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ORIGINAL PAPER

# Humboldt, Darwin, and theory of evolution

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**Abstract**
Numerous authors have examined the influence of other thinkers on Darwin's formulation of some of the key concepts of the theory of evolution. Amongst those, Alexander von Humboldt often stands out – a scholar who, following his intention to explain the interconnection of various parts of the natural system, seems to tackle the question of evolution but does not offer an explicit answer. In this article, I examine Humboldt's thoughts on evolution and the origin of species and evaluate his contribution to Darwin's theory of evolution. First, I analyse and explicate the fundamental assumptions and goals of Humboldt theory, and compare them to Darwin. Moving forward, I highlight the similarity of their methods, and argue that Humboldt and Darwin conduct similar investigation of fossil record and geographical distribution of species. Finally, I show that Humboldt acknowledges essential elements of Darwin's theory of evolution: evidence given by fossil records, struggle for survival and relation between natural environment and living organisms. Humboldt, however, concludes we cannot know the evolution of species. I explain this stance, and contend that theories of Humboldt and Darwin turn out to be more similar than they seem, yet their different conclusions regarding the evolution of species stem from different initial assumptions underlying their respective frameworks.

**Keywords** Humboldt · Darwin · Theory of evolution · Natural selection · Struggle for survival

A number of researchers have examined the influence of Darwin's (1809–1882) predecessors on his creation of the theory of evolution (e.g., Egerton, 1970, pp. 325–360; Gale, 1972, pp. 321–344; Bowler, 1976, pp. 631–650; Sloan, 2001, pp. 251–269,

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2009, pp. 21–43; Richards, 2002, 2009, pp. 10,056–10,060). Given the importance of Darwin's ideas about evolution of natural species, other thinkers contributing to the formulation of the theory should certainly be acknowledged. Contemporary Darwin's scholarship emphasizes the influence of two prominent figures of XIX century, namely, Charles Lyell (1797–1875) and Thomas Malthus (1766–1834). As it is known, Lyell is the father of *uniformitarianism* – a naturalistic view based on a (at the time) bold claim that Earth was shaped in the past by slow and gradual action of natural forces; Lyell believed these forces operate in the present as well. Malthus, on the other hand, expressed the idea that conflicts between organisms arise due to limited natural resources (food). On his famous voyage, the event he considered as most important in his life, Darwin took several books, including the first volume of Lyell's *Principles of Geology* (1830); on the island of St. Jago, Darwin grasped the superiority of Lyell's geological uniformitarianism in explaining geological phenomena (Darwin, 1892, p. 27). In October 1838, Darwin became familiar with Malthus's *Essay on the Principle of Population* [1798], and stated: "Here, then, I had at last got a theory by which to work." (Darwin, 1892, p. 40) However, contemporary authors[1] engage in an on-going debate whether we should acknowledge one more precursor of Darwin's theory of evolution – Alexander von Humboldt (1769–1859). My proposal in this paper is the following: in addition to Lyell and Malthus, we should recognize Humboldt as a precursor of Darwin's theory of evolution, and as an evolutionist. To make my case, and show there are some evolutionary thoughts in Prussian's works, I deconstruct Humboldt's theory and isolate his fundamental assumptions, empirical method, and goals in order to compare them to Darwin. As I point out, Darwin seeks to provide a theory about a specific problem – the problem of the origin of species. Meanwhile, Humboldt aims to present a holistic theory of natural system whose parts are interconnected in such a way as to contribute to its maintenance, i.e., the "harmony of nature." Moving forward, I explain that Humboldt and Darwin conduct similar investigation of fossil record and geographical distribution of species – essential evidence for Darwinian theory of evolution. Finally, I show that both scholars utilize the notions of natural environment and struggle for survival. However, their essential difference lies in how they use these notions. Whilst Humboldt emphasizes the holistic unity of the living world and natural environment in which organisms are embedded as constituents and gives no priority to either notion and domain, Darwin stresses their segregation and gives priority to the notion and domain of the natural environment. In effect, Darwin sees the struggle for survival as a process of adaptation to the external conditions of natural environment and preservation of useful variations, whilst Humboldt sees it as a manifestation of the agency of the living world that not only seeks to expand, but also to *create and preserve* the conditions for its own survival. As I show, this conceptual difference in notions of struggle for survival and natural environment is reflected in Darwin's and Humboldt's distinct conclusions on evolution. Whilst Darwin states that we *can know* evolution of natural species, and trace the course of such a process, Humboldt declares this is and must remain an

[1] For example, Glaubrecht (2022) and Helmreich (2009) offer arguments that Humboldt's is anti-evolutionist, whilst Schmuck (2014) declares Humboldt is an evolutionist, even though he is not a Darwinian due to the methodological limitations of his theory.

unresolved mystery. However, this does not mean Humboldt completely discredits evolution. As I point out, Humboldt, led by fossils record, admits some kind of evolutionary process is happening in nature. In other words, Humboldt is an evolutionist. Yet, he concludes that we *cannot know the exact course* of such a process. This conclusion resurfaces in Humboldt's discussion on the problem of speciation of species.

These conceptual differences indicate that Humboldt's and Darwin's disagreement over the possibility of discovering the origin of species is a result of different initial assumptions in their respective epistemological frameworks. Humboldt seeks to provide a holistic outlook on the nature and, equipped with Kantian ideas, utilizes the notions of natural environment and struggle for survival to lay the foundations for a synchronic model where it is impossible to isolate one of many possible histories about the origin of species. Darwin takes exception with Kantian understanding, adding diachronic movement to the model and forming a mechanism that does exactly that – isolates one possible history that explains the origin of species.

## 1 Humboldt and darwin: goals and fundamental assumptions

The question of relation between Humboldt's ideas and Darwin's theory of evolution presents an intriguing topic for any historian of science. It is well known that Darwin first encountered Humboldt's work when he was a student at Cambridge, and he read Humboldt's *Personal Narrative* [1814] almost every day during his famous travels. Egerton points out that their books (e.g., *Personal Narrative* and *The Voyage of Beagle* [1839]) are similarly organized and that Darwin, inspired by Humboldt, sought to provide descriptions similar to those in Humboldt's book (1970, p. 329).[2] Archibald claims that Humboldt's *Personal Narrative* provided to young Darwin a "compass to direct him on his similar and even overlapping explorations into the distribution of plants and animals." (2017, p. 80) Finally, in his *Voyage of Beagle*, Darwin reveals how much he has been influenced by *Personal Narratives*: "As the force of impressions generally depends on preconceived ideas, I may add, that mine were taken from the vivid descriptions in the Personal Narrative of Humboldt, which far exceed in merit anything else which I have read" (1997, p. 477).[3] Thus, given the extensive textual evidence,[4] it seems that Humboldt had a remarkable influence on Darwin. To show that this influence goes beyond notable literary similarity between *Voyage of Beagle* and *Personal Narrative*, I will start with analysis of Humboldt's and Darwin's fundamental assumptions and research goals.

[2] Citing the letter of Caroline Darwin to Charles Darwin, Baron (2010, p. 03) points out that Humboldt's influence on Darwin can be detected even in the poetic descriptions of landmarks and life presented in Darwin's correspondence letters. Humboldt's vivid descriptions of South America left a notable impression on Darwin. Because of that, some authors also discuss Humboldt's Romantic influence on Darwin's work, e.g., Richards (2002); Sloan (2009); Greif (2015); White (2012).

[3] Puig-Samper & Rebok (2010) offer a detailed overview of correspondence and mutual reference between Humboldt and Darwin.

[4] More examples of similar evidence can be found in *Voyage of Beagle* where one can find many references to Humboldt, as well as numerous Darwin's letters.

Generally speaking, Humboldt's research is directed towards the investigation of nature, its living and non-living parts. What became known as "Humboldt's formula" states that everything is interdependence ("Alles is Wechselwirkung"), and summarizes the prevailing perception of nature of his time (Glaubrecht, 2022, p. 11). This *credo* outlines Humboldt's aim to represent nature as a *holistic system*. The holistic approach to the study of nature can be detected at the very beginning of *Cosmos* [1845] where Humboldt lays out fundamental principle of his work – a constant tendency to "embrace the phenomena of the universe as a natural Whole" (Humboldt, 1851, p. 09), and reveal their interrelation that contributes to the maintenance of this whole, i.e., *harmony of nature*. This notion, however, should not be understood in the sense that was widely accepted at the time, whereby nature is in perfect balance, and the occasional conflicts amongst her parts are anomalies (Gale, 1972, p. 327). For Humboldt, the harmony of nature is reflected in "a unity in diversity of phenomena; [a harmony], blending together all created things, however dissimilar in form and attributes; one great whole animated by the breath of life" (Humboldt, 1893, pp. 02–03). This harmony is not achieved because Lyell's great "Author of Nature" causally intervenes in natural processes. Rather, it is realized in accordance with the function and behaviour of organic and inorganic life. Whilst inorganic nature includes the size, shape, and density of the planet, as well as its internal temperature, electro-magnetic activity etc., organic nature incorporates mutual relations between individual life forms and distinct parts of Earth's surface (Humboldt, 1860, p. 13) In addition to numerous examples that indicate the mutual connection of these domains,[5] their relation is also confirmed by the fact that organic beings consist of the same substances we find in inorganic Earth's crust:

> It must, however, be remembered, that the inorganic crust of the Earth contains within it the same elements that enter into the structure of animal and vegetable organs. A physical cosmography would therefore be incomplete, if it were to omit consideration of these forces, and of the substances which enter into solid and fluid combinations in organic tissues, under conditions which, from our ignorance of their actual nature, we designate by the vague term of *vital forces*, and group into various systems, in accordance with more or less perfectly conceived analogies. (Humboldt, 1893, p. 349)

Thus, to engage in natural philosophy implies the study of plant and animal life form in "each latitude, at different heights, and at different degrees of temperature; it studies the relations under which particular organizations are more vigorously developed, multiplied, or modified" (Humboldt, 1827, p. 180).

Humboldt follows a method called *rational empiricism* – an analysis based on scientific facts previously tested and confirmed by rational operations of mind (1893, p. 30). As he notes:

[5] For example, Humboldt states there are many relations between atmospheric electricity and other natural phenomena. In the case of the organic world, atmospheric electricity has an impact not only as a meteorological process, but as an electrical force that directly affects the nerves and promotes the circulation of "organic juices" (Humboldt, 1893, pp. 342–343).

> The objective world, conceived and reflected within us by thought, is subjected to the eternal and necessary conditions of our intellectual being. The activity of the mind exercises itself on the elements furnished to it by the perceptions of the senses (Humboldt, 1893, pp. 59–60).

In other words, Humboldt argues there is a *subjective* aspect in formation of knowledge about external world. We can distinguish two moments of this epistemological aspect: (1) receiving particular information through our senses and (2) connection and combination of sensory information through the operations of mind. Finally, we attain knowledge of certain physical phenomena: "Observation, aided by reason, endeavours to trace phenomena to the causes from which they spring" (Humboldt, 1893, p. 17). Nonetheless, Humboldt remains an empirical researcher:

> In conformity with the character of my former writings, as well as with the labours in which I have been engaged during my scientific career, in measurements, experiments, and the investigation of facts, I limit myself to the domain of empirical ideas. (1893, p. 58)

Romanowski (2009) points out that Humboldtian science represents a science found on precise observation and utilisation of correct scientific instruments; it is a science that shows the urge to explore and evaluate new ideas, as well as conceptual and visual mechanisms. Finally, Humboldtian science implies the application of these, we may say, principles to the domain of physical reality (Romanowski, 2009, p. 191). It seems that Humboldt aimed to satisfy each of these conditions in his scientific investigations. However, one should note that Romanowski apparently omits the most important element of Humboldt's theory and Humboldtian science – the interrelation of natural phenomena and natural and social sciences that are connected by the same relations that bind together all natural phenomena (Humboldt, 1822, p. iv).[6]

It can be said Humboldt's theory is extensive. *Cosmos* exposes his tendency to investigate as many phenomena as possible, which leads towards comprehensive analysis of celestial, atmospheric, hydrosphere and terrestrial phenomena, as well as the domain of organic life. However, this theory is not complete, and Humboldt believes no theory, not even the whole of science, can reach completeness:

> Experimental sciences, based on the observation of external world, cannot aspire to completeness; the nature of things, and the imperfection of our organs, are alike opposed to it. We shall never succeed in exhausting the immeasurable riches of nature; and no generation of men will ever have cause to boast of having comprehended the total aggregation of phenomena. (1893, p. 56)

The final goal of experimental sciences can be found in the discovery of natural laws. Every research that exceeds the scope of physical description of the universe slips

[6] Due to limited space, the fact one can write another paper dedicated just to the Humboldtian science, and possible long digression on this topic, I refrain to futher discussion of this notion.

into the sphere of speculation (Humboldt, 1893, p. 30). With that in mind, we can identify the following fundamental assumptions of Humboldt's holism:

1) *Holism of natural phenomena*: all natural phenomena are mutually connected into holistic network representing the Whole, i.e., nature.
2) Investigation of natural phenomena should be conducted regarding their relation with the *Whole*.
3) *Holism of sciences*: adequate and successful research of nature acquires the systematic connection of different sciences, e.g., geology, astronomy, chemistry, biology, etc.
4) There are *limits of possible knowledge*; when we overstep these boundaries, we enter the realm of dogma and speculation.
5) Due to the imperfection of our cognitive apparatus, which consists of sensory and mental processes, as well as the imperfection of scientific instruments, the *completeness of science is not possible*.

Discussion of the limits of possible knowledge leads Humboldt towards the following conclusion: "But the empirical domain of objective contemplation, and the delineation of our planet in its present condition, do not include a consideration of the *mysterious and insoluble problems of origin and existence*" (Humboldt, 1893, p. 348, my emphasis). His *Personal Narrative* expresses the similar stance:

> In the vegetable as well as in the animal kingdom, the causes of distribution of the species are among the number of mysteries, which natural philosophy cannot reach. This science is not occupied in the investigation of the origin of beings, but of the laws according to which they are distributed on the globe. It examines the things that are, the coexistence of vegetable and animal forms in each latitude, at different heights, and at different degrees of temperature; it studies the relations under which particular organizations are more vigorously developed, multiplied, or modified; but it approaches not problems, the solution of which is impossible, since they touch the origin, the first existence of a germ of lifes. (Humboldt, 1827, pp. 180–181)

Apparently, Humboldt argues that we *cannot* discover the causes of the distribution of species, neither the origin of *species* and the origin of *life*.[7] However, we can investigate the laws governing the distribution of organisms on the planet. Thus, Humboldt once again opts for empirical knowledge of the "things that are," i.e., present geographical distribution of the species.

Although he initially believed that the study of fossils, "this wonderful relationship in the same continent between the dead and the living" could shed light on the question about the origins of organic beings (Darwin, 1997, p. 165), Darwin does not investigate the origin of life. In his autobiography, he argues it is futile to contemplate about the origin of life; it would be tantamount to thinking about the origin of matter

[7] The origin of life refers to the moment of actual creation, the beginning of existence from the non-existence (Humboldt, 1893, p. 68).

itself (Darwin, 1892, p. 257). Darwin's research is directed towards discovery of the *causes* of distribution of organisms and *history* of transmutation of natural species:

> In considering the Origin of Species, it is quite conceivable that a naturalist, reflecting on the mutual affinities of organic beings, on their embryological relations, their geographical distribution, their geological succession, and other such facts, might come to the conclusion that species had not been independently created, but had descended, like varieties, from other species. Nevertheless, such a conclusion, even if well founded, would be unsatisfactory, until it could be shown how the innumerable species inhabiting this world have been modified, so as to acquire that perfection of structure and coadaptation which justly excites our admiration. (2009, p. 02).

Thus, Darwin sets two goals for his research. The first goal is to show *how* natural variations of organisms have occurred; the second goal is to *explain* the origin of the species. Accordingly, we note two significant differences between Humboldt and Darwin. Whilst Humboldt's investigation is aimed towards *general* research of nature, Darwin addresses the *specific* problem about the origin of species. In other words, we observe the first important difference between Humboldt and Darwin in the distinction of their goals of research. Humboldt raises the question of transmutation of species *within* the general holistic investigation of action of natural forces, geographical distribution of species, relations between organic and inorganic nature etc. *Contra* him, Darwin chooses the problem of the origin of species as the *main* goal of his research.

We find another difference between Humboldt and Darwin in their conclusions about the possibility of knowledge about the origin of species. Humboldt believes that the discovery of the origin of species must remain among "the number of mysteries;" this question belongs to a group of philosophical and scientific problems that transcendent the limits of possible knowledge. Darwin, however, takes the opposite stance: it is possible to know the origin of a species. These differences between Humboldt and Darwin are relevant because, as I go on to explain, they do not result from diversity of their methods. In fact, we note significant similarities between Humboldt's rational empiricism and Darwin's empirical method.

## 2 Fossil records

In previous section, I presented Humboldt as an empirical researcher. I explained the method of rational empiricism as a specific, and partially subjective, analysis based on scientific facts previously tested and confirmed by rational operations of mind. In his autobiography, Darwin writes that he worked "on true Baconian principles," and that he, without any theory, collected facts that would later lead him to formulate a theory of evolution (1892, p. 40). In addition to observation and induction, Dar-

win's method involved the conduction of experiments,[8] and establishing the analogy between "man's power of selection" and natural selection. Finally, Darwin uses his method to investigate fossil record and geographical distribution of species – the most important evidence for his theory of evolution. As a great synthetic thinker, Humboldt does not ignore palaeontology, and his results in the field of geographical distribution of species made him a "father of biogeography," raising an obvious question.[9] What enables Darwin to formulate the theory of evolution when Humboldt cannot?

It is well acknowledged that Darwin's research relies heavily on the evidence provided by fossil records. We can identify several reasons for such methodological decision: (1) fossils exibit the similarities between the living and deceased species; (2) geological record indicated to Darwin that Galapagos Archipelago is of younger origin than initially thought, raising the question about the origin of species on these islands, and, finally, (3) fossils *affirm the imperfection of geological data*. As it is known, in chapter IX of *The Origin of Species* [1859], Darwin utilizes the fossil records to show the imperfection of geological data and defend his theory of evolution.[10] Accordingly, he identifies the problems of the evidence of fossil records (Darwin, 2009, pp. 264–289):

1) The absence of intermediate varieties of present day, and in any geological formation;
2) Sudden appearance of groups of species in some younger, and the oldest fossil strata we know.
3) The poorness of palaeontological collections.

Referring to the problem of the absence of intermediate varieties, Darwin notes that the opponents of his theory will insist on showing intermediate species; "I will answer yes, if you will show me every step between bulldog and grey-hound" (1892, p. 170). In other words, changes between species arise slowly and gradually. After a certain period of time, the accumulation of smaller variations leads towards manifestation of bigger changes which, finally, lead towards the creation of a new species. However, we observe *only the final product* of such a process – already formed new species:

> We see nothing of these slow changes in progress, until the hand of time has marked the lapse of ages, and then so imperfect is our view into long-past geological ages, that we see only that the forms of life are now different from what they formerly were. (Darwin, 2009, p. 66)

[8] For example, Darwin designed an experiment to determine how plants and animals migrate to distant island (Darwin, 1997).

[9] However, one should note that Humboldt was not the first to study biogeography. For example, August Wilhelm von Zimmermann also developed a historical biogeography and his influence on Humboldt, as Glaubrecht notices, should not be underestimated (Glaubrecht, 2022, p. 33).

[10] Reasons for such methodological decision can be found, on the one hand, in creationist interpretation of fossils and, on the other hand, in numerous criticisms that emphasized the shortcomings of this form of evidence as evidence for the theory of evolution. For details on these aspects, please see (Archibald, 2017).

The second problem of the sudden appearance of a group of species seems more significant for Darwin who tries to provide an adequate answer:

> We do not make due allowance for the intervals of time, which have elapsed between our consecutive formations, —longer perhaps in most cases than the time required for the accumulation of each formation. These intervals will have given time for the multiplication of species from some one parent-forms; and in the succeeding formation, such groups or species will appear as if suddenly created. (2009, pp. 282–283)

Given the problems of creating and preserving fossils, we should not be surprised by the scarcity of paleontological collections. But we should not expect geology to provide us with a complete collection of transitional forms between species (Darwin, 2009, p. 280). Accordingly, fossil record shows us that:

1) Between living and extinct species exists the *relation of heritage* that enables us to observe distinct similarities between those species;
2) Geological data *are not* perfect.

It seems that fundamental assumptions of Darwin's conceptual framework imply a certain interpretation of geological data (Archibald, 2017, p. 38). His discussion of the *Archeopteryx* archetype apparently confirms such a conclusion. Namely, this fossil represents a good example of an intermediate form that challenges the hypothesis that a whole class of birds suddenly appeared in the Eocene period (Darwin, 2009, p. 284). Instead of using this example in his discussion of intermediate forms, Darwin refers to it in order to show that birds appeared about 150 million years ago (Archibald, 2017, p. 39). Thus, Darwin believes arguing for the imperfection of geological data is necessary for affirmation of his theory of evolution.

As indicated, Humboldt does not ignore the fossil records that enables us to "ascend the stream of time, as in our study of the relations of super-position we descend deeper and deeper through the different strata, in which lies revealed before us a past world of animal and vegetable life" (Humboldt, 1893, p. 272). But, is this a world of relatable, parent species of present organisms, or is it the world of natural species created by an intelligent creator? In other words, does Humboldt accept the evolutionary paradigm about the origin of species? Some of his claims indicate the negative answer:

> The characteristic forms of the plants and animals that occupy the earth today do not seem to have undergone any changes since the remotest times. The ibis buried in the Egyptian catacombs, a bird that goes back almost to the time of the pyramids, is identical to the one fishing today on the banks of the Nile; this identity shows that the huge amounts of animal fossils found in the interior of the earth do not belong to varieties of current species, but to a very different order of things from ours, and too ancient for any of the traditions to remember. (Humboldt, 2009, p. 71)

Humboldt seems to reconcile with the influential French zoologist and naturalist of the 19th century, George Cuvier, who believes that fossils do not affirm the hypothesis of transmutation of organisms, and that evolution *did not* occur in nature. To prove his claim, Cuvier refers to the aforementioned example of ibis (Jackson, 2009, p. 20). Thus, one can argue that in his *Essay on the Geography of Plants* [1807], Humboldt rejects the possibility of the evolution of species.[11] However, such conclusion conflicts with Humboldt's claims in *Cosmos*:

(a) In the midst of this immense variety, and this periodic transformation of animal and vegetable productions, we see incessantly revealed the primordial mystery of all organic development, that same great problem of *metamorphosis* which Göthe has treated with more than common sagacity (1893, p. 21).
(b) Organic forms that had long remained isolated, both in animal and vegetable kingdom, have been connected by the discovery of intermediate links or stages of transition … These connecting links and stages of transition may be traced, alternately, in a deficiency or an excess of development of certain parts, in the mode of junction of distinct organs, in the differences in the balance of forces, or in a resemblance to intermediate forms which are not permanent, but merely characteristic of certain phases of normal development (1893, p. 31).
(c) The vegetation of the primitive period exhibits forms, which from their simultaneous affinity with several families of the present world, testify that many intermediate links must have become extinct in the scale of organic development (1893, p. 283).

These parts of *Cosmos* indicate that we can recognize Humboldt as an *evolutionist*, and show that Humboldt uses fossils as evidence for:

1) Discovery of geographical distribution of species in past geological periods;
2) Investigation of the evolution of natural species.

In addition, Humboldt studies the fossil records in order to discover past geological changes: discovery of fossils enables the discovery of the history of country in which they are found (Humboldt, 1893, pp. 273–274).

Darwin studies the fossils for the same purpose. Discovery of the fossils of the same species in remote places attests about its' geographical distribution and adaptation to different conditions. In the study of the evolution of species, Darwin uses the fossil records to argue for the imperfection of geological data and defend his theory from various critiques. Humboldt, however, finds that fossil records indicate that a "transition" of species is happening in nature. In addition to observed analogies between fossilized and living species, detailed analysis of fossils reveals changes in organic development of organisms, appearance of new or loss of "old" organs etc. Further, such analysis allows us to establish (hereditary?) relations between distinct species and identify intermediate and dominant life forms. Also, Humboldt notices

[11] Besides Jackson, Helmreich states that Humboldt completely adopts Cuvier's anti-evolutionist argumentation (2009, p. 60).

that difference between living and extinct species proportionally increases as they belong to more ancient sedimentary formations (Humboldt, 1893, p. 277). As known, Darwin reaches the same conclusion (2009, p. 304). Finally, the last aforementioned (c) part of *Cosmos* indicates that Humboldt, as Darwin, observes the imperfection of geological data. Fossils "testify that many intermediate links must have become extinct in the scale of organic development." Thus, the study of fossils can determine whether there are any "links" between two or more extinct species of different geological periods, indicating there are many undiscovered species whose fossil remains cannot be discovered due to changes in the past. If this is so, then geological data *must be* imperfect. As previously noted, Darwin comes to a similar conclusion.

Let us return now to Humboldt's words in *Essay*:

> The characteristic forms of the plants and animals that occupy the earth today do not seem to have undergone any changes since the remotest times. The ibis buried in the Egyptian catacombs, a bird that goes back almost to the time of the pyramids, is identical to the one fishing today on the banks of the Nile; this identity shows that the huge amounts of animal fossils found in the interior of the earth do not belong to varieties of current species, but to a very different order of things from ours, and too ancient for any of the traditions to remember. (Humboldt, 2009, p. 71)

On the first glance, it seems that Humboldt makes the opposite statements about transmutation of organisms. Accordingly, one can say Humboldt changes his stance about evolution of species in years after the publication of the *Essay*, finally establishing his "evolutionary position" in *Cosmos*. However, my impression is that such a change did not occur. I believe further analysis of Humboldt's claim in *Essay* can clear up his evolutionary view. To prove my case, I will dissolve his statement into two following parts:

1. "The characteristic forms of the plants and animals that occupy the earth today do not seem to have undergone any changes since the remotest times."
2. "This identity shows that the huge amounts of animal fossils found in the interior of the earth do not belong to varieties of current species, but to a very different order of things from ours, and too ancient for any of the traditions to remember."

First, we should not overlook the fact that Humboldt makes his claim in the context of study of geographical distribution of species. Before reaching this apparently anti-evolutionary conclusion, Humboldt argues that man, travelling through different regions, "forced a certain number of plants to live under many climates and in many altitudes; but the domination he exercised over these organized beings did not modify their primitive structure" (2009, p. 71). Thus, it seems the first proposition emphasizes that science has not documented any meaningful modification in vegetable and animalistic forms during the geological period knowable to *man*, i.e., since the first appearance of human species. As Humboldt notes in *Cosmos*: "But what are such intervals of time compared to the length of the geonostic periods revealed to us in stratified series of formations, and in the world of extinct and varying organisms"

(1893, p. 302) In other words, modification, and creation of new species require longer intervals of time than those marked by human existence. And Darwin makes a similar observation: "Time cannot have sufficed for so great an amount of organic change, all changes having been effected slowly" (2009, p. 266). Given that the emergence of new species happens in long intervals of time, we may conclude that the species found in fossiliferous strata belong to "a very different order of things from ours" that preceded the existence of human species. However, this does not mean we can observe no relation between the "ancient" and the present order of nature. Detailed and careful analysis of fossil record can reveal the modification of certain parts of organism, and show the transition of organic forms (Humboldt, 1893, p. 31).

If my analysis is successful, then Humboldt does not reconcile with Cuvier's view of immutability of species. *Contra* Cuvier, Humboldt remarks that during his entire existence, man failed to notice subtle, but significant modifications of organisms and transmutation of organic forms. Thus, he declares the immutability of species, and concludes that fossilized species are replaced with the new series of organic beings created by intelligent creator. Nevertheless, once we realize that the emergence of new species requires long intervals of time (in fact, longer than the entire period of human existence), we will affirm the hypothesis of variability of species.

## 3 Geographical distribution of species: Humboldt's synchronous analysis and Darwin's diachronic model

Geographical distribution of species represents an important part of Humboldt's theory. To present the physical description of nature, Humboldt explores present and past geographical distribution of species. In this section, I will show how Humboldt's reflections on this phenomenon relate to his investigation of evolution of species.

Humboldt conducts his research on geographical distribution of species in the context of his methodological holism. His investigation of species according to different climate and geography reveals the interconnectedness of natural phenomena. By comparing and combining the results of observation, we are enabled

> To discover the relations existing in common between the climatic distribution of beings and the individuality of organic forms …; and it is by induction that we are led to comprehend numerical laws, the proportion of natural families to the whole number of species, and to designate the latitude or geographical position of the zones in whose plains each organic form attains the maximum of its development. (Humboldt, 1893, p. 42)

The conjunction "maximum of its development" betokens an important assumption of Humboldt's holism: the organic world seeks to expand. Living beings penetrate the depths of earth's crust and reach great atmospheric heights (Humboldt, 1893, p. 353). Such a view, as I go on to explain, implies a specific interpretation of struggle for survival, and relation between natural environment and organic beings.

As known, Darwin's *Voyage* reveals his observations about geographical distribution of species. I noted there are significant similarities between this work and

Humboldt's *Personal Narrative*. For example, Darwin, as Humboldt before him, discovers the abundance of living world: "Well may we affirm, that every part of the world is habitable! … All support organic beings" (1997, p. 66). Such observations seem to be excluded from *The Origin of Species*. However, in *Origin*, Darwin refers to his investigation of species on Galapagos Archipelago, and provides a convincing proof of evolution of species.

In *Views of Nature* [1808], Humboldt associates conflicts amongst organisms with their fear. In his description of the nocturnal life of the tropical primeval forest, he argues that what indigenous peoples call "the animal's celebration of the return of the full moon" actually centres on the fear of being the victim of a predator: "To me the scene appeared rather to be owing to an accidental, long-continued, and gradually increasing conflict among the animals" (Humboldt, 1878, pp. 199). Using a jaguar pursuing peccaries and tapirs as an example, Humboldt notes the ensuing disturbance amongst the apes on the trees; this, in turn, unsettles the tribes of birds, "and suddenly the whole animal world is in a state of commotion" (1878, p. 200).[12] Based on such examples, abundant in *Views of Nature*, it seems the notion of "struggle for survival" can be defined in terms of predator-prey relations.

As previously mentioned, Humboldt's view of nature diverges from the formerly accepted harmonic understanding of it. The harmony of nature presents a holistic unity of distinct natural spheres.[13] Yet, it seems that conflicts in nature interfere with this Humboldtian harmony – if conflicts occur inside and outside individual spheres, how does the system continue to exist? Whilst observing the behaviour of animals, Humboldt concludes "the golden age has ceased" (1819, p. 421–422). Humboldt's notion of "struggle for survival" can have a twofold meaning, however, thus resolving the apparent inconsistency. Namely, Humboldt observes the limits nature imposes on living beings; the earth, overpopulated with various vegetable forms, does not allow the full development of certain species. Thus, these beings have found their habitat on other natural species; trunks of trees are covered with green layers of trailing plants (Humboldt, 1818, p. 36). In other words, organic beings compete for natural resources such as soil, food, and light, the lack of which affects their life and growth (Wulf, 2015, p. 56). Humboldt writes: "Yet, such are the immutable laws of nature, their races are preserved in the *struggle with the elements*, and amid so many sufferings and dangers" (1819, p. 395–396, my emphasis).[14] Natural species, prevented from inhabiting one part of ecosystem (e.g., the earth), search for their habitat in other

[12] Humboldt takes this example from Vol. V of his *Personal Narrative* (Humboldt, 1819, pp. 437–438).

[13] As noted, *Cosmos* is divided into several thematic units dealing with the phenomena of five different spheres: atmosphere, hydrosphere, lithosphere, biosphere (the domain of living beings), and the celestial sphere. Making an exception with these terms, Humboldt does not use the term "sphere" in the sense I opt to use it. Nonetheless, I believe the notion of five natural spheres can introduce us to a better understanding of Humboldt's holism: life equally affects the natural processes in each of these spheres and contributes to the creation and maintenance of harmony in nature. I offer a detailed explanation in due course. On this place, I feel the need to shortly explain my usage of this term.

[14] To my knowledge, Humboldt does not use the term "struggle for survival." He does, however, speak of the "struggle with the elements", where the term "elements" betoken different phenomena that challenge the survival of organic beings, e.g., limited food resources, potential predators, natural disasters etc. It seems to me that the notion of struggle with the elements captures Darwinian sense of the struggle for survival.

parts of the same ecosystem; in this case, on other living beings such as trees. Apparently, the struggle for survival occurs here as well, and it contributes to the *fullness* of organic world in tropical forests.

Humboldt argues that "uniformity of association" is unknown in tropical forest; the excessive variety of flora

> Renders in vain to ask, of what do the primeval forests consist. Numberless families of plants are here crowded together; and even in small spaces, plants of the same species are rarely associated. Every day, and with every change of place, new forms present themselves to the traveller's attention. (1878, p. 194–195)

In addition to the abundant diversity in individual ecosystems, the living world tends to expand and occupy *every spot* of free space. Climbing plants *inhabit* the trunks of trees. And the application of a microscope reveals the luxuriance of animal forms in the ocean; even air contains the elements of organic life (Humboldt, 1893, pp. 315–316). This is a very significant point because it suggests *the living world itself becomes part of the natural environment, and the struggle for survival stems from the need to adapt to the given conditions*. Accordingly, the notion of *natural environment* is expanded to include not only external conditions like temperature and humidity but also the living world that inhabits it. Although the environment imposes certain conditions on the living world, the former does not take precedence over the latter – their status is equal. The organic world is not enclosed within a sphere in which some principles (e.g., Darwinian natural selection) determine its agency. The *living world sets its own limits* because of its ability to create external conditions, adapt, and survive.

Concepts of Humboldt's epistemological framework are interconnected in the same manner as the spheres. Recall that Humboldt seeks to uncover the intimate connections between natural phenomena of the five spheres: atmosphere, lithosphere, hydrosphere, biosphere, and celestial sphere. These spheres are ontologically equal and causally influence one another. By the same token, the phenomena of inanimate nature can affect the living world by creating conditions to which it adapts, and the living world causally affects inanimate nature *in the same way*. It actively participates in the creation and organization of the natural environment of different ecosystems. The notions of "struggle for survival" and natural environment reflect these relations: besides the predator-prey relations, the "struggle for survival" refers to the living world's expansion and mutual competition to survive in the natural environment, including: (1) external conditions such as temperature, humidity, etc.; (2) *all the other organisms in the same ecosystem*. These two concepts have equal epistemological status, just like the Earth's spheres are ontologically equal. Therefore, the role of the natural environment in Humboldt's conception of nature is twofold: (1) the natural environment imposes certain external conditions on the living world to which it must adapt. However, since the living organisms constitute *part of* the natural environment, (2) through them, it indirectly participates in the struggle for survival. This is not the case in Darwin's theory of evolution.

Before offering a definition of natural selection, Darwin explicitly accepts the assumption that strong and complex relations affect not only the domain of natural

species, but also the physical conditions of the environment they inhabit (2009, pp. 62–63). Giving the example of the climate change in a particular environment, Darwin states that "the proportional numbers of its inhabitants would almost immediately undergo a change, and some species may become extinct" (2009, p. 63). Thus, Darwin seems to acknowledge certain relations in inorganic nature may cause the change of a particular natural environment. Consequently, a new order of species is made, and which species will last depend on the characteristics of each. Every organism possesses certain characteristics or variations; Darwin calls natural selection the preservation of advantageous and rejection of harmful variations. Variations that are neither useful nor harmful will not be influenced by natural selection:

> A change in the conditions of life, by specially acting on the reproductive system, causes or increases variability; and in the foregoing case the conditions of life are supposed to have undergone a change, and this would manifestly be favourable to natural selection, by giving a better chance of profitable variations occurring; and unless profitable variations do occur, natural selection can do nothing. (Darwin, 2009, p. 64)

Hence, Darwin seems to believe changes in the natural environment causally affect the changes of certain organisms inhabiting it. In a letter to Wallace, Darwin argues that some effect must be attributed to external influences, and that he considers such effect "very slight" (1892, p. 183). Darwin eventually changes his opinion and writes that an impact of natural environment is much greater and direct (1892, p. 278). In *Origin*, he states that changed conditions of life are "of highest importance in causing variability, both by acting directly on the organisation, and indirectly by affecting the reproductive system" (Darwin, 2009, p. 31). However, the aforementioned part suggests that changes in living conditions are *necessary*. If such changes were not to occur, natural selection would not have "the free scope for the work of improvement" (Darwin, 2009, p. 64). In other words, external factors directly affect the modification of organisms.

If variations exist amongst organisms, a struggle for survival will occur: "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" (Darwin, 2009, p. 65). Darwin understands preservation of a certain variation as its transmission from parents to offspring to preserve advantages and ensure higher chances of survival in a given environment. The "struggle for survival" may therefore be viewed as the struggle to reach a period of reproductive maturity and produce offspring. Nevertheless, this secondary notion relies on a more basic and primary concept of the "struggle for survival," one connoting the predator-prey relations: to reach a period of reproductive maturity, an organism must first survive in a dynamic environment featuring the Malthusian struggle for external limited resources (such as food). Let us consider Darwin's example of a wolf who, in search of food, isolates certain animals by means of its craft, strength, and fleetness (2009, p. 70–71). Suppose that in a particular environment, during the period when wolves "are hardest pressed for food," deer "had from any change in the country increased in numbers, or that other prey had decreased in numbers" (Darwin, 2009, p. 70–71). In such circumstances, the fastest

and slimmest wolves will survive. Their variations will be preserved and transferred to their offspring.

This example suggests the following: organisms must constantly adapt to minor or major changes in the environment. The more successful they are, the higher their chances of reaching a period of reproductive maturity and producing offspring. Certain variations will thus be preserved. The notion of the "struggle for survival" appears to have two meanings here: one is the ability to reach the period of reproductive maturity, as it implies successful avoidance of predators, and the other entails procreation and thus the preservation of useful variations in offspring.

The first meaning is also found in Humboldt's theory; the wolf's hunt for prey reminds us of the jaguar's hunt in the jungle. However, Humboldt does not speak about the second meaning, perhaps because of his initial assumption that the origin of species is the kind of question that will remain "one of the mysteries of life." Nevertheless, a much more important difference between Darwin and Humboldt stems from their concepts of the natural environment and the living world. The Humboldtian standpoint represents the living world as an essential part of the environment it inhabits; it assigns causal power to the living world, allowing it to influence the natural environment in the same manner as the environment influences living organisms. The Darwinian standpoint tears down these holistic relations and separates the two domains. The notion of natural environment has priority over the notion of living world because the natural environment possesses phenomena that causally affect living organisms. However, these causal relations operate only one way; organisms cannot causally affect the natural environment, nor are they part of it in Humboldt's sense. Consequently, the adaptation of organisms occurs only with respect to the *physical conditions of the environment, not with respect to other organisms in the same environment*. Darwin's use of the concepts of natural environment and "struggle for survival" reflects these relations. Just as the natural environment is primary for the organisms that inhabit it, so too its concept is primary to the "struggle for survival." The natural environment imposes conditions to which organisms have to adapt; unlike Humboldt, Darwin does not recognize the interconnection of the whole natural system.

On the first glance, this conclusion contradicts Darwin's famous "entangled bank" metaphor from the final paragraph of the *Origin*. Here, Darwin writes:

> It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance, which is almost implied by reproduction; Variability, from the indirect and direct action of the conditions of life, and from use and disuse; a Ratio of Increase so high as to lead to a Struggle for Life, and as a consequence to Natural Selection, entailing Divergence of Character and the Extinction of less-improved forms. Thus, from the war of nature, from famine

> and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. (2009, p. 429)

Darwin is explicit that natural laws are dictating the decease and birth of new life forms. Since these laws are essential part of nature, it seems that Darwin is aware of interconnectedness between natural environment and living organisms, and I concur. However, I believe this Darwinian between nature and living beings is not *identical* to the one we find in Humboldt. Darwinian conception postulates relation in which nature, by laws of growth, reproduction, variability etc., determines behaviour and changes in living species. As noted, this causal relation operates only one way, meaning that living beings cannot causally influence natural environment. Humboldtian relation between inorganic and organic nature is different. Recall that Humboldt states the living world manifests the *same* forces we see functioning in the planet itself, and that many substances we find in nature can also be found in the living world (1893, p. 349). This indicates that inorganic and organic nature are susceptible to the *same* natural laws. Further, since the living world is composed of the same substances we find in different spheres of Earth, and manifests the same natural forces we see functioning in nature, it can be said that living beings *can* influence inorganic nature, and cause changes in different ecosystems. This, I believe, is not the case in Darwin's theory.

If the analysis is placed in a broader context of epistemological frameworks, we seem closer to answering the questions asked at the outset:

1. Did Humboldt contribute to the formulation of Darwin's theory of evolution?
2. *Why* does Humboldt believe we cannot acquire knowledge about the evolution of natural species?

So far, my analysis indicates the positive answer to the first question. Simultaneously, it advances the ambiguity of Humboldt's conclusion about the impossibility of knowledge about the evolution of organisms. As shown, Humboldt acknowledges the essential elements of the evolution theory, although he does not explicitly formulate them; he observes the variability of species and their struggle for survival; his investigation encompasses the examination of fossils and geographical distribution of species; finally, he observes the relation between organic and inorganic nature.[15] Yet, Humboldt *does not speak* about natural selection. In fact, he believes we *cannot* discover the *causes* of numberless varieties of living forms:

> We may easily comprehend how, on a given area, the individuals of one class of plants or animals may limit each other's numbers, and how, after the long-continued contest and fluctuations engendered by the requirements of nourishment and mode of life, a condition of equilibrium may have been at length estab-

[15] I should not that Humboldt does not separately define and discuss these phenomena. Nonetheless, they represent an important part of his general research of nature. Uncovering the relations between his distinct discussions in various writings reveals a coherent picture of his position on the problem of the evolution of species.

> lished; but the causes which have determined their typical varieties, and have circumscribed the sphere of the distinction of the forms themselves, no less than the number of individuals of each form, are shrouded in that impenetrable obscurity which still conceals from our view all that relates to the beginning of things and the first appearance of organic life. (Humboldt, 1878, p. 288)

According to Egerton, Humboldt raises the question about evolution of species just to let it drop (1970, p. 338). I believe he is partly correct; Humboldt does raise and consider the evolution of organisms. I also believe Humboldt does not "drop" this question. Instead, he offers an extensive inquiry of this phenomena in various writings. For example, the extended annotation in *Views of Nature* reveals Humboldt's thinking about speciation. Here, Humboldt reflects on the reason ratios of *families* in neighbouring countries are *consistent*, even though the *species* that compose these families are *different*. Recognizing that the thermal conditions alone cannot explain this phenomenon, Humboldt writes:

> Those who delight in conjectures respecting the gradual transformation of species, and who regard the different parrots, peculiar to islands situated near each other, as merely transformed species, will ascribe the remarkable uniformity presented by the above numeral ratios to a migration of the same species, which having been altered by climatic influences, continuing for thousands of years, appear to replace each other. (1878, p. 286)

Apparently, Darwin provides such explanation in *The Origin of Species*. Here, he refers to his discussion of bird on Galapagos Archipelago. Namely, Darwin recognizes that the habits, gestures, and tones of birds in the Galapagos Archipelago bear significant resemblance to American species. How, he asks, given the geographical distance from the mainland, can this resemblance between distinct species be explained? The distance between the American continent and the Galapagos Archipelago is greater than the distance between the islands of the Archipelago.[16] Nevertheless, those birds possess striking similarities: "Why should this be so? Why should the species which are supposed to have been created in the Galapagos Archipelago, and nowhere else, bear so plainly the stamp of affinity to those created in America?" (Darwin, 2009, p. 354) Darwin posits a two-part explanation. One is the migrations of natural species; in this case, birds who "occasionally arriving after long intervals of time in a new and isolated district, and having to compete with new associates, would be eminently liable to modification, and would often produce groups of modified descendants" (Darwin, 2009, p. 348). The other is the already mentioned secondary meaning of the "struggle for survival," i.e., producing offspring and preserving useful variations. In fact, Darwin suggests that, if in certain areas, we encounter species similar to those we have seen elsewhere, we can conclude the parents of the current organisms have previously inhabited those lands:

[16] A significant observation given the fact that the difference among the birds on islands is greater compared to the South American species.

> And we almost invariably find that wherever many closely allied species inhabit two areas, some identical species are still common to both... It is a rule of high generality that the inhabitants of each area are related to the inhabitants of the nearest source whence immigrants might have been derived. We see this in the striking relation of nearly all the plants and animals of the Galapagos Archipelago. (2009, p. 419)

Therefore, Darwin's overall explanation of this phenomenon can be formulated as follows: a group of organisms of a single species, in this case American birds, can migrate to the nearest part of the Archipelago and discover new external conditions. They must go through the process of adjustment to the new conditions of life, and this, in turn, leads to the creation of new variations. Through the production of offspring and preservation of these variations, a new natural species is created. This new species will exhibit similarities with American birds until *enough* time has passed and constant adjustment to external conditions has eliminated their resemblance.

It is worth noticing that Darwin's example of bird in Galapagos Archipelago bears meaningful similarities to Humboldt's example of canaries in Canary Islands:

> These birds, well known in Europe, were in general uniformly green: some had a yellow tint on their backs; their note was the same as that of the tame canary. It is nevertheless remarked, that those which have been taken in the isle of the Great Canary, …, have a stronger, and at the same time the most harmonious song. Under every zone, among birds of the same species, each flock has its peculiar note. The yellow canaries are a variety which has taken birth in Europe; … But of all the birds of the Canary islands, that which has the most heartshoothing song is unknown to Europe. (Humboldt, 1822, pp. 194–195)

Humboldt's observations in the Canary Islands seem strikingly similar to Darwin's remarks of birds in the Galapagos archipelago. Namely, Humboldt notes that canary subspecies differ in colour and tonality, and inhabit different areas of the islands. However, here he does not question the reason for observed differences amongst canary flocks, and the Canary and European species. Humboldt's fourth volume of *Personal Narratives* provides an answer to such question: "The manners of animals vary in the same species according to local circumstances difficult to investigate" (1819, p. 380). Thus, Humboldt apparently believes that local – external – conditions of a system determine the behaviour of individuals in such system. If local conditions of two neighbouring systems are different, then the behaviour of organisms (even if they spring from the same species) in given ecosystems will also be different. This is essentially Darwin's conclusion. Yet, it seems that Humboldt would not reconcile with Darwin. He poses another riddle. If it is indeed the case that natural species migrate to the nearest mainland, he asks for an explanation of the following conundrum:

> Why have our common heath, (Calluna vulgaris,) and our oaks not penetrated to the east of the Ural Mountains, and passed from Europe to northern Asia?

> Why is there no species of the genus Rosa in the southern, and scarcely any Calceolaria in the northern hemisphere (Humboldt, [1808] 1878, p. 286)?

Humboldt's question can be formulated in the following way: if mainland birds can migrate to nearby islands and speciate, why cannot our heath, oaks and roses similarly migrate across *continents* and speciate? As mentioned, thermal conditions alone cannot explain this phenomenon because the climates are the same.

As Werner notices, it seems that Humboldt could not provide any evidence to contribute to the spread of species through migration (Werner, 2009, p. 78). Whilst Humboldt is puzzled by the riddle, Darwin's epistemological framework enables him to give an answer:

> But we often take, I think, an erroneous view of the probability of closely-allied species invading each other's territory, when put into free intercommunication. Undoubtedly, if one species has any advantage over another, it will in a very brief time wholly or in part supplant it; but if both are equally well fitted for their own places, both will probably hold their separate places for almost any length of time. (2009, p. 356 )

On the one hand, Humboldt's holistic assimilation of the natural environment with organic life explains his silence. It forces him to observe the problem of migration and speciation through the lenses of life forms which tend to spread everywhere and thrive *within* environmental limits. On the other hand, Darwin contends the barrier is not environmental – it is the struggle for survival. Species can and do invade neighbouring environments. During this process, they compete with native species. In this competition, only the fittest will survive, adapt, and preserve useful variations.

Darwin reaches the answer Humboldt seeks because he makes two basic assumptions. The first is the essential premise that we *can* know the origin of species, and the second is the non-holism of his theory. Because of these two assumptions, Darwin is able to explain the process of migration and speciation by means of the theory whose key concepts are "struggle for survival" and "adaptation," the basic mechanism of which is natural selection. However, we should not overlook the fact that Humboldt would not accept Darwin's answer, not just because of the missing holistic aspect, but because of Darwin's assumption that the knowledge of the origin of species can be reached. Why can he not accept this?

This question becomes even more significant when we recognize that Humboldt employs *all* the key elements of Darwin's evolution theory. Although he does not write about natural selection, he recognizes the Malthusian struggle for survival amongst organisms and the influence of the natural environment they inhabit. He questions the speciation and migration of species, and he acknowledges the significance of fossils record and geographical distribution of species. Finally, Humboldt directly, albeit obscurely, writes about evolution: "The fruitful doctrine of evolution shows us how, in organic development, all that is formed is sketched out beforehand, and how the tissues of vegetable and animal matter uniformly arise from the multiplication and transformation of cells" (1845/ 1893, p. 56). How can we reconcile these elements with his denial of the possibility of knowing the origin of species? As

indicated, the answer to this question lies in the initial assumptions of Humboldt's epistemological framework. More precisely, Humboldt's radical conclusion stems from a fundamental assumption about limits of our possible knowledge. As I argue in the following section, Humboldt adopted such assumption under the influence of Kant's doctrine and his teachings about physical geography.

## 4 Kant and Humboldt: the impossibility of knowledge about the evolution of species

Casas rightfully notes that Humboldt and Kant were interested in each other's work, which can be attested in their writings (2018, p. 36).[17] Whilst both scholars were certainly interested in discipline of geography, their strongest similarities are found in the dynamic, holistic conception of nature (Knobloch, 2004, p. 33). However, I believe Kant's influence extends also on Humboldt's reflection about transmutation of species.

It is well known that Kant considers living organisms as products of nature, and that he seeks to explain them through the notion of *purpose*. In *Critique of Judgement* ([1790] 2007), Kant argues the contingency of the organization and behaviour of organisms does not allow us to explain them by referring to mechanical laws, as we do when examining the phenomena of inanimate nature. Within this context, living organisms are *mechanically inexplicable*. Although Kant's use of the notion of "mechanical explanation" is ambiguous and seems to vary throughout his works (Ginsborg, 2001, pp. 238–243), we can understand his meaning: matter, of which organisms are composed, can organize itself in a thousand different ways. That being the case, the organization we currently encounter is a mere contingency:

> So where the structure of a bird, for instance, the hollow formation of its bones, the position of its wings for producing motion and of its tail for steering, are cited, we are told that all this is in the highest degree contingent. (Kant, 2007, p. 188)

In this respect, it is not possible to use the mechanical laws to explain the structure and behaviour of organisms:

> Indeed, so certain it is, that we may confidently assert that it is absurd for human beings even to entertain any thought of so doing or to hope that maybe another Newton may some day arise, to make intelligible to us even the genesis of but a blade of grass from natural laws that no design has ordered. (Kant, 2007, p. 228)

[17] For example, in *Cosmos*, Humboldt refers many times to Kant's *Universal Natural History and theory of the heavens* ([1755] 2012), and Kant argues in his *Physical Geography* that "it is to be hoped that we shall get to know a significant part of South America better through von Humboldt" (Kant, 2012 p. 508).

For this inexplicability to become tolerable, Kant relies on the use of the notion of purpose. Purpose has a heuristic role – it should explain the organization and behaviour of organisms *as if* they were intentionally created by an intelligent designer. The conjunction "as if" has an important role because it allows us to compare organisms to human artefacts whilst simultaneously leading to a different conclusion: although they look *as if* they were created by an intelligent designer, organisms are actually the products of nature. The notion of purpose does not have a causal role in creating their organizational unity, but it does play a role in our ability to *cognize* them in a respectful way (Richards, 2002, p. 8–9). The mechanical inexplicability on the one hand and the notion of purpose on the other explain our inability to discover the origin of species. Kant thinks we must have precise information about the initial conditions beforehand if we are to come to a conclusion on the specific formation of a particular fragment of matter. Every explanation of origin must start with already organized matter (Ginsborg, 2001, p. 243).[18] Therefore, we cannot know the origin of species because of the very nature of organisms – their organization and behaviour do not fall into the domain of the operation of the mechanical laws manifested in inanimate nature. They can be understood, however, through the notion of purpose. Kant's mechanical inexplicability teaches us that matter could organise itself in a thousand different ways. In effect, we cannot know that its' current organisation is necessary. This conclusion echoes Humboldt's statement that, by natural laws alone, we cannot grasp the origin of species, perhaps because history of species could also organise itself in many different ways.

There is, however, another reason that leads Kant towards the conclusion of the impossibility of knowledge about the origin of species: it seems that such question belongs to the domain of natural history (*Naturgeschichte*). For Kant, nature is the epitome of all entities that constitute our experience (Knobloch, 2004, p. 38). However, Kant believes that knowledge about natural history is unattainable because it reaches beyond such experience. He argues that the presently observable order of things is the basis

> On which we obtain and apply our knowledge. But for that to be **able** to happen which the **understanding** tells us **ought** to happen, we need to know the nature of the subject, without which this is not possible. Moreover, we need to become acquainted with the objects of our experience **as a whole**. Thereby our knowledge is not an **aggregation** but a **system**; for in a system the **whole** is prior to the parts, while in an aggregation the **parts** have priority. (Kant, 2012, p. 158)

Thus, writing about natural history requires knowledge about nature as a *Whole*, i.e., it requires knowledge about distinctive geography (*Naturbeschreiben*) as it has been through different geological epochs (Kant, 2012, p. 161). In other words, Kantian

[18] Lofti explains the functionality of living organisms must be regarded as operating in accordance with the mechanical laws but says Kant was skeptical that we would be able to explain it from such a point of view (Lofti, 2010, p. 124); Kolb contrasts Kant's view of organic teleology with his account of mechanical processes and concludes that explanations of purposiveness of organisms requires "both a systematic conception of a whole not found in mechanical explanations and a reversal of the mechanical order of cause and effect" (Kolb, 1992, pp.12–13).

concepts of *time* and *space* constitute the crucial nuance which differentiates history from geography. Although both disciplines represent descriptions, history is a description of time, whereas geography is a description of space (Casas, 2018, p. 40). And only if one were to describe the events of the whole of nature (space) as they manifested throughout time, then and only then would one write the so-called natural history:

> If, for example, one were to consider how the various breeds of dogs descended from one line, and what changes have befallen them through all time as a result of differences in country, climate, reproduction, etc., then this would constitute a natural history of dogs… But there is the problem that it has to be guessed, more through experiments than by accurate testimony. For natural history is not one whit shorter than the world itself. But we cannot guarantee the accuracy of our information. (Kant, 2012, AK 9:162)

Accordingly, we can argue that Kant believes the question about the origin of species requires knowledge of the entire history of natural organisms. Such knowledge embraces all changes of various organisms through different geological times, detection of intermediate species etc. However, just as we cannot know what changes have taken place in the line of creation of various breeds of dogs, so too we cannot uncover the changes that have manifested in the long line of creation of distinct species. If this is the case, then we cannot know the origin of the species.

Kant's insistence on knowing objects as a whole and forming a *system* of knowledge resurfaces in Humboldt's theory in a form of intention to uncover Kantian systematic network in which all phenomena are interconnected:

> In this great chain of causes and effects, no single fact can be considered in isolation… And while each series of facts must be examined separately in order to recognize a specific law, the study of nature, which is the main problem of general physics, demands the gathering together of all the knowledge dealing with modifications of matter. (Humboldt, 2009, p. 79)

Even though Humboldt welcomes Kant's interpretation of physical description of earth, he takes exception with Kantian conclusion about possibility of knowledge about natural history. Jackson argues that Humboldt acknowledges the necessity of historical aspect in investigation of natural phenomena, but often retreats from formulation or evaluation of any historical hypothesis: "In fact, he frequently asserts that the problems are insoluble and that historical hypothesis are untestable" (Jackson, 2009, p. 19). In a similar manner, Helmreich states that Humboldt believes the history of earth cannot be the subject of scientific research due to the uncertain and sparse evidence (Helmreich, 2009, p. 58). Yet, it seems this is not always the case. In his *Essay*, Humboldt writes how investigation of the *present* geography of plants and their distribution can enable us to determine the "ancient link" between neighbouring continents:

> The geography of plants can furnish precious materials for this kind of research: up to a point, it can show that the separation of Africa from South America occurred before the development of organized forms of beings... The geography of plants can assist us in going back with some degree of certainty to the initial state of earth. (Humboldt, 2009, p. 67)

The importance of historical research is also emphasized in *Cosmos.* Even though the present state of nature is introduced as the subject of scientific research (Helmreich, 2009, p. 58), the importance of historical perspective is reflected in Humboldt's alternating use of concepts of physical history and physical description of the universe:

> The physical history of the universe, whose exposition I attempt to develop, does not pretend to rise to the perilous abstractions of a purely rational science of nature, and is simply *physical geography*, *combined with a description of regions of space and bodies occupying them*. (Humboldt, 1893, p. 29–30)

In other words, knowledge about physical geography, or physical description of the universe, *includes the knowledge of natural history*. Humboldt believes that geography of plants and geological data can provide some insight into the past states of earth: "The study of strata which are so differently formed and arranged before our eyes… leads the reflective observe, by simple analogies, to draw a comparison between the present and an age that has long passed" (1893, p. 147). Thus, the investigation of the present state of things, and adequate analogies, lead towards knowledge about the past states of earth, i.e., discovery of natural history. However, the phenomenon of evolution of species seems to show that *some causes* cannot be discovered. If that is so, we can conclude that the investigation of the present state of affairs *should* enable the knowledge about the Earth's past.

Finally, why Humboldt rejects the possibility of knowledge about the evolution of species? I believe the reasons for such conclusion lie in Kant's study about limits of our possible knowledge, and mechanical inexplicability of organisms. Led by the Kantian conception of the limits of our knowledge, Humboldt treats the question about the origin of species as a problem that lies "beyond" our experience and cannot be resolved. Unlike Darwin, who applies the evidence obtained in the investigation of fossils to the problem of origin, Humboldt uses it to determine the differences between *past and present natural species*, as well as the location and ecosystems they inhabit. As seen in his annotation on speciation, Humboldt's primary goal is to determine the geography of distinct species across the mainland and to explain their expansion in nature. This does not mean he discredits evolution; on the contrary, he seems to admit such a process really did occur. Thus, it can be said that Humboldt is evolutionist. However, he appears to think there is no undeniable systematic evidence to determine the exact course of that process. Humboldt writes:

> According to an ancient Indian myth, the earth is borne up by an elephant, who in his turn is supported by a gigantic tortoise, in order that he may not fall; but it is not permitted to the credulous Brahmins to inquire on what the tortoise

> rests. We venture here upon a somewhat similar problem, and are prepared to meet with opposition in out endeavours to arrive at its solution. (1893, p. 288)

In other words, of the many possible histories (about natural species), we have no evidence based on which we can accurately identify one as true. In that sense, his position is located between the Lyellian/Malthusian and Darwinian positions. On the one hand, the recognition of the interconnection amongst parts of nature and of the evolutionary process suggests Humboldt thinks the struggle for survival can lead to a qualitative change in organisms (whatever it may be), and not their extinction. More precisely, whilst he acknowledges the extinction of certain species, Humboldt does not observe their extinction as the *consequence* of the struggle for survival. On the other hand, because of the limits of possible knowledge, the exact course of evolution (and, hence, the origin of natural species) must remain unknown.

At the beginning of this paper, I posed two questions. First, why Humboldt denies the possibility of knowing the evolution of species? Second, did Humboldt's results contributed to Darwin's theory of evolution? I believe we finally arrived to answers to these questions. In response to the first, we may conclude that Humboldt adopts Kant's study of limits of possible knowledge and mechanical inexplicability of organisms. Nonetheless, Humboldt remains evolutionist. With that in mind, the answer to the second question seems straightforward; the similarities and differences emphasized in this paper lead me to conclude that Humboldt did contribute to Darwin's theory of evolution. If we acknowledge the fact that Darwin thoroughly read Humboldt's writings, and was strongly influenced by his *Personal Narrative* (where Humboldt sketches the idea he further developed in *Cosmos*), we may say that Humboldt's research provided the basis for development of Darwin's evolutionary ideas. Obviously, Humboldt does not formulate the principle of natural selection. However, he seems to observe phenomena that indicate its causal action: the struggle for survival (which leads to qualitative changes in organisms), and relation between natural environment and organic beings. Thus, Humboldt achieves profound influence on Darwin. Although their fundamental epistemological assumptions and goals are different, both scholars are more similar than it may seem at first glance. They are great systematists, using the empirical method and focusing their attention on almost identical events in the natural environment. Yet, as I emphasized, Humboldt believe some causes (in this case, the natural selection) cannot be discovered. Realising that fossil record alone is imperfect evidence for theory of evolution, Darwin turns his attention to geographical distribution of species, (2009, pp. 290–362) an area of research that made Humboldt a "father of biogeography". This can be seen in Darwin's example of birds in Galapagos Archipelago; Darwin's research of their speciation finally enabled him to formulate a convincing argument for theory of evolution. As Archibald notes:

> Bringing his natural selection together with arguments for how oceanic islands became populated still stands as one of the strongest cases uniting his observations with his mechanism. This pulled together Darwin's arguments for the interactions of closely related living species on continents, closely related fossil species on the same continents, and now the very active and quite recent populating and diversification on oceanic islands. The combined scenario proved a

> very strong demonstration of his transmutation of species, or evolution. (2017, p.160)

We can say that, unlike Darwin, Humboldt is focused on what is *present*. For him, only synchronous analysis is justified, and, for that reason, he uses fossils to show the distribution of all known species in the natural system. To this synchronic model, Darwin adds a diachronic moment reflected in a mechanism that isolates one of many possible histories and explains it. Humboldt could therefore be seen as inferior to Darwin because he does not recognize this diachronic aspect. In other words, Humboldt does not realise that contingency of historical chain does not imply its falseness. But because Darwin overlooks the systematic moment – the unity of nature as a holistic system – Humboldt is at the same time superior to him.

## 5 Concluding remarks

The succession of Darwin's theory of evolution inspired many scholars to search for Darwinian predecessors, and investigate evolutionary thoughts before Darwin's time. In contemporary literature, one can often encounter the on-going debate whether Alexander von Humboldt should be recognized as pre-Darwinian evolutionist, and precursor of Darwin's theory of evolution. Whilst some scholars offer negative, and other positive answer to this question, one can also find authors who argue that Humboldt is evolutionist, but not a Darwinian theorist.[19] My analysis led me towards the following conclusion: Humboldt is the evolutionist and, in addition to Lyell and Malthus, should be recognized as a precursor to Darwinian theory of evolution. To examine and justify this conclusion, I started with analysis of Humboldt's fundamental assumptions, goals and method of rational empiricism. Next, I compared them to Darwin in other to investigate similarities between Humboldt's and Darwin's stance. My analysis indicates that both scholars are more similar than it may seem at first glance, and that we can detect Humboldt's influence on Darwin throughout his creative lifetime. Humboldt does not formulate theory of evolution, but he offers some insightful thoughts for younger scientist. Darwin read and learned from Humboldt about the war of nature and "struggle with the elements", i.e. struggle for survival. In his personal copy of *Personal Narrative*, Darwin scribbled a note: "To show how animals prey on each other - what a 'positive check'" (Barrett & Corcos, 1972, p. 160). Further, Humboldt indicated Darwin the implications of fossil records and geographical distribution of species.

Humboldt's thoughts on evolution of species are scattered throughout many essays, which can leave us with the impression that Humboldt failed to developed a theory of nature (Glaubrecht, 2022, p. 35). However, I believe Humboldt provided such theory. We find its' parts throughout all of his writings where he, alongside

[19] As noted before, Glaubrecht (2022) and Helmreich (2009) retain their conclusions that Humboldt is not evolutionist. Werner states we cannot find any evolutionist thesis in Humboldt's *Cosmos* (Werner, 2010). Wulf states that Humboldt is evolutionist, and indicates he indeed is a pre-Darwinian Darwinist (Wulf, 2015,p. 272). Schmuck (2014), however, argues Humboldt is an evolutionist, even though he is not a Darwinian due to the methodological limitations of his theory.

the phenomena of trade, commerce, statistics, history, politics etc., occasionally discusses the problem of evolution of species.[20] Humboldt's holistic theory reveals the intimate relations between various natural phenomena. Through it, we recognize the agency of the living world – the essential element of the contemporary Gaia theory. Moreover, Humboldt was thinking about speciation, migration and geography of plants before Darwin took his first steps toward the theory of evolution. At the same time, we see the deep influence of the Kantian philosophical system. Kant discredits the ability to know the origin of species because organisms are mechanically inexplicable. Further, this question belongs to the problematic domain of natural history. Accordingly, Humboldt declares it must remain one of the mysteries of life. Operating under a different framework, Darwin withdraws the question of evolution from the domain of mystery and places it in the domain of empirical research. Thus, it seems we can safely say the propositions each thinker uses to derive conclusions significantly depends on the initial assumptions of his framework. Whilst Humboldt's epistemological framework disallows the knowledge of the origin of species, Darwin's rests on different initial assumptions that allow him to move past the Kantian limitations of possible knowledge.

Does this mean the reconstruction of each conceptual framework is sufficient to justify one's claim? Quine thinks no statement is immune to revision (1951, p. 40). I believe such a conclusion is reckless. Even so, when attempting the philosophical analysis of a problem, it is not enough to observe isolated argumentation. It is necessary to understand what motivates it. Philosophical analysis should start from the very beginning – from the selected basic assumptions underlying the formulation of the arguments.

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[20] In fact, Humboldt's general theory represents the fusion of natural, social and political observations, which probably represents the greatest difference between him and Darwin.

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