

## **Darwin Puzzled? A Computer-assisted Analysis of Language in the *Origin of Species***

**Abstract:** The aesthetically optimistic view of life in the last paragraph of Darwin's *On the Origin of Species* contrasts with the evidence in his autobiography of a supposed perceptive colour blindness to the magnificence of nature. Accepting the theory of evolution as one of the scientific theories that has contributed to disenchantment, my aim is to delve into the Darwinian perception of natural beauty and solve this contrast of perceptions within the framework of the Weberian concept of "disenchantment of the world." To do this, I have carried out a computer-assisted study of Darwin's language focusing on the frequency of aesthetic-emotional and religious adjectives and adverbs in the six editions of the *Origin*. A semantic analysis of the lexicon shows that, although disenchanted, Darwin perceives nature as aesthetically enhanced. I arrive at the conclusion that Darwin's alleged colour blindness does not come from a loss of his capacity to aesthetically perceive nature, but from his loss of religious belief.

**Key words:** Perception and description of natural beauty; Darwin; *On the Origin of Species*; Weberian disenchantment; lexical analysis; computer-assisted analysis of language, semantic analysis of language.

## 1. INTRODUCTION

This work combines the philosophical study of Darwinism with Computational Corpus Linguistics methodologies in order to take a deeper look at Darwinian language and, thus, to lay the ground for drawing stronger conclusions about the conceptual heritage we have received from Darwin, which is a constitutive pillar of the contemporary scientific worldview.

Darwin's view of nature is analysed in this paper using a texts analysis software package as methodological assistance. Considering language as a quantifiable unit, objectively analysable and measurable in terms of occurrences, a computer-assisted scrutiny of Darwin's lexicon in his major work *On the Origin of Species* (1859) has been developed in order to extract underlying onto-epistemological presuppositions about nature and the perception of its beauty. Within the framework of the Weberian concept of "disenchantment of the world", the objective has been to answer the question *was Darwin disenchanted?* and so unravel the secrets of the relationship between Darwin's scientific view of nature and his perception of natural beauty, being this last one surely, after all, very closely related to our current aesthetic perception of nature; even though crucial advances in bio-evolutionary sciences have inevitably made us consider Darwinism, in its most original and archaic form, conceptually and methodologically obsolete, this scientific past has so solidly stalemated in our worldviews that it glimmers from within, making us see the world through Darwin's eyes. By defining Darwin's view of natural beauty, we are, ultimately, defining our own.

Thus, this paper is a journey towards the characteristics of the Darwinian perception of beauty in nature that will take the reader through six chapters, ranging from the publication of the *Origin* in 1859, passing through Darwin's later autobiographical text (1887), until current historiographical studies on the concepts of disenchantment and re-enchantment.

### 1.1. Darwin's view of nature: a contrast of perceptions?

The view of nature that Darwin describes in the final paragraph of *On the Origin of Species* (from now on OS) is aesthetically optimistic:

There is grandeur in this view of life [...] whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved (Darwin 1859, p. 490)

The aesthetic optimism inferred in these final lines is rooted in Darwin's capacity to observe nature from the viewpoint of his theory of evolution and, as a consequence, perceive its beautiful and marvellous

forms in constant evolution. Darwin's aesthetic optimism is also, therefore, disenchanted in the strict, literal sense of the term (dis-enchanted), as there is no evidence that would lead to an understanding of the Darwinian explanation of the existence and evolution of species as cases of *vestigia Dei*.

That said, this inspirational and positive view of nature, in aesthetic and emotional terms, contrasts with what Darwin would go on to state years later in his posthumous autobiography (1887) (from now on AB):

I well remember my conviction that there is more in man than the mere breath of his body. But now the grandest scenes would not cause any such convictions and feelings to rise in my mind. It may be truly said that I am like a man who has become colour-blind (Barlow 2005, p. 76)

What Darwin diagnoses as a scenic "loss of perception," coupled with the fact that, as he goes on to add, he has lost his taste for poetry ("I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me" (Barlow 2005, p. 113)), pictures and music ("I have also lost my taste for pictures or music" (ibid., p. 113)) and landscapes ("I retain some taste for fine scenery, but it does not cause me the exquisite delight which formerly did" (ibid., p. 113)), may be a sign of a supposed partial cerebral atrophy: "why this should have caused the atrophy of that part of the brain alone, on which the higher tastes depend, I cannot conceive" (ibid., p. 113). In short, his mind, perhaps due to the effects of an over-dedication to scientific activity, seems to have been mechanised and become "a kind of machine for grinding general laws out of large collections of facts" (ibid., p. 113).

However, the atrophy that Darwin suspects he suffers from is symptomatically fickle, as it allows him to keep his taste for the reading of historical, biographical or travel texts: "This curious and lamentable loss of the higher aesthetic tastes is all the odder, as books on history, biographies, and travels (independently of any scientific facts which they may contain), and essays on all sorts of subjects interest me as much as they did" (ibid., p. 113).

Darwin's language indicates sorrow and puzzlement. Is it possible that Darwin, faced with his turmoil, could have misinterpreted his perceptive "colour blindness", his "loss of the higher aesthetic tastes" and his cerebral "atrophy"?

## **1.2. Maybe we can solve Darwin's puzzlement**

Both Darwin's symptoms and diagnosis could fit with Weberian "disenchantment" (explained in more detail in the next chapter), perhaps caused by Darwin's assimilation of his own theory and a subsequent

loss of the meaning of life. That said, how is it possible that Darwin ends OS, one of the most prominent works in the history of science to have contributed to disenchantment, with a message both of intellectual and aesthetic-emotional satisfaction, whilst it isn't, allegedly, until years later that he experiences pernicious symptoms for the appreciation of natural magnificence and of art? Was it Darwin's disenchanted view of nature that led him to believe he was colour-blind when looking at magnificent natural landscapes?

I will answer these questions throughout five more chapters dedicated to the analysis of the characteristics of the Darwinian perception of natural beauty and its relationship with Weberian disenchantment. The first three chapters will introduce the reader into the whole theoretical panorama by defining first, the central problem, on which this research is founded, about Darwin supposedly being disenchanted; second, key concepts regarding the relationship between the publication of OS and Weberian disenchantment and its role in history; and third, the hypothetical and methodological core of the paper. The fourth chapter will present the results obtained from an iterative analysis of Darwin's lexicon across the six editions of OS, particularly focusing on the frequency of aesthetic-emotional and religious adjectives and adverbs. The fifth chapter will delve into a complementary hypothesis proposed to solve the issue of Darwin's disenchantment. Finally, the sixth chapter will wrap up all ideas and present the conclusive remarks.

## **2. WHAT IS DISENCHANTMENT AND WHAT DOES IT HAVE TO DO WITH DARWIN?**

In the conference "Science as a Vocation" (1917) Max Weber uses the term "disenchantment of the world" (*Entzauberung der Welt*) to refer to the social manifestation arising from the certainty that "we are not ruled by mysterious, unpredictable forces, but that, on the contrary, we can, in principle, *control everything by means of calculation*" (Weber 2004, pp. 12-13). According to Weber, in the process of intellectualisation and rationalisation in the modern cultural world, technology and calculation are the main explanatory supports for the conditions in which we live; the acceptance of this fact is the seed of the disenchantment of the world and, consequently, of feelings of emotional helplessness caused by the weakening of religion.

That said, this is a social phenomenon that can be understood in two ways. As advanced above, in the strict or literal sense of the term, the disenchantment of the world means dispensing with magical, supernatural premises that explain the workings of the world. In the pessimistic, or Weberian, sense of

the term, disenchantment could be taken to mean a demoralising and distressing sentiment faced with the conviction that scientific knowledge can explain the world without resorting to magical and religious explanations which are, in short, enchanted.

The publication of Darwin's OS in 1859 is a specific case that would appear to confirm the Weberian theory of disenchantment of the world, both from a strict interpretation and a pessimistic viewpoint of the term. The cultural reception of the secularising implications of Darwin's analysis of nature in OS was bitter and provoked deep wounds in the morale and religious beliefs of many of its readers.

In fact, as a counterpoint to the despair of a life condemned to disenchantment, recent historiographical reactions to the issue of the disenchantment with science in general, and with Darwinism in particular, have led to the appearance of the concept of re-enchantment.<sup>1</sup>

There are chiefly two authors who have related Darwin's work to the concepts of disenchantment, enchantment and re-enchantment. On the one hand, R. J. Richards (2011), defender of Darwinian enchantment, sets out to demonstrate that nature, as conceived by Darwin in OS, is not devoid of spiritual power or moral value. As proof of this, he cites the fact that the terms *object* and *purpose* appear more frequently (some 63 times) than the terms *mechanical* and *mechanistic* (some 5 times), and thus concludes that teleological explanations of nature are more visible in OS than mechanistic explanations. On the other hand, G. Levine (2008), defender of Darwinian re-enchantment, inspired by the final lines of OS, suggests accepting the view of nature that Darwin presents in OS as secularly re-enchanting and not as disenchanting. As methodological backing for his thesis against Darwinian disenchantment, Levine (2011) demonstrates Darwin's capacity for wonder through the counting up of the occurrences of terms *wonder* (6 times), *wonderful* (28 times), *wonderfully* (7 times) and *wondrous* (once).

However, Richards' and Levine's linguistic evidence is not exhaustive enough and, therefore, hardly decisive. The analysis of such a limited series of terms in just one edition of OS is not a robust enough methodological strategy to achieve conclusive results. Even more importantly, highlighting the relevance of one group of terms without analysing the linguistic context of OS in which they appear –

---

<sup>1</sup> There is extensive bibliography on the concepts of disenchantment and re-enchantment. I highlight here three of the most informatively exceptional works: Graham (2007); Taylor (2011); Josephson-Storm (2017).

A significantly extended version of this paper containing the full results of my research has been accepted for publication at *History and Philosophy of the Life Sciences* journal: Jiménez-Pazos (2021).

i.e. which nouns and adjectives they affect, or in which sense they are used – does not lead to the drawing of precise conclusions.

### **3. WHAT'S WRONG WITH DARWIN? SOME HYPOTHETICAL AND METHODOLOGICAL REMARKS**

In view of the discord between, first, the positively disenchanting view of nature in the last lines of OS, second, Darwin's testimony to his "colour blindness" in AB and, third, critical literature (Levine 2008, 2011; Richards 2011) that, assuming the disenchanting power of Darwin's theory of evolution, insists on its enchanting and re-enchanting potential, an ultimate question arises: is disenchantment compatible with aesthetic experience and sensitivity in nature?

#### **3.1. Hypothesis on Darwinian disenchantment**

Despite not considering the secularly re-enchanting view proposed by Levine prescriptive, I will adopt, as a conditional premise on which to construct my research hypothesis, his rejection of disenchantment as a detrimental phenomenon to the capacity for aesthetic wonder in the face of the beauty of nature.<sup>2</sup>

My hypothesis (a complementary hypothesis will be formulated in chapter 5) is that the progressive acquisition of scientific-explanatory knowledge of nature – i.e. disenchanted – shaped the ontological and epistemological presuppositions on which Darwin's conception of nature was founded, in such a way that, as a consequence, he would have adopted a disenchanted conception. Nevertheless, disenchantment need not necessarily have weakened Darwin's aesthetic sensitivity, but just the opposite – strengthened it, as we can gather from the aesthetic-emotionally satisfied view of life that Darwin describes at the end of OS.

How could we test this hypothesis? The analysis of descriptions of natural objects, processes, laws, mechanisms etc. in OS should reveal on what onto-epistemological assumptions Darwin builds his conception of nature, thus making it possible to detect in the lexical evolution of the six editions of OS (1859; 1860b; 1861; 1866; 1869; 1872) – the content of which Darwin conscientiously corrected, modified, updated, reduced and extended over the years – the lexical keys to and corresponding onto-epistemological presuppositions of his understanding of the world.

---

<sup>2</sup> As a representative landmark of the literature that defends scientific knowledge as a route to an aesthetically strengthened perception of nature, I recommend the preface to the work *Unweaving the Rainbow* (Dawkins 1998).

The semantic testimony of the lexicon of OS should have more authority than Darwin's own opinion about his aesthetic sensitivity, as the texts reveal what the semantic mass contains, including its logical implications, which need not necessarily coincide with the author's opinion. Consequently, my methodology does not aim to reconstruct Darwin's will or intentions, but the logical implications of his text.

### **3.2. Methodology: computational tool and procedure**

I will adopt the methodology of comparative analysis of lexical frequencies in OS that both Richards and Levine have applied to reinforce their theories. However, unlike that of these two authors, my analysis will be computationally assisted.<sup>3</sup>

Thus, the tool used in my methodology is text analysis aided by the software package *WordSmith Tools* (Scott 2017). With the aim of obtaining an empirically reliable semantic mass, firstly, I have processed the texts of the six editions of OS<sup>4</sup> with the tool *WordList* to obtain word frequency lists from each of the six editions of OS, which are useful for comparing the frequency of usage of key words in the different editions.

The terminology chosen for analysis has been: on the one hand, adjectives and verbs of an aesthetic-sentimental tenor (e.g. *admirable, beautifully*, etc.), because the semantic analysis of these terms should reflect Darwin's capacity for experiencing aesthetic sensations in nature; and on the other hand, adjectives (I didn't find any adverbs in any of the six editions of OS) of a *potentially* religious, spiritual, magical or mystical tenor (e.g. *divine, miraculous*, etc.),<sup>5</sup> because the absence or presence of this type of lexicon in OS should be a determinant aspect of the degree of enchantment or disenchantment on which Darwin establishes his theories.

Secondly, the selected aesthetic-sentimental and religious adjectives and adverbs have been processed using the tool *Concord*, which is useful for locating a certain term in the lexical context of each edition of OS and semantically analysing the surrounding lexicon.

---

<sup>3</sup> Other studies have also analysed computationally particular aspects of Darwinian lexicology. See, for instance, Sainte-Marie et al. (2011); Hidalgo-Downing (2014). For an online comparative study of lexical variations in the six editions of OS, I recommend the Online Variorum of Darwin's Origin of Species (Bordalejo 2012), available at <http://darwin-online.org.uk> (van Wyhe 2002).

<sup>4</sup> The texts have been taken from <http://darwin-online.org.uk> (van Wyhe 2002) and have been adapted via the use of text mining strategies, in order to be processed in *WordSmith Tools*.

<sup>5</sup> To abbreviate, I will refer to this kind of adjectives as religious.

The comprehensive development of this computer-assisted methodology should solve the dilemma as to whether the acceptance of evolutionist principles led Darwin to adopt a disenchanted view of nature, intellectually and aesthetically more valuable (as I propose in the hypothesis), or weakened, as Darwin suggests in AB. This fact should be reflected especially in the frequency of aesthetic-sentimental and religious lexicon in OS, an indicator that should be illustrative of the consequences that the evolutionary theory has had on the perception of nature in Darwin, and, consequently, on the issue of disenchantment.

#### 4. COMPUTER-ASSISTED ANALYSIS OF DARWINIAN LEXICON: RESULTS AND SEMANTIC DISCUSSION

Scrutiny of the six word frequency lists has allowed me to locate adjectives and adverbs that, without prior analysis of the terminology affected by them, could possess aesthetic-sentimental nuances. Table 1 contains the total count of occurrences that each adjective and adverb has in the six editions of OS:

**Table 1. Total count of the occurrences of aesthetic-emotional adjectives and adverbs across the six editions of OS**

Adjectives	Occurrences in <i>Origin of Species</i>					
	1 <sup>st</sup> ed.	2 <sup>nd</sup> ed.	3 <sup>rd</sup> ed.	4 <sup>th</sup> ed.	5 <sup>th</sup> ed.	6 <sup>th</sup> ed.
Admirable	19	19	20	20	21	23
Admirably	2	2	2	3	2	6
Astonishing	8	8	9	11	12	12
Astonishingly	2	2	2	2	2	2
Attractive	6	6	6	6	4	4
Beautiful	15	15	19	34	34	35
Beautifully	5	5	6	7	7	9
Delicate	2	2	4	5	5	10
Delicately	2	2	2	2	2	2
Enthusiastic	1	1	1	1	1	1
Exquisite	2	2	2	2	2	2
Exquisitely	2	2	2	2	3	3
Extraordinarily	12	11	12	13	12	12
Extraordinary	21	22	23	24	27	32
Formidable	0	0	0	0	2	3
Gorgeous	1	1	1	2	2	2
Harmonious	1	1	1	2	2	1
Harmoniously	0	0	0	1	1	1
Magnificent	1	1	1	1	1	1
Magnificently	0	0	0	1	1	1
Marvellous	5	5	5	5	5	6
Marvellously	0	0	0	1	1	0
Nicely	3	3	3	3	3	3



Picturesque	0	0	0	0	1	0
Pretty	3	3	3	3	2	2
Prodigious	9	9	9	9	7	9
Splendid	2	2	2	2	2	2
Stupendous	1	1	1	1	1	1
Sweet	5	5	5	5	4	4
Wonderful	27	27	27	29	33	41
Wonderfully	7	7	6	8	8	16
Wondrous	1	1	2	2	2	2

As far as adjectives of a religious slant go, Table 2 shows the total count of the occurrences of each adjective across the six editions of OS:

**Table 2. Total count of the occurrences of religious adjectives across the six editions of OS**

Adjectives	Occurrences in <i>Origin of Species</i>					
	1 <sup>st</sup> ed.	2 <sup>nd</sup> ed.	3 <sup>rd</sup> ed.	4 <sup>th</sup> ed.	5 <sup>th</sup> ed.	6 <sup>th</sup> ed.
Divine	3	4	2	5	2	2
Holy	5	5	0	9	0	0
Immaterial	2	2	3	3	4	4
Miraculous	2	3	5	5	5	5
Mysterious	4	4	4	4	4	5
Mystical	0	0	1	1	1	1
Sacred	1	1	1	2	1	1
Supernatural	0	1	1	2	1	1

The smaller variety and lower frequency of terms of this kind is a sign that could anticipate disenchanted lexicon content in OS, in the strict sense of the term (dis-enchanted), i.e. a text with a minimal religious lexicon.

That said, while the highlighted adjectives and adverbs could be categorised *a priori* as aesthetic-sentimental and religious, their real semantic usage is only discovered when the corresponding analysis in the context of OS is done.

#### **4.1. The beauty and wonderfulness of nature's most essential features: Semantic analysis of aesthetic-emotional adjectives and adverbs**

One characteristic of the Darwinian lexicon to take into account is that a considerable number of aesthetic-emotional adjectives affect terminology that is either: (a) referring to contexts with a historiographic slant, such as *admirable* which, with the exception of the terms *varieties* (strawberries), *division of labour* and (*architectural*) *powers*, is mainly used to refer to distinguished naturalists and

their works and ideas, such as *palaeontologist* (Forbes) or *Memoirs* (Mr. Prestwich); or (b) used as a colloquial intensifier, like *pretty*, that affects the terms *clear*, *freely* and *well*; or (c) describe relational aspects between living beings and the rest of nature, such as *attractive*, that affects *partner*, *peacock*, *horn-like protuberances*, *flowers* and *plants* – that is, objects and attributes of nature that are attractive to other natural beings; or (d) serve to refine objective descriptions of the observed nature, like *delicate*, that affects *shells*, *hexagonal walls*, *nature (quality)*, *cell-constructing work*, *branching coralline*, *inhabitants of the cells*, *filaments*, *membrane*, *texture*, *inner coat of the eye* and *fleshy organs*; *sweet*, that affects *peas*, *juice* and *excretion*; *extraordinary* and the adverb *extraordinarily*, that affect *combination of circumstances*, *fact*, *capacity*, *degree*, *amount of modification*, *difficulty*, *instinct*, *force*, *cases*, *out-growths*, *adaptation*, *habit*, etc. – affected by *extraordinary* – and *abnormal species*, *rapid increase of naturalised productions*, *severe mortality*, *developed part or organ*, *great modification*, *long horns*, *different*, *rare gales of wind*, *shaped pieces of bone* and *differ in length and form of beak* – affected by *extraordinarily*; that's to say, elements and attributes of nature that possess the quality of being delicate, sweet, unique, exceptional and unusual.

The absence of aesthetic-emotional connotation in the usage of the adjectives *delicate*, *extraordinary*, *attractive*, *sweet*, *admirable*, *pretty* and the adverb *extraordinarily*, in favour of a prevalent usage of its merely descriptive meaning of physical or biological aspects of nature, could be considered an indication of a disenchanting lexicon, i.e. of a marked naturalist inclination.

Terms which shouldn't go unnoticed are *division of labour* (1<sup>st</sup>-6<sup>th</sup> eds.) and (*architectural*) *powers* (1<sup>st</sup>-6<sup>th</sup> eds.), affected by the adjective *admirable*, as they indicate that Darwin's admiration lies, firstly, in an ant's instinct of division of labour and, secondly, in bees' instinct for building their hives. Similarly, there is a hint of a surge of admiration in Darwin's language when using the nouns *instinct* (3<sup>rd</sup>-6<sup>th</sup> eds.) and *adaptation* (5<sup>th</sup>-6<sup>th</sup> eds.), affected by the adjective *extraordinary*, to refer to the rarity and complexity of some animal instincts and specific plant adaptations. Ultimately, this group (e) of terminology shows that Darwin feels admiration for the instinctive-adaptive properties resulting from evolutionary processes – i.e. essentially constitutive of nature and imperceptible, logically, without the influence of previously acquired scientific knowledge.

This linguistic peculiarity that can be succinctly glimpsed in these few examples, is, as I will now go on to show, the most characteristic descriptive tendency of the OS lexicon.

#### **4.1.1. Adjectives of an aesthetic-emotional slant**

The analysis of the lexical conduct of *beautiful* and *wonderful*, the most frequent aesthetic-emotional adjectives in OS, enables us to highlight the semantic features of Darwin's aesthetic-sentimental sympathy for natural qualities from essential or constitutive aspects, such as the structural, adaptive, functional, instinctive, or factual qualities that define a great variety of living beings.

Starting with the adjective *wonderful*, Darwin uses it to describe, from the first to the third edition, aspects of nature such as *difference in beaks, development, fact/s* (6 times), *structure* (the eye) (1<sup>st</sup>-5<sup>th</sup> eds.), *power of scent, metamorphoses in function* (1<sup>st</sup>-5<sup>th</sup> eds.), *instinct/s* (8 times), *(not very wonderful) instincts, (not very wonderful) modifications of instincts, sort of shield* (worker ants), *collection of fossil bones, relationship (between the dead and the living)*, or *endless forms*. The high frequency of the noun *instinct* shouldn't go unnoticed.

Another fact worth noting is that, from the fourth, fifth and sixth editions, Darwin adds a considerable number of expressions like *differing manner* (offspring of two sexes), *the most wonderful of all cases* (alternate generations of animals) (4<sup>th</sup> ed.), *difference between worker ants and perfect females, thickness* (sedimentary strata), *changes of structure, law of the long endurance of allied forms, fact, organ* (the eye), *powers of the human eye, changes in function, one of the most wonderful animals in the world* (Greenland whale), *manner* (changing natural species), *co-adaptations, connecting link* (Tytotherium), *case/s* (twice) or *manner in which certain butterflies imitate other species*. Among these expressions, stands out the recurrence of those related with changes or differences in the structure and functions of living beings, without forgetting *difference in beaks, metamorphoses in function* and *(not very wonderful) modifications of instincts*, expressions included from the first edition.

The lexical evolution of the adjective *wonderful*, with abundant additions from the fourth edition onwards, indicates that the acquisition of new scientific-technical knowledge – probably coming from comparative observations, judging from the repetition of allusions to discordant or changeable aspects of nature – could be the intellectual basis of a progressively disenchanting conception of nature that would have allowed Darwin to aesthetically-emotionally appreciate facts and complex adaptive aptitudes such as instincts, the development or the functional and structural changes of living beings.

In a similar vein, Darwin uses the adjective *beautiful*, from the first to the third edition of OS, to describe aspects of nature such as *blue colour (bird), races of plants, co-adaptations* (twice), *adaptation/s* (6 times), *diversity and proportion of kinds, males, contrivance* (twice), *ramifications, (and harmonious) diversity of nature, work* (bees'), *endless forms, (really wondrous and beautiful)*

*organisation* or (*and complex*) *structure*. We mustn't ignore the repetition of the nouns *adaptation/s* or *co-adaptations*.

That said, it is significant that in the fourth edition of OS Darwin adds a wide variety of terms affected by *beautiful*, such as *crystalline lens*, *organic beings*, *objects* (3 times), *volute and cone shells*, *productions of nature* (flowers), *male animals*, *birds*, *fishes*, *mammals*, *butterflies*, *insects*, *reptiles*, *males*, *colours* (twice, once eliminated in the 5<sup>th</sup> ed.), *flowers* (twice), *fruits* (4<sup>th</sup>-5<sup>th</sup> eds.), *living objects* (4<sup>th</sup>-5<sup>th</sup> eds.). These terminological additions – the majority referring to objects of nature – carry an undertone of purely naturalistic interest and contribute to the refinement of Darwin's arguments. For example, the expressions *crystalline lens* and *volute and cone shells* indicate a strong influence of knowledge with a physical-mathematical basis; and the mentions of the beauty of colours, fruit and flowers refer to aspects that other living beings, not Darwin, find beautiful, and therefore have an essential function in evolutionary-adaptive processes.

The aesthetic-sentimental intensity of some less frequent adjectives gives weight to the conjecture that scientific study contributes to Darwin's intellectual, aesthetic and sentimental interest for natural objects and qualities of a naturalistic interest. Thus, Darwin, for example, describes the sea as a *formidable barrier*; he finds a certain *lapse of time* and the *geographical revolutions*, among others, *prodigious*; the compound eyes of butterflies in a state of chrysalis are *magnificent*; the adjective *stupendous* affects the noun *degradation*, referring to the deterioration of some volcanic islands; the adjective *wondrous* describes the electrical *organs* of some fish and the beautiful physical *organisation* of living beings low down on the evolutionary scale; lastly, the adjective *exquisite* affects *adaptations* and *structure of a comb*, a structure that Darwin, furthermore, claims to observe with *enthusiastic admiration*.

Incidentally, Darwin occasionally describes certain aspects of nature with the simple intention of transmitting his aesthetic sentiments. For example, the *diversity of nature* is *harmonious* and some *birds* and the *plumage* of the *birds of paradise* are described as *gorgeous*, some varieties of fruit trees as *splendid* or the *beauty in scenery* as *picturesque*. However, if they are taken within the context of OS, these expressions with a minimum frequency, are always contextually subordinate to the scientific explanation of mechanisms, processes and natural facts.

All things considered, these lexical results are reliable indicators that, despite Darwin not dispensing with very occasional descriptions of natural beauty in itself, he values, above all, the beauty of technical complexity, adaptive excellence and the diversity of natural mechanisms, such as how wonderful it is,

for his intellectual delight, to know that natural instincts of a complex biological functionality can be seen with rigorous precision in animal behaviour. It is obvious that the increasing focus on these aspects is only possible due to the growing expansion of his scientific-technical knowledge. And it is reasonable to infer that from this knowledge is induced a latent disenchanting understanding of nature that is precisely reflected in his admiration for the complexity of natural phenomena which he can explain through merely natural causes.

#### **4.1.2. Adverbs of an aesthetic-emotional slant**

The semantic analysis of aesthetic-emotional adverbs strengthens the idea that Darwin's aesthetic-emotional intensity lies in objects and results of the adaptation process that cannot be admired, however, without the perspective of a scientific viewpoint.

In an attitude similar to that shown in the usage of aesthetic-emotional adjectives, Darwin applies *beautifully*, one of the most frequent aesthetic-emotional adverbs, to exalt the physiological beauty and perfection of natural structures and objects, and, above all, the ability of living beings to adapt to diverse life conditions: *plumed seed of the dandelion* (1<sup>st</sup>-6<sup>th</sup> eds.), *adapted to its end* (structure of a comb) (1<sup>st</sup>-6<sup>th</sup> eds.), *hooked seeds* (1<sup>st</sup>-6<sup>th</sup> eds.), *constructed natatory legs* (1<sup>st</sup>-6<sup>th</sup> eds.), *adapting* (power) (1<sup>st</sup>-6<sup>th</sup> eds.), *related to complex conditions of life* (parts of organic beings) (3<sup>rd</sup>-6<sup>th</sup> eds.), *coloured* (male and female) (1<sup>st</sup>-6<sup>th</sup> eds.), *adapted* (giraffe's frame) (6<sup>th</sup> ed.) and *adapted* (structures) (6<sup>th</sup> ed.).

Likewise, despite their low frequency, on the one hand, the adverb *admirably* has a bearing on the adaptability of living beings to their surroundings: *adapted* (*woodpecker*) (1<sup>st</sup>-6<sup>th</sup> eds.), *adapted* (*pleuronectidae*) (6<sup>th</sup> ed.), *adapted* (a highly complex pollinium) (6<sup>th</sup> ed.) and *adapted* (species) (6<sup>th</sup> ed.); and, on the other hand, the adverb *exquisitely* describes the physiological and adaptive excellence of natural objects like *constructed hooks* (1<sup>st</sup>-6<sup>th</sup> eds.), *adapted parts and organs* (1<sup>st</sup>-6<sup>th</sup> eds.) and *feathered gills* (5<sup>th</sup>-6<sup>th</sup> eds.). Disenchantment is shown again here in the way the influence of a specialised knowledge of nature and its aesthetic-emotional appreciation merge together.

The influence of the scientific point of view is particularly visible in the usage of the adverb *wonderfully*, which, as a comparative, affects to a greater extent notable cases of differences and similarities between organisms such as *perfect structure* (hive-bees') (1<sup>st</sup>-6<sup>th</sup> eds.), *differed in shape* (the worker ants' jaws) (1<sup>st</sup>-6<sup>th</sup> eds.), *sudden* (extermination of whole groups of beings) (1<sup>st</sup>-6<sup>th</sup> eds.), *departing* (withered flowers) (1<sup>st</sup>-6<sup>th</sup> eds.), *diverse forms* (Crustacea) (1<sup>st</sup>-2<sup>nd</sup> eds.), *complex jaws and*

*legs in crustaceans* (1<sup>st</sup>-6<sup>th</sup> eds.), *distinct* (forms of Crustacea) (4<sup>th</sup>-6<sup>th</sup> eds.), *alike* (eyes) (6<sup>th</sup> ed.), *differing in structure* (two kinds of flowers) (6<sup>th</sup> ed.), *little* (pollen) (6<sup>th</sup> ed.), *close* (resemblance between insects) (6<sup>th</sup> ed.), *perfect* (prehensile organ) (6<sup>th</sup> ed.), *close* (gradations) (6<sup>th</sup> ed.), *changed* (individuals) (6<sup>th</sup> ed.) and *fine* (gradations) (6<sup>th</sup> ed.). Most of these results are added in the sixth edition of OS, contributing to the fact that the increase in occurrences between the first and sixth editions is more than double. Expressions like *perfect structure* (1<sup>st</sup>-6<sup>th</sup> eds.), *complex jaws and legs in crustaceans* (1<sup>st</sup>-6<sup>th</sup> eds.) and *perfect* (prehensile organ) (1<sup>st</sup>-6<sup>th</sup> eds.), that especially emphasise the complexity and structural, functional and physical perfection of beehives, crustaceans and prehensile organs, reaffirm the idea that Darwin's aesthetic-emotional sensations intensify in accordance with his growing specialised knowledge of nature.

Disenchantment revealed in the form of a link between aesthetic-emotional adverbs and natural states or objects continues up to the usage of other adverbs like *astonishingly*, solely affecting technical aspects of nature, such as *improved breeds by crossing them* (1<sup>st</sup>-6<sup>th</sup> eds.) and *rapid increase of various animals* (1<sup>st</sup>-6<sup>th</sup> eds.). In a similar manner, the adverb *marvellously* is used to describe the perfection of ocular attributes (*perfect attributes* (4<sup>th</sup>-6<sup>th</sup> eds.) / *characters* (5<sup>th</sup>-6<sup>th</sup> eds.)) and the adverb *nicely* accentuates the possible fluctuations in the steadiness of the scale of species' forces in the struggle for life (*balanced forces* (twice; 1<sup>st</sup>-6<sup>th</sup> eds.); *balanced scale in the struggle for life* (1<sup>st</sup>-6<sup>th</sup> eds.)).

That said, although minimal, there is also room in OS for the mere aesthetic description of some attributes of nature. For example, butterflies possess the quality of being *magnificently coloured* (4<sup>th</sup>-6<sup>th</sup> eds.) and bees extend the vermilion colour of wax over the axes of hive cells *as delicately as a painter could have done with his brush* (1<sup>st</sup>-6<sup>th</sup> eds.).

In conclusion, the repeated use of aesthetic-sentimental adverbs to describe scientific-technical aspects of nature indicates that it is thanks to the influence of scientific knowledge that Darwin experiences intense emotions of aesthetic magnificence, admiration and surprise in the face of the adaptive excellence and the physiological perfection and complexity of living beings.

#### **4.2. Semantic analysis of religious adjectives**

Religious adjectives are low and irregular in frequency and, what is most important, they do not add any theoretical value to OS since Darwin doesn't incorporate them as determinant lexical components of his descriptions and explanations of nature.

There are plenty of examples which corroborate this conclusion. Beginning with the adjective *divine*, Darwin's evocation of the *divine power* (1<sup>st</sup>-6<sup>th</sup> eds.) is a quote from Whewell in which the value of divine power is rejected in the face of the general laws of nature; the expressions *divine love* (1<sup>st</sup>-6<sup>th</sup> eds.; twice in 1<sup>st</sup> and 2<sup>nd</sup> eds.; one occurrence is eliminated from the 3<sup>rd</sup> ed.) and *divine elements* (3<sup>rd</sup>-6<sup>th</sup> eds.) belong to the list of bibliographical references in OS; lastly, the expression *divine author* (2<sup>nd</sup>-6<sup>th</sup> eds.) alludes to an author mentioned by Darwin. All the nouns affected by *holy* (*land* (3 times in 1<sup>st</sup>, 2<sup>nd</sup>; twice in the 4<sup>th</sup> ed.), *altar* (1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup> eds.), *places* (1<sup>st</sup>, 2<sup>nd</sup>, 4<sup>th</sup> eds.) and *scripture* (twice in the 4<sup>th</sup> ed.)) are found in the bibliographical list of OS. The only occurrence of *mystical* affects the noun *natur-philosophie* (3<sup>rd</sup>-6<sup>th</sup> eds.), which is a reference to the work of Oken. *Sacred* affects *beetle of the Egyptians* (1<sup>st</sup>-6<sup>th</sup> eds.) and *places* (4<sup>th</sup> ed.), a noun belonging to the bibliography. *Supernatural* is used to quote Butler (*what is supernatural or miraculous...*) (2<sup>nd</sup>-6<sup>th</sup> eds.) and to refer to a part of the content of a work by Guizot (*The Supernatural*) (4<sup>th</sup> ed.). *Immaterial* (1<sup>st</sup>-6<sup>th</sup> eds.) does not have religious connotations but is used as a synonym for "irrelevant".

There are, however, two adjectives that are useful in part for the arguments in OS. On the one hand, *mysterious* affects expressions referring to unknown aspects of Darwin's research, or that are no longer unknown, such as *laws of the correlation of growth* (1<sup>st</sup>-6<sup>th</sup> eds.), *causes* (1<sup>st</sup>-6<sup>th</sup> eds.), *the succession of the same types of structure* (1<sup>st</sup>-6<sup>th</sup> eds.), *a manner* (1<sup>st</sup>-6<sup>th</sup> eds.) and *cases of correlation* (6<sup>th</sup> ed.). On the other hand, *miraculous* – in addition to the aforementioned Butler quote – is used to illustrate how the sudden creation of species is for Darwin theoretically incompatible with the theory of natural selection, affecting *act/s of creation* (twice; 1<sup>st</sup>-6<sup>th</sup> eds.), *interposition* (3<sup>rd</sup>-6<sup>th</sup> eds.) and *process* (3<sup>rd</sup>-6<sup>th</sup> eds.).

These lexical facts show that the only usefulness Darwin could obtain from adjectives of a religious slant is to demarcate the explanatory reach of OS with allusions to causes, processes and unknown laws, in the case of *mysterious*, and with examples of theoretical incompatibility with his theory of evolution, in the case of the adjective *miraculous*.

In summary, the results of a semantic analysis of adjectives of a religious slant show a low and irregular frequency and, with the exception of the adjectives *mysterious* and *miraculous*, as well as the mention of the *sacred beetle of the Egyptians*, they do not have any explanatory value in the texts of OS. It could be deduced, therefore, that OS is a disenchanted text in the strict, or literal sense of the word – i.e. lacking in references to supernatural entities that would be theoretically relevant to the line of argument adopted in OS.

## 5. A COMPLEMENTARY HYPOTHESIS

A semantic analysis of the Darwinian lexicon shows that Darwin's idea of nature is built on disenchanted onto-epistemological pillars and that, nevertheless, his view of nature has been aesthetically strengthened. This is known as positive disenchantment. However, this conclusion seems to be in conflict with the puzzling statements Darwin makes in his autobiography about a supposed loss of his capacities of artistic perception and appreciation of natural beauty, as shown in the introduction.

Let's recall and expand Darwin's confession in AB in which he laments having become colour-blind in the face of the magnificence of nature, whilst in his youth he had experienced a feeling of there being something more to human beings than the mere breath of their bodies:

In my Journal I wrote that whilst standing in the midst of the grandeur of a Brazilian forest, "it is not possible to give an adequate idea of the higher feelings of wonder, admiration, and devotion, which fill and elevate the mind." I well remember<sup>6</sup> my conviction that there is more in man than the mere breath of his body. But now the grandest scenes would not cause any such convictions and feelings to rise in my mind. It may be truly said that I am like a man who has become colour-blind[...] The state of mind which grand scenes formerly excited in me, and which was intimately connected with a belief in God, did not essentially differ from that which is often called the sense of sublimity (Barlow 2005, p. 76)

The hypothesis I propose<sup>7</sup> to resolve the mystery of the supposed weakening in Darwin's aesthetic-emotional sensitivity focuses on the loss of his religious belief. In this quote, Darwin speaks about sentiments of "wonder," "admiration," "devotion," "sublimity" and "belief in God," arising from experiences of magnificent natural landscapes. The supernatural is the main feeling when experiencing the majesty of nature in Darwin's youth. Then, if according to Darwin, his belief in God was closely linked to a perception of the grandeur of nature, thus creating a classical experience of the sublime, it is understandable that he would attest to suffering colour blindness – i.e. a defective perception of natural splendour – once his religious belief had been weakened; and it is more than plausible to infer that this belief was diluted to the point of disappearing over the years due to the disenchanted onto-epistemic implications of his theory of evolution. The semantics of OS show that the trans-natural explanatory hypothesis is logically unnecessary.

---

<sup>6</sup> This memory is included in *Journal of Researches*: "no one can stand in these solitudes unmoved, and not feel that there is more in man than the mere breath of his body." (Darwin 1860, p. 503).

<sup>7</sup> Here is a selection authors who have analysed Darwin's supposed loss of aesthetic taste from multiple perspectives which include, but don't limit to, family and health issues: Campbell 1974; Fleming 1961; Beer 1985; von Sydow 2005.



That said, it is striking that Darwin doesn't clarify that that which is really defective, i.e. the cause of his sensation of colour blindness, is the theological link of the triad: 1. Perception of the beauty/magnificence of nature; 2. belief in God; 3. experience of the sublime, and not his capacity for perception. In other words, Darwin should have clarified that, in any case, what he has gone through is a *modification* of the perception of natural beauty, not a loss of his perceptive capacity, as shown in the lexicon of OS.

The mistake in Darwin's interpretation could be syllogistic, since his mind appears to work in the following way: a) there is an aesthetic experience if – in art or in nature – contents XYZ are perceived; b) I can no longer perceive them; c) I then don't have aesthetic sensitivity. This syllogism could have led Darwin to believe that, similarly, he was suffering from a loss of the higher aesthetic tastes, caused by a supposed partial cerebral atrophy. If Darwin identifies natural beauty with the mark of the divine in nature, and stops establishing such a relationship given the ideological consequences derived from the assimilation of his theory of evolution, it is therefore plausible to accept that he believed he had lost, at the same time, the taste for music, poetry, landscaping and painting – arts which could equally lead the reader, observer or listener to experience feelings of religious exaltation.

The cause of the syllogistic mistake may lie in the main premise, in which Darwin would have substituted XYZ for perception or sentiment of *vestigia Dei* in the naturally sublime – an axiom culturally prevalent in his environment and education. Nevertheless, his work shows that Darwin can have experiences of the sublime – as shown at the end of OS – without an *onto-logical* need to see *vestigia Dei* in it. Darwin may have been swept along by the inertia of the cultural weight of the prevailing axiom of the time, by which the sublime is equal to divine vestiges.

In summary, the loss of a perception of the divine in nature – a consequence of the internalising of a disenchanted understanding of nature – may have caused in Darwin a feeling of having lost his aesthetic sensitivity.

## 6. CONCLUSIONS

In short, is disenchantment compatible with an aesthetic experience and sensitivity in nature? The results obtained from a computer-assisted semantic analysis of the aesthetic-sentimental and religious lexicon in the six editions of OS allow us to answer in the affirmative, as they show that, despite Darwin's idea of

nature being sustained by disenchanted onto-epistemological assumptions, his aesthetic experience not only doesn't lack emotional intensity but becomes perceptibly more complex.

Darwin's disenchanted and aesthetically reinforced conception of nature manifests itself in two different ways in the lexicon of OS: on the one hand, through a reduced usage of language with an onto-theological charge and with little or no explanatory value for the content of OS, as shown in the semantic analysis of religious adjectives; and on the other hand, through a frequent use, increasing as the editions of OS progress, of aesthetic-sentimental adjectives and adverbs to describe imperceptible – and therefore aesthetically indescribable – natural objects, facts, processes, structures, powers and mechanisms, without the influence of a base of scientific-technical knowledge of nature. Darwin's perceptive ability can be seen especially in the usage of adjectives like *wonderful* and *beautiful*, particularly focussed on describing functional, structural and instinctive beauty and excellence of nature, i.e. aspects biologically constituent of living beings.

Regarding the question as to whether it was Darwin's disenchanted view of the world that led to him feeling colour-blind in the face of the magnificence of natural landscapes, certainly from what can be deduced from his puzzling confessions in AB, the disenchantment that Darwin experiences, i.e. the ceasing of his religious beliefs, appears to take him close to a disenchantment of a negative connotation as suggested by Weber. Darwin's testimony in AB, therefore, would appear to contradict the conclusions obtained by analysing lexical usage in OS.

Nevertheless, Darwin could have misinterpreted his feelings. Given the correlation between the perception of beauty in nature, of the sublime in it, and of the sentiment of the supernatural inferred through recalling the passage in *Journal of Researches* in which he claims to feel there is something more in human beings than the mere breath of their bodies, the loss of religious sentiment, together with the loss of higher aesthetic tastes, may have led Darwin to deduce a loss of aesthetic perception in general, instead of seeing it as a modification of perception.

To conclude, the possible cause of Darwin's error of interpretation about his aesthetic sensitivity may reside in the acceptance of the equation of equality between aesthetic sensitivity in the face of natural beauty and the perception and interpretation of this beauty as *vestigia Dei*, in such a way that the first could not happen without the second.

#### **Acknowledgements:**

Departamento de Educación del Gobierno Vasco. *Programa Postdoctoral de Perfeccionamiento de Personal Investigador Doctor*. Grant code: POS\_2019\_2\_0012.

### **Funding:**

Departamento de Educación del Gobierno Vasco. *Ayudas para Apoyar las Actividades de Grupos de Investigación del Sistema Universitario Vasco*. Project code: IT1228-19.

### **References:**

- Barlow N (ed) (2005) *The autobiography of Charles Darwin, 1809-1882*. W.W. Norton & Company, New York.
- Beer G (1985) Darwin's reading and the fictions of development. In: Kohn D (ed.) *The Darwinian Heritage*. Princeton University Press, Princeton (New Jersey).
- Bordalejo B (2012) Online variorum of Darwin's *Origin of Species*. In: van Wyhe J (ed) *The complete work of Charles Darwin online*. Available at <http://darwin-online.org.uk>. Accessed 2 February 2021.
- Campbell J A (1974) Nature, religion and emotional response: a reconsideration of Darwin's affective decline. *Victorian Studies* 18 (2): 159-174.
- Darwin C R (1859) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London.
- Darwin C R (1860) *Journal of researches into the natural history and geology of the various countries visited by H.M.S. beagle round the world, under the command of capt. Fitz Roy, R.N.* John Murray, London.
- Darwin C R (1860b) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London.
- Darwin C R (1861) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London.
- Darwin C R (1866) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London.
- Darwin C R (1869) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London.

- Darwin C R (1872) *The origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. John Murray, London.
- Darwin, F (ed) (1887). *The life and letters of Charles Darwin, including an autobiographical chapter*, 3 Vols. London, John Murray.
- Dawkins R (1998) *Unweaving the rainbow: science, delusion and the appetite for wonder*. Houghton Mifflin Company, Boston.
- Fleming D (1961) Charles Darwin, the anaesthetic man. *Victorian Studies* 4: 219-236.
- Graham G (2007) *The re-enchantment of the world: art versus religion*. Oxford University Press, Oxford.
- Hidalgo-Downing L (2014) The role of negative-modal synergies in Charles Darwin's *The Origin of Species*. In: Thompson G, Alba-Juez L. (eds) *Evaluation in context*. John Benjamins Publishing Company, Amsterdam.
- Jiménez-Pazos B (2021) Darwin's perception of nature and the question of disenchantment: a semantic analysis across the six editions of *On the Origin of Species*. *History and Philosophy of the Life Sciences* (in press).
- Josephson-Storm J A (2017) *The Myth of Disenchantment: magic, modernity and the birth of the human sciences*. The University of Chicago Press, Chicago and London.
- Levine G (2008) *Darwin loves you: natural selection and the re-enchantment of the world*. Princeton University Press, Princeton (New Jersey).
- Levine G (2011) *Darwin the Writer*. Oxford University Press. Oxford.
- Richards R J (2011) Darwinian Enchantment. In: Levine G (ed) *The joy of secularism: 11 Essays for how we live now*. Princeton University Press, Princeton (New Jersey).
- Sainte-Marie M B, Meunier J, Payette N, Chartier J F (2011) The concept of evolution in *The Origin of Species*: a computer-assisted analysis. *Literary and Linguistic Computing* 26 (3): 329-334.
- Scott M (2017) *WordSmith Tools*, version 7. Lexical Analysis Software, Stroud.
- Taylor C (2011) Disenchantment-reenchantment. In: Levine G (ed) *The joy of secularism: 11 Essays for how we live now*. Princeton University Press, Princeton (New Jersey).
- van Wyhe J (ed) (2002) *The complete work of Charles Darwin online*. Available at <http://darwin-online.org.uk> (accessed 3 January 2020).

- von Sydow M (2005) Charles Darwin: a christian undermining christianity? In: Knight D M, Eddy M D (eds) Science and beliefs: from natural philosophy to natural science, 1700-1900. Ashgate, Burlington.
- Weber M (2004) Science as a vocation. In: Owen D, Strong T B (eds), Livingstone R (trans) The vocation lectures. Hackett Publishing Company, Indianapolis and Cambridge.