proposed discussion is summarized by the expression 'Romantic drive' of Luiz Fernando Dias Duarte (2012), understood as a tendency in Western cosmology that always appears in tension with its opposite, the Enlightenment drive. Some of the eminent authors who, in biology, as well as anthropology, who have been closely involved in the series of critiques reinvigorating their respective disciplines, and are represented in this work, can be identified, according to Duarte, as authors associated with the 'post' moment, an expression of a neo-Romantic movement (Duarte 2004: 16), who, though rejecting existing theoretical systems, nonetheless bring to light values central to the Romantic ideals. Among these values, the author highlights the desire to apprehend flows and totalities, focusing on the sensible, rather than remaining content to comprehend the world without the unpredictability of living phenomena, excluding the whole and its mediations.

This demand, which invades the biological and anthropological sciences, has provoked a new kind of interconnection between nature and culture at an epistemic level since it enables biologists and anthropologists to combine forces against universalist mechanisms and schemas, which fail to explain what they identify as essential to exploring and describing the phenomenon under examination (Duarte 2004 and 2012). Following Gregory Bateson's lead, Tim Ingold inaugurates an ecological anthropology (see, for example, Steil & Carvalho 2014) that refuses to excise the living dimension from the human condition, pursuing a wide-ranging dialogue with natural scientists, as well as calling for dialogue with other disciplines (architecture, archaeology, arts and psychology). His main interlocutors in biology are those who, following the footsteps of Richard Lewontin and Susan Oyama, argue for the renewal of neo-Darwinism by adopting an approach in which the agency of living beings and a less generic and abstract 'environment' form part of a totality with all its diverse nuances. A parallel movement of anthropologists and biologists can be noted, therefore, which, driven be related concerns, are able to dialogue on very different and more productive grounds to earlier attempts like sociobiology (see, for example, Silva 1993 and 2006).

But while the concept of culture has been explicitly questioned in anthropology by Ingold and other authors, among biologists the critiques have not struck the heart of neo-Darwinism – that is, the idea of natural selection – although Lewontin's critique of adaptationism comes very close. We are compelled to reflect, then, on the capacity for survival of the concept that describes a natural principle that can be extended to almost all living beings – an exception being made originally by Darwin for civilized humans, a fact of fundamental importance. When he asserts in his work (Darwin 2004b) that civilized man is not governed by social selection, the naturalist left this explanation – that of social evolution – to be provided by a distinct paradigm of natural selection.

As a working hypothesis, I suggest that the longevity of this principle can be explained by its characteristic combination of randomness and teleology (without the inherent contradiction being emphasized). The central inspiration for this interpretation comes from a formulation of Latour concerning what he ironically calls "the invincibility of the moderns." For him, the moderns enunciate in their Constitution two great divides, mutually interconnected, that found the production of scientific knowledge: on one hand, the possibility of distinguishing between facts and values, and, on the other, the separation between nature and culture. In practice, though, the moderns mix these domains unendingly, which allows them to maintain the modern Constitution without ever fulfilling it (Latour 1994).

Similarly, I argue that the capacity to remain safe from criticisms displayed by the concept/principle of natural selection is related to its contradictory character, an aspect highlighted, as we shall see, by Étienne Gilson (1971: 138), who asserted that Darwin achieves a "finalism without final cause." It is thanks to this chimeric character (a mixture of randomness and finalism) that the concept of natural selection manages to become consensual and hegemonic, revered for more than a century as the seal of scientificity for biologists, combining its stochastic base (of chance genetic mutations) with a selection or adaptation to environmental conditions. This process of adaptation, which the biologist Lewontin critically labelled 'adaptationism' (Lewontin 1978), is also known as the struggle of living beings for existence or survival. The idea of adaptation thus contains the presupposition of a common finality to the life of living beings.

By attributing a selector role to nature/the environment, Darwinism can explain how the world acquires a 'Larmackist appearance,' that is, a world where everything seems to be formed in order to adapt 'itself' to the 'rest,' only through an aleatory process.[1] This effect is achieved thanks to the finalism contained within it (and expressed in the term 'itself'), already observed by Gilson (1971), a huge admirer of Charles Darwin.

Despite the fact that randomness is the characteristic that distinguishes Darwin's biology from that of his evolutionist contemporaries and predecessors, and raises his theory to scientific status, there is a constant use in biology books of metaphors that describe genes and other molecules, as well as diverse types of living beings and organs, as though they possessed a capacity for volition, intention and decision. Now, if living organisms are selected thanks to a phenotypical peculiarity carried by themselves and which gives them an adaptive advantage, but which was obtained due to a genetic mutation, a chance outcome over which they have no power of influence or decision, then the use of metaphorical language to describe nature – which operates on a random basis, i.e. natural selection – betrays what it attempts to portray by anthropomorphizing it. I take the fondness for teleological metaphors to be a strong indication that natural selection is, itself, a chimeric conception.

1 And non-Lamarckist: for the use, disuse and inheritance of acquired characters.

1 – Two concepts, one nature

In 1871, when the British freethinker Edward Burnett Tylor defined what came to be known as culture, he also defined a scientific field. He inaugurated the discipline called Anthropology at the University of Oxford. In 1975, Roy Wagner (2010) argued that what we anthropologists call culture is an invention: far from being a well-grounded concept, it is an index, a name encompassing a huge set of phenomena that anthropologists, along with 'their' natives, began to delimit amid the shock that took place (and still does) between colonizing industrial society and colonized peoples.

Tim Ingold engages in an even more radical critique of the idea of culture. He observes that Durkheim's approach distinguished two portions to the human being: one properly social and conceptual, and thus collective and permanent; the other primordially subjective and individual, the seat of sensations, characterized by its chaotic and fleeting nature. Ingold also notes that Durkheim believed that perception occurred in two stages: the initial reception of ephemeral and meaningless data, followed by the organization of the latter in the form of social representations (Ingold 2000:159). This impact of this idea left by Durkheim, revered as the founding father of an exclusively social field of research, autonomous from another, psychological field, would reverberate among subsequent generations of European anthropologists. And although Franz Boas inculcated another approach in North American cultural anthropology, which argued that individual and culture could be understood as two levels of interconnected phenomena, Ingold identifies points of contact here too with Durkheim's sociology. Even the anthropology of Clifford Geertz, by stressing that the domain of cultural symbols is social rather than psychological and public rather private, is seen to show the influence of the French master. What seems to be the most deep-rooted Durkheimian legacy, however, permeating the most diverse anthropological traditions, has been the privileged status of representations in the understanding of culture, associated with the fact that their locus is the human mind, a legacy that Durkheim in turn took from Descartes.

Ingold asks how a cognitive program – one which, biologically speaking, would allow for the development of all cultures in their specificities – was attained uniformly by the entire human species. The plasticity of a program that endows all human brains with the aptitude to develop any culture would have to be something, Ingold points out. He adds that an innatist vision is equally found in the doctrine of cultural relativism with its assumption that cultural differences are unrelated to biological phenomena. Ingold encounters an alternative to these hegemonic visions, in anthropology and biology alike, in the ecological psychology of James Gibson and his concept of *affordance*, as well as the phenomenological philosophy of Heidegger and Merleau-Ponty, and the biology of Jakob Von Uexküll, in particular his idea of the *Umwelt*. The reference to Uexküll highlights the pertinence of Duarte's (2012) analytic framework: not only was Uexküll heir to a Germanic tradition in which transformism (or the evolution of the species), as proposed by Charles Darwin, lacked the same impact attained elsewhere, he was also swayed by his personal convictions which drew him to the question of 'totality,' introduced by Driesch (Uexküll 2008: 239). In this same sense, Ingold's anthropology stubbornly resists dichotomies of the type mind/body, representation/sensation, culture/nature.

Ingold continually reflects in his work on the idea of culture, always opposing its comprehension as a system of rules through which the mind constructs representations of the external world that reach it thanks to the body's sensations (Ingold 2000: 361). In *The Life of Lines*, Ingold returns to Durkheim to explore his legacy from another angle. Rather than focusing on the Cartesian inheritance in which disembodied representations of empirical phenomena are stored in individual minds that give rise to social life, he calls attention instead on the fact that Durkheim's notion of the superorganic is located on a specific plane of reality where individuals and bodies all merge, creating something different from the sum of the parts. Ingold encounters this same idea in the anthropology of Marcel Mauss, who recognizes that gift exchange produces a fusion of mind and body, owned and owner, giver and receiver, and giver, gift and recipient. Ingold does not convert to the French sociology of a century ago; he simply identifies within it the virtual existence of what he calls a meshwork. In this complex mixture of material and immaterial flows is found too what we anthropologists conventionally call 'culture' and which we isolate from this meshwork through the artifices of our disciplinary practice (Ingold 2015: 9-11).

In the Ingoldian universe, as established in *The Life of Lines*, the word 'culture' has already fallen into disuse. In *Biosocial Becomings*, co-authored with Gílsi Pálsson, Ingold discusses the need to critique this notion, abandon dichotomies and those mechanisms resulting from them (commonly called mediators) and that, with the declared intention of uniting arbitrarily distinct domains – like nature and culture – end up reinforcing their supposed isolated existences. For Ingold culture does not explain, it merely indicates what needs to be explained:

> What, then, is culture? Does culture evolve? On the first score, we would say that culture is the name of a question, but it is not the answer. The question is: why does life, especially human life, take such manifold forms? To answer that these forms are forms due to culture is patently circular (Ingold 2013b: 4-5).

Far removed from the Victorian era when Christian cosmology was still competing with scientific thought for the monopoly of eschatological explanations, a period when determinist views flourished more readily in the humanities, the epithet 'culture' now has little to add to anthropological thought. As Wagner (2010) discerned in the 1970s, the importance of the idea of culture persisted in the robust cultural determinism of the North American tradition, thanks to its index function to which the adjective 'disciplinary' can be added.

While Tylor delimited as civilization or culture as that which was proper to Man, an area to be investigated by anthropologists, Darwin saw in natural selection the principle of natural beings, without culture or civilization, the explanatory basis of the theory that he presented in *On the Origin of Species*, and which later enabled the construction of a paradigm central to the field of 'biological sciences,' as Foucault (1966) closely analysed.

2 – Natural selection and its seductive polysemy

Natural selection is the distinctive principle of the theory elaborated by Charles Darwin (2004a: 160-161) on how living species emerged from previous species, a theory today called neo-Darwinism (or the modern synthesis) that integrates the legacy of the eminent British naturalist with the knowledge developed subsequently by disciplines like genetics and biochemistry. As soon as Darwin had created the term, the philosopher Herbert Spencer argued that the term natural selection could be liable to misinterpretation by being overly metaphorical and treating nature as an entity that acts like a selector God; Spencer suggested that Darwin use the expression "survival of the fittest," and subsequently "the fittest," which in his view would be more scientific (Spencer 1893: 160-161). In fact, Darwin was sure that chance was the source of individual changes, the basis for the transformation of the species, and the incorporation of Malthusian ideas into his own formulations would, the naturalist thought, shield his theory from accusations of religious premises or any other form of teleology: his fear had always been the opposite.

All the fuss that surrounded the publication of *On the Origin of Species* because of its supposedly heretical content, including Spencer's critique in the opposite direction, failed to deter the flourishing of neo-Darwinism in the twentieth century. A consensus formed around the principle, the contemporary definition of which is as follows:

> Variations arise within populations, in a haphazard and undirected way. Some of these variant characteristics lead the individuals who bear them to have more offspring than others. When these favoured characteristics are inherited across generations, the population will change (Godfrey-Smith 2009: 1).

In his analysis of evolutionist theory today, the philosopher Peter Godfrey-Smith highlights two major trends in the field of neo-Darwinism. One, which he names as the classic school, the one with which he himself identifies, is structured around three components: individual variations, the possibility of inheriting these variations through descent, and, finally, the possibility of their bearers thus being able to leave more descendants, as described in the excerpt above. The other school, which he calls the "gene's eye view," emerged from the ideas of Richard Dawkins[2] (see, for instance, Dawkins 2007, Sahlins 1980) and proposes that the mechanism of natural selection operates in favour of genes, rather than the individuals of a Darwinian population – that is, a set of members of a species that coinhabit and procreate among themselves. For Dawkins and his followers, genes are replicators that use organisms for their own multiplication (Godfrey-Smith 2009:129): in other words, organisms are vehicles for the multiplication of genes. In the classic view, genes comprise the mechanism through which organisms can be perpetuated. Godfrey-Smith argues that the weak point in Dawkins's conception is that what biologists call a gene does not possess a clearly delimitable biochemical unit on the chromosome (Godfrey-Smith 2009: 136).

The global outcome of this evolutionary dynamic is understood as an alteration in the population of individuals arising from the change in genetic frequencies. However, neo-Darwinists extend the principle of natural selection to all the hierarchical levels studied by the biological sciences, not just members of a single population: natural selection can take place at the level of molecules, cells, between individuals of a species and between species. From its conception in the writings of Charles Darwin (2004 a e b) to its widespread use in the present, therefore, the principle of natural selection has described a competition, a generalizable "struggle for survival" (Haraway 2004: 30), or simply for 'survival' (Jablonka & Lamb 2010: 186-287).

The principle of natural selection does not refer just to the standard mode through which living beings coexist. As the psychologist and philosopher Susan Oyama observes, it also merges with the more general process of evolution that it itself is deemed to promote:

> Evolution, or natural selection, with which evolution is too often identified, is frequently depicted as an agent that continuously scrutinizes organisms in order to identify those best suited to life. (Oyama 2000b: 10-11)

Working along the same lines, the philosopher Anna Carolina Regner takes the concept of natural selection to refer simultaneously to a mechanism and to nature as a whole, which seems to indicate an ambiguous conception of the natural world on the part of the naturalist (Regner 2001: 690-691).

Spencer's criticism vanished from view in the nineteenth century. Over the following century, the abundant contributions to Darwinism also dismissed the relevance of a second critique that emerged in the 1970s: the ruthless attack by Karl Popper who stated diverse times that natural selection was an "almost tautological" concept (Popper 1978: 344) since it had a descriptive rather than explanatory value:

> Quite apart from evolutionary philosophies, the trouble about evolutionary theory is its tautological, or almost tautological, character: the difficulty is that Darwinism and natural selection, though extremely important, explain evolution by 'the survival of the fittest' (a term due to Herbert Spencer [sic]). Yet there does not seem to be much difference, if any, between the assertion 'those that survive are the fittest' and the tautology 'those that

2 This current is commonly known as sociobiology and was created by O. Wilson. Richard Dawkins argues that altruistic behaviour is motivated by selfish behaviour (Dawkins 2007) linked to the advantage of increasing the chance of perpetuation of its own genes through descent.

survive are those that survive.' For we have, I am afraid, no other criterion of fitness than actual survival, so that we conclude from the fact that some organisms have survived that they were the fittest, or those best adapted to the conditions of life (Popper 1978: 221).

There is no evidence that Popper's critique received any support from other philosophers or from biologists. Mathematical modelling and other instruments of scientification seemed to offer the possibility of overcoming the obstacle identified by philosophy. In the appendix to one of his books, Godfrey-Smith provides modelizations for calculating genetic frequencies that change as a result of the adaptive value of the mutant genes (Godfrey-Smith 2009: 165-183). This means that, in the case of a mutation to a gene that makes it more adaptive than the wild gene (i.e. the one that underwent the mutation), there are mathematical equations that indicate not only how the frequency of this gene will increase within the population, but also how this modified and supposedly more adapted population will consequently increase over time within a certain environment. However, as we shall see below, these modelizations are heavily questioned (Lewontin 2001) for overly simplifying what happens.

3 – Critique of 'genecentrism' results in the Extended Synthesis

As neo-Darwinism developed, the evolution of the species also began to be explained by other events (genetic drift, isolation and migration) identified as constitutive elements in the transformation of species, but without the principle of selection losing its explanatory centrality or its theoretical pre-eminence. Other views also emerged around the 1980s, more critical than enriching per se, which questioned the neo-Darwinist 'genecentrism' (the privilege attributed to genes as a determinate cause) and 'atomism' (the perception that the natural world is produced through the inter-relation of previously individualized beings) and advocated a more processual and holistic vision of living organisms.

The twentieth-century appropriations of Darwinism occurred within the context of huge developments in genetics and the valorisation of phylogenetic approaches over investigations in the field of ontogenesis. Ontogenetic development and hereditariness were treated as separate phenomena by neo-Darwinism since the phenomena related to hereditariness were considered sufficient to explain the evolution of the species and their diversity. While genetics flourished extraordinarily over the course of the twentieth century, therefore, studies of the development of the living being from its embryonic phase to adulthood[3] were eclipsed – a period in the history of the biological sciences analysed by Haraway (2004) and by Canguilhem and others (Canguilhem et al. 2003), as observed in previous works focusing on this question (Silva & Duarte 2016). Ingold too in innumerable publications (1986, 1990, 2001, 2004, 2013b) has discussed how neo-Darwinism abandoned ontogeny to prioritize the study of phylogenetic relations between beings from the viewpoint of genetic frequencies. However, this perspective and its creation of an equivalence between genetic frequency and natural selection or evolution has attracted some heavyweight critics. Developmental Systems Theory (hereafter DST), initially developed by the psychologist and philosopher Susan Oyama, led to a series of research programs on ontogenesis. DST argues precisely that there is a kind of 'contemporary preformationism'[4] dominating biology in which genes are seen as the major and unique repositories of what will become the living being originating from them (Oyama 2000a: 26).

3 Ontogeny and ontogenesis are terms that can designate both the discipline that studies this process of development and the process itself.

4 The name preformationism covers a set of views that, especially from the eighteenth century in Europe, argue that the germ or egg waiting to develop already contains organic structures that will be present in the new being (Canguilhem 2012).

From the 1980s onwards, and especially during the so-called 'gene decade' (the 1990s),[5] many phenomena were observed without enabling a reinforcement or 'hardening' (Latour 2000: 85-94) of neo-Darwinism in general and the concept of natural selection as a scientific principle in particular. Biologists discovered, for instance, two previously unknown forms of mutation: induced genetic mutations, observed in bacteria, and epigenetic mutations.

Induced mutations were observed in bacteria when these encountered each other in environments lacking a substance important to their survival. This unfavourable situation unleashed a series of mutations in certain sites of the bacteria's chromosome (or DNA), increasing the chance of survival.

Epigenetic mutations are so-called because, unlike genetic mutations, they do not alter the structure of the DNA. They merely suppress or activate gene functioning in response to the presence of certain substances in the environment. They can be passed through descent, and are found in plants and animals, including humans. These discoveries led to a revival of a brand of 'Lamarckism' (Jablonka & Lamb 2010) insofar as they did not fit with the Darwinian premise that the environment does not induce variability, since only random mutations had been considered by earlier scientists. The frustration of many of the expectations concerning the Human Genome Project (Rabinow 1999) also showed the need to reformulate disciplinary postulates such as the very definition of what a gene is.

Today, then, there exists a sizeable group of leading researchers working to revise modern synthesis theory (or neo-Darwinism) as a whole. They argue in favour of an Extended Evolutionary Synthesis (hereafter EES) in a divergence from 'orthodox theory' (or neo-Darwinism). For some of these scientists, the discovery of epigenetic mutations is sufficient to prompt a revision of biology's central dogma,[6] proposed by Crick in 1970 (Jablonka & Lamb 2010).

According to the biologist Kevin Laland et al. (2014), the EES basically covers four research themes: (1) the evolutionary development biology, a topic explored for decades by the team of Susan Oyama and other US researchers identified with the Evo-Devo label[7] (Hoekstra & Coyne 2007; Carroll 2008); (2) inclusive inheritance (which investigates epigenetic mutations); (3) environmental plasticity; and (4) niche construction theory, to which Laland himself is committed.

The research affiliated to evolutionary development biology seeks to understand the process involved in the constitution of living organisms, maintaining that ontogeny should be seen within the evolutionist perspective as an active process involving historical contingencies, as Carroll argues:

> There can be no doubt that if the facts and insights of evo-devo were available to Huxley, embryology would have been a corner-stone of his Modern Synthesis, and so evo-devo is today a key element of a more complete, expanded evolutionary synthesis (Carroll 2008: 34)

The works affiliated to the area of environmental plasticity examine the adaptations that living organisms present altering their bodies without any genetic change being involved (Lewontin 1998: 23) – in other words, how individuals or populations can change their phenotype without alteration of the genotype. Finally, the theorists of niche construction seem to be the most distant from the concept of natural selection promoted by the neo-Darwinists since they research how living beings are established and procreate creatively in their environments, altering and transforming the latter into an always renewed dimension for subsequent generations (Laland, Odling-Smee & Feldman 2001). I think that the four themes of EES, each in its own way, end up shifting away from the dichotomy constituting the principles of natural

5 The name given to the decade in which the Human Genome Project was developed under the administration of the US president Bill Clinton (1993-2001).

6 A central dogma is the assumption that a protein is incapable of creating a DNA molecule or any other protein.

7 The Evo-Devo combines the terms 'evolution' and 'development,' and the respective disciplines, previously isolated.

selection, though this is not a question especially emphasized by these insurgent biologists. By taking seriously the construction of the organism, previously obscured by the pre-eminence of phylogenetics, the new approaches united under EES also foster precisely an understanding of the 'environment' as a dimension different from the idea of something completely external to beings that can thus be seen to possess agency and history, and not just passively selected organisms, as the synthetic theory argues, following in the wake of what Lewontin had already pointed out.

4 – Lewontin and the critique of adaptationism

The biologist Richard Lewontin made a number of important criticisms of adaptationism and many of the ideas explored by the scientists linked to EES are already apparent in his early studies, including those presented in a well-known article on adaptation (1978). Adaptationism is a view that provides the foundation to selectionist neo-Darwinism and that attributes the main cause of the genesis and diversification of structures, and their functions, to the adaptive needs of organisms (Sepúlveda, Meyer & El-Hani 2011: 162).

The title of his book *The Triple Helix* alludes to the conception that an organism is more than its genetic baggage – in other words, it is not just a double helix (the form that represents the spatial organization of the DNA molecule). For Lewontin, the organism is also a product of the contingencies involved in its own development and the conditions of the environmental in which it subsists. Hence, for the author, studies of the evolution of species must take into account these three aspects (genes, organism and environment) and not just the first dimension as has usually occurred. He also argues that the primacy given to the genetic dimension in evolutionary studies entails simplifications and even omissions in relation to aspects that, being less conducive to application of the already established interpretation, became seen as secondary or exceptional.

One example is the definition of 'gene,' widely accepted at least until the repercussions of the Human Genome Project, in which the 'gene' is identified as the section of DNA responsible for the synthesis for a specific protein. Lewontin explains that proteins are complex molecules and that the amino acid sequence obtained from a section of DNA (or gene) does not by itself define the final form taken by the molecule, which depends on other biochemical interactions. Hence the designation of a gene was known to be different from what was observed in the laboratory, but its propagation is consistent with the ideology of 'genecentrism.'

In the 1978 article cited above, Lewontin criticized the understanding of the niche as pre-existing the beings that need to adapt to it (Lewontin 1978: 213), which led to an understanding of evolution as a process of adaptation. He also argued that were natural selection a mechanism for increasing the species' adaptation to the environment, as believed, it would be impossible for species to live adapted for any length of time in the same environment given that the latter can change constantly (Lewontin 1978: 215). He adds that this this adaptationist evolutionary view does not explain or much less predict the large diversity of beings found in any single habitat. How, for example, should we explain how warm-blooded (homoeothermic) animals emerged and multiplied in an environment in which cold-blooded (poikilothermic) animals were already fully dominant? (Lewontin 1978:216). How can we explain the emergence of new organs? And above all how can we be sure that a particular part of the body is an evolutionary unit?[8] (Lewontin 1978: 217). He adds:

8 Although it may appear otherwise from a lay perspective, the delimitation of morphological units is unclear from both the embryological and evolutionary viewpoint.

> The current procedure for judging the adaptation of traits is an engineering analysis of the organism and its environment. The biologist is in the position of an archaeologist who uncovers a machine without any written record and attempts to reconstruct not only its operation but also its purpose (Lewontin 1978: 218)

Lewontin recalls that the formulation of natural selection as a principle does not specify how an organism adapts to the environment that selects it. He argues that if greater adaptation leads to selection, natural selection in turn does not always lead to greater adaptation (Lewontin 1978: 222). Hence, not all evolutionary change should be understood in adaptive terms (Lewontin 1978: 225) since natural selection – that is, the fact that a particular change survived – is not necessarily linked to an increase in adaptability, thanks to natural selection, but can constitute a neutral alteration[9] that became fixed in the population through another evolutionary process (mentioned earlier) denominated genetic drift (Lewontin 1978: 225).

Lewontin had already formulated criticisms in the 1970s, not with the aim of dismissing the scientificity of the principle of natural selection, but rather of indicating that the laboratories sustained formulations that simplified their own practices and observations. In his book *The Triple Helix*, the author re-examines all these questions, reviving his criticism of the view that a living being's adaptation to a pre-existing environment can be likened to a key fitting a lock (Lewontin 1998: 41), and the idea that organisms result passively from an encounter in which "the environment poses problems and the organism throws up random solutions" (Lewontin 1998: 45). He defines selection as survival (Lewontin 1998: 40) and emphasizes the impossibility of predicting which mutations offer an advantage, making it equally "impossible to predict which genotype would be favoured by natural selection because of its superior survival" (Lewontin 1998: 26), a line of reasoning that appears to coincide with Popper's position.

Lewontin thought that although the notion of 'adaptation' and the expression 'adaptive value' became technical terms, they merely expressed the possibility of survival and the rate of reproduction of a phenotype or genotype in numbers (Lewontin 1998: 41). And, he adds, a phenotype is not an organism. For Lewontin, the concept of natural selection describes a process that presumes and reaffirms the effective existence of a separation between each living organism and its environment, as though the environment presents problems and the organisms randomly presents solutions (Lewontin 1998: 40-41). The practice of laboratories continues to provoke criticisms from insurgent biologists from the EES who can longer comprehend their object of study as a random solution in response to a problem posed by the environment.

The form of representation of living beings and their environment, common to Darwin and the neo-Darwinists, is consistent with the analytic form, which above I classified as 'atomist,' with which modern western cosmology – in its Enlightenment guise, as defined in Duarte's analysis (2012) – apprehends the natural world. Lewontin (1998: 45) refers to "an organism's environment" and asserts that the environment is connected to the "peculiar biology of each species," calling attention precisely to the singularity of beings in their respective environments and, consequently, contributing to an idea of a more dynamic niche, contrary to the inside/outside separation established by the Darwinism of natural selection. Lewontin considers that the 'Darwinist mechanicism' – which separated the inner world and the beings of the outer world, the 'environment' itself – was at a certain point essential to the founding of modern biology against religious 'obscurantist holism.' Yet the current exaggeration of this mechanism, he writes, can lead to the "loss of the relations that mediate between the parts and the whole" (Lewontin 1998: 65).

Notably, therefore, Lewontin advocates a more refined and less simplistic approach to the phenomenon of life and the process called evolution. His intention is not to deny the role of random chance in this dynamic but to focus rather on the subtleties of their inter-relations. There are clear points of affinity

9 Mutations are considered neutral when they bring neither advantages nor disadvantages for their carriers. Gametes often present random genetic variations that are neutral from an adaptive viewpoint. In the 1960s and 70s selectionists and neutralists clashed heavily, but the works initiated by the leading neutralist biologist Motoo Kimura encountered empirical difficulties to becoming hegemonic.

between Lewontin's ideas and those of Uexküll, particularly in relation to what the latter called *Umwelt* – that is, a particular environment that is perceived through the singularity of each organism or kind. For Uexküll there is a general coinhabited environment, but each species exists in its 'own world,' the product of its sensory and cognitive capacities.

Georges Canguilhem, criticizing the Cartesian analogy between organism and machine, turns precisely to the notion of *Umwelt* coined by Uexküll (Canguilhem 2012: 157) and cites the remarkable passage describing the female tick and its wait at the top of a tree for as long as 18 years for a mammal to approach, which it perceives thanks to the rancid butter like smell (butyric acid) exhaled by the animal's cutaneous glands and the heat emanated by the temperature of its body (Uexküll 2008: 30-31). The ethologist and physiologist describes these and other phenomena in detail, in the style of an 'ethography' or an 'animal ethnography,' to use Lestel's (2002) expression. Biology's recuperation of practices common to natural history, such as vivid and detailed description, "the actual living being," is precisely one of the strategies Lewontin (1998) recommends for circumventing the impasses of neo-Darwinism: fieldwork, the importance of paying attention to the empirical, the direct observation of the details, the description of the mode in which each living being populates and constituted the world (a style that the reader can encounter, as it happens, in Darwin's many writings). As becomes clear in the following citation, this confirms the proximity between Lewontin's suggestions and the procedure adopted by Uexküll:

> A realistic evolutionary genetics that takes context dependence of fitness seriously cannot continue to operate at the purely superficial level of directly measuring fitnesses, of characterizing outcomes without understanding their mediation. What is required is an experimental program of unpacking 'fitness'. This involves determining experimentally how different genotypes juxtapose different aspects of the external world, how they alter that world and how those different environments that they construct affect their own biological processes and the biological processes of others. The understanding of living systems cannot be achieved merely through a description their details, but neither can that understanding be obtained by ignoring them. The truth may not be in details, but the details matter and we must have them in hand for our program of explanation. Ironically, the demand for a dialectical is, at first pass, a demand that evolutionary biologists take Descartes's original machine metaphor seriously (Lewontin 2001: 57)

Lewontin's criticisms failed to strike at the heart of the ideology expressed in the concept of natural selection, in the sense of undermining its validity, and merely resulted in improving neo-Darwinism. The teleological dimension at work in adaptationism obviously does not evoke a theology. though this does not alleviate the discomfort of dealing with finalism in scientific theories. The fact that, for adaptationist finalism, the final cause of the existence of living beings is the environment, not God, frees it from the clutches of a theology, but from not a teleology. The axiom according to which every living being should adapt itself to the environment is neither a demonstrable nor a self-evident presupposition.[10] It takes on this appearance only if the 'living being' is conceived as a unit that moves about or survives in a sealed environment with which it establishes clear boundaries, and if this being is deprived of its agency both in relation to the outside environment and in relation to its own genes. This scenario – neo-Darwinist – describes a world of passive, atomized beings, separate from the environments in which they were born and to which they must adapt.

10 For a good discussion of causality in biology, see El-Hani & Videira (2001).

5 – The chimera of natural selection: combining chance and teleology in metaphor

The importance of metaphor in scientific writing and its legitimacy vary according to one's understanding of the nature of scientific knowledge. For example, the historian of science Lily Kay (1998), adopting a clearly positivist stance, opposed scientific language to rhetoric and argued that scientific writing should avoid resorting to metaphors. A very distinct approach is adopted by Marilyn Strathern, who sees metaphor and scientific descriptions as fundamentally indissociable. Drawing from Gillian Beer's work, the author shows how Darwin made ample use of metaphors in *On the Origin of Species*, including the evocation of a kinship that relates all living beings. Strathern wishes to show that even in the scientific register there is no way to avoid fiction completely (Strathern 2013: 45-46).

Donna Haraway presents a third way of understanding of the use of metaphor in scientific practice. In *Crystals, Fabrics and Fields. Metaphors that shape embryos*, Haraway turns to Thomas Kuhn in order to explore paradigm shifts in biology. Developing the ideas of Mary Hesse in parallel, she argues that metaphor is a central aspect of the paradigm insofar as it contains an image generally connected to a sensible object (such as the machine in the Cartesian metaphor). The recourse to metaphor can endow even a highly abstract idea with coherence and concreteness (Haraway 2004: 9), allowing both its instrumentalization and a switch in paradigms.

For Haraway, metaphor also enables the most characteristic aspect(s) of a set of ideas to be accentuated. The most notable aspect of the expression 'natural selection,' in her view, is the corpuscular view, i.e. a world constituted of individualized parts, which the concept manifests:

> By 1859 Darwin had published his *On the Origin of Species*, a work that was in many ways suspect to the archmechanists of biology (Sachs, Loeb, and Roux). But the *Origin* represented a kind of thinking very compatible with corpuscular world view. Natural selection was not unlike the invisible hand of Adam Smith. The freeplay forces and the lack of internal constraints and organizing relations were central (Haraway 2004: 20)

The biologists identified with the EES proposal also make no complaints about the use of metaphors per se, but rather about the inadequacies of the theories with which they are associated. Oyama laments the distortion caused by evoking a supposed dichotomy between the innate/genetic/internal/programmed and the acquired/learnt/external:

> Contemporary thinking about each of these three (concepts: natural selection, innateness, and hereditary transmission of traits) is dominated by a ruling metaphor. Natural selection is treated as action by an external agent. Innate traits are attributed to internal "programs". And, finally, heredity is modeled on the transmission of wealth and objects in human societies – thus traits are "passed" from one organism to another. These metaphors distort the phenomena they describe and create a spurious set of connections among them (Oyama 2000b: 77-78)

Lewontin, for his part, criticizes adaptationist metaphors for reinforcing an absolute finalism to the process through which living beings adapt to a pre-existing environment. This finalism, this movement oriented by the purpose of surviving in an environment that is already there, can only be undone if environment and living being exist concomitantly without any relation of pre-existence. At the other extreme, Lewontin also sees a new depiction of the organism as a machine in radical self-constructivism, in which all the subunits are perfectly adjusted to each other in a paradise of motivated and mutually induced nestings, without any margin for randomness and error. Hence he calls for moderation in the use of allegories, recalling that: "The metaphor of computation is just a trendy form of Descartes's metaphor of the machine. Like any metaphor, it catches some aspect of the truth but leads us astray if we take it too seriously" (Lewontin 1998: 36).

It could be said that Lewontin's critique of adaptationism targets the same problem identified by Spencer vis-à-vis the term natural selection. The word selection indicates an action in which there is a selector pole and a selected pole. Taking as a reference point the (intentional) artificial selection of the gardener or animal breeder, nature is presumed to decide for itself and indeed to make decisions. The criticism of the Victorian philosopher was that the term contained a certain deism. The combination of contradictory ideas in the same paradigm has been observed in relation to authors like Sober and Young, as Oyama points out:

> Sober argues that it is a mistake to speak of a metaphorical relationship between natural and artificial selection. Rather, he says, the latter is natural selection occurring in a particular niche (1984, p.19). Even if one takes this position, however, it is reasonable to point out the special qualities of this niche – something Darwin himself was careful to do. If the image of a deliberating, manipulating breeder with fixed goals influences our thinking about evolution, it is perhaps worthwhile to reflect on this influence. Young (1985, chap.4) argues that the anthropomorphism of Darwin's descriptions of natural selection had the paradoxal effect of increasing the acceptance of this ideas for just the wrong reasons: by making evolution seem to be the work of a creating agent (Oyama 2000b: 222)

The fact that Darwin had been inspired by recognisably fairly non-random models when formulating his principle of natural selection (artificial selection; the invisible hand of the market as conceived by Adam Smith; and the famous geometric and arithmetical progressions of demographic growth and food production postulated by the devout Malthus) did not help rid the principle of its teleological aspect, but may have helped make it more acceptable, as we can read in the citation above. Today the use of metaphoric language that lends intentionality to genes, organs and biological processes, present not only in works disseminating science but also in works by eminent biologists, can perhaps be explained as a means of facilitating acceptance, a didactic recourse.

Godfrey-Smith (2009), observing the recurrent use of such language, did not consider it to be a characteristic of neo-Darwinism as a whole, but specifically as an influence of the 'gene's eye view' current led by Dawkins:

> Treating genes as evolutionary units is often allied with a version of the 'agential' approach to evolution, the approach that understands evolutionary processes as contests between agents with goals and strategies. [...] It can be unclear where metaphor ends and literal usage begins (Godfrey-Smith 2009: 142)

> In the case of descriptions of a genic point of view, however, these formulations developed an unusual power and role. They became more than a shorthand, being used not just to summarize complicated ideas but to shape foundational description of evolution (Godfrey-Smith 2009: 143)

> How did the gene's eye view acquire such apparent power as a foundational description? I conjecture that is because the gene's eye view of evolution is a special kind of agential narrative (Godfrey-Smith 2009: 144)

However, a language that attributes intentionality to biological processes is not peculiar to sociobiologists like Dawkins. It can be found in books by less orthodox scientists with no links to sociobiology and who are critical of neo-Darwinism, like Jablonka and Lamb (2010) as well as Lewontin (1998):

Each mutation is a single substitution in DNA. To produce a selectively useful genetic variant from the current DNA sequence may require not one mutation but several, each of exactly the correct sort. [...] Selection may call, but there may be no mutations to answer (Lewontin 1998: 82-83)

The object of this process [sex] is to create those individual differences which form the material out of which natural selection produces new species (Jablonka & Lamb 2010: 35)

The 'decision' over which polypeptide will be formed depends on developmental and environmental conditions, as well as other genes in the genome (Jablonka & Lamb 2010: 87)

Metaphors – present in the quotations above, sometimes with the use of quote marks to indicate that they are really just metaphors – attribute intention, volitions and needs to organic structures and biological processes, which indicates that the neo-Darwinist view (without the need for extreme and even caricatural interpretations like those of sociobiology) is sufficiently permeable to accept, or be willing to accept, that natural selection has a point of view and desires new mutations; or that the cell decides to fabricate certain polypeptides and that sexual reproduction meets the designs of genetic variability from which natural selection 'chooses' the best.

For this reason, my first supposition concerning this recurrent use of intentional or teleological language is that it comprised a didactic resource necessary to temper Darwinist 'atomism,' 'mechanism' or 'reductionism' that impoverish the comprehension of vital processes. However a text by John Maynard-Smith (2000), in which the author discusses the advantages of using computer language to understand the functioning of genes and protein synthesis, provides a clear illustration of why teleological language is neither a 'correction' of reductionism, as might be supposed, nor a didactic metaphor. In the article, Maynard-Smith shows how natural selection has the important function of occupying the place of the creator of an intelligent design,[11] since the final result is the same even though attained via chance. Teleological language is not invented by the sociobiologists, nor is it a mere didactic resource: it is a potential and a true potency of Darwinism. Far from being a correction to the latter, it forms an integral part of it basic conceptual framework.

Maynard-Smith argues that computer language (which, in principle, has nothing to do with the intentional or teleological language that I am examining) has been used to contrast genetic causes to environmental causes, an important distinction for the discipline, delimiting the innate from the acquired and sustaining genecentrism. For the geneticist, the organism is born with a programming, which comprises its genetic baggage. This is information that it brings with it, independently of the environment. Treating genes as bytes is a metaphor consistent with the selectionist metaphor, since both set out from the premise that a chasm exists between the interior and exterior of each living being.

The idea that the principle of natural selection allows a separation between what is born with the organism (to be selected) and what is acquired (and does not pass down through descent) is also found in Lewontin. The latter also believes that at a given moment this separation represented an advance against religious 'obscurantist holism,' as we saw earlier too. For Maynard-Smith this metaphoric separation relates to a real process between the innate (genetic) and the acquired within which natural selection operates. Through the adaptation of beings to their respective environments/niches [vacuums], this process generates the appearance that everything in nature is created in accordance with an intentionality.

11 Richard Dawkins also believes, like Maynard-Smith, that the appearance that everything in nature was created for a purpose is an optical illusion generated by the process of natural selection. Ingold argues that Dawkins, in saying that a blind watchmaker can assemble a watch, is confusing foresight (contained in a project) with sight. In order to make a watch it is not enough to design a watch project: it is necessary to have the manual dexterity and good magnifying lenses to fit the tiny parts. In other words, a blind watchmaker cannot make a watch, just as an organism is not equivalent to the sum of its genes. For Ingold, an organism is the constant product of its development – the outcome of its own particular history (Ingold 2013a: 61-73).

For the neo-Darwinist geneticists, then, natural selection acts on random changes and its power of selection ends up modelling the world *as if* it had a creator, a designer, an intelligent design in command. As a consequence, teleological language is permitted since it merely leapfrogs random movement to reach the final result, which would end up being the same, at least in appearance, were everything as intentional as the metaphor implies:

> Modern biology not only adheres to Darwin's theory of adaptive evolution by natural selection but bears the marks of the original model of the relation between organism and environment that Darwin imposed. *Fitness* and *adaptive value* are now technical terms for the numerical probability of survival and rate of reproduction of a genotype or phenotype. Thus a population geneticist will say that one genotype has a fitness of 0.78 compared with a fitness of 1.0 of another genotype, although an explanation is rarely offered about the way in which the superior genotype actually "fits" into some environment. As the terms are actually used there may not even be any implication that such a story could be uncovered (Lewontin 1998: 41)

Rather than identifying this teleology as a weak point in the notion, the philosopher Étienne Gilson (1971: 138) argued that this was actually a brilliant aspect of Darwinism since it implied a finalism without a final cause. For Gilson, it is not up to natural science to refute or demonstrate the ultimate purpose of things. The finalist question, to which philosophers or mystics can devote themselves, goes far beyond what scientists can attain in their laboratories. The latter can explain "by what means this occurs," but not "what is the ultimate purpose of the process?" (Gilson 1971: 204). Although finality lies beyond their methods, researchers are not exempted from what Gilson calls the "biophysical constant" (Gilson 1971? 198), which is a kind of impulse implicitly posed by the question: "for what?" By removing God from the process, (neo)Darwinism removes the cause of the causes or the final cause, and introduces chance by inventing a concept with scientific value.

The philosopher Étienne Gilson (1971) argues that natural selection adds a teleological dimension to the dimension better known as scientific-stochastic. Gilson analyses that this teleological dimension is a kind of philosophical imperative, a philosophical rather than scientific response to a question that cannot be answered scientifically due to its nature. My interpretation is that this finalist or teleological aspect present in the mechanism of natural selection persists as a metaphor without, therefore, contradicting the other, scientific-stochastic aspect. This gave the concept the plasticity needed to ensure its hegemonic persistence in the field for more than a century.

The concept of natural selection has become a seal of scientificity due to its stochastic aspect, combined with its important role in demarcating a scientific field. In Foucault's analysis, Darwin's work marks a "great discontinuity in the episteme of western culture" (Foucault 1966: 11) and can be considered the starting point of modern biology. Lewontin observed that the separation between internal and external effected by Darwin constituted an advance at a very particular moment of modern science, overthrowing what Lewontin describes as an "obscurantist holism" (Lewontin 1998: 44). I argue that, irrespective of the explanatory capacity of the principle, the latter was important in terms of delimiting the phenomenon that would, from that point on, be approached by biology as a scientific discipline. As we know, something analogous would happen concomitantly with the idea of culture in the field of social anthropology in the nineteenth century.

Since culture is a concept criticized for failing to solve what it is supposed to, does natural selection not suffer from the same problem? Why preserve the concept if it seems more like what Tylor would call – with apologies for the pun – a 'survival' than a natural principle free of finalism? It remains intriguing to know what caused so many illustrious Darwinists to be seduced by the concept:

> In Darwin, one can find finalism not in things themselves but in his choice of words – he has been frequently reproached for his term *selection* (Canguilhem 2012: 149)

The observation of a philosopher of Canguilhem's stature invites us to reflect on the reverence that the western cosmovision has maintained for the thought of the British naturalist. Scientific knowledge gives itself the task of managing to exact a correspondence between words/concepts and things. When Darwin, as the eminent epistemologist asserts, coined finalist terms that have lasted for a century at the centre of the scientific framework, how are we to understand this extended life of a metaphor that does not illustrate what it sets out to explain, sustaining no less than the entire paradigm of modern biology? I consider the fondness for teleological metaphors a strong signal that natural selection is a chimerical conception.

Final considerations

In this work, I have explored the longevity of natural selection as a basic principle in the biological sciences, venturing the hypothesis that, having encountered criticisms, and being hegemonically considered to possess a considerable explanatory value, there is something more that sustains the persistence of this principle, namely its chimerical quality. It was the distancing from religious finalism that marked the explanation for the transformation of the species given in the work *On the Origin of Species*, but the teleological bias never left Darwin's reflections. Gilson (1971) cites an excerpt from the diary of the Duke of Argyll that refers to a passage where the beauty of cultivated orchids and the curious behaviour of worms, also closely studied by the eminent naturalist, left both men enraptured as they walked in the grounds of Down House, home of the Darwin family, sharing their anguishes. Charles Darwin, with his famed personal charm and complete intellectual and personal honesty, admitted to the Duke that sometimes he too doubted whether chance functioned as the cause behind natural processes and wondered if there might not exist an intelligence at work behind so many marvellous phenomena…

> An abstract from the remembrances of the Duke of Argyll reports what perhaps were the last words of Charles Darwin on the subject: […]
>
> – I said it was impossible to look at these without seeing that they were the effect and the expression of mind. I shall never forget Mr. Darwin's answer. He looked at me very hard and said: 'Well, that often comes over me with overwhelming force; but at other times,' and he shook his head vaguely, adding, 'it seems to go away' (Gilson 1971: 143)

In transcribing the above, Gilson's intent was not to question the scientificism of Darwin's work. In fact, much the opposite: he argues that science can walk hand-in-hand with philosophy, although it cannot give the same answers. My own wish in citing this moment of wonder shared by the British master and his guest is to illustrate how this enchantment has been badly disguised and substituted, over the course of a century and a half, by neo-Darwinism, a nature in which the blunt work of natural selection shaped a product so well adapted that it could be compared by geneticists like the sociobiologist Richard Dawkins (2007) to the work of a 'blind watchmaker' or to a 'design' without a 'designer,' as geneticist Maynard-Smith (2000) suggests. I have already cited Ingold's observation (2013a: 61-73) that Dawkins confuses foresight (contained in a project) with sight when he claims that a blind watchmaker can assembly a watch. To make a watch requires more than just design a plan for a watch. It is also necessary to have the manual skill and good eyeglasses to adjust the tiny parts. In other words, a blind watchmaker cannot construct a watch, in the same way that an organism is not equivalent to its set of genes. The organism is the constant product of its development, the product of its own particular history.

It is not a question here of judging the scientificity of the concept, as was already stated initially, but of calling attention to certain aspects that distance it from the ideals established by the biologists themselves, such as its inherent teleological quality. It is also more accurately conceived as a descriptive concept rather than a natural universal principle – were we to agree with Lewontin, for example. And finally it embodies the role of a label for an entire discipline. Analogously, the latter two characteristics approximate the concept to the notion of culture.

In the view of Isabelle Stengers, the modern sciences cannot be approached as though there were no specificities between them. This, however, is not to deny the scientific status of any of the sciences concerned. A major difference between physics and the biological sciences, for instance, is the degree of abstraction that characterizes the concepts of the former and affords its predictive capacity, something not seen in studies of living beings. Stengers cites a couple of remarks by Einstein help illustrate these differences:

> The Greeks could have, perhaps, discussed these words of Einstein: "The only thing that really interests me is to know whether or not God had a choice in creating the world," but they could not have then understood Einstein's formulation of another reflection: "The most incomprehensible thing about the world is that it is comprehensible" (Stengers 1991:30)
>
> […]
>
> The abstract nature of certain scientific knowledge is not the outcome of abstract thinking, Rather it is linked to the discovery of the possibility of abstraction proper to one or another aspect of the real that the sciences explore.
>
> Einstein said how miraculous it is that the world is comprehensible. This notion of miracle has, from the viewpoint advocated here, a dimension of truth: it so happens that, in our world, certain objects are cut off, or can be cut off, without losing their interest, and this fact, *because it might not have been the case*, can effectively be accepted as a 'miracle.' But this miracle should not be exaggerated, and above all should not be prolonged, by deliberate artificial decisions. The discovery of the possibility of abstraction is an event, not the translation of a rule of law, and the recognition of the limits of relevance of the concepts whose power is thereby discovered can reduce the 'miracle' to its true dimensions, providing an understanding of what was singular about that which was defined as an object of abstract knowledge. Correlatively, where the "miracle does not occur, where neither the atom, molecule, planet or bacteria are allowed to be cut, it remains, including in physics and chemistry, to learn through clues and conjectures which singular histories allow themselves to be deciphered, which circumstances and which regularities can confer an intelligible meaning to whatever we are dealing with (Stengers 1991:60)

Stengers also points out that Einstein's sense of wonder that the world is comprehensible reveals his belief in a rationality intrinsic to the world, although this perception is a product of the history of his own particular discipline. It is this history which assures the rationality of the explanations attributed to phenomena at a determined moment (Stengers 1991:61). The wonder felt by Darwin[12] and shared by the Duke of Argyll can be seen from this same viewpoint, albeit emphasizing that the naturalist opposed, in his own singular historical context, other kinds of hypotheses that took into consideration not the invisible forces of physics, like gravitational or energetic forces, but the "laws of use and disuse" and "laws of acquired characters," such as those defended "on the continent" by his Lamarckist colleagues.

12 Although comparing the contexts in which each scientist – Einstein and Darwin – posed this question is tempting, it would open up a new universe, with apologies for yet another pun.

A second reflection of Stengers that touches directly on the question examined here concerns the degree of abstraction of the concepts linked to the dimension of the real to which they refer. The author rejects the model of physics as the sole parameter of scientificity, arguing that 'descriptive concepts' and 'descriptive sciences' should not be considered 'pre' or 'non' scientific if we wish to avoid making the most commonplace of positivist judgements (Stengers 1991:50). By questioning the dogma, as we saw earlier, will biologists end up questioning the universality – or in terms of (political) epistemology, the scientificity – of the principle of natural selection? Were they to do so, the discussion on the limits of universalization would strike at an important mainstay of the natural sciences.

Working with the ideas of 'invention' and 'indexation,' Roy Wagner (2010) sets out from the premise that anthropology as a discipline lacks conditions of conceptual abstraction, clearly manifested in the way in which the author shows how what comes to be culture is constructed or rendered conventional (see especially Wagner 2010: 27-48; 205-240). Arguing that to invent – or, put otherwise, to create – is the human way of being able to get by in the world, Wagner proposes that by creating (or inventing) their own culture, humans also create their own nature (Wagner 2010: 221-229). Consequently, in learning about the Other, anthropologists create their own culture and that of the Other through this contrast. In line with his academic tradition, the author does not claim the existence of a concept with a greater capacity for abstraction or prediction. On the contrary, he seeks to show that an understanding of this creative activity can only be achieved through this encounter. Without wishing to remove the work from the context in which it was produced, such ponderations by Wagner (2010) end up endorsing the argument of those today who, like Ingold, show the idea of culture to be a circular notion that, although presented as a solution, is rather a question that elicits an infinite number of ethnographic responses. These conceptions can lead to another formulation, one central to my own ideas, where culture is seen as a disciplinary label in the service of the great (and obsolete) divide between society, the realm of convention, and nature, the place of laws and the innate, similarly to the role performed by the principle of natural selection in the biological sciences.

In conclusion, I argue that natural selection is more than a polysemic concept. It is also a chimeric concept since it contains a contradiction that renders it extremely seductive: its premise – and also its seal of scientificity – is that the source of the diversity of species is finding the right answer through random individual genetic mutations to the challenges posed by the environment to which these species are compelled to adapt. It can simultaneously be: (a) deemed a principle through which nature functions in a polarized form between a selecting entity and a selected organism, evoking a teleology; (b) understood as a metaphor that leaves implicit the existence of a selecting entity; (c) taken as a scientific concept that presumes the randomness of the evolutionary process; (d) seen as a mechanism and a model of understanding nature that divests living beings of their agency, evincing its capacity to subsume a field of science dedicated to the study of all beings excluded from the field of human rationality and agency.

Thus I believe that the concept of natural selection performs, analogously and homologously to the concept of culture, the important epistemological function of delimiting its own scientific field. This epistemological function becomes evident when Darwin admits that his principle does not explain society, it applies only to nature.

In addition to being coeval, natural selection and culture can be considered 'sibling concepts,' as Gilson (1938: 185) designated the Reformation and the Renaissance, seeing them as 'inseparable phenomena' insofar as they only made sense – within a historical conceptual framework – in relation to one another. Likewise, having been raised to the level of scientific concepts, they perhaps explain less than they delimit: two large fields of knowledge of the western cosmovision, natural and culture, solidifying the construction that Latour calls "the great divide" (1994: 96).

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