Darwin's Analogical Argument: The Rhetorical Function between the Artificial and the Natural / *O argumento analógico de Darwin: a função da retórica entre o artificial e o natural*

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ABSTRACT
The evolutionary theory became a strong paradigm in Biology after Darwin's book *On the Origin of Species by Natural Selection* was published in 1859. This work presents part of the laboratory trials as well as dada taken from Darwin's investigation and consideration on nature in order to support nature's selective regulation through an analogy. The rhetoric and the rationality were present in the Darwinian speech. From a philosophical point of view, researches on Darwin carried out by the analytical tradition in Philosophy put forth studies aiming the logical aspect of the Darwinian argument. I present here an analytical perspective from the rhetorical tradition, mainly the theory of argumentation from the Chaim Perelman School.
KEYWORDS: Evolution; Rhetoric; Epistemology of Biology; Analogy; Natural selection

RESUMO
A teoria da evolução consolidou-se como paradigma da Biologia com a publicação, em 1859, da obra A origem das espécies*, de Darwin. Nela foi exposta parte das experiências laboratoriais, bem como dados extraídos da investigação e reflexão de Darwin sobre a natureza, com a finalidade de fundamentar, por meio de uma analogia, a lei seletiva da natureza. A lógica e a retórica se fizeram presentes no texto darwiniano. Do ponto de vista filosófico, as pesquisas efetuadas sobre Darwin, pela tradição analítica da filosofia, desenvolvem trabalhos cujo objeto é o caráter lógico do argumento darwiniano. Neste artigo apresento uma perspectiva de análise advinda da tradição retórica, particularmente da teoria da argumentação de Chaïm Perelman.*
PALAVRAS-CHAVE: Evolução; Retórica; Epistemologia da Biologia; Analogia; Seleção natural

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I

The role played by the theory of evolution of C. R. Darwin and A. R. Wallace in biological thought is undeniable. Both authors independently developed their ideas on the modification of species and published them in the Journal of the Proceedings of the Linnean Society of Londonin 1858. In general, the papers reflect on a natural force that acts in favor of the transformation of the species. Such a force received a detailed treatment one year later, in 1859, when Darwin finished writing his theory in which he had worked for more than a decade.

The book, whose title *Origin of Species by Means of Natural Selection*: or the Preservation of Favored Races in the Struggle for Life, from the beginning, had a great impact in England and had sold out on first day of release, November 24t^{h}, 1859 (BROWNE, 1996).[1] In this book, the British naturalist developed a long argument about the material origin of life, thereby breaking with the prevailing metaphysical tradition. In addition to this innovative aspect of philosophical thought, another characteristic of Darwin's work was the theoretical unification of disciplines that were previously isolated, such as physiology, zoology, botany, and others.

When Darwin was still alive, he had his book *Origin* translated into several languages: to German in 1860; to the French, in 1862; to Russian and Italian, in 1864; to the Swedish, in 1869; to the Danish, in 1872; to Polish and Hungarian, in 1873; to the Spanish, in 1877; and to the Serbian in 1878. It is interesting to emphasize this aspect of the translation during Darwin's life for several reasons, among them: (a) the theoretical acceptance of the scientific community, (b) the recognition of the argument presented in the work and (c) the influence of evolutionary thinking in the process of constructing science and an image of reality. Here, I explore the Darwinian arguments in the construction of the Natural Selection concept, from the perspective of rhetoric.

[1] BROWNE, J. *Darwin's Origin of Species*: A Biography. London: Atlantic Books, 2006.

II

The paper published on International Review of Philosophy, Chaim Perelman (1982)[2] affirmed the importance of the rhetorical mechanisms of analogy and metaphor to poetry and scientific theories. In general, analogies and metaphors compose all types of speeches. However, in the process of making science, this construction has a somewhat diverse design, since there is not, in science, such creative freedom as in poetry. While poetry has complete freedom to accomplish its metaphors, the sciences are governed by logical-mathematical thinking, a fact that limits the creation of the analogical or metaphorical model. Even so, the figures of rhetoric, although limited by the logical-mathematical universe, are present in scientific speeches.

In this context, when observing the history of philosophy, we verify that philosophical systems express different analogies and metaphors. In the early days of modern science, we observed in Descartes the human body resembling tropologically to the clock. Both are running machines. The mathematical character is present in the clock mechanism and, in the same way, in the description of the physical reality of the human body, which is extension, subject matter of mathematization and quantification.

At the same time, the analogies of philosophical systems have historical characteristics: the clock was a recent discovery at the time of Descartes and turned out to be an example of the world's idea as a machine and was an example of the ideology of the world as a machine. This analogy created, at the time, a communion of spirits, which led their readers to the same trope: a structure whose function is the effect of closely connected gears. The body was a machine and its analog, the clock. Perelman (1982)[3] also says that analogies and metaphors are indispensable to philosophical thought; after all, they are the means by which the philosopher provides the contours that structure his reality. This subjectivity ends up linking it to a tradition. Both analogy and the metaphor define a reality, explain the world. They provide meaning when it means the real.

In Darwin the opposite is not the case. The thought of the British naturalist also carries analogies in his philosophical system. The analogy leads the reader to the acceptance of his

[2] PERELMAN, C. *The Realm of Rhetoric*. Translated by William Kluback. Notre Dame, Indiana: University of Notre Dame Press, 1982.
[3] For reference, see footnote 2.

theory by means of a quasi-logical argument of comparison (PERELMAN, 1997).[4] There is a dual function of the analogy in Darwin's scientific theory: (1) introducing a general law and (2) showing its aspects of the truth. The first has a logical nature and the second a rhetorical nature. The scientific theory that stands out is based on the concept of natural selection. This concept, however, has its presupposition in the millennial domestication that men and women did with animals and plants along the history, a phenomenon that provided the notion of artificial selection.

From the logical standpoint, the work done by researchers passes through an exploration of the axioms of the adaptationist program.The Darwinian argument is reflected along the lines of a syllogism, as observed in the tradition initiated with Howard in 1982, continued by Mayr in 1988, and Caponni in 2009. In this tradition, we divide the *Origin* into three parts: (I) theoretical nucleus: chapters I-IV; (II) responses to possible objections: Chapters V, VI and IX; and (III) theoretical consequences: Chapters VII, VIII and X-XV.

The content exposed in the theoretical nucleus contained the information that allows inferring the idea of structural modification in organic beings and, according to Howard (1982), is constituted in three generalizations: G1, G2, and G3.

G1: There is variation among individuals of the same species;

G2: Part of this variation is hereditary and is transmitted to the posterior generations;

G3: Organisms tend to multiply geometrically, which would exceed the environmental capacity of livelihood, but do not do so precisely because the resources are limited. Therefore, there is a struggle for survival in search of resources.

These generalizations are taken as axioms and the relation that they establish between them structures the syllogism in which the conclusion C is deduced from the premises P1 and P2. The direct consequence is the formalization of theory. We have, then:

P1: All organisms vary, and a part of the variations is inherited;

P2: Organisms produce descendants, but few survive;

C: Organisms that survive carry in themselves variations that are favorable to their survival in a certain ecological context and will propagate with greater intensity in this context. When conditions change, the variations, before favorable, may cease to be.

Based on the data taken from nature and reflected in the light of economic theory, the natural selection was presented, as Darwin said, in "one long argument" (1859, p.459). By

[4] For reference, see footnote 2.

reflecting on the argumentative construction of the theoretical nucleus, Darwin chose the theme variation as the first chapter of *Origin*: the habit, the use and the disuse of parts, the correlated variation and the heredity; the variation in plants and animals, the possible origin of domestic breeds by the gradual accumulation of alterations, through selection made by man; and the breeds of domestic pigeons, their differences and origins and, ultimately, the notion of unconscious selection. In the first paragraph of the text, Darwin (1859, p.7; emphasis added) wrote:

> When we look to the individuals of the same variety or sub-variety of our older cultivated plants and animals, one of the first poits which strikes us, is, that they generally differ much more from each other, than do the individuals of any one species or variety in a state of nature. *When we reflect on the vast diversity of the plants and animals which have been cultivated, and which have varied during all ages under the most different climates and treatment, I think we are driven to conclude that this greater variability is simply due to our domestic productions having been raised under conditions of life not so uniform as, and somewhat different from, those to which the parent-species have been exposed under nature.*

An argumentative movement presents itself. The work was directed to the naturalists of his time; however, the Victorian intellectual elite were composed not only by professional and amateur scientists. Professional science, conceived as a market product, germinated in Darwin's time. Moreover, both the knowledge itself and its way of production were not confined solely to the laboratories of universities and research institutes.

Naturalists were, for the most part, the breeders of animals on their farms and homes. Others were members of the elite who devoted themselves to the study, collection and observation of nature. Some taught at universities while others were priests and lived in small villages. There were breeders, cultivators, curious, or still, gatherers who exploited the Americas or Australia to make a living, as Wallace did, in search of many exotic species to sell them to museums and collectors (BROWNE, 2002).[5]

Many people who were dedicated to the creation or cultivation of any kind of species had a basic notion of what Darwin said in that first paragraph of his book. The variability was a known phenomenon and it was known its hereditary character. This was a common fact the minds to which the work was directed, and it was used as a rhetorical device, a structuring of

[5] BROWNE, J. *Charles Darwin*: The Power of Place. New York, NY: Alfred A. Knopf, Inc., 2002.

the real. Put differently, by postulating that the cause of variability in domestication is a pressure exerted by man, Darwin became like his peers, also practitioners of natural history. It created a communion with the spirits that shared that empirical data, thus constituting a place of speech (PERELMAN; OLBRECHTS-TYTECA, 1969).[6] Darwin's letters help us to understand this.

Among the various informants and correspondents there were breeders, researchers, amateur naturalists, farmers, and a variety of men who somehow exercised a type of activity with pigeons. The years 1855-1858 concentrate the longest time period of correspondences on the subject. Here, it draws attention to Eduard Blyth, Bernard Peirce Brent, Charles Lyell, William Bernhard Tegetmeier, Alfred Russel Wallace and John Jenner Weir.

A search amid Darwin's correspondences[7] present these names connected to the problems of the first chapter. Blyth was a zoologist, writer and zoology's editor, who lived a few years in Calcutta, where he was curator of the Museum of Asiatic Society of Bengal in India. Brent was an admirer and wrote about domestic animals; he studied pigeon breeding in France and Germany. Lyell was a lawyer but became known as a renowned Scottish geologist, given his uniformitarianism theory of the Earth; he was a close friend of Darwin. Tegetmeier was an editor, journalist and naturalist admirer and expert pigeon breeder; he provided several species for Darwin to develop experiments at Down House. Wallace, like Darwin, wrote about domestication and artificial selection.[8] Weir was an entomologist, and his investigations focused on the feeding of insectivorous birds. Most of the letters bring elements with information about variety in structure and domestication of pigeons (and ducks) throughout the world. On April 6th, 1859, Darwin wrote to Wallace:

> You are right, that I came to conclusion that Selection was the principle of change from study of domesticated productions; & then reading Malthus I saw at once how to apply this principle. Geographical Distrib. & Geological relations of extinct to recent inhabitants of S. America first led me to subject. Especially case of Galapagos Islds.[9]

[6] PERELMAN, C.; OLBRECHTS-TYTECA, L. *The New Rhetoric*: A Treatise on Argumentation. Translated by John Wllkinson and Purcell Weaver. Notre Dame, Indiana: University of Notre Dame Press, 1969.

[7] DARWIN Correspondence Project. Cambridge University Library, Cambridge, UK. Avaialble at: [http://www.darwinproject.ac.uk/].

[8] Here's a caveat. Wallace wrote about such mechanisms; however, there is a difference in nomenclature as well as in epistemological perspectives. While Darwin focused on the individual which provided clues to a liberal economy in his epistemological assumptions, Wallace developed grounds in which the natural economy presents reflections of a social system (HULL, 2005).

[9] Letter no. 2449. Avaialable at: [http://www.darwinproject.ac.uk/DCP-LETT-2449].

In 1984, when analyzing the argument, Evans showed that, between the years 1837 and 1839, Darwin had a certain regularity of writing, something around one page and a half a day. However, this regularity changed, precisely in September 1838, a time period which coincides with his reading of Malthus, when he wrote about nine pages a day in The Transmutation Notebooks. The economic ideas of Malthus were essential for understanding the struggle for existence in nature. In addition, Hodge (2012) tells us, the ideas are in the analogy in a relation of cause. The struggle for existence is proportionally for animals and wild plants what the breeder is for domestic animals. It is a relationship between two tropes: Nature and breeder (REBOUL, 1998).

On June 3rd, 1857, Darwin wrote to Hooker some of his remarks about the struggle for existence. His garden experiences helped him to understand this phenomenon:

> My observations, though on so infinitely a small scale, on the struggle for existence, begin to make me see a little clearer how the fight goes on: out of 16 kinds of seed sown on my meadow, 15 have germinated, but now they are perishing at such a rate that I doubt whether more than one will flower. Here we have choking, which has taken place likewise on great scale with plant not seedlings in a bit of my lawn allowed to grow up. On other hand in a bit of ground 2×3 feet, I have daily marked each seedling weed as it has appeared during March, April & May, and 357 have come up, & of these 277 have already been killed chiefly by slugs.[10]

This tropological relationship is defined in a scientific speech of natural history. There are facts, examples, descriptions, emphases and other rhetorical features that gradually contribute to the elaboration of the theory. Within the concept of variation, for example, the notions of use-disuse and correlated variation are found.

Darwin believed that behavior was also a component in the process of specific modification. The relationship between the savage and the non-savage is always present. The emphasis was an important mechanism to show and persuade the reader of the intimate relationship between the backyard's breeders and the nature's yard.

> Habit also has a decided influence, as in the period of flowering with plants when transported from one climate to another. *In animals it has a more marked effect; for instance, I find in the domestic duck that the bones of the wing weigh less and the bones of the leg more, in proportion to the whole skeleton, than do the same bones in the wild-duck; and I presume that this*

[10] Letter no. 2101. Available at: [http://www.darwinproject.ac.uk/DCP-LETT-2101].

> *change may be safely attributed to the domestic duck flying much less, and walking more, than its wild parent*. [...] If man goes on selecting, and thus augmentig, any peculiarity, he will almost certainly unconsciously modify other parts of the structure, owing to the mysterious laws of the correlation of growth (DARWIN, 1859, pp.11-12; emphasis added).

Darwin was unaware of genetic laws,[11] based solely on data drawn from experience, observation, and careful exchange of data with men who worked in the same area and were knowledgeable in such matters. During several domestic examples, he deliberated the pigeons as an object of analysis. He presented a description of the differences between the main domestic breeds and then discussed the possibilities of the origin of such breeds (MARTINS, 2012).

In general terms, the argument of the pigeons is presented in a few pages. The hypothesis that arises is: there is, in the literature (scientific, of breeders, specialized magazines, annals of societies and museums), a great variety of domestic pigeons; however, where does this broad diversity come from? To answer the question, there are three possible hypotheses: (1) although there is a variety of breeds, each specific breed may have come from a single one, a kind of wild pigeon; (2) all breeds come from crossings of different wild pigeons; that is, there is more than one wild breed in nature; (3) all breeds of pigeons have a single correspondent in nature, a unique type of wild pigeon. Based on the principle of parsimony, also known as Occam's Razor (namely, in the face of more than one phenomenal explanation, the simplest is chosen), Darwin opted for the third hypothesis (DARWIN, 1859; MARTINS, 2012).

The pigeons were then analyzed. Among many characteristics, breeders detected varieties in the voice, feathers, body structure, color, beak shape, coloration, reproductive behavior, among others. In Origin, Darwin presented the following breeds: Pouter, it has an upright posture; Tumbler, which gives pirouettes when flying or when is on the ground;

[11]At that time, the Mendelian laws of heredity were still unknown. Although the history of genetics began in 1856, when Gregor Mendel started his investigations with peas in Brünn, it was only in the early 1900s that his laws became known by the scientific community. The proportion of the factors transmitted from parents to descendants occurs in pairs. By realizing this process, Mendel concluded that this fact had relevance to heredity. The results of his work were presented in lectures delivered on February 8th and March 8th, 1865. In the first one, he presented the crosses and the mathematical expression. In the second presentation, Mendel referred to the hybrid and hybrid crosses and retro crossing. The lectures were published in 1866, in the annals of the Brünn Society (HENIG, 2000). However, the scientific community did not give importance to his research, so his conclusions remained unknown for almost forty years when, in 1900, three men reached the same conclusions (KELLER, 2000; WATSON, 2017). Bibliographic references of the books: HENIG, R. *The Monk in the Garden*: The Lost and Found Genius of Gregor Mendel, the Father of Genetics. New York, NY: Houghton Mifflin Harcourt, 2000; KELLER, E. *The Century of the Gene*. Cambridge, Massachusetts: Harvard University Press, 2000; WATSON, J. *DNA*: The Secret of Life. Fully revised and updated. London: Random House UK, 2017.

Trumpeter, which has a peculiar birdsong; Homer/Homing (pigeon post or pigeon mail), special for its sense of guidance; Fantail, which its tail has a higher number of feathers than other pigeons and remains in upright position; Jacobin, with curveted feathers at the front and longer ones around the head which involve it as the high and exaggerated turtleneck of the Jacobins of the time of the French Revolution; Runt ("giant runts or Roman pigeons"), the largest of all domestic pigeons, it has a long beak and long feet; Carrier, it has long and thin beak; Barb ("Polish"), similar to the carrier but it has a shorter and wider beak; Turbit ("necktie") it has curved feathers on the neck and chest, and also inflates the esophagus (DARWIN, 1859; MARTINS, 2012).

The analysis was presented under two moments: the attack to the multiple origin and the defense of the unique origin. Darwin assumed there was a possibility of a multiple origin of clustered characters. To do so, it would be necessary for a certain number of characteristics scattered in a minimum number of species to be realized and/or found in nature, which would result in seven or eight initial wild kinds of pigeon.

However, this possibility is still subject to objections and with a high degree of refutability, since, in this context, all breeds must necessarily have been domesticated by the prehistoric man. In addition, all different breeds should produce fertile hybrids, which rarely occurs in nature and eventually all kinds of wild ones would have been extinct in nature shortly after domestication.

This confluence of responses is somewhat unfounded. Thus, by excluding the difficulties of the assumption of a multiple origin, Darwin initiated his defense of a single origin. And it was believed that the rock dove, *Columba livia*, was the only pigeon that lived in its natural state and it had not been extinct.

The rock dove, *Columba livia*, was the wild pigeon and common ancestor. It is still today found almost everywhere in the world, more often in squares and parks, where they are fed by many people. Its appearance has a gray color, with shades of blue; there are two dark bands at the end of its wings and at the tip of the tail the feathers are also dark. The outer feathers of the tail have a white border at the base. Its back is white. Its average size varies between 32-34 centimeters, with a wingspan of 60cm and a weight that revolves around 400g.

Today, the second decade of the 21st century, we know that since the Neolithic period the pigeons were domesticated and there are more than 350 breeds that have broken down into different colors, structures and behaviors. In a study published in Science magazine in January

2013, scientists made a genomic and evolutionary analysis of the crest of the head of the rock dove (SHAPIRO *et al*, 2013). Amid the conclusions of the study, we can infer that the concentration of breeders in qualitative characteristics allowed the identification, with greater ease, of the genes responsible for the phenotype of the crest in the different breeds. In addition, it was possible to observe a geographical line of breeds from the commercial routes that came out of the Middle East before the nineteenth and twentieth centuries.

A single gene in the pigeons determines the crest, the EphB2. Such a gene was found in the domestic breeds and in the savage ones. Scientists do not rule out the hypothesis that there is a regulatory variant that can alter the expression of other genes. However, once the gene is shared by all the crested pigeons, this allowed the association of this characteristic to the EphB2. A mutation had occurred just once and had spread throughout the population or, then, a variation of the wild rock dove was selected by the breeders. The study also showed that the rock dove is not the only wild pigeon specimen and that the wild types still have a single common ancestor.

In Victorian England, genomics analysis mechanisms were not known. Moreover, it was thanks to the development of Darwinian Theory and the Modern Synthesis (Neo-Darwinism) that in our time the analysis performed by Shapiro was possible. In Darwin's case, to argue for the sake of a single origin, his text had a growing movement in which facts were gradually added so that the idea was corroborated.

Again, the tropological parallel was present. The breeder's backyard and the nature's yard were once again evoked to structure the reality and model a picture of the world. First, the general characteristics of domesticated animals and the rock dove were presented. The fertility of domestic crossings and the infertility existing in most wild hybrids, as well as the existence of intermediaries between the most extreme domestic pigeons and the rock dove, were comparisons that conferred strength to the argument.

In rhetoric, during a speech preparation, whatever it may be, there are presumptions that establish an agreement between the speaker and the audience. In this case, the facts exposed were not only of a truth character, since they were facts of observation, but they still had a character of universality, due to the popularity of domestic pigeons and, as such, they were of paramount importance to science, since this is an essential component of scientific theories: the elaboration of a universal law that explains a force of nature.

A fact is only possible in an argumentative situation if there is a universal agreement; otherwise it is liable to refutation. Darwin had this universal agreement with his audience. The known presumptions deriving from the observations made since the domestication in the Neolithic and which were known supported this universality. In addition, such presumptions carried values, which, in Perelman and Olbrechts-Tyteca's opinion (1969, p.75, emphasis added):

> [...] enter, at some stage or other, into every argument. In reasoning of a scientific nature, they are generally confined to the beginning of the formulation of the concepts and rules that constitute the system concerned and, insofar as the reasoning aims at the truth value, to the conclusion. As far as possible, the actual unfolding of the argument is free from values, and this exclusion is at a maximum in the exact sciences. But in the fields of law, politics, and philosophy, values intervene as a basis for argument at all stages of the developments. *One appeals to values in order to induce the hearer to make certain choices rather than others and, most of all, to justify those choices so that they may be accepted and approved by others*.

There is another kind of evidence that Darwin used in favor of his ideas: a laboratory experiment of reversal to the common ancestor, the offspring to the rock dove. In May 1855, the entire physical structure needed to breed pigeons was built in his house, in Kent. On August 31st of that same year, he wrote to Tegetmeier, requesting pigeons for his experiment at Down House:

> I have been thinking over your offer of helping me to the dead bodies of some of the good birds of Poultry. Really considering how complete a stranger I am to you, I think it one of the most goodnatured offers ever made to me. I have hardly the means to keep all the kinds of poultry, & to buy first-rate birds, merely to make skeletons of them, I should think too great an outlay. Therefore if you can help me even to a few it would be a very great assistance.[12]

The experiment was done with fantail pigeons and black Polish pigeons: he crossed them and obtained a lineage with black birds and painted brown. He crossed them again and obtained pigeons with white backs, double black bar on the wings, white edges on tail feathers

[12] Letter no. 1751. Available at: [http://www.darwinproject.ac.uk/DCP-LETT-1751].

like the rock dove. The reversal was not strict as in the case of Shapiro's analysis (2013). However, it provided explanatory elements made in his home-laboratory.

Some methodological techniques were discussed through exchanged letters. On November 26th, 1855, he wrote to Thomas Campbell Eyton, a British naturalist who worked with birds:

> As you have had such great experience in making skeletons, will you be so kind as to take the trouble to give me some pieces of information. But I must premise that I have been making a few, & when I took the body out of the water, the smell was so dreadful that it made me reach awfully. Now I was told that if I hung the body of a bird or small quadruped up in the air & allowed the flesh to decay off, & the whole to get dry, that I could boil the mummy in water with caustic soda, & so get it nearly clean, but not white, with very little smell. What do you think of this plan? And pray tell me how do you get the bones moderately clean, when you take the skeleton out, with some small fragments of putrid flesh still adhering. It really is most dreadful work.— Lastly do you pluck your Birds?[13]

After more than a year since the beginning of his experiment with pigeons– in addition to pigeons, rabbits, ducks and other animals were dissected in Down House – on September 29th, 1856, Darwin wrote to James Dwight Dana, geologist and zoologist of the United States:

> […] I have of late been chiefly at work on domestic animals, & have now got a considerable collection of skeletons […]. But Pigeons offer the most wonderful case of variation, & as it seems to me conclusive evidence can be offered that they are all descended from C. livia.[14]

Finally, he considered that the results of his experiment could only be explained as follows:

> From these several reasons, namely, the improbability of man having formerly got seven or eight supoosed species of pigeons to breed freely under domestication; these suposed species being quite unknown in a wild state, and their becoming nowhere feral; these species having very abnormal characteres in certain respects, as compared with all other Columbidae, though so like in most other respects to the rock-pigeon; the blue colour and various marks occasionally appearing in all the breeds, both when kept pure and when crossed; the mongrel oofspring being perfectly fertile; - from these several reasons, taken together, I can feel no doubt that all our domestic breeds have

[13] Letter no. 1784. Available at: [http://www.darwinproject.ac.uk/DCP-LETT-1784].
[14] Letter no. 1964. Available at: [http://www.darwinproject.ac.uk/DCP-LETT-1964].

> descended from the Columba livia with its geographical sub-species (DARWIN, 1859, pp.26-27).

A perception that stems from this reflection is the perception of plasticity. Since the variations alter the organic form, then it is inferred that the living matter is subject to movement. Human beings do not cause variability, nor are they able to prevent it from happening; however, they select, preserve and accumulate variations given by nature (DARWIN, 1859). Artificial selection is the repetition of this selective process made by man. Similarly, to nature, the human being acts in the breeds of species, distinguishing them in their different specific forms of being (MARTINS, 2012; EVANS, 1984).

The analysis of the pigeons showed the true traits that enclose the concepts of variety and human selection. The explanation in domestic status allowed the creation of a role to be performed by these concepts. However, by continuing with the theoretical presentation, Darwin changed the stage in which the scene occurred. The scene was no longer in the breeder's backyard, nor would the man's hands select the variations. Now the stage was the nature's yard and the notions were staged in the natural world.

This is the theme of the second chapter, Variation under Nature. To carry out this reasoning, it was necessary to establish a limit. At that time there was no limited perception of the concept of species and variety. Naturalists classified varieties of the same species as new species or, conversely, new species as varieties of the same one. There was a conceptual confusion among the naturalists of the Victorian period. Darwin used this to argue for the hereditary character and, for this reason, he focused on the small anatomical differences (DARWIN, 1859).

Anatomy helped him to separate species, subspecies, and varieties. The work done by anatomists with structural homologies provided allowance for a possible limit. History showed that in many cases individual differences were observed in the same way of being, that is, varieties that could be grouped – a certain group of varieties characterize the pigeon mail, for example. In some cases, the grouping eventually spelled out a subspecies. When the varieties were too distant, they constituted a species that distinguished themselves.

This aspect of the theory is verified in the history of primates.Today, in the 21st century, the division between chimpanzees comprises the *Pan* troglodytes, the violent chimpanzee, which until the first half of the twentieth century was the only known form of this species. Besides the troglodytes it was discovered that the *Pan Paniscus* is also a chimpanzee. One day,

at the Tervuren Museum in Belgium, the German anatomist Ernst Schwarz analyzed the skull of a peculiar chimpanzee – which was thought to be a juvenile due to its physical structure. It was a distinct species whose structural form differed in varieties from its nearest evolutionary relative, the *troglodítus*. This was how *Pan Paniscus*, later known as Bonobo, was discovered. By finding the Bonobos in the wild, that loving characteristic that distanced him behaviorally from the violent *troglodítus* came to be understood more rationally and helped to explain why that individual was peculiar: the ecology and behavior of the *Paniscus* were different from those presented by *troglodítus* (DE WALL, 2006).[15]

In a manner, Darwin wrote in *Origin* (1859, pp.51-52) that:

> Hence I look at individual differences, though of small interest to the systematist, as of high importance for us, as being the first step towards such slight varieties as are barely thought worth recording in works on natural history. And I look at varieties which are in any degree more distinct and permanent, as steps leading to more strongly marked and more permanent varieties; and at these latter, as leading to sub-species, and to species.

After writing the general notions of variation and selection and limiting the notions of species, subspecies and variety, the scenario was ready. Now he needed to explain the background in which nature's yard was. In this rhetorical context, the third chapter followed with the title Struggle for Existence. It has an interesting foundation: the economic basis of the mathematician Thomas Malthus.

The metaphor of the struggle was extracted from the text of Malthus, which presented a discourse about the conflict between the power of food production and the power of procreation of the human species. It was first published in 1798 under the title *An Essay on the Principle of Population*: As it Affects the Future Improvement of Society, with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and Other Writers (2014).[16] Besides Darwin, the other father of the theory of evolution, Wallace, had also been based on the reading of Malthus.

During the time of the French Revolution there was speculation about the creation of a society based on equality, especially as regards economic and social aspects. The *Essay on the Principle of Population* arose as a critic to the elaboration of these ideas. Malthus believed in

[15] DE WALL, F. *Our Inner Ape*: A Leading Primatologist Explains Why We Are Who We Are. New York, NY: Riverhead Books, 2006.
[16] MALTHUS, T. *An Essay on the Principle of Population*. Scotts Valley, California: CreateSpace Independent Publishing Platform, 2014.

two fundamental postulates: the need for food for human existence and the passion between the sexes as something that would endure to the dawn of times. These postulates are laws of nature and emanate two powers: the power of the population and the power of the production of the land.

His belief was that population power was superior to the natural power of food production. In a manner, if the population were not controlled, it would grow in geometric progression, while the food, in arithmetic progression. Thus, Malthus said that it was necessary to have a constant balance of these forces, a control in the population from the difficulties that survival imposed. Otherwise, the consequences for mankind would be misery and vice and thus feasible in a society in which not all human beings live happily, without worrying about their livelihood (MALTHUS, 2014).[17]

In a logical reasoning, the Malthusian argument has seven assumptions that indicate the conclusion in the following order:

A. The population grows in geometric progression;

B. Food grows in arithmetic progression;

C. There is a natural inequality between the population and food production powers;

D. Men naturally need food for their existence;

E. The effect of these two powers must be maintained;

F. Operational control is needed in the population, based on the difficulty of livelihood;

G. The difficulty of livelihood will affect mankind. The consequences are misery and vices;

W. A society in which all men have a quiet, happy and idleness life is not possible.

Thus, in an order of causes, the arguments, according to Fisher (2004),[18] follow the following structure:

$$\big((A + B) \rightarrow C + D\big) \rightarrow E \rightarrow F \rightarrow G \therefore W$$

[17] For reference, see footnote 16.
[18] FISHER, A. *The Logic of Real Arguments*. 2.ed. Cambridge: Cambridge University Press, 2004.

Logical reasoning and formalization expressed based on these ideas are the historical precursors of population dynamics. In the population dynamics, the birth and mortality rates of a given species are proportional to the number of present individuals. As stated by Kato and Bellini (2009), in this model the population varies continuously at a constant rate and proportional to the initial population. The difference between birth and mortality rates, that is, the reproductive rate of the population, supports a constant *r* to the model, so if we know the number of individuals in two distinct units of time (*t* and *t*+Δ*t*), we have:

$$N(t+\Delta t) = N(t) + r\,\Delta t\,N(t)$$

N is the number of individuals at the time *t*+Δ*t*, which, in turn, correlates with the original number of individuals in *N(t),* added to the number of offspring resulting from *r Δt N(t)*.

Kato and Bellini (2009) conclude that the Malthus model does not understand nature in its complexity. It ignores biological elements important to specific population dynamics. Among these elements, the authors mention the age distribution and the variations in birth and mortality rates due to the environment in which a given population is located. In other words, by assuming **r** as a constant rate of population growth, biological meanings that are instilled are not taken into account, because the Malthusian model does not understand decisive ecological phenomena for the explanation of success or existential failure dynamics in populations.

However, although limited, the model carries out a description of nature in a space and time, thus contributing as a tool for observing aspects of reality. Moreover, "several species, in different situations, may have their dynamics represented, even if only during a short time, by the model of Malthus" (KATO; BELLINI, 2009, p.180).[19]

The Malthusian argument has a problem. In *A* (The population grows in geometric progression) and *B* (Food grows in arithmetic progression), which are empirical affirmative assumptions, observations are taken from nature. However, in order to constitute argumentative data, they must be confirmed historically, because only that way is its true value assured. Historical records should corroborate the geometric progression of population growth rates in

[19] In original: "diversas espécies, em diferentes situações, podem ter sua dinâmica representada, mesmo que somente durante um período, pelo modelo de Malthus."

our species. Similarly, historical referring to food production should comprise a vast amount of time, through which the arithmetic increase of food production would occur (FISHER, 2004).[20]

In general, Malthus's argument is open to many questions at various points in his text. In addition, the epistemological support that confers validity to his premises is not safe, because it is susceptible to doubt. Besides, as Fisher (2004)[21] points out, some inferences that can be made of them are even fallacious. But even so, it influenced Darwin's thought.

The metaphor of war and power struggle found in the Essay on the Principle of Population (MALTHUS, 2014)[22] provided a philosophical support for the creation of the concept of struggle for existence in *Origin*. At the same time, Darwin presented the two concepts: struggle for existence and natural selection. It suggests the intimate relationship that the concepts have with each other. It is a mutual epistemic dependence, something like a *petitio principii*.

The struggle for existence ensures that part of the variation passes to the next generation. The new generation will have a greater chance of survival, because it supposedly inherited the variations of the fittest. That is why many individuals are born, but few survive. Darwin called this principle, through which variations, if useful, are preserved, natural selection so as to mark its relationship with the power of human selection. That is, understanding the concept of natural selection only occurs if, and only if, organic beings are in a context of struggle for life. In this way, a universe of power struggle is transposed from one trope to the other. Darwin removes the notion of power struggle from the Malthusian argument and then provides the backdrop that allows the movement of the concept of natural selection.

The metaphor was elaborated. First the struggle for existence was explained. Darwin admitted the metaphorical use of his concept and, at the same time, presented argumentative data that provided examples of its operational and pedagogical character. He explained a natural force, whose foundation was the geometric growth of populations:

> In a state of nature almost every plant produces seed, and amongst animals there are very few which do not annually pair. Hence we may confidently assert, that all plants and animals are tending to increase at a geometrical ratio, that all would most rapidly stock every station in which they could any how exist, and that the geometrical tendency to increase must be checked by destruction at some period of life (DARWIN, 1859, p.65).

[20] For reference, see footnote 18.
[21] For reference, see footnote 18.
[22] For reference, see footnote 16.

Even with the whole argumentative script written, the main character of the play still had to be presented. The stage was already set and most of the actors had taken their places. The notion of selection was based on analogy to domestication; the variation proved itself to be a complex actor, and it brought the marks of the natural history, hereditary marks, something that was not well known by science, but whose role was fundamental to that plot. The struggle for existence was the background that characterized the scene in which the other concepts acted. The spectacle was carefully organized and in the fourth chapter of *Origin*, Darwin presented the main actor: Natural Selection.

The last chapter of the theoretical nucleus concluded the exposition of the adaptive mechanisms that Darwin conceived in his mind. Some historical notes show us years of reflection on the law of modification of living forms. On January 11th, 1844, he wrote to Hooker:

> […] I have been now ever since my return engaged in a very presumptuous work & which I know no one individual who wd not say a very foolish one.— I was so struck with distribution of Galapagos organisms &c &c & with the character of the American fossil mammifers, &c &c that I determined to collect blindly every sort of fact, which cd bear any way on what are species.— I have read heaps of agricultural & horticultural books, & have never ceased collecting facts— At last gleams of light have come, & I am almost convinced (quite contrary to opinion I started with) that species are not (it is like confessing a murder) immutable […].[23]

A lot of research and laboratory work was still needed. Part of the research was done through his correspondences, with the indication of themes and objects of investigation as well as improvement of techniques, collection and creation of a database. An arsenal of natural and methodological information was also born in mind. The laboratory, at times, was his house – at his house the experiences with pigeons happened, as already said.

In 1855, for example, the British naturalist kept in touch with Thomas Vernon Wallaston, a remarkable entomologist. Wallaston had great knowledge in beetles, published several papers on the Coleoptera, and provided data on insects and variability. Later that year he exchanged some letters with Hewett Cottrell Watson, who was a renowned phrenologist and edited the Phrenological Journal between the years of 1837-1840. Watson had a personal

[23] Letter no. 729. Available at: [http://www.darwinproject.ac.uk/DCP-LETT-729].

herbarium with species he collected in the Azores, in Portugal, in the year 1842. He wrote extensively about geographic distribution of plants, a theme that was also part of Darwin's evolutionary concerns. However, it was on June 8th, 1858, that Darwin wrote to Hooker:

> […] The discussion comes in at end of long chapter on variation in a state of nature, so that I have discussed, as far as able, what to call varieties.— I will try to leave out all allusion to genera coming in & out in this part, till when I discuss the "principle of Divergence," which with "Natural Selection" is the key-stone of my Book & I have very great confidence it is sound.[24]

In the book, the argument is outlined in direct analogy to the selection made by man. This was the resource used by Darwin since the first chapter. It is only by analogy that natural selection was possible as a rhetorical argument, which expresses a significant symbolic reality to human existence, a *continuum* with other forms of being. Darwin mentioned names of friends, also naturalists, such as Asa Gray, and with that wrote arguments of authority. The natural force that causes varieties in nature gained weight with names widely known by the audience. The scientific discourse emanated from the authority, not just of a man, but of members of a community. There are examples as well as a discussion about the interbreeding of individuals and the production of new forms from natural selection. The whole chapter follows the model of a quasi-logical argument.

Quasi-logical arguments have a demonstrative appearance. The persuasive force of this type of argument has its nature in proximity to logic and mathematics. Its constitution brings into evidence the formal scheme of reasoning and seeks homogeneity. In addition, it operates reductions that allow the insertion of data in this schema. According to Perelman and Olbrechts-Tyteca (1969, p.193),[25] what characterizes this argumentation is its "nonformal character and the effort of thought which is required to formalize it." This reduction to the schemas occurs in the argumentative entities, the terms of discourse, and the quasi-logical structure which has its correspondent.

[24] Letter no. 2282. Available at: [http://www.darwinproject.ac.uk/DCP-LETT-2282].
[25] For reference, see footnote 6.

III

When analyzing the theoretical nucleus and the use of the analogy between the artificial and the natural, we perceive a singular insight of reason. Darwin knew the philosophical consequences of his theory for the explanation of human existence. He knew his ideas would clash with the metaphysical explanation given by religion. A proof of this is the debate on creationism *versus* evolutionism that has been established since the publication of the *Origin*. Also, as I highlighted, the pigeons would be the best argument to reach a large audience, it was the common place. The domestic animals were material elements, a data of experience, which served as a universal example in the structuring of a reality through which a communion of spirits was created with the reader.

The notion of artificial had its foundation in the experience and, in addition to the struggle for survival, allowed, then, that the phenomenon expressed by it could be explained similarly in nature. Thus, the rhetorical, pedagogical and persuasive function of the analogy fulfilled its role in an almost-logical schema of thought. It was a device of the argumentative reason that contributed to the characterization of the aspects of the truth that the evolutionary theory presented to the readers. In the metaphor of the theater, it was the one who directed the play staged in the *Origin*.

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