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# An Analysis of Darwin's Theory of Natural Selection from Leibniz's Perspective

**Resumen**: *Charles Darwin publicó seis ediciones de El origen de las especies durante su vida y, partiendo de la premisa de que este libro es de naturaleza filosófica, aquí se analiza el capítulo IV de dicha obra para buscar los elementos que subyacen a la explicación de la selección natural a lo largo de las siete ediciones. Utilizando los criterios establecidos por Leibniz en su Disertación sobre el estilo filosófico de Nizolio, se determinó que la calidad filosófica en la primera edición es intermedia y aumentó en las ediciones siguientes, principalmente en la tercera en comparación con la segunda.*

**Palabras clave:** *Selección natural, Darwin, calidad filosófica, Leibniz, evolución biológica.*

**Abstract**: *Charles Darwin published six editions of The Origin of Species during his lifetime. Starting from the premise that said book is philosophical, Chapter IV of the work was analyzed here to find the elements underlying the explanation of natural selection throughout the six editions. Using the criteria established by Leibniz in his Dissertation on the Philosophical Style of Nizolio, it was determined that the philosophical quality in the first edition is intermediate and increased in the following editions, mainly in the third compared to the second.*

**Keywords:** *Natural selection, Darwin, philosophical quality, Leibniz, biological evolution.*

## 1. Introduction

Charles Darwin is known as the father of the theory of evolution (Ruse, 2009). In his seminal work *On the Origin of Species by Means of Natural Selection, or the Preservation of the Favoured Races in the Struggle for Live*, published in its first edition in 1859, he proposes that natural selection is the causal mechanism behind the emergence of organisms over time and devotes chapter IV to describing this mechanism. During the life of its author, six editions of *The Origin of Species* were published between 1859 and 1876, and, despite being a fundamental work in the further development of biological sciences for authors such as Popper (1985, p. 235), it is not scientific but philosophical in nature.

Starting from this premise, the objectives of this essay were to analyze Chapter IV of *The Origin of Species* to look for the philosophical elements underlying the explanation of natural selection and to evaluate the internal coherence and the explanatory value in the approach of the principle of natural selection along the six mentioned editions. The question that arises here is: Was there a significant change in philosophical

quality between the consecutive editions of *The Origin* that Darwin published during his lifespan? Furthermore, if so, can this change be related to the author's knowledge construction process? In this sense, it would be relevant to determine whether an analysis such as the one proposed would allow us to detect the elements that the author has considered in constructing his philosophical discourse.

The next step was to find an appropriate criterion to evaluate the philosophical quality of the text that, moreover, was before or contemporary with Darwin so that there was a possibility that he knew it. Such may be Gottfried Leibniz, whose work *Dissertation on the Philosophical Style of Nizolio* (Leibniz, 1993) systematizes a methodology for analyzing philosophical texts. In some of his correspondence, Darwin seems to evidence his knowledge of Leibniz's philosophy when he maintains that the continued creation of monads is an unnecessary and unfounded doctrine (letter to Lyell, October 11th, 1859, Darwin, 1898, p. 6), and, when response to Bronn's objection related to the impossibility of explaining the origin of life Darwin refers to Leibnitz (sic) objection to Newton's gravitational theory (letter to Asa Gray, February 23rd, 1860, Darwin, 1898, pp. 83-84). With those objectives in mind, it was decided to follow Leibniz's recommendations to study philosophical texts (Leibniz, 1993), incorporating some authors' comments on Darwinian theories.

## 2. Methodological considerations

Leibniz sets out ten criteria, and I have arbitrarily assigned a numerical value to each one to determine what I call the index of philosophical quality. This intends to obtain a line of comparison between the analyzed texts. The characteristics that determine a good philosophical quality of texts, based on Leibniz's criteria, are the following:

1. Philosophical studies: A relationship between the author's philosophical studies and their coincidences and discrepancies with previous and contemporary authors.
2. The contributions of the work: An analysis of the contributions that the work studied makes to the field, including its shortcomings and discoveries.
3. The quality of the discourse: A verification of the qualities of the philosophical discourse, among which the following should be found:

    i. Clarity is the use of words known to everyone who «pays attention»|

    ii. The quality of the terms used is based on the notion that the standard for using terms should be either the most concise popularity possible or the most popular concision possible.

4. Achromaticity: A determination of the achromaticity of the text, that is, the definition of whether the proposed philosophy is achromatic (in which everything is demonstrated) or exoteric (in which certain things are stated without demonstration and explained by examples and comparisons proposed topically). The latter style is considered not very rigorous and accurate.
5. Good interpretation and non-slander: A reference to the errors of interpretation or even slander that the author incurs concerning other authors who serve as references. This recommendation is related to number 1; it would imply a critical analysis of the background of the text under study and could influence what was called by Umberto Eco «*intentio auctoris*» (Eco, 1992, pp.29-32).
6. Good sense by itself indicates whether the text must be hunted for meaning through innumerable conjectures. If so, the discourse does not deserve praise, for its clarity will be obscure if the reader must arrive at its meaning from external circumstances.
7. Respect for the rule of nominals: A comment related to the respect for the rule of nominals, namely, do not multiply entities or assumptions unnecessarily since the truth

depends on the names given to things, and names depend on human discretion.

8. The use of induction: An evaluation of the principle that there is no science by demonstration but simply a process of induction, keeping in mind that if the cause is the same or similar in all cases, the effect will be the same or similar in all cases and that the existence of a thing that is not perceived is not presupposed: everything that is not presupposed in practice must be taken for nothing before it is proved. This could be a valuable recommendation from an epistemological point of view. Here, Leibniz agrees with Descartes (2006) when he points out not to admit anything as true unless he knew with evidence that it was or that only mathematicians have been able to find some demonstrations, and with the Kant's notion of knowledge as a product of a combination of understanding and sensitivity (Kant, 2006).

To quantify these characteristics to have a more measurable notion of the quality of philosophical discourse, it could be thought that the fulfillment of each of Leibniz's criteria could be assigned one of three levels: 1. Low, 2. Intermediate, and 3. High. In this way, a trait such as respect for the nominal rule that is met at a high level will have a rating of 3 in that item, while a discourse with a low achromaticity will have a rating of 1 in that characteristic. Considering that the quality of the discourse has two components (clarity and quality), the above list consists, then, of nine characteristics and, therefore, a philosophical text in which all of them are evaluated with the proposed numerical scale, which could have a total rating of between 9 points (low quality) and 27 points (high quality). Thus, based on the criteria proposed by Leibniz and with the scale indicated above, it is possible to figure out a percentage of quality of the philosophical discourse that would result from the sum of the points obtained in the evaluated categories divided by 27 and multiplied by 100. According to the indicated criteria, this percentage would then range between 33% and 100%, depending on whether the text in question has a low or a high philosophical quality.

The texts used to carry out this analysis come from Darwin's complete works as they appear in *The Complete Works of Charles Darwin Online* (available at http://darwin-online.org.uk/), where the texts appear in PDF format and have been scanned from the original editions. To compare the successive editions, the texts in PDF format were copied to the Word format of Office 2007, and the text comparison program Compare *it! 4.1* was used (available at http://www.grigsoft.com/wincmp3.htm).

Considering the above, the objectives of this essay are:

1. To carry out an analysis of chapter IV of *The Origin of Species* in its first edition to assign it the percentage of quality of philosophical discourse, defining the latter according to Leibniz.
2. To compare chapter IV of the first edition of *The Origin of Species* with six successive editions published by Darwin in his lifespan.

## 3. Chapter IV of The Origin of Species in the six successive editions

Table 1 shows the publication dates of the six editions of *The Origin of Species* that appeared during the author's lifetime and the respective indexes of *Chapter IV*. Notably, the first three editions were published in consecutive years, while the last three were published at three-year intervals. The most extended period occurred between the third and fourth editions, five years. The short time between the publication of the first and third editions raises the question of why the author considered the preparation of these editions necessary and whether this was related to any significant change in the content of the respective texts or was just a sales issue. The length of pages of chapter IV in the first six editions and the sixth corrected edition was 51 (first and second), 65 (third), 66 (fourth), 74 (fifth), and 44 (sixth and sixth corrected). Thus,

the most notable changes concerning the amount of text are observed in the third and fifth editions (increases) and sixth (decreases). These changes in the length of the text are due to:

1. In the third edition, new sections were introduced: *Advance in organisation — Low forms preserved — Objections considered — Indefinite multiplication of species — Summary,*
2. In the fifth edition one more new section was introduced: *Uniformity of certain characters due to their unimportance, and to their not having been acted on by Natural Selection*,
3. In the sixth edition, the sections: *Objections considered — Uniformity of certain characters due to their unimportance, and to their not having been acted on by Natural Selection,* from the previous edition, are restructured in the section *Convergence of character.*

**Table 1:** Year of publication of the six editions of *The Origin of Species* published during the life of its author and respective content of *Chapter IV* (Continues)

| Edition | Year | Contents of Chapter IV |
|---|---|---|
| 1 | 1859 | **NATURAL SELECTION.** Natural Selection — its power compared with man's selection — its power on characters of trifling importance — its power at all ages and on both sexes — Sexual Selection — On the generality of intercrosses between individuals of the same species — Circumstances favourable and unfavourable to Natural Selection, namely, intercrossing, isolation, number of individuals — Slow action — Extinction caused by Natural Selection — Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation — Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent — Explains the Grouping of all organic beings. .. .. .. .. .. .. .. .. .. 80-130 |
| 2 | 1860 | **NATURAL SELECTION.** Natural Selection — its power compared with man's selection — its power on characters of trifling importance — its power at all ages and on both sexes — Sexual Selection — On the generality of intercrosses between individuals of the same species — Circumstances favourable and unfavourable to Natural Selection, namely, intercrossing, isolation, number of individuals — Slow action — Extinction caused by Natural Selection — Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation — Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent — Explains the Grouping of all organic beings .. .. .. .. .. .. .. .. .. 80-130 |
| 3 | 1861 | **NATURAL SELECTION.** Natural Selection — its power compared with man's selection — its power on characters of trifling importance — its power at all ages and on both sexes — Sexual Selection — On the generality of intercrosses between individuals of the same species — Circumstances favourable and unfavourable to Natural Selection, namely, intercrossing, isolation, number of individuals — Slow action — Extinction caused by Natural Selection — Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation — Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent — Explains the Grouping of all organic beings — Advance in organisation — Low forms preserved — Objections considered — Indefinite multiplication of species — Summary .. .. .. 83-147 |

**Table 1 (Cont.):** Year of publication of the six editions of *The Origin of Species* published during the life of its author and respective content of *Chapter IV* (Continues)

| Edition | Year | Contents of Chapter IV |
|---|---|---|
| 4 | 1866 | **NATURAL SELECTION.** Natural Selection — its power compared with man's selection — its power on characters of trifling importance — its power at all ages and on both sexes — Sexual Selection — On the generality of intercrosses between individuals of the same species — Circumstances favourable and unfavourable to Natural Selection, namely, intercrossing, isolation, number of individuals — Slow action — Extinction caused by Natural Selection — Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation — Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent — Explains the Grouping of all organic beings — Advance in organisation — Low forms preserved — Objections considered — Indefinite multiplication of species — Summary.. .. .. .. ... .. .. 90-156 |
| 5 | 1869 | **NATURAL SELECTION, OR THE SURVIVAL OF THE FITTEST.** Natural Selection — its power compared with mans selection — its power on characters of trifling importance — its power at all ages and on both sexes — Sexual Selection — On the generality of intercrosses between individuals of the same species — Circumstances favourable and unfavourable to the results of Natural Selection, namely, intercrossing, isolation, number of individuals — Slow action; Extinction caused by Natural Selection — Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation — Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent — Explains the Grouping of all organic beings — Advance in organisation — Low forms preserved — Objections considered — Uniformity of certain characters due to their unimportance, and to their not having been acted on by Natural Selection — Indefinite multiplication of species — Summary .. .. .. .. .. .. .. 91-164 |
| 6 | 1872 | **NATURAL SELECTION; OR THE SURVIVAL OF THE FITTEST.** Natural Selection—its power compared with man's selection—its power on characters of trifling importance—its power at all ages and on both sexes—Sexual Selection—On the generality of intercrosses between individuals of the same species—Circumstances favourable and unfavourable to the results of Natural Selection, namely, intercrossing, isolation, number of individuals—Slow action—Extinction caused by Natural Selection—Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation—Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent—Explains the grouping of all organic beings—Advance in organisation—Low forms preserved—Convergence of character—Indefinite multiplication of species—Summary Page 62-105 |

**Table 1 (Cont.):** Year of publication of the six editions of *The Origin of Species* published during the life of its author and respective content of *Chapter IV.*

| Edition | Year | Contents of Chapter IV |
|---|---|---|
| 6, with additions and corrections | 1876 | **NATURAL SELECTION; OR THE SURVIVAL OF THE FITTEST.** Natural Selection—its power compared with man's selection—its power on characters of trifling importance—its power at all ages and on both sexes—Sexual Selection—On the generality of intercrosses between individuals of the same species—Circumstances favourable and unfavourable to the results of Natural Selection, namely, intercrossing, isolation, number of individuals—Slow action—Extinction caused by Natural Selection—Divergence of Character, related to the diversity of inhabitants of any small area, and to naturalisation—Action of Natural Selection, through Divergence of Character and Extinction, on the descendants from a common parent—Explains the grouping of all organic beings—Advance in organisation—Low forms preserved—Convergence of character—Indefinite multiplication of species—Summary Page 62-105 |

### 3.1 First Edition (1859)

Table 2 shows the result of the analysis of chapter IV of the first edition of *The Origin of Species* (Darwin, 1859, pp. 80-130). The best quality characteristic refers to the good interpretation and non-slander of the authors who serve as references for Darwin: he knows contemporary and predecessor authors and refers to them appropriately and coherently.

With an intermediate philosophical quality are the characteristics of the contributions of the work and the quality of the discourse. About the first characteristic, the description of the variety of life forms that currently exist is confused with the mechanism that produces it. The mechanism Darwin calls «natural selection» has no original explanatory capacity; it does not provide any clear explanation for the origin of species but is limited to a poorly founded metaphor full of examples of what, according to the author, is equivalent to human selection. Concerning the second above-mentioned characteristic, the medium quality of the speech is due, fundamentally, to the author's excessive use of euphemisms and circumlocutions instead of stating his ideas directly.

The rest of the characteristics evaluated were of low philosophical quality, and the reasons are common to most of them: it is noticed the use of multiple terms that are unclear or not previously defined, so the meaning of the text becomes not self-sufficient.

Finally, the main reproach that can be made to Darwin's discourse regarding induction is that no justification is presented to equate natural selection with human selection. On the contrary, Chapter IV seems to give rise to the notion, not only unjustified but erroneous, that, since human selection pursues a particular goal, so does natural selection.

**Table 2:** Scores of *chapters IV* of *The Origin of Species* in editions 1 to 6 to calculate the percentage of philosophical quality based on the characteristics indicated by Leibniz. The scoring scale is 1=low, 2=medium, 3=high.

| **Evaluated Characteristic** | **Edition** | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| Philosophical studies | 1 | 1 | 1 | 2 | 2 | 2 |
| The contributions of the work | 2 | 2 | 2 | 2 | 2 | 2 |
| Discourse clarity | 1 | 2 | 2 | 2 | 2 | 2 |
| Discourse quality | 2 | 2 | 2 | 2 | 2 | 2 |
| Achromaticity | 1 | 1 | 1 | 1 | 1 | 1 |
| Good interpretation and non-slander | 3 | 3 | 3 | 3 | 3 | 3 |
| Good sense by itself | 1 | 1 | 2 | 2 | 2 | 2 |
| Respect for the rule of nominals | 1 | 1 | 1 | 1 | 1 | 1 |
| The use of induction | 1 | 1 | 2 | 2 | 2 | 2 |
| Total score | 13 | 14 | 16 | 17 | 17 | 17 |
| **Philosophical quality percentage** | **48** | **52** | **59** | **63** | **63** | **63** |

Below are indicated some examples of the text that allow the considered characteristics to be evaluated:

1. Philosophical studies

i. pp. 80-81:

> *...(remembering that many more individuals are born than can possibly survive)...*

In this text, which refers to the importance of adaptive advantages in the struggle for existence, the origin of the information is not indicated. However, it is understood that it refers to Malthus.

ii. p.82:

> *We have reason to believe, as stated in the first chapter, that a change in the conditions of life, by specially acting on the reproductive system, causes or increases variability; ...*

Here, there seems to be confusion with Lamarck's concepts. Asa Gray, in his letter to Hooker on January 23rd, 1860, is worried about Darwin been confusing his theories with Lamarck's:

> *Well, what seems to me the weakest point in the book is the attempt to account for the formation of organs, the making of eyes, &c., by natural selection. Some of this reads quite Lamarckian.* (Darwin, 1898, p. 66).

iii. p. 90:

> *..., which we cannot believe to be either useful to the males in battle, or attractive to the females.*

Darwin refers to some neutral characteristics, but this discrepancy concerning his theory is not explained.

iv. p.91:

> *...but to this subject of intercrossing we shall soon have to return.*

However, this discrepancy is subsequently not adequately explained.

v. p.109:

> *Natural selection acts solely through the preservation of variations in some way advantageous, which consequently endure.*

In this text, the phenomenon of annihilation remains unexplained.

2. The contributions of the work

i. pp.82-83:

> *No country can be named in which all the native inhabitants are now so perfectly adapted to each other and to the physical conditions under which they live, that none of them could anyhow be improved; for in all countries, the natives have been so far conquered by naturalised productions, that they have allowed foreigners to take firm possession of the land.*

However, the inhabitants mentioned above exist and can reproduce successfully.

ii. p.84:

> *It may be said that natural selection is daily and hourly scrutinising, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life.*

If such is the case, how are neutral variations explained, and can even lower beings reproduce?

In a letter to C. Nägeli on June 12th, 1866, Darwin writes:

> *The remark which has struck me most is that on the position of the leaves not having been acquired through natural selection, from not being of any special importance to the plant. I well remember being formerly troubled by an analogous difficulty, namely, the position of the ovules, their anatropous condition, &c. It was owing to forgetfulness that I did not notice this difficulty in the 'Origin'.* [Nägeli's Essay is noticed in the 5th edition] *Although I can offer no explanation of such facts, and only hope to see that they may be explained,... it is not clear to me that a plant, with its leaves placed at some particular angle, or with its ovules in some particular position, thus stands higher than another plant.*(Darwin, 1898, pp. 234-235).

iii. p.84:

> *When we see leaf-eating insects green, and bark-feeders mottled-grey; the alpine ptarmigan white in winter, the red-grouse the colour of heather, and the black-grouse that of peaty earth, we must believe that these tints are of service to these birds and insects in preserving them from danger.*

Nevertheless, in this, as in other characteristics described, it is not explained how they originated.

iv. p.88:

> *But in many cases, victory will depend not on general vigour, but on having special weapons, confined to the male sex.*

Despite this circular reasoning and the criticism that sexual selection received (a letter from Darwin to C. Lyell, February 15th, 1860, says:

> *A stranger writes to me about sexual selection, and regrets that I boggle about such a trifle as the brush of hair on the male turkey, and so on,* Darwin, 1898, p. 79).

Years later Darwin maintains his conviction when he wrote to August Weismann on April 5th, 1872:

> *I may have erred on many points, and extended the doctrine too far, but I feel a strong conviction that sexual selection will hereafter be admitted to be a powerful agency.* (Idem, p. 336).

v. p. 88-89:

> *Amongst birds, the contest is often of a more peaceful character. All those who have attended to the subject, believe that there is the severest rivalry between the males of many species to attract by singing the females…that female birds, by selecting, during thousands of generations, the most melodious or beautiful males, according to their standard of beauty, might produce a marked effect.*

The broad descriptions of natural diversity without any explanation of the mechanisms that give rise to it provoked criticism such as those of the Secrétaire Perpétuel de l´Académie des Sciences:

> *Enfin l'ouvrage de M. Darwin a paru. On ne peut qu'être frappé du talent de l'auteur. Mais que d'idées obscures, que d'idées fausses! Quel jargon métaphysique jeté mal à propos dans l'histoire naturelle, que tombe dans le galimatias dès qu'elle sort des idées claires, des idées justes. Quel langage prétentieux et vide! Quelles personifications puériles et surannées! O lucidité! O solidité de l'esprit français, que devenez-vous ?* (Darwin, 1898, p. 215).

In the same way, a member of the Academy wrote*:*

> *What has closed the doors of the Academy to Mr. Darwin is that the science of those of his books which have made his chief*

*title to fame – the 'Origin of Species', and still more the 'Descent of Man', is not science, but a mass of assertions and absolutely gratuitous hypotheses, often evidently fallacious. This kind of publication and these theories are a bad example, which a body that respects itself cannot encourage*. (Idem, p. 400)

vi. p. 89:

*...but I have not space here to enter on this subject.*

Sometimes, Darwin warns that he has abundant evidence but that, due to space limitations, he cannot provide it, or he will do so later (e.g., Darwin, 1859, p. 89), but the explanations do not appear either.

vii. pp. 89-90:

*...that is, individual males have had, in successive generations, some slight advantage over other males,...*

The difficulty remains for Darwin to explain these phenomena simply by chance. In a letter to Asa Gray on May 22nd, 1860 (Darwin, 1898, p. 105), he writes:

*I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion at all satisfies me. I feel most deeply that the whole subject is too profound for the human intellect.*

Contemporary authors have discussed the difficulty that the unpredictability produced by random variation represents for the theory of natural selection (Beatty, 2008; Wagner, 2012; Haufe, 2012).

viii. p.91:

*Now, if any slight innate change of habit or of structure benefited an individual wolf, it would have the best chance of surviving and of leaving offspring.*

As indicated in point 2. v, the description of a characteristic does not explain the mechanism of its appearance.

ix. p.92:

*Those individual flowers which had the largest glands or nectaries, and which excreted most nectar, would be oftenest visited by insects, and would be oftenest crossed; and so in the long-run would gain the upper hand.*

If so, what about other features? The proposed mechanism does not explain more complex situations.

x. p.93:

*No naturalist doubts the advantage of what has been called the "physiological division of labour;"...*

Nevertheless, the apparent current advantage of a feature does not explain how it is originated.

xi. pp. 95-96:

*...so will natural selection, if it be a true principle, banish the belief of the continued creation of new organic beings, or of any great and sudden modification in their structure.*

Darwin came to consider that the greatest value of his theory was, precisely, to offer an alternative to creationism, as he wrote in a letter to Professor Gray on May 11th, 1863:

*Personally, of course, I care much about Natural Selection; but that seems to me utterly unimportant, compared to the*

*question of Creation or Modification*. (Darwin, 1898, pp. 163-164).

xii. p.101:

*...in many others it occurs perhaps only at long intervals; but in none, as I suspect, can self-fertilisation go on for perpetuity.*

Self-fertilization, as well as intercrossing, as commented in 1. iv, was always problematic for Darwin.

xiii. p.104:

*...as long as their conditions of life remain the same, only through the principle of inheritance, and through natural selection destroying any which depart from the proper type; but if their conditions of life change and they undergo modification, uniformity of character can be given to their modified offspring, solely by natural selection preserving the same favourable variations.*

Natural selection alone does not explain the origin of species. Despite the author's efforts to explain it, Darwin «felt strongly that the really important point was that the doctrine of Descent should be accepted». (Darwin, 1898, p. 163).

xiv. p.112:

*...we see in man's productions the action of what may be called the principle of divergence,...*

A *principle* is proposed here, but it is not explained.

xv. p.113:

*The more diversified in habits and structure the descendants of our carnivorous animal became, the more places they would be enabled to occupy.*

But it is not explained how such characteristics arise and are fixed.

xvi. p.125:

*And the two new families, or orders, will have descended from two species of the original genus; and these two species are supposed to have descended from one species of a still more ancient and unknown genus.*

The entire explanation derived from the previously presented diagram is purely speculative and is based on unproven or poorly explanatory premises: divergence, natural selection, and the struggle for existence.

3. The quality of the discourse

i. Clarity

a) p.80:

*...that other variations useful in some way to each being...*

In several passages of the text, there is uncertainty in determining the biological unit susceptible to natural selection. Here, «each being» is mentioned, but starting with the fifth edition, Darwin goes from referring to the «individual» to talking about the «community» (Darwin, 1859, pp. 87 and 94 versus Darwin, 1869, p. 99 and 109, respectively), or from «incipient species to registered varieties» (Darwin, 1859, p. 110 versus Darwin, 1872, p. 85).

b) p.85:

*...such differences would effectually settle which variety, whether a smooth or downy, a yellow or purple fleshed fruit, should succeed.*

c) p.91:

*...; and from the continued preservation of the individuals best fitted for the two sites, two varieties might slowly be formed.*

In the two previous examples, the modifiable biological entity is «variety», not «species», so the nominal rule is not met, and the uncertainty discussed in example 3.i.a) is repeated.

d) p.105:

*...has been most favourable for the production of new organic forms, we ought to make the comparison within equal times; and this we are incapable of doing.*

However, the mechanism of natural selection as proposed here is impossible to test.

ii**.** Quality

a) p.82:

*...by better adapting them to their altered conditions, would tend to be preserved;*

The low quality, in this case, is related to circumlocution.

4. Achromaticity

i. p.81:

*This preservation of favourable variations and the rejection of injurious variations, I call Natural Selection.*

The problem here, as in other cases, is the absence of a demonstration or evidence since only one possible mechanism is stated.

ii. p. 82:

*...,extremely slight modifications in the structure or habits of one inhabitant would often give it an advantage over others;...*

However, it is a phenomenon that is not demonstrated. Furthermore, it is a statement that suffers from little achromaticity.

iii. p.83:

*As man can produce and certainly has produced a great result by his methodical and unconscious means of selection, what may not nature effect?*

Why should such a conclusion follow from such a premise? It seems like an exoteric text.

iv. p.86:

*...,and by their inheritance at a corresponding age.*

Nevertheless, how this happens at a *corresponding age* is not explained.

v. pp.102–103:

*And in this case the effects of intercrossing can hardly be counterbalanced by natural selection always tending to modify all the individuals in each district in exactly the same manner to the conditions of each; ...*

So, for the proposed mechanism to be sustained, an isolation condition is required, with which this would become an exoteric statement.

vi. p.110:

*From these several considerations I think it inevitably follows, that as new species in the course of time are formed through natural selection, others will become rarer and rarer, and finally extinct.*

This is an indirect and unexplained consequence.

5. Good interpretation and non-slander

i. p.83:

> *And as foreigners have thus everywhere beaten some of the natives, we may safely conclude that the natives might have been modified with advantage, so as to have better resisted such intruders.*

Nevertheless, descriptions like this do not imply the appearance of a species.

ii. p.87:

> *Now, if nature had to make the beak of a full-grown pigeon very short for the bird's own advantage, the process of modification would be very slow, and there would be simultaneously the most rigorous selection of the young birds within the egg, which had the most powerful and hardest beaks, for all with weak beaks would inevitably perish: or, more delicate and more easily broken shells might be selected, the thickness of the shell being known to vary like every other structure.*

There is no clarity about which characteristics are preferred and which are rejected by natural selection (this is also observed when comparing the modifications between Darwin, 1859, p. 104 and Darwin 1876, p. 81, as well as between Darwin, 1859, p.115 and Darwin, 1876, p. 89) so the questions arise: are the same variations that are preserved or only the similar ones? and under what circumstances does this preservation occur?

6. Good sense by itself

i. p.83:

> *Man selects only for his own good; Nature only for that of the being which she tends.*

To sustain the «good of the being», conjectures that are not well justified are made.

ii. p. 83:

> *Under nature, the slightest difference of structure or constitution may well turn the nicely-balanced scale in the struggle for life, and so be preserved.*

However, no justification is provided for this.

iii. p.88:

> *...to say a few words on what I call Sexual Selection.*

Nevertheless, perhaps the excessive economy of language goes against the text having clarity in itself.

iv. p.92:

> *…and the act of crossing, we have good reason to believe (as will hereafter be more fully alluded to), would produce very vigorous seedlings.*

However, it does not indicate what those reasons are.

v. p.106:

> *...and if some of these many species become modified and improved, others will have to be improved in a corresponding degree or they will be exterminated.*

The question arises: What evidence supports this statement? *Good sense by itself* is not preserved.

7. Respect for the rule of nominals

i. p.80:

*How will the struggle for existence, discussed too briefly in the last chapter, act in regard to variation? Can the principle of selection, which we have seen is so potent in the hands of man, apply in nature? I think we shall see that it can act most effectually. Let it be borne in mind in what an endless number of strange peculiarities our domestic productions, and, in a lesser degree, those under nature, vary; and how strong the hereditary tendency is.*

If the struggle for existence was discussed very briefly in the previous chapter, it could have been discussed more fully in this one, but it was not done. A term is introduced that is not explained, namely, the struggle for existence. An attempt at induction is made when trying to equate the phenomenon of human selection with that of natural selection, but the justification of this is not understood. Also, what is a *hereditary tendency*?

ii. p.105:

*...; and fewness of individuals will greatly retard the production of new species through natural selection,...*

Again, another condition or assumption is necessary to help support the argument.

iii. p.108:

*Nothing can be effected, unless favourable variations occur, and variation itself is apparently always a very slow process. The process will often be greatly retarded by free intercrossing.*

Here, other required conditions or assumptions appear.

iv. p. 108:

*...,I do not believe so. On the other hand, I do believe that natural selection will always act very slowly,...*

Beliefs are presented without any demonstration.

v. p.111:

*Nevertheless, according to my view, varieties are species in the process of formation, or are, as I have called them, incipient species. How, then, does the lesser difference between varieties become augmented into the greater difference between species? That this does habitually happen, we must infer from most of the innumerable species throughout nature presenting well-marked differences.*

«Incipient species» is another term whose validity has not been demonstrated. What follows is an unnecessary inference.

vi. p.114:

*Farmers find that they can raise most food by a rotation of plants belonging to the most different orders: nature follows what may be called a simultaneous rotation.*

This statement goes against the rule of nominals and is not adequately explained.

vii. p.118:

*...,consequently they will tend to vary, and generally to vary in nearly the same manner as their parents varied. Moreover, these two varieties, being only slightly modified forms, will tend...*

Why is this stated? Accepting it requires unwarranted assumptions.

8. The use of induction

i. p. 80:

*…in the great and complex battle of life, should sometimes occur in the course of thousands of generations?*

This appears to be a forced induction. Darwin's position on the preference of inductive versus deductive reasoning seems to fluctuate because in a letter to Lyell on December 12th, 1859, he writes:

> *I agreed most fully and truly that I have probably greatly sinned in this line, and defended my general line of argument of inventing a theory and seeing how many classes of facts the theory would explain* (Darwin, 1898, pp. 36-37).

But, in another letter to A. R. Wallace, on August 28th, 1872, he writes:

> *I know not why, but I never feel convinced by deduction, even in the case of H. Spencer's writings*. (Darwin, 1898, p. 346).

ii. p.82:

> *...and natural selection would thus have free scope for the work of improvement... and unless profitable variations do occur, natural selection can do nothing.*

However, none of these claims have been proven.

iii. p. 88:

> *This depends, not on a struggle for existence, but on a struggle between the males for possession of the females; the result is not death to the unsuccessful competitor, but few or no offspring.*

Neither the death nor the non-reproduction of the unsuccessful competitors have been proven.

iv. p.90:

> *In order to make it clear how, as I believe, natural selection acts, I must beg permission to give one or two imaginary illustrations.*

Here, the question arises: Why not use real examples, given the extensive information the author collected during his trip?

v. p.97:

> *…it is a general law of nature (utterly ignorant though we be of the meaning of the law) that no organic being self-fertilises itself for an eternity of generations; but that a cross with another individual is occasionally—perhaps at very long intervals—indispensable.*

Another poorly justified induction appears.

vi. p. 100:

> *...;and I have made these few remarks on the sexes of trees simply to call attention to the subject.*

However, what these examples clarify regarding natural selection is not well understood.

vii. p.102:

> *A large number of individuals, by giving a better chance for the appearance within any given period of profitable variations, will compensate for a lesser amount of variability in each individual, and is, I believe, an extremely important element of success.*

A statement is presented here, but it is not proven.

viii. p.104:

> *Intercrosses, also, with the individuals of the same species, which otherwise would have inhabited the surrounding and differently circumstanced districts, will be prevented.*

It is not explained how this happens.

ix. pp.111-112:

> *As has always been my practice, let us seek light on this head from our domestic productions.*

After this text, an induction is made that is not necessarily valid.

x. p.112:

> *Again, we may suppose that at an early period one man preferred swifter horses;...*

Nevertheless, from human «preferences» are not follow the «preferences of nature».

xi. p.113:

> *What applies to one animal will apply throughout all time to all animals—that is, if they vary—for otherwise natural selection can do nothing.*

The proposed mechanism loses value if the cause of the divergence is not explained.

xii. pp.115-116:

> *The advantage of diversification in the inhabitants of the same region is, in fact, the same as that of the physiological division of labour in the organs of the same individual body—a subject so well elucidated by Milne Edwards.*

Again, this is a poorly justified induction.

### 3.2 Second Edition (1860)

The differences between Chapter IV in the second edition (Darwin, 1860, pp. 80-130) and the first are minimal and refer mainly to how the text is presented, with a more direct wording observed in the second edition. Furthermore, when the term «natural selection» is presented, a clarification is made that did not exist in the first edition:

> *This principle of preservation, I have called, for the sake of brevity, Natural Selection* (Darwin 1859, p. 127).

> *This principle of preservation, I have called, for the sake of brevity, Natural Selection; and it leads to the improvement of each creature in relation to its organic and inorganic conditions of life* (Darwin 1860, p.127).

For these reasons, the score assigned to this edition is practically the same as the previous one. However, it could be considered that the text gains clarity, so it was assigned to a medium level in this category.

### 3.3 Third Edition (1861)

Significant differences can be noted when comparing chapter IV to the third (Darwin, 1861, pp. 83-147) and second editions. One of these is Darwin's clarification that the term «selection» does not imply conscious choice on the part of the animal that is going to be modified. In this sense, he justifies himself by pointing out that in Chemistry and Astronomy, it is also customary to use this metaphorical language:

> *Others have objected that the term selection implies conscious choice in the animals which become modified; and it has even been urged that as plants have no volition, natural selection is not applicable to them! In the literal sense of the word, no doubt, natural selection is a misnomer; but who ever objected to chemists speaking of the elective affinities of the various elements?—and yet an acid cannot strictly be said to elect the base with which it will in preference combine. It has been said that I speak of natural selection as an active power or Deity; but who objects to an author speak-*

> *ing of the attraction of gravity as ruling the movements of the planets? Every one knows what is meant and is implied by such metaphorical expressions; and they are almost necessary for brevity. So again it is difficult to avoid personifying the word Nature; but I mean by Nature, only the aggregate action and product of many natural laws, and by laws the sequence of events as ascertained by us. With a little familiarity such superficial objections will be forgotten.* (Darwin 1861, p. 84-85).

Darwin presents another clarification also motivated by a criticism made of the previous edition of his text: on pages 110-111, he points out that:

> *...because it has been erroneously asserted that the element of time is assumed by me to play an all-important part in natural selection, as if all species were necessarily undergoing slow modification from some innate law. Lapse of time is only so far highly important, as it gives a better chance of beneficial variations arising, ...*

With these modifications in the third edition, it is considered that the text has improved in two characteristics: good sense by itself and the use of induction (Table 2).

### 3.4 Fourth Edition (1866)

In chapter IV of the fourth edition (Darwin, 1866, pp. 90-156), two relevant differences are noted concerning the previous edition: the description of what Darwin called «sexual selection» is expanded, and two objections raised to natural selection are answered. The first difference does not significantly improve the text because the descriptive nature of the phenomenon is maintained without providing any explanatory capacity for the possible causes.

About Darwin´s answers to the objections to his theory, the following two should be noted:

> 1. *...a distinguished German naturalist has recently asserted that the weakest part of my theory is, that I consider all organic beings as imperfect: what I have really said is, that all are not as perfect in relation to the conditions under which they live, as they might be;...*(Idem, p. 146), and

> 2. *...a French author, in opposition to the whole tenor of this volume, assumes that, according to my view, species undergo great and abrupt changes, and then he triumphantly asks how this is possible, seeing that such modified forms would be crossed by the many which have remained unchanged...*(Idem).

### 3.5 Fifth Edition (1869)

The most important changes noted in this edition (Darwin, 1869, pp. 91-164) are related to a greater abundance in the description of examples of sexual selection (Idem, 1869, pp. 103-106) and to the clarification that there is no innate tendency towards perfectibility or progressive development (Idem, 1869, pp. 150-158). Despite the increase in the length of Chapter IV (from 67 to 74 pages), there is no significant improvement in its philosophical quality; that is why the score remains the same (Table 2).

### 3.6 Sixth Edition (1872)

Starting with the sixth edition, the title of the book was modified by eliminating the preposition *On*; in addition, a glossary of scientific terms was added.

Regarding Chapter IV, the most notable modification in this edition (Darwin, 1872, pp. 62-105) is the one that refers to the clarification that the author makes regarding the fortuitous destruction of organisms with which the validity of natural selection has been challenged. Here, as indicated in the fourth edition, although the presentation and discussion of objections increase the quality of the author's analysis of the discrepancies, the solution he provides to them does not increase the expository value of the text since he states that:

> *It may be well here to remark that with all beings there must be much fortuitous destruction, which can have little or no influence on the course of natural selection* (Darwin, 1872, p. 68).

Therefore, the score assigned for this edition remained the same as for previous editions (Table 2).

### 3.7 Sixth Edition, with Additions and Corrections to 1872 (1876)

Given that chapter IV of the 1876 sixth edition with additions and corrections (Darwin, 1876, pp. 62-105) remained the same as in the 1872 edition, its evaluation and score were the same as the previous edition, and no additional result is presented in Table 2.

## 4. Conclusions

1. When evaluating chapter IV of *The Origin of Species* in its first edition according to the characteristics suggested by Leibniz, it was determined that its philosophical quality is average.
2. When comparing chapter IV of *The Origin of Species* in the first six editions, an increase in the philosophical quality of the text was observed mainly in the third edition compared to the second.

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Recibido: 27 de febrero, 2025.
Aprobado: 12 de marzo, 2025.