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The Darwinian Tension

Romantic Science and the Causal Laws of Nature

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Abstract

There have been attempts to subsume Charles Darwin's theory of evolution under either one of two distinct intellectual traditions: early Victorian natural science and its descendants in political economy (as exemplified by Herschel, Lyell, or Malthus) and the romantic approach to art and science emanating from Germany (as exemplified by Humboldt and Goethe). In this paper, it will be shown how these traditions may have jointly contributed to the design of Darwin's theory. The hypothesis is that their encounter created a particular tension in the conception of his theory which first opened up its characteristic field and mode of explanation. On the one hand, the domain of the explanandum was conceived of under a holistic and aesthetic view of nature that, in its combination with refined techniques of observation, was deeply indebted to Humboldt in particular. On the other hand, Darwin fashioned explanations for natural phenomena, so conceived, so as to identify their proper causes in a Herschelian spirit. The particular interaction between these two traditions in Darwin, it is concluded, paved the way for a transfer of the idea of causal laws to animate nature while salvaging the romantic idea of a complex, teleological and harmonious order of nature.

Keywords

Charles Darwin; Alexander von Humboldt; John F.W. Herschel; teleology in nature; aesthetics of nature; causal explanation

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1. Introduction

History and philosophy of science has seen an equally impassioned and unresolved debate as to which of two distinct intellectual traditions Charles Darwin and his theory of evolution ultimately belong. One side mobilises the broad and ready-to-hand evidence that shows the commitment of Darwin's theory to the standards of modern natural science and its ideals of exact, predictive knowledge, which became canonised in early 19th century Britain by the philosophers of science John Herschel, William Whewell and John Stuart Mill,[1] and which also informed political economics of the Malthusian stripe. Against this majority view, other historians set out to demonstrate Darwin's deep sympathy for a wave of ideas crossing the Channel from Germany that emerged in critical reaction to modern science: the romantic approach to arts and science, paradigmatically embodied in the literary and scientific achievements of Johann Wolfgang Goethe and Alexander von Humboldt.

In this essay, which is intended as a historically informed endeavour in the philosophy of science, I will argue that a strict disjunction between the above interpretations of Darwin's place in the history of ideas is inappropriate, and that both traditions played a formative role in Darwin's theorising. These traditions and their specific styles of reasoning may not merely have cohabited as the proverbial Goethian two souls dwelling in one breast, nor have they been adopted by Darwin in sequential order, with the romantic being discarded in favour of the modern scientific view, nor were they a mere conjunction of a romantically informed literary style and a more traditional approach to scientific explanation. Instead, my hypothesis is that that their encounter created a particular, and productive, tension in the conception of Darwin's theory which first opened up its characteristic field and mode of explanation.

The argument is of a dialectic kind: romantic science, with its foundations in idealistic *Naturphilosophie* and mostly in its Humboldtian incarnation, provided Darwin with a particular *language and theory of observation*, while the Victorian science of his day delivered to him the *theoretical models* on which to base his explanation. The very synthesis of what first appears disjunct is an image of nature that bears many of the characteristics of the romantic view while being made amenable to an explanation in the terms and in the spirit of

[1] For an exposition of Darwin's relation to those philosophers, see Hull (1973, 2003) and Ruse (1975).

the more mechanistically inclined natural sciences of Darwin's Victorian compatriots.

I will first provide a brief outline of the competing, pro- and anti-romantic interpretations of Darwin's theory (Section 2), before moving to an account of the influence on Darwin exerted by the key figure in science to emanate from (and ultimately transcend) German romanticism: Alexander von Humboldt (Section 3). This source of influence will then be matched against the other tradition to which Darwin was indebted, the Victorian variety of modern science (Section 4). The synthesis of these influences will be the topic of the concluding section (5).

2. Contested Influences

In the last chapter of his *The Romantic Conception of Life*, titled "Darwin's Romantic Biology", Robert J. Richards (2002) seeks to put Darwin and his theory into a carefully adjusted romantic light. He argues that Darwin was not only a great admirer of Humboldt and his works—whom he portraits as one of the standard-bearers of German romanticism—but that Darwin's observations of nature were also marked by an aesthetic sensitivity that was typical for that movement. This aesthetic approach was based on a conception of nature that, too, conformed to the romantic view. More precisely, both Darwin's and the romantics' conception of nature, on Richards' reading, was that of a fundamental unity of mind and nature. By implication, nature appears as inherently purposeful and dynamic in character, where, firstly, creative force permeates all matter, animate and inanimate, and where, secondly, the development of nature is considered progressive in direction, and where, thirdly, any living being's morphology adheres to archetypal patterns. Moreover, Richards claims that Darwin believed in a genuine moral significance of nature that was at odds with the then-dominant utilitarian views. The romantic view of the world, on Richards' reading, includes precisely the three elements he also identified in Darwin: a specifically holistic metaphysical conception of nature, an aesthetics based on the immersion in nature, and an ascription of normative qualities to nature.

In a spirit similar to Richards' (2002) but within the framework of textual analysis, David Kohn (1996) makes an elaborate case for the central importance of two romantic metaphors in Darwin's theorising, the tension between them, and their synthesis in his *Origin of Species*: the "wedging" metaphor (1859, p. 67), with its connotations of force and upheaval,

representing the sublime character of natural phenomena, and the "entangled bank" metaphor (1859, p. 489), with its connotations of peace and tranquillity, standing for the beauty of natural phenomena. It is a common romantic endeavour to juxtapose and possibly reconcile the sublime and the beautiful aspects of nature in one coherent, integrated aesthetic—and this is what Kohn sees embodied in the *Origin*.

In *The Meaning of Evolution* (1992), Richards delivers a detailed historical and more matter-of-factual account of the influence on Darwin's evolutionary theorising exerted by the transcendental morphology of Goethe and some of his contemporaries via Richard Owen, and their views of embryonic development. In fact, the latter kind of process had been the referent of the term of "evolution" before Darwin repurposed it for an application to the phenomenon of species change. This twofold meaning of the term evolution, Richards argues, is neither an instance of arbitrary terminological choices nor a matter of coincidental analogies but testifies to the development of Darwin's theory from those morphological roots (and hence, using one of the biological terms at issue here as a metaphor, a homology between them).

We can now identify two levels of romantic influence on Darwin that have been argued for: firstly, there is the claim of concrete (but sometimes implicit) references to theories and theorists belonging to the romantic tradition; secondly, a less tangible relatedness in spirit to the metaphysical, aesthetic and normative underpinnings of romantic science and its conceptions of nature is claimed, where the realness of that relation—in terms of shared reference to an identical set of ideas rather than coincidental similarities between them—is somewhat more difficult to demonstrate. These two levels of influence, although natural companions and genealogically related, are note entailed by each other. One could adopt the theories in question for circumscribed explanatory purposes without actually buying into the metaphysics and aesthetics in which they were embedded as well as one could embrace the aesthetics and some of the metaphysics of nature without caring much about the scientific pretentions that travel with them. The strongest case for a romantic influence on Darwin will be the one that confirms it on both levels.

Michael Ruse is an outspoken advocate of the received, nature-red-in-tooth-and-claw view of Darwin's theory, as becomes particularly clear from his (1999) book *The Darwinian Revolution*. In his review (2004) of Richards' above-mentioned last chapter, he would not accept either level of romantic influence. Although he does not deny that supposedly romantic thinkers, above all

Humboldt, had an influence on Darwin, he locates all decisive factors in the formation and elaboration of his theory within the British tradition in which Darwin grew up. At most, the views to be found in the romantic sources are not too dissimilar from the ones he encountered closer to home, which, as Ruse claims, were the ones he actually referred to—for example the notion of homology, the above-mentioned ideas in embryology, the belief in the progressiveness of evolution, and the deistic God-as-nature rather than the traditional Christian theistic spiritual undercurrent.[2] Above all, however, Ruse argues that there is no way in which the central Darwinian tenet of natural selection could be made to fit into a thoroughly romanticised picture of Darwin. Without postulating that causal mechanism, his theory would not be an explanatory theory; with that mechanism included in the picture, there are key components in Darwin's theory that escape the romantic view, which hence is unable to capture the essence of his theory *qua* theory.

Natural selection as a mechanistically conceived causal force that gives rise to intricate design in nature is a leitmotif not only in Ruse's rendering of Darwin's theory but also in the mainstream of evolutionary thinking after Darwin, mostly in what has been termed "Neo-Darwinism". Richards (2004) takes issue with this interpretation in two ways. Firstly, Ruse's (and presumably many other Neo-Darwinists') view of Darwin's theory in general and natural selection in particular is deemed ahistorical. It reads contemporary interpretations of evolutionary processes into Darwin's thinking, as if natural selection were an immovable, timeless concept rather than an idea conceived by real people and subject to the transformative but often capricious powers of

[2] In his argument against Richards, Ruse neatly divides scientific and philosophical positions along geographic and political boundaries, where romanticism is considered a specifically Germanic state of mind, and where modern science is the profession of the sober Englishman. Ghiselin (2015) adopts a similar position, with the addition of seeking a non-British key influence on Darwin in French rationalism rather than German romanticism. Such stereotyped arguments *ad patriam* might be particularly difficult to apply to the scholarly realities of Darwin's day though. German, British, French and other scientists and natural historians were aware of each others' works, not least because the fields were small enough to allow each individual to know a significant portion of what his colleagues on the other side of the Channel (or the Rhine) did and thought. Agreement and dissent between them did not neatly divide along geographical boundaries either. One does not have to look further than Humboldt to find examples of a matter-of-course scientific cosmopolitanism in the early to mid 19th Century (a phenomenon that, however, was to face much harder times in the 20th Century).

biography and history. Secondly, Richards accepts that Darwin considered natural selection as a crucial force in evolutionary processes but insists that it was not conceived as a mechanism by Darwin. On Richards' interpretation, it was a manifestation of the very creative forces that are the hallmark of romantic thinking about nature.

There is a possibility that neither Richards nor Ruse appear to properly consider in their controversy—which will continue in their co-authored book *Debating Darwin* (Richards & Ruse, forthcoming). The possibility is that a strict disjunction between Darwin the romantic and Darwin the modern scientist is not entirely appropriate. Conceding that Darwin was a man of many influences, as both authors do (Richards, 2004, p. 34; Ruse, 2004, p. 9), does not go deep enough either, as they do not proceed to asking what the specific role of those other influences may have been but hasten to continue their respective exclusively romantic vs. mechanistic narratives. However, the conceptual gap between romantic and modern science was not quite as unbridgeable as it might look to the present observer, where the mechanistic view has firmly consolidated its dominant role, and where romantic notions have become difficult to perceive as scientific at all. It might just be that Darwin was a thinker who tried to bridge this gap in an innovative way.

Attempts at more balanced perspectives on the influences that worked on Darwin and his theory include, for example, the one proposed by Benjamin Bradley (2011), who traces the origins of Darwin's notion of the sublime back to (British) literary romanticism—and ultimately to Kant—where the sublime is understood as a sentiment of awe in the face of the experience of one's limitedness as a human being, as compared with the vastness, complexity and apparent perfection of nature. The argument has an epistemological twist: acknowledging the richness and complexity of nature has to be separated from any presumed understanding of how it came about. Concerning the task of gaining a true understanding, Darwin resorts to his and other naturalists' experimental practice. Phillip Sloan (2003) provides evidence for a diversity of intellectual roots when he recounts Darwin's formative years and the personal, educational and literary influences during that time. All of these influences were catalysed by the encounters with nature and people during the *Beagle* voyage into a first theoretical synthesis within a few months after his return, in which his notion of evolution is already manifest. In an earlier essay, Sloan (2001) traces the influences of various religiously informed but scientifically relevant conceptions of nature—theistic, deistic, and romantic-pantheistic—

that Darwin endorsed throughout his life, which seem to be at odds with each other but were integrated by Darwin into one theoretical edifice. It is in the line of these integrative perspectives on Darwin's theorising in which I see what follows, adding a slightly different take that focuses on Darwin's style and methods of inquiry.

3. Humboldtian and Romantic Science

A good indicator why it might be useful to adopt an integrative perspective on the formation of Darwin's theory is the observation that, when recounting in his *Autobiography* which books contributed most to his career choice as a naturalist, Darwin mentions Humboldt's *Personal Narrative* (1818) in close conjunction with Sir John Herschel's *Introduction to the Study of Natural Philosophy* (1830)—a work that is in some important respects at variance with Humboldt's approach to science and its romantic underpinnings:

> During my last year at Cambridge, I read with care and profound interest Humboldt's 'Personal Narrative.' This work, and Sir J. Herschel's 'Introduction to the Study of Natural Philosophy,' stirred up in me a burning zeal to add even the most humble contribution to the noble structure of Natural Science. No one or a dozen other books influenced me nearly so much as these two. (Darwin, 1905, vol. I, p. 47)

Intriguingly, some Darwin scholars, when commenting on this passage, tend to ignore either its reference to Humboldt or to Herschel.[3] One may argue that doing so amounts to selective blindness. Alternatively, one may assume that the tradition in which Humboldt stood was not that different from the Herschelian one in the first place. In fact, the disjunction between these traditions is not as strict as the polemics around Darwin-the-romantic vs. Darwin-the-modern-scientist would suggest—while remaining systematically relevant. After all, their disagreements occurred within one and the same scientific-philosophical discourse.[4] It is this field of tension in which Darwin navigated, steering between different perceptions of the nature of the

[3]See Hull (1973, p. 5) and Ruse (1975, p. 164) vs. Depew & Weber (1995, p. 59). But see Sloan (2003, pp. 23–25), for a more balanced perspective.

[4] For example, mostly in the third volume of *Kosmos* (1845), Humboldt frequently refers to Herschel's astronomical work rather than his philosophy of science. Herschel in turn honoured Humboldt's *Kosmos* and the conception of science embodied therein with an in-depth philosophical critique in the *Edinburgh Review* in 1848 (reprinted in Herschel, 1857).

naturalistic inquiry and between different perceptions of what constitutes the natural order.

3.1. Humboldtian Views

To a certain extent, Alexander von Humboldt's mode of inquiry into nature may look like the paradigm of the romantic subtype of *Naturphilosophie*, and it is thus characterised by Richards (2002). *Naturphilosophie* was a direct albeit in some respects heretical descendant of German idealism, and its tenets informed romantic science throughout.[5] On Richards', and similarly on Michael Heidelberger's reconstruction (1998), the basic tenet of *Naturphilosophie* was that the intuitive self-awareness of the mind provided for a faculty that, although not in a flatly material sense, *gave rise* to a world of natural phenomena as objects of the mind's experience. Accordingly, the apparent design to be found in nature is a feature of the mind reflected in all nature. In experiencing outward nature, the mind would encounter its *own* nature—in a fundamental relation of likeness between them. Despite the wide variety of interpretations that could be, and have been, given to this doctrine by various proponents of *Naturphilosophie*, the common goal was to tear down, in some way or another, the barrier between mind and nature that, on their view, had been imposed by idealism.

Doubts have been raised by some historians of science as to whether "Humboldtian science" really or completely fits into the category of *Naturphilosophie* and, by implication, romantic science. On one set of views, Humboldtian science was hardly connected to the romantic tradition at all: Lenoir (1982), for example, argues that Humboldt has been brought up and was working in a different tradition altogether. He adds that only a small faction of late 18th and early 19th century German biologists adhered to the doctrines of *Naturphilosophie*, while the majority, including Humboldt, adopted positions that only bore "superficial similarity" to those doctrines, while actually standing in traditions discontinuous with, and critical of, *Naturphilosophie* (p. 6). He cites as proof the majority's upbringing as students of

[5] Richards (2002, p. 516) notes that, whereas not all *Naturphilosophie* is to be subsumed under the romantic tradition, all romantic science adheres to the tenets of *Naturphilosophie*. Heidelberger (1998), on he other hand, draws a fairly direct line of influence from *Naturphilosophie* to the romantics. The bottom line however is that romantic thinkers, to the extent they concerned themselves with science, were followers of *Naturphilosophie*.

Johann Friedrich Blumenbach (who coined the term "Bildungstrieb"), a Kantian whom he claims to have had little inclination towards *Naturphilosophie* (for an alternative interpretation of these relations, see Richards, 2002, pp. 216–229). Alternatively, it has been argued that, even if having part of its roots in romanticism and *Naturphilosophie*, Humboldt's style of conducting science was marked by a particular method of empirical investigation that cannot be found in the romantic approach to nature. According to Susan Faye Cannon (1978, ch. 3), in her account of what she termed "Humboldtian Science", this particular style even gave rise to a distinctive paradigm of scientific research, whose influence reached far beyond romantic circles (a similar disjunction can be found in Daston, 2010).

In fact, Humboldt distanced himself from those strands of *Naturphilosophie* that merely indulged in metaphysical speculations about nature unconnected to any systematic mode of experiencing it.[6] However, this critique does not amount to an outright dismissal. Sloan (2001) notes that there are two distinct traditions of *Naturphilosophie*, the more idealistically, more speculative and more systematic inclined Schellingian and the pantheistic, more aesthetically—and ultimately more romantic—Goethean one.[7] Humboldt adopted and further developed the latter of these traditions, and bequeathed his version of it to Darwin. Michael Dettelbach (1999, 2001) argues for a fundamental continuity between conceptions of empirical science in enlightenment and romanticism, in their respective Humboldtian interpretations, where exact measurement and aesthetic sensibility go hand in hand.

On the background of these latter observations it can be argued that, inasmuch as Humboldt's style of scientific inquiry indeed differed from his romantic contemporaries, the difference lies in how it complemented their *Naturphilosophical* tenets and their aesthetical approach to nature with empirical methods rather than in repudiating them. After all, some of the paramount norms of romantic science can be found impressively embodied in Humboldt's multi-volume *Relation historique du Voyage aux Régions équinoxiales du Nouveau Continent* (1814) and *Kosmos* (1845), both based on his travels as a naturalist to

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[6] He explicitly does so in Humboldt (1845, vol. I, p. 68 f)—while endorsing Schelling's views of nature in the same chapter (p. 39).

[7] The complicated and changing relationship between Humboldt and the Schellingian variety of *Naturphilosophie*, from early appreciation to later rejection, is reconstructed by Dettelbach (2001).

the Americas: an organicist, holistic concept of nature and a genuinely aesthetic approach to its investigation. On the basis of these norms, he crafted a mode of description of natural phenomena that aims at a comprehensive, both truthful and aesthetically compelling, image of nature, and as such equally belongs to the domains of the arts and of science. The complementarity in question can be found on two interrelated levels, concerning methodological and ontological aspects.

The first complementarity lies in Humboldt's suggestion that intuition should be sharpened and improved by a systematically guided experience of nature, and in his proposal of a practical mode of methodically generating such experience. He understood measurement as an extension and refinement of one's senses as a living being, thus being very much in line with the aesthetic approach to nature characteristic of romanticism, not, vs. Cannon (1978), alien to it (see Dettelbach, 1999). Hence, the aesthetic apprehension of nature is the starting point, and it is supposed to be the aim of the naturalist's endeavour, but it is not its only means. For example, Humboldt (1818, vol. I, p. v) states that "It would be injurious to the advancement of the sciences to attempt rising to general ideas, in neglecting the knowledge of particular facts", while "The ties which unite these phenomena, the relations which exist between such varied forms of organized beings, are discovered only when we have acquired the habit of viewing the Globe as a great whole" (ibid., p. 230). A more systematic account of how to go about appreciating nature is to be found in an exposition of the "Stufen des Naturgenusses" ("gradations of the enjoyment of nature") in Humboldt (1845, vol. I, pp. 6 f, 15–22): from the primordial, instinctive awareness of a unity of nature entertained by the primitives, and via the crude, prejudice-laden and dogmatic empiricism of pre-scientific world-views that first tried to order and systematise natural phenomena, one arrives at the recognition of nature's inner being that scientific inquiry affords. Nature and her charms are best appreciated when subsuming a manifold of observational facts from a manifold regions under a unifying view, so as to intellectually grasp the intrinsic connections between them.

Secondly, and consequently, Humboldt's endeavour started from the *Naturphilosophical* assumption of an intrinsically lawful, all-encompassing order of nature that manifests itself in manifold local phenomena. In the face of the complexity of phenomena, empirical regularities in terms of patterns of distribution of qualities and their intensities were sought. Those empirical

regularities, being called "laws" by Humboldt, were to be identified in two ways, on two mutually supporting levels:

1. in the systematic, precise, instrument-based, quantitative measurements of natural phenomena in the field, followed by their successive statistical documentation and the spatial and temporal mapping of distributions of properties;
2. in comprehensive representations of nature ("Naturgemälde") guided by aesthetic intuition, under which the properties detected in nature were arranged in such a way as to enable apprehension, through all the details, of its structuring features.

These practices were designed to detect common, but not directly perceivable features behind variable individual instances. Concrete examples of laws in the Humboldtian sense are to be found in "das physische Gesetz in der Vertheilung der Continental-Massen", that is, the physical law of the distribution of continental masses (Humboldt, 1845, vol. I, p. 29), or in Kepler's law of planetary motion, as distinguished from the Newtonian forces that demonstrate the theoretical necessity of the regularity to be detected therein (Humboldt, 1845, vol. III, p. 26 f). The "law of embryonic resemblance" referred to in Darwin (1859, p. 439) would also have to be subsumed under this kind of laws.

3.2. Darwin's Humboldt

An obvious way in which Darwin followed Humboldt was the mode of empirical inquiry heralded by the latter. Above and beyond Darwin's own claims, it is widely agreed that Humboldt's *Personal Narrative*, the English translation of Humboldt (1814), made a major contribution to his intellectual upbringing—even providing him with the motive for his *Beagle* voyage.[8] In Darwin's travel *Journal*, all references to Humboldt that address scientific matters serve to elaborate on his own observations against the background of Humboldt's descriptions of, and ways of inquiry into, natural phenomena. Down to the observational techniques, and down to the mode and style of description, and even down to partly visiting the same places as Humboldt,

[8] See Himmelfarb (1959, pp. 46 f, 70); Egerton (1970); Cannon (1978, pp. 86–92); Desmond & Moore (1991, pp. 91, 115 f, 119); Depew & Weber (1995, p. 59); Sloan (2003).

Darwin followed his ideal of the naturalist's endeavour.[9] Perhaps the most beautiful and instructive passage in Darwin's *Journal* to be cited as evidence is the following:

> During this day I was particularly struck with a remark of Humboldt's, who often alludes to 'the thin vapour which, without changing the transparency of the air, renders its tints more harmonious, and softens its effects.' This is an appearance which I have never observed in the temperate zones. The atmosphere, seen through a short space of half or three-quarters of a mile, was perfectly lucid, but at a greater distance all colours were blended into a most beautiful haze, of a pale French grey, mingled with a little blue. The condition of the atmosphere between the morning and about noon, when the effect was most evident, had undergone little change, excepting in its dryness. In the interval, the difference between the dew point and temperature had increased from 7.5° to 17°. (Darwin, 1913, p. 33)

But even when not directly referring to Humboldt, Darwin emulated his peculiar perspective on nature.[10] Firstly, measurements and detailed observation reports were combined with statements about perceptions that not only emphasised the subjective qualities of the phenomena, but essentially consisted in invocations of those qualities. Secondly, those uniquely styled reports, aptly for a travel journal, were mostly arranged not in topical order, but along the spatio-temporal sequences of the travel itinerary, thereby constructing multi-faceted images of certain places of the kind that Humboldt called "physiognomies". The image of each subject matter in turn was built up in intermittent steps, emulating the subjective growth of experience.

In search of comprehensive images of this sort, Darwin's *Journal* combined musings on the wholeness and grandeur of natural phenomena encountered in some place in the wilderness with accounts of the difficulties in practically

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[9] It did not escape Humboldt's attention that Darwin's observations on his Beagle voyage followed an aesthetic-scientific paradigm similar to his own, whose origin he in turn locates in Georg Forster's travels and works; see Humboldt (1845, vol. II, p. 72) and the letter he wrote to Darwin in September, 1839 (first published and translated in Barrett & Corcos, 1972).

[10] In a similar vein, Egerton (1970) argues that Humboldt's *Personal Narrative* instructed Darwin "how and what to observe and how to write about it", but this influence is seen restricted to the general organisation of the text and to the analysis of animal and human populations.

coping with the hardships of travelling to and from that place.[11] It also combined meticulous observations of animals, plants and climate with, sometimes normatively laden, descriptions of social and cultural phenomena encountered in the same region.[12] Most significantly, it traced biogeographical patterns of distribution of plants and animals, trying to map their presence and absence in different places within the regions visited onto the climatic, geological and biological conditions encountered there, testing whether or not they covary with each other and with the species' distribution. These complex observations would become part of the foundations of the *Origin*, being recapitulated in the chapters on "Geographical Distribution".[13]

Darwin did not embark on systematic theorising in the *Journal*. This should hardly be surprising, since the book was a naturalist's travel report, not a scientific treatise. When finally moving to explanatory theories, despite the significant influence of Humboldt, Darwin would choose a different path. Again, this should not come as a surprise, as Humboldt's writings would not have provided much in the way of an explanatory theory, but remained an expressly *descriptive* endeavour, albeit of a special kind. Humboldt's *Weltbeschreibung* neither was, nor was intended to be, a *Welterklärung*. If and when done properly though, a comprehensive description would ultimately reveal the purposeful structure of nature.

Nonetheless, the Humboldtian heritage is still visible in many passages of the *Origin of Species*, although there are no more explicit references to Humboldt

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[11] See, for example, Darwin (1913, p. 26): "It is easy to specify the individual objects of admiration in these grand scenes; but it is not possible to give an adequate idea of the higher feelings of wonder, astonishment, and devotion, which fill and elevate the mind." This introspection is followed by observations about the adventure of road travel in Brazil.

[12] See, for example, Darwin (1913, p. 24), where he, after concluding his observations on evaporation in rainforests, gives an eyewitness account of the practice of slavery, expressing his disgust for it; or ibid., pp. 104–108, where a painstakingly detailed description of the anatomy of a species of Virgularia is followed by a report of the genocidal Argentinean "Indian Wars", the chapter being finished with observations about the size and distribution of flintstones.

[13] Darwin concludes a rather detailed report on the distribution patterns of different species of ostriches and of the Tinochorus family of birds in Argentina with a remark that tempts the contemporary reader to read it as vaguely foreshadowing the idea of evolution: "This small family of birds is one of those which, from its varied relations to other families, although at present offering only difficulties to the systematic naturalist, ultimately may assist in revealing the grand scheme, common to the present and past ages, on which organised beings have been created" (Darwin, 1913, p. 98).

to be found in this book.[14] However, Darwin's literary style alone may already serve as a convincing testimony of this heritage (see Bradley, 2011; Kohn, 1996). After returning to the geographical distribution of species in southern South America in the *Origin*, Darwin makes a remark that, while strongly echoing the Humboldtian view, indicates the transition from one conceptual framework to another:

> We see in these facts some deep organic bond, prevailing throughout space and time, over the same areas of land and water, and independent of their physical conditions. [...] This bond, on my theory, is inheritance [...] (Darwin, 1859, p. 350)[15]

This passage reads like a direct rejoinder to Humboldt's claim "[...] daß ein gemeinsames, gesetzliches und darum ewiges Band die ganze lebendige Natur umschlinge" (1845, vol. I, p. 9) or, in the somewhat truncated English translation, the claim of "one indissoluble chain of affinity binding together all nature" (Humboldt, 1849, vol. I, p. 9), which would be more precisely rendered as "one common, lawful, and hence eternal bond entwining all nature". Darwin continues with an explanation of similarities and dissimilarities between organisms in one region in terms of common descent and natural selection. The organic bond between natural beings that remains suspended between *Naturphilosophical* speculation and the tracing of empirical laws in Humboldt, in Darwin's *Origin* becomes a concrete causal link of explanatory value within a circumscribed domain of application. Where nature was

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[14] It is well known that the *Origin* is marked by the absence of a critical apparatus. It is also well known that this absence owes to the rush in which the book was written after evidence of Wallace's parallel invention of an almost identical theory of evolution by natural selection emerged. In this light, Humboldt's absence does not seem significant. For implicit traces of the Humboldtian ideal of science in Darwin (1859), see for example his reference to the struggle for life explaining forms of beauty that exceeds works of art (p. 60 f); his emphasis on the complex, systemic interdependencies between different organisms (pp. 74 f, 77); his metaphorical likening of Nature to a person purposefully caring for each living being (p. 83); his introduction of the tree of life metaphor, likening animate nature to a complex organism (pp. 128–130); and, of course, the deeply poetic concluding passage (pp. 485–490). Explicit references to Humboldt can be found in the *Essay of 1844* (Darwin, 1909, pp. 71, 166), but, once again, only referring to observations.

[15] A very similar formulation is to be found already in Humboldt (1818, vol. IV, p. 217): "Nothing appears isolated; the chemical principles, that were believed to be peculiar to animals, are found in plants; a common chain links together all organic nature."

comprehended by Humboldt "as a whole, animated and moved by inward forces" (1849, vol. I, p. [xviii]) or, in the original wording, "ein durch innere Kräfte bewegtes und belebtes Ganze" (1845, vol. I, p. vi), Darwin chose to look for real organic bonds. From the premiss of inquiry, that organic bond is transformed into its very topic.

3.3. The Harmony of the Natural Order

> Whatever be the peculiar inherent or temporary character of the scene contemplated—even in her most agitated moods—this sense of the regulated and the imperturbable is never wholly effaced. We know that the storm will rage itself to rest, the angry billows subside, the earthquake roll away, and that holy calm which is her habitual mood be restored, as if it had never been broken. (Herschel, 1857, p. 268)

In what seems a straightforward inference from the holistic, teleological and organicist view of nature in romantic science, the order of nature was also considered harmonious. That harmony could be read in both descriptive and normative fashion: if an integrated, goal-directed organisation of nature is presumed, the normal state of affairs of that organised whole would be marked by an overall orderliness, equilibrity and stability in the interactions between its elements. At the same instance, such a state of affairs would also be considered worthy of aesthetic contemplation and admiration.

Darwin's adoption, with modification, of Humboldt's style, method and content of inquiry has a parallel in his views on that apparently harmonious order of nature. The modifications he applied can be detected in his references to contemporaneous, biological theories, especially those committed to a romantic-*Naturphilosophical* view of science and in his metaphorical characterisations of nature.

Firstly, Darwin in the *Origin* discusses the claim that all morphological elements of vertebrate animals are at root metamorphosed vertebrae—a doctrine shared by the theories of the vertebrate archetype that were devised simultaneously by Goethe and Lorenz Oken, and taken over by Richard Owen.[16] Darwin accepts this theory, albeit with a significant modification: the "metamorphosis" postulated by those theorists should be understood as a historical fact in terms of phylogeny. While, to the former authors, archetypes

[16] In this context, Goethe is mentioned twice in the *Origin* (Darwin, 1859, p. 147), and in the *Historical Sketch* that was added in the sixth edition (Darwin, 1872, pp. xiv, xx).

were ideal forms of, or idealisations from, concrete phenomena, Darwin applied a philosophically realistic interpretation to that theory: to him, the archetype simply *was* the ancestor (Darwin, 1859, p. 438 f; Richards, 1992, pp. 105 f, 125).

Secondly, and closely related (spatially and thematically) to the first issue, Darwin refers to recapitulationist embryology, another domain strongly influenced by *Naturphilosophical* thinking (Darwin, 1859, pp. 439–450): the question whether and in which way embryonic development recapitulated either an ideal or a historical, phylogenetical hierarchy of living forms was a central issue in early 19th century biology. It can be, and has been, argued that recapitulationism took part in informing Darwin's theory, where it received, once again, a realistic interpretation: embryonic development recapitulates phylogenetic history.[17]

In the morphological and recapitulationist thinking to which Darwin related it was presupposed that nature, in and by itself, is an inherently teleologically and harmoniously ordered whole, from which the phenomena in question could be derived. Ideal archetypes were believed to preordain the growth and form of individual organisms and entire species, whereas the archetypes themselves were not considered in need of explanation. They were the *providers* of explanations—to the extent they figured in an explanatory kind of endeavour at all. For Darwin, a harmonious order of nature was not a matter of course anymore. What appears as harmonious in nature rests on processes that may not bear harmonious characteristics themselves. The morphologist's and recapitulationist's explanatory solutions were thus transformed into Darwin's explanatory problems.

The epistemological problematisation of a harmonious natural order was complemented with an aesthetic ambiguity and its resolution in Darwin's writings. Kohn (1996) argues that Darwin's joyfully romantic descriptions of natural scenes, such as the concluding paragraph of the *Origin*, have an underside, affectually and imaginatively, that, in its very normative connotations, informed his theory of natural selection. The seeming opposition between the sublime and the beautiful in nature was resolved by placing phenomena of a rather sublime quality, namely overwhelming complexity of interactions as well as predation, violence and death, at the source of the

[17] For this argument, see Ospovat (1981, pp. 153–157); Richards (1992, pp. 92, 115 f, 123–129). For a different view, see Gould (1977).

beauty and harmony of the natural scenes that evoke those feelings of grandeur that Darwin mentions in the concluding passage of the *Origin*—the work of Darwin in which Bradley (2011) sees the culmination of Darwin's reverence to the sublime.

The transformation of the status of the harmonious order of nature from an unanalysed general explanatory premiss into a concrete explanatory problem and the emphasis on an aesthetic ambiguity between the beautiful and the sublime in nature jointly figure on the level of Darwin's systematic theorising. Although Humboldt was well aware of the phenomena of population pressure and competition for resources, and even though he appreciated Thomas Malthus' famous work on that issue (1826), Humboldt, unlike Darwin, did not presume these to be universal phenomena. He considered them deviations from an ideally harmonious and in principle eternal order of nature (see his reference to that common, lawful, and hence eternal bond entwining all nature cited in the preceding subsection). In contrast, Darwin brought into full view the presence and the effects of competition for resources, population pressure, and predation on the distribution of populations over space and time, thus expanding the scope of Humboldt's population thinking and placing it in a different normative light.[18] Moreover, despite his fascination with natural history, it seems that Humboldt held an ambiguous view of the possibility of historical explanations of natural phenomena, and that he never openly considered ideas of transmutation of species, although it is highly probable that he was informed of Darwin's theory.[19]

In Darwin, the very vagaries of competition within and between populations and the risk of extinction came to figure as the *sources* of a harmonious order of nature. Stability and teleological order in nature became a *historical* phenomenon in terms of locally and temporally circumscribed, transient equilibria whose dynamics were now the topic of investigation.

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[18] This argument for the differential importance given to population pressure and competition between Humboldt and Malthus, and then Darwin, is made by Egerton (1970), who also traces the influence of Humboldt's interest in Malthusian population thinking on Darwin.

[19] This is what Helmreich (2009) and Werner (2009) argue for in their reconstructions of the relationship between Humboldt and Darwin.

4. The Quest for True Causes

> It is so easy to hide our ignorance under such expressions as the 'plan of creation', 'unity of design,' &c., and to think that we gave an explanation when we only restate a fact. (Darwin, 1859, p. 482)

Darwin's turn away from the presupposition of an inherently harmonious order of nature and towards causal laws are closely and systematically connected, inasmuch as causal laws were now supposed to explain that order. Yet before this step is accomplished, a notion of causal laws that are able to explain the phenomena of the animate world and the apparent harmony therein has to be established in the first place. Such a notion did not fall within the domain of romantic science. This is the systematic point of divergence between Darwin's adoption of the romantic view and his adherence to the norms of the science of his Victorian compatriots, a point of divergence that can be traced back to Humboldt's vs. Herschel's interpretations of the laws of nature.

The empirical laws introduced by Humboldt (see Section 3.1 above) are not to be confused with the causal laws envisioned, first and foremost, by John Herschel (1830, 1857). Both Humboldt and Herschel were aware of this distinction. However, only Herschel embarked on the project of identifying causes that necessitate the empirical regularities in question. Humboldt's abstention from a causal inquiry neither was a matter of neglect nor of a general scepticism towards a causal inquiry as such but a sign of epistemological caution:

> […] when we cannot hope to penetrate the causes of natural phenomena, we ought at least to endeavour to discover their laws, and distinguish, by comparison of numerous facts, what is constant and uniform from what is variable and accidental. (Humboldt, 1818, vol. II, p. 214)[20]

In fact, Humboldt fully acknowledged the importance of causal explanations—to the extent to which they are available, sufficient and appropriate. Yet, firstly, availability of such explanations may be limited, in terms of information that is missing at the current stage of inquiry. Secondly, Humboldt considered a causal inquiry inappropriate to detecting the plan of nature, as such an inquiry

[20] See also Humboldt (1845, vol. I, pp. 67 f).

can only be concerned with the properties of matter.[21] Moreover, that inquiry will aim at analysing limited sets of phenomena rather than getting the cognitive grasp of the world in its entirety that he considered the pinnacle of scientific inquiry (Humboldt, 1845, vol. III, p. 25). Thirdly and conversely, a causal account, if designed to encompass nature in its entirety, is considered insufficient inasmuch as nature is to be conceived of as "an infinite in extent and content" ("ihrem Umfange und Inhalte nach, ein Unendliches", Humboldt, 1845, vol. I, p. 81). If and when however causal explanations are applied within circumscribed domains and to an appropriate set of phenomena, they will be a worthwhile endeavour. Causal explanation, as Humboldt observed, is a process of abstraction, of carrying over the phenomenal laws into the light of the conceptual realm ("in das Lichtreich des Gedankens (eines denkenden Erkennens der Natur) übertragen", Humboldt, 1845, vol. III, p. 26 f).

Nonetheless, Humboldt believed that the combination of an aesthetic and holistic outlook with systematic observation of empirical patterns by means of comparative measurements will ultimately provide a deeper insight into the plan of nature than the refined abstraction of causal explanation could achieve. Some of the most important relations in nature are not of a causal kind. The common, lawful, eternal bond entwining all nature is not exhaustively described by identifying causal relations.

Herschel certainly did not have a difficulty with the notion of a plan of nature as such, but he had an issue with how that plan is to be revealed—and with Humboldt's notion of what constitutes that plan in the first place. Humboldt suggested that even the uninstructed mind will intuitively grasp the most important relations in nature. In contrast, Herschel believed that "the hidden powers which work beneath the surface of things" (1857, p. 271), namely physical causes, will have to be methodically traced, and that doing so requires the development of appropriate skills, which, if properly applied, will allow one to infer the design of nature and the will of its author. In other words, where Humboldt saw nature's purpose revealed in nature's workings, as

[21] Intriguingly, this claim about the limitations of the physical sciences was added to the English via the French edition of the *Kosmos* by the author and cannot be found in Humboldt (1845); see the modifications of (ibid., vol. I, p. 31 f) in Humboldt (1849, p. 32 f) and the editor's remarks on p. [x]. It is however this very claim that Herschel quotes, with critical intent, in (1857, p. 272 f).

he believed nature as such and in itself to be purposefully organised, Herschel believed, in Newton's wake, that one should aim for insight into a higher, divinely created and externally teleological causal order of nature that is not quite as directly revealed in the phenomena (Herschel, 1830, p. 43). Nor could that order be revealed by merely generalising over phenomena that have an appearance of being related, however finely crafted the modes of uncovering and recording the relations between appearances may be.

Where Humboldt believed that the human mind itself, by its very nature, would provide for the "combination of impressions connected with each other by unperceived links of secret analogy" (as quoted in Herschel, 1857, p. 270), Herschel assumed that sensual impressions and reasoning by analogy will be of no help or even misguiding in a world where physical powers hitherto unknown are connecting kinds of phenomena that are entirely unrelated in appearance. The quest should thus be for true causes, Herschel's famous *verae causae*, that can be proven to be at work and thus provide for the genuine relations between such phenomena. Any science that abstains from a quest for *verae causae* would ultimately remain a superficial affair—even if as empirically rich and comprehensive as Humboldt's.

An implication, if not a corollary of this divergence in interpretation of empirical and causal laws lies in the role and importance that is given to historical analyses, which becomes apparent in the disagreement about the historical scope of geology between Humboldt and another significant influence on Darwin: Charles Lyell. Lyell's view of nature is deeply historical, in that he is concerned with how current geological formations came into existence, and how they shaped biogeographical patterns. However, that historical perspective relies on the presumption of a uniformity of causes that, throughout history, have shaped the patterns in question. Already in the subtitle of Lyell (1835), *Principles of Geology: Being an Inquiry how far the former Changes of the Earth's Surface are Referable to Causes now in Operation*, his programme is made explicit: unlike many earlier geologists, Lyell maintained that the same causes that are now observable have been at work in building the most ancient formations and strata (ibid. p. xi). It is not only that the causal laws have been the same all along, they also have been expressed in the same fashion, providing for processes of gradual transformation rather than abrupt changes. As already indicated, Humboldt saw too much uncertainty in historical explanations and thus did not inquire into relations between geological history

and the currently observable patterns with which he was concerned.[22] That uncertainty is based on an uncertainty about causal patterns: unless one assumes that causal laws are not only *universal*, in terms of remaining unchanged as such over different times and places, but also operate in *uniform* manner throughout, so that contextual conditions can be systematically dispensed with, all history will remain confined to being a narrative of a sequence of, more or less contingent, events.[23]

The case for the universality of causal laws relies on the hypothetical assumption of conditions in nature that never really obtain (e.g., a perfect vacuum). Whenever one systematically removes interfering contextual conditions, the same patterns will emerge. If uniformity is granted above and beyond universality, causal laws will sufficiently explain the currently observable phenomena. On Humboldt's view, on the other hand, universality of laws of nature is compatible with non-uniformity. As indicated above, his universal laws are not causal laws in the first place, but are warranted on a different, metaphysical level and are revealed in patterns of local phenomena. It is thus perfectly conceivable that local conditions not only modify the expression of universal laws, but *are* their expression. It is this interplay between universal laws and local conditions, as they are observable and measurable, that Humboldt was interested in, not the idealisation and abstraction from local conditions that is a prerequisite for any causal account and that might get in the way of revealing a number of crucially important relations in nature.

Although Lyell's causal account of the history of the earth does include biogeographical patterns, it does not include the purposeful organisation of life as such, which is referred to fixed types and a notion of adaptedness that echo the Aristotelian view of life. In important respects, life is thereby exempted from Lyell's causal-historical account. This, theoretically incoherent, exemption was based on metaphysical presuppositions that put the living world out of reach of causal explanations per se (see Depew & Weber, 1995, p. 107).

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[22] See, for example, the observation in Egerton (1970) that Humboldt was little concerned with stratigraphy in geology, but only with contemporaneously observable phenomena, which Egerton sees as a limitation to Humboldt's account of populations.

[23] For the relation between the notions of universality and uniformity, see Daston (2010, especially p. 53) and Depew & Weber (1995, p. 95 f), who contrast the causal histories of uniformitarian with the narrative histories in catastrophist geology. For Lyell vs. Humboldt on history and the issue of uniformity of causes, see Hodge (2009, p. 33).

Perhaps ironically, it was Darwin's thorough adoption of Lyell's causal uniformitarianism that resulted in an explanation of species change and thus a genuinely historical account of what had been exempted from the historical realm.

5. Synthesis

On the background of the observations in the preceding sections, the Darwinian tension can be stated as follows: on the one hand, Darwin adopted a notion of a universal and uniform order of nature that allows for causal-historical explanations (as Ruse, 2004, insists), yet without buying into the external teleology that, to Herschel and Lyell, first warranted that order. On the other hand, he adopted the Humboldtian and the general romantic view of nature that emphasises its complexity, integration and goal-directedness, and he inherited the aesthetically refined techniques of approaching his subject of investigation (as Richards, 2002, claims and Ruse denies), yet without taking for granted an internal teleology that first warranted for nature's purposes (unlike Richards suggests).

That Darwin kept a distance from either notion of teleology does not imply that he was the sceptical materialist he is often made out to be. The uneasy combination of the causal and the romantic views rather made him a seeker of a synthesis that, in consequence and possibly unintentionally, undermined the metaphysical presuppositions on either side. Darwin's synthesis was motivated by a desire to account both for the specific patterns of the animate world and the possible causes underlying those patterns, in a theory that was causal and historical and holistic at the same instance.

The universal and uniformly operating cause identified by Darwin was natural selection working on heritable traits. That cause is modelled on two sources: firstly, the art of breeding, where a common practice is to select favoured adult individuals for further breeding. This analogy, derived from Darwin's own breeding experiments, delivered the basic principle of selection. Secondly, as the mechanism to realise that principle in nature, Darwin adopted and adapted Malthus' putative law that population increase is kept in check by the limitation of resources. That limitation results in a struggle for existence between the individuals in that population, so that those variant individuals within a population that have been produced in excess of the means of sustenance, and that match the present conditions of existence to a lesser

extent than other individuals, will not reproduce.[24] Inheritance and variance would also give rise to a second important regularity: a prima facie coincidental divergence in character, under a given set of conditions of existence, may lead to functional diversification—which, in turn, was modelled on the Smithian concept of the division of labour in a market economy.[25] Natural selection and functional diversification were supposed to act as external environmental forces on individuals and populations with the necessity and determinacy of a causal law of nature.

What motivated Darwin's synthesis between the Humboldtian-romantic image of nature and causal explanations modelled on a mechanistic view of nature was an epistemological problem raised by the empirical practice of the naturalistic inquiries of his day: the purpose of these inquiries was to identify some of the deeper regularities in animate nature. In order to do so, they had to rely on at least some patterns of development that remain unchanged, lawful, and eternal—whether they were established by divine creation or by the dynamic, self-organising properties of nature. The explananda of those inquiries were the places and interrelations of individuals in the natural order, not the natural order as such. However, the very same inquiries brought up evidence that called into question the fixity of what had been considered the paradigm of natural kinds by many: biological species. Where variation had been expelled from the realm of scientific explanations as contingent effects and anomalies, it now became the very object of attention.

In the face of the arising difficulties, the methodically refined intuitions that were so helpful in perceiving and describing nature would not offer a viable starting point for its explanation. To Darwin, a way of overcoming this impasse was to suggest to the naturalist that his "reason ought to conquer his imagination", encouraging him to start from assumptions that actually *counter* natural intuitions about design in nature: purposeful structures in nature may arise without the guidance of any kind of teleology, internal or external, but

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[24] See Malthus (1826). For his references to Malthus, see Darwin (1859, pp. 5, 67); Darwin (1905, p. 68); Darwin (1909, pp. 7 f, 88 ff).

[25] See Smith (1789). The Smithian sources are not nearly as expressly mentioned by Darwin as the Malthusian ones, as they appear to have worked via indirect routes. These routes have been carefully reconstructed by Schweber (1980). An explicit link between divergence of character and the concept of division of labour is made in Darwin (1859, pp. 93, 112 f). For arguments in favour of an interaction of Malthusian and Smithian insights in Darwin's conception of natural selection, see also Gould (1993, p. 148 ff); Depew & Weber (1995, pp. 7–9, 81 f).

may be explained by laws of nature (Darwin, 1859, p. 188). The "deep organic bond" connecting all forms of life, and the adaptive complexity they display, were now open to a type of empirical investigation that did not presuppose those qualities but had a chance of demonstrating how they came about.

Exactly this is where Darwin's romantic-*Naturphilosophical* paradigm of observation complements his quest for laws of nature. If animate nature had been explained by laws of necessity in the same vein as physical phenomena, either the complexity of interrelations and the phenomenal richness of the explanandum would have been lost in simplification, or the mechanism of explanation, by overextending its scope, would have been powerless in accounting for that richness. The initially counterintuitive point of Darwin's doctrine is that the struggle for existence, in its very simplicity, harshness and utter disharmony, *explains* the complexity of natural adaptations whose purposeful structures and whose aesthetic qualities, both in beauty and sublimity, exceed anything human craftsmanship could achieve. This is where romantic, *Naturphilosophical* intuition, moving from likeness to subtle likeness, detecting patterns of similarity by means of a perceptual apparatus refined by aesthetic *Bildung* and practice, could not go by itself.

Just as Darwin's quest for a causal explanation countered romantic indifference towards causes, the outlook and the techniques of perception and observation that he inherited from that tradition provided him with the sensitivity and the perspective that were necessary for carefully carving out the domain of the explanandum in the first place, including its aesthetic and normative qualities. It was the methodically refined romantic view that made the history of the animate world amenable to an explanation that at least, and at last, approximated the standards of a science that, in spite of its claims for universality and uniformity, would not dare to embark on a quest for a causal history of the animate part of nature on its own.

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