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Darwin teleologist? Design in the *Orchids**Darwin téléologue ? Le problème du dessein dans Les Orchidées*

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## ABSTRACT

Focusing on the *Orchids*, this article aims at disentangling the concepts of teleology, design and natural theology. It refers to several contemporary critics of Darwin (Kölliker, Argyll, Royer, Candolle, Delpino) to challenge Huxley's interpretation that Darwin's system was "a deathblow" to teleology. The *Orchids* seem rather to be a "flank-movement" (Gray): it departs from the Romantic theories of transmutation and the "imaginary examples" of the *Origin*; it focuses on empirical data and on teleological structures. Although Darwin refers to natural selection, his readers mock him for his fascination for delicate morphological contrivances and co-adaptations – a sign that he was inescapably lured to finality. Some even suggested that his system was a "theodicy". In the history of Darwinism, the *Orchids* reveal "another" quite unexpected and heterodox Darwin: freed from the hypothetical fancies of the *Origin*, and even suggesting a new kind of physico-theology.

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## R É S U M É

Parues trois ans après l'*Origine des espèces*, les *Orchidées* de Darwin précisent la place de la téléologie dans la nature (la perfection des « dispositifs » et des « designs »). Cet article analyse les interprétations proposées par différents contemporains de Darwin (Kölliker, Argyll, Royer, Candolle, Delpino). Il conteste l'alternative simpliste proposée à la suite de Huxley (Darwin a-t-il ou non détruit la téléologie ?). Les *Orchidées* constituent plutôt un « mouvement tactique » (Gray) qui laisse entrevoir « un autre Darwin » : abandon du transformisme spéculatif pour des recherches empiriques ; intérêt pour les structures téléologiques qui séduit ses contemporains en semblant réintroduire en contrebande une certaine finalité dans la nature. Darwin, s'occupant de « dispositifs » morphologiques raffinés, les explique par la sélection naturelle, mais paraît pris au piège de la téléologie : il attribue des fonctions aux structures et identifie de « merveilleuses co-adaptations ». Plusieurs n'hésitent pas à y voir le fondement d'une nouvelle « théodicée ».

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## 1. Introduction

After the publication of the *Origin of species* in 1859, the book was much debated and often rejected as lacking empirical background: Richard Owen (1804–1892) made fun of the fanciful example of a swimming black bear

susceptible to becoming a whale, while other critiques were challenging the "imaginary examples" which were the only possible application Darwin offered his readers in his book [1,2]. For physiologists like Claude Bernard (1813–1878), Darwin was a "transmutationist", a disciple of Lorenz Oken and an instance of Romantic "Naturphilosophie" [3: 140]. Even "Darwin's bulldog", Thomas Huxley (1825–1895), in his first review on "The Darwinian hypothesis" (1859), revealed how difficult it was "to affirm

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absolutely either the truth or falsehood of Mr. Darwin's views at the present stage of the inquiry": a state of mind, Huxley called, after Goethe, "*Thätige Skepsis*, active doubt". Huxley "commend[ed] this state of mind to students of species, with respect to Mr. Darwin's or any other hypothesis, as to their origin" [4: 20]. One can infer that Darwin decided to meet this challenge and to give empirical proofs of natural selection.

Similarly, Darwin's readers questioned the limit of the applicability of his theory. French botanists did not believe in evolution by selection: most of them (like Joseph Decaisne, 1807–1882) followed closely in the footsteps of their secretary P.M.J. Flourens (1794–1867): they clearly distinguished variability and transmutation and thought Darwin had confused the two [5]. The field of experimental culture was very vivid (especially with Louis de Vilmorin, 1816–1860) and Darwin's *Origin* was understood as contradicting Charles Victor Naudin (1815–1899)'s and Dominique Alexandre Godron (1807–1880)'s studies, which were probably more influential than Darwin on the community of plant breeders [6–8]. However, his botanical works endured a much better reception than the *Origin* among French botanists. Quite similarly, the Oxford botanist Charles Daubeny (1795–1867) recommended "to Naturalists the necessity of further inquiries, in order to fix the limits within which the doctrine proposed by Darwin may assist us in distinguishing varieties from species" [9,10].

How did Darwin answer those critics? He was at the time well known among academic circles: a Fellow of the Royal Society since 1839, already famous for his works on geology and zoology, related to his circumnavigation on H.M.S. Beagle, for his theory of atoll formation and his thorough study on the barnacles (*Cirripedia*). Darwin immediately after the *Origin* undertook an immense investigation on the causes, laws and characters of variation, this "grand and almost untrodden field of inquiry" [11: 486], to which he had devoted the fifth chapter of his book. As he wrote to Daniel Oliver in October 1860: "I am convinced that I ought to work on Variation and not amuse myself with interludes." [12: 440] Strikingly enough, it is in the field of botany that he will publish, three years later, a new book, to answer the universal skepticism with which his *Origin* was met. If, among others, his work on the sexual dimorphism in the genus *Primula* had opened the way in 1861 [13], Darwin devoted a careful study in 1862 to the anatomical structures related to the fecundation of orchids. But rather than going straight to the point of natural selection, Darwin gave to his new book a long and convoluted title: *On the Various Contrivances by which British and Foreign Orchids are Fertilised by Insects, and the Good Effects of Intercrossing* (1862) [14]. A second edition will be published later with an abridged title: *The Various contrivances by which orchids are fertilised by insects* (1877) [15].

Why did Darwin put forth the concept of "contrivances", if his goal was plainly to give support to the theory of natural selection? Why, if not to bring back teleology into the biological picture?

But what does teleology mean? There has been considerable discussion of the meaning of this word in

recent literature: teleology is commonly distinguished from teleonomy, both words being ambiguous [16, 17: 47–51, 18]. Furthermore, teleology implies two different questions: the description of contrivances and structures exhibiting design; and the inference from the existence of design in nature to an overall powerful designer. The classic Darwinian theory explains the presence of design in the structure of organisms as the unexpected outcome of a blind process: this is what Michael Ruse calls "the organism-as-if-it-were-designed-by-God picture" [19: 122]. But teleology is also a debated matter, since, in the tradition of physico-theology, contrivances necessarily lead to the existence of a contriver. Therefore, once the presence of some sort of teleology is accepted in nature, one has to wonder: are teleology and design two synonyms? Do the teleological features of organisms indicate the existence of a Designer?

In fact, four different tenets must be clearly distinguished:

- the problem of teleology (perfection of contrivances in nature);
- the problem of dysteleology (imperfection in nature);
- the problem of the argument from design (inference from perfection to an intelligent designer);
- the problem of natural theology (inference from natural facts to a perfect God).

That Darwin has always been especially interested in "wonderful contrivances" and "beautiful devices", is well known. It has often been emphasized that, as a student, Darwin admired William Paley (1743–1805)'s *Natural theology* and that, as a consequence, his work strongly focuses on the "beautiful adaptations" in nature [20]. Darwin's position towards theology has also been intensely commented: it is well known that Darwin's "descent with modification" is a refutation of the theory of "special creations", and yet Darwin refers to some "laws impressed on matter by the Creator" [11: 488]. Far from giving the expected experimental proofs of natural selection, or evolution by transmutation, the *Orchids* describe the structure of these flowers in a teleological fashion. Many of its readers have underlined the presence of design in the Darwinian conception of nature, calling Darwin a "teleologist", even interpreting his thought as a new framework for natural theology. They have seen the "wonderful contrivances" of the flowers in orchids as bridging the gap from a design to a designer.

My article will try to understand how such interpretations have been possible: Darwin's *Orchids* support various and, at times, contradictory interpretations. Quotations are borrowed from it and played against the usual understanding of the *Origin* [2]. Through the *Orchids*, another (unexpected) Darwin appears, which might be understood as a thorough "teleologist". If this article focuses on some "ambiguities" in Darwin's theory, I have to stress, as did David Kohn, that "my own purposes are not ambiguous": they are to give a better understanding of the context of evolutionary thought, and to clarify the constituents of Darwin's theory by confronting them to some contemporary readings [21].

## 2. Beautiful contrivances in nature

### 2.1. Kölliker vs Huxley: teleology in the Origin?

The suspicion that Darwin was a teleologist predates the publication of the *Orchids*. In a review of the *Origin*, the anatomist and histologist of Würzburg R. Albert von Kölliker (1817–1905) claims that Darwin is a teleologist, pure and simple:

“Darwin is, in the fullest sense of the word, a Teleologist. He says quite distinctly that every particular in the structure of an animal has been created for its benefit (*zum Besten desselben*), and he regards the whole series of animal forms only from this point of view.” [22: 175].

And again:

“The teleological general conception adopted by Darwin is a mistaken one.” [22: 178].

Basing his argument on the interpretation of two pages of the *Origin* [11: 199–200] where Darwin examines the “utilitarian doctrine that every detail of structure has been produced for the good of its possessor”, Kölliker blames Darwin for being a teleologist and claims:

“The assumption that an organism exists only on account of some definite end (*Zweck*) in view, and represents something more than the incorporation of a general idea (*Gedanken*), or law, implies a one-sided conception of everything that is. Assuredly, every organ has, and every organism fulfils, its end, but here is not the principle (*Grund*) of its existence. Every organism is also sufficiently perfect for the purpose (*Zweck*) it serves, and in that, at least, it is useless to seek for a principle of its improvement.” [22: 178].

If natural selection is altogether a utilitarian doctrine, then Darwin contradicts the general principle that “varieties arise irrespectively of the notion of purpose, or of utility, according to general laws of Nature, and may be either useful, or hurtful, or indifferent” [22: 178]. This sentence might sound essentially Darwinian to us, but it seems to Kölliker that Darwin *denies* the existence of purposeless variations. In fact, Kölliker does not acknowledge what Ernst Mayr called “the two-step process” in the Darwinian theory [23: 16, 24: 770], and he has difficulties understanding how natural selection operates and what is the extent of its agency. But Kölliker is also most forcibly raising the question of the relationship between natural selection, utility and design. Darwinism is classically understood as contrary to the teleological reading, as in Thomas Henry Huxley’s answer to Kölliker:

“According to Teleology, each organism is like a rifle bullet fired straight at a mark; according to Darwin, organisms are like grapeshot of which one hits something and the rest fall wide.

For the teleologist an organism exists because it was made for the conditions in which it is found; for the Darwinian an organism exists because, out of many of its kind, it is the only one, which has been able to persist in the conditions in which it is found.

Teleology implies that the organs of every organism are perfect and cannot be improved; the Darwinian theory simply affirms that they work well enough to enable the organism to hold its own against such competitors as it has met with, but admits the possibility of indefinite improvement. But an example may bring into clearer light the profound opposition *between the ordinary teleological, and the Darwinian, conception.*” [4: 84–85, *emphasis added*].

Huxley underscores here the opposition between Darwinism and teleology. Undoubtedly, Darwin rejects any consideration of the final causes as it was for instance understood by Charles Daubeny: for Daubeny “the final cause of the existence of sexual organs” was to be found in several “ends” or “purposes” that those structures fulfilled (dissemination of the species, gratification of the senses of man by the beauty of the flowers, promotion of variation...) [9]. But Huxley nevertheless opens the door for what we could call a “not-ordinary” conception of teleology: the “Darwinian” one. And this is precisely what Kölliker’s rebuttal targets.

### 2.2. Perfect adaptation and special design in Orchids

If we get a closer look at the *Orchids*, we might understand in what sense Darwin is or is not to be understood as a teleologist. As early as the first sentence of the introduction, he observes how the “contrivances” in orchids are “as varied and almost as perfect as any of the most beautiful adaptations in the animal kingdom” [14: 1]. The contrivances depicted are complex and intensely teleological. In the case of the bee-ophrys:

“When we consider the unusual and perfectly-adapted length, as well as the remarkable thinness, of the caudicles of the pollinia; when we see that the anther-cells naturally open, and that the masses of pollen, from their weight, slowly fall down to the exact level of the stigmatic surface, and are there made to vibrate to and fro by the slightest breath of wind till the stigma is struck; it is impossible to doubt that these points of structure and function, which occur in no other British Orchid, *are specially adapted* for self-fertilisation.” [14:65, *emphasis added*].

Teleology appears to be important in Darwin’s text, since it pervades every description he gives. However, at the same time, the contrivances in orchids can be interpreted as the outcome of nature’s “tinkering”. François Jacob’s concept of tinkering [25] explains that evolution works on preexisting structures, which constrain its creative process. As a “tinkerer”, nature reemploys structures that are present and do not necessarily fulfill any purpose. Those structures are available for further uses, provisions that have been made, “just in case”. Darwin’s orchids provide many examples of such devices: the substance that glued the pollen on the stigmata could, after some slight modification, stick the pollen to the body of insects and thus allow crossed fecundation; the nectar, which attracts insects, can be traced to an excretory product [15: 265–266]... Many structures that seem

typical of one species (like the *rostellum*) result indeed from the transformation of preexisting organs. Each one can be interpreted as a vestige of an older function:

“Although an organ may not have been originally formed for some special purpose, if it now serves for this end, we are justified in saying that it is specially adapted for it. On the same principle, if a man were to make a machine for some special purpose, but were to use old wheels, springs, and pulleys, only slightly altered, the whole machine, with all its parts, might be said to be specially contrived for its present purpose. Thus throughout nature almost every part of each living being has probably served, in a slightly modified condition, for diverse purposes, and has acted in the living machinery of many ancient and distinct specific forms.” [15: 283–284].

Such contrivances are *specially adapted* to a purpose, without having been *specially designed or created* with this purpose in view. In other words, purpose in nature is no destination. Orchids “exhibit an almost endless diversity of beautiful adaptations”. Nonetheless, “when this or that part has been spoken of as adapted for some special purpose, it must not be supposed that it was originally always formed for this sole purpose. The regular course of events seems to be, that a part which originally served for one purpose, becomes adapted by slow changes for widely different purposes” [15:282].

Those cases of adaptation without purpose have been coined “exaptations” by Stephen Jay Gould and Elisabeth Vrba, to emphasize the absence of pre-determination [26]. Gould’s philosophy of contingency has paid a good deal of attention to those tinkering devices and contrivances. Read in this light, Darwin’s work is an attempt to focus on structures, which would remain incomprehensible in a world ruled by the infallible wisdom of a Designer. On the clumsy foundation of tinkering, and out of the cruel struggle for existence, Darwin can account for perfect adaptations. He thus builds a nomological pattern and transforms biology into a predictive body of knowledge. Ultimately, this will lead to the famous case of the prediction of a butterfly capable of pollinizing an orchid of Madagascar (*Angraecum sesquipedale*) [15: 165–166].

### 2.3. Useless structures

However, perfect adaptations are by no means a universal rule. Darwin opens up the possibility that some detail of structure has no adaptative significance. Michael Ghiselin in his edition of the *Orchids* (1984) points out that “Darwin’s basic manner of reasoning is probabilistic”: “If all the parts are intricately arranged in such a manner that the proposed function can be carried out, then the reconfiguration is not likely to have been coincidental. But the possibility that some detail of structure has no adaptative significance must also be considered” [27: 15]. Among “useless” organs, “vestigial organs” were functional in some ancestor but now exist as mere remnants. Other “useless” organs can be related to the correlation of growth. Analyzing the structure of the labellum, Darwin details its morphological features, and how “by these

several means insects are forced to brush against the *rostellum*”; but he immediately adds:

“We must not, however, suppose, that every detail of structure in the labellum is of use: in some instances, as with *Sarcanthus*, its extraordinary shape seems to be partly due to its development in close apposition to the curiously shaped *rostellum*.” [15: 276].

An organ might also lose any utility and remain only in a rudimentary form, such as male organs in female flowers.

The question of utility is linked to the question of symmetry – an issue raised by Augustin-Pyramus de Candolle (1778–1841), in the first edition of his *Théorie élémentaire de la botanique* [28]. For Candolle, if a part does not serve any purpose in the organism, then far from refuting the idea of a general order of nature, it most contrarily serves as a strong argument in favor of it. The § 150 of the second edition develops the idea: Nature is like a nicely dressed table, a “*brillant banquet*”; anatomy teaches that each meal is well prepared and physiology adds that each meal is perfectly adapted to each participant. But, Candolle adds, there are also some fake meals (*simulacres*), which have been added for the sake of symmetry. Candolle strongly emphasizes that natural *designs* are not necessarily *teleological*: “conclusions drawn from symmetry correct in great part what is defectuous in the theory of the final causes” [29: 186]. According to Candolle, arguments to a wise Designer can be drawn not only from the consideration of teleology in nature, but also from useless parts: those useless parts manifest a divine Intelligence caring for symmetry. In Candolle’s theory of botany, this argument from symmetry has also an anti-transformist flavor. Individual variations, though numerous among plants, don’t evince any “non-permanence of species”. On the contrary, once the permanence of species has been denied, Candolle observes, naturalists often tend to make finalist (read: silly) claims, such as “man has a nose because he blows it”: this “dangerous pyrrhonism” has to be avoided, and naturalists should rather learn to identify “the possible causes of the variations among beings” [29: 195–196].

Darwin alludes several times to Candolle’s simile, always with a strongly critical accent. First in the 1842 Sketch, he simply mentions “De Candolle’s analogy of table covered with dishes” and writes on back of the page:

“I repeat, these wondrous facts, of parts created for no use in past and present time, all can by my theory receive simple explanation; or they receive none and we must be content with some such empty metaphor, as that of De Candolle, who compares creation to a well covered table, and says abortive organs may be compared to the dishes (some should be empty) placed symmetrically!” [30: 47].

Then, most explicitly in the end of the *Essay* of 1844, Darwin refers to the “loose metaphors as that of De Candolle’s, in which the kingdom of nature is compared to a well-covered table, and the abortive organs are considered as put in for the sake of symmetry!” [30: 238]. In the *Orchids*, Darwin implicitly refers to Candolle’s simile without the slightest regard:

“At a period not far distant, naturalists will hear with surprise, perhaps with derision, that grave and learned men formerly maintained that such useless organs were not remnants retained by the principle of inheritance at corresponding periods of early growth, but were specially created and arranged in their proper places like dishes on a table (this is the comparison of a distinguished naturalist) by an Omnipotent hand ‘to complete the scheme of nature’.” [14: 244, 15: 203].

### 3. Critical readings of the *Orchids*: the return of teleology?

Viewed with the contemporary eyes of readers such as Gould or Ghiselin, it might seem that the case of an alleged “Darwin teleologist” has been clearly and definitely solved: T.H. Huxley’s reading has prevailed against A. Kölliker’s. But in fact, Kölliker’s argument has also been raised again by James Lennox [31,32], or critically analyzed by Michael Ruse [19]. Indeed, the interpretation of Darwin as a teleologist is not a weird thesis linked to Kölliker’s flawed understanding of *The Origin*. It was a very common reading of Darwin’s works in the 19th century, especially when it comes to the *Orchids*. I will give three examples of readers convinced that the book clearly evinces that Darwin was a teleologist through and through: Alphonse de Candolle’s critique, Federico Delpino’s praise, the Duke of Argyll’s mockery.

Geneva botanist Alphonse de Candolle (1806–1893), son of Augustin-Pyramus, but favourable to the idea of evolution and to the “philosophical spirit” of Darwin, regrets that his British colleague made use of expressions such as “their corollas have been increased for that special purpose”, where he should have written, most plainly: “their corollas being increased in size, the consequence is, etc.”. Or instead of “subserve any special end”, “have any effect”. And Candolle adds:

“...since observation only shows forms and consequences or effects, and not purposes or intentions. Our words ‘goal, end’ (*but, fin*), suppose an intention, an external will. And, in order to know an intention, one has to question the one to which this intention has been attributed, or hear him speak up his mind – such events that never occur in natural phenomena.” (Alphonse de Candolle to Darwin, 31 July 1877 [33: 147–148]).

Candolle aptly notes an ambiguity in the English vocabulary: the words *Purpose* and *End* “have two contradictory meanings”, suggesting either a “premeditated goal”, or “an effect, a cause, a result”. Probably, translators did not pay enough attention to this difficulty and this will cause “a confusion of ideas”. Words entail a necessary vagueness, and that is why Candolle urges Darwin to avoid any expression that would betray the supposition of intentions in nature, if he really is to pursue methodically causes and effects in nature.

Italian botanist Federico Delpino (1833–1905) is also an interesting case of a naturalist who debated with Darwin without abandoning finalism. Darwin tacitly encouraged Delpino in his attempt to reconcile teleology and natural selection. As G. Pancaldi phrased it:

“It is no surprise that Delpino was a great admirer of the [*Orchids*] and together a critic of the *Origin*. He found in the first the description of numerous phenomena which appeared in harmony with his teleological interpretation of nature; in the latter, he found an implicit *philosophy of nature* inconciliable with his views.” [34: 25].

Delpino’s program was twofold: to enlarge the study initiated by Darwin in the *Orchids* and to amend the Darwinian theory of the *Origin* in the light of teleology. He took teleology as a simple way to fight against the invasive system of materialism. As Pancaldi has showed, his twofold program led Delpino to two different works: his teleological ideas were summed up in an article on the organs of fertilisation in phanerogams, published in German [35], while the battle on ideological and philosophical fields was led in the *Pensieri sulla biologia vegetale* [36].

George John Douglas Campbell, Duke of Argyll (1823–1900), also commented the *Orchids*, first in “The Supernatural”, an article published in the *Edinburgh Review* (1862), and then, in his *Reign of law* (1867) [37: esp. 38–40]. According to Argyll, it is striking that Darwin pays a great deal of effort to find out “the use, object, intention or purpose of the different parts of the plant” but that he does not try to discover “how those parts were made, and out of what materials”:

“Now, it is very remarkable that of these two questions, that which may be called the most abstract and transcendental – the most nearly related to the Supernatural and the Supermaterial – is again precisely the one which Darwin is able to solve most clearly. We have already seen how well he solves the first question – what is the use and intention of these various parts? The next question is, What are these parts in their primal order and conception? The answer is, that they are members of a numerical group, having a definite and still traceable order of symmetrical arrangement. They are expressions of a numerical idea, as so many other things – perhaps as all things – of beauty are.” [37: 43].

Argyll has an easy business underscoring the contrast between on the one hand Darwin’s clarity and eloquence when it comes to identify “the use and intention of the various organs” or “the primal idea of numerical order and arrangement which governs the whole structure of the flower” and, on the other hand, his embarrassment as soon as he has to account for the origin of variations and explain how this or that organ was formed by means of natural selection. Argyll remarks how Darwin describes with much accuracy many devices and how he is prompt and even neglectful in attributing intentions to nature.

“‘Caution in ascribing intentions to nature’ does not seem to occur to him as possible. Intention is the one thing which he does see, and which, when he does not see, he seeks for diligently until he finds it.” [37: 40].

It is not without an ironical grin that Argyll feigns to be surprised that the words describing intentions and mental

purposes are so numerous in the instinctive vocabulary of Darwin, “this most advanced disciple of pure naturalism” [37: 40]. And therefore, the *Orchids* appear to be the crux of Darwinian teleology, while actively supporting the principle of natural selection: “If an organ is largely developed, it is because some special purpose is to be fulfilled. If it is aborted or rudimentary, it is because that purpose is no longer to be subserved.” [37: 42]. We understand that the teleological reading of the organism is grounded in the convertibility between the utility of an organ and the attribution of a purpose to this organ. It leads to intermingling the effects of natural selection (understood as a principle of economy) together with the effects of use and disuse: what is useful is developed, what is not useful aborts. Argyll’s interpretation helps us understand that Darwin is wavering on the question of the utility of the organs, since natural selection itself seems to entail a utilitarian reading of the organism, as in the famous definition that Darwin gives in the chapter 4 of the *Origin*: “I have called the principle, by which each slight variation, if useful, is preserved, by the term Natural selection” [11: 61, emphasis added].

Against the Darwinian conception of an ex-post utility (an organism *proposes* a structure and natural selection *disposes*, acknowledging or rejecting it according to its utility), Argyll claims that utility is not the agency of a physical cause acting on preexisting organs, but that it is linked to a *Motive as a mental purpose*, aiming at *contriving* organs before they come into existence. In other terms, the only *bond* uniting inner and outer correlations is identified to “the Bond of Creative Will, giving to organic forces a foreseen direction” [37: 274]. For Argyll, “contrivance” is simply “a necessity arising out of the reign of law” [37: 128].

#### 4. Darwin as a natural theologian?

All these diverse readings come from an ambiguity in the book itself, in its phrasing if not in his theory: several Darwins are included in Darwin’s own texts, perplexing both opponents and supporters of Darwin. Argyll ironically rejoices of unexpected convergences with Darwin’s views; while supporters of the Darwinian naturalistic view deplore that their champion’s position is not always fully consistent. It seems that Darwin has not always been fully aware of the philosophical consequences of his view or, at least, that he consciously played an ambiguous part, what Asa Gray will call: “a flank-movement”.

##### 4.1. The *Orchids* as a Bridgewater treatise?

In September 1861, Darwin describes the project of *Orchids* to his publisher John Murray:

“The facts are new and have been collected during 20 years and strike me as curious. Like a Bridgewater Treatise the chief object is to show the perfection of the many contrivances in Orchids. The subject of propagation is interesting to most people, and is treated in my paper so that any woman could read it. Parts are dry and purely scientific: but I think my paper would interest a

good many of such persons who care for Nat. History, but no others.” (Darwin to Murray, 21 September 1861) [38: 273].

This reference to the Bridgewater treatises refers to the series of eight works published between 1833 and 1836, in order to exhibit “the power, wisdom and goodness of God, as manifested in the creation”. Does this mean that the *Orchids* are a Bridgewater treatise, giving a perfect example of natural theology, or merely that it shares with them an obsession with explaining perfection? A second letter, three days later, is even more ambiguous. Darwin wonders who the public for his book is going to be:

“I have had some qualms and fears. All that I can feel sure of is that the M.S. contains many new and curious facts & I am sure the Essay would have interested me, & will interest those who feel lively interest in the wonders of nature: but how far the public will care for such minute details, I cannot at all tell. It is a bold experiment. . .”

And a few lines later:

“I think this little volume will do good to the *Origin*, as it will show that I have worked hard at details, and it will, perhaps, serve to illustrate how natural history may be worked under the belief of modification of species.” (Darwin to Murray, 24 September 1861) [38: 278–279].

In fact, none of these declarations can be taken for an accurate or neutral description, since Darwin is only trying to convince Murray to publish his text. Both the reference to the *Bridgewater treatises* and to a follow-up to the *Origin* are instrumental in demonstrating that the *Orchids* has a chance to sell well. But interestingly enough, Darwin makes use of both sides of the argument: the *Orchids* are like a *Bridgewater treatise*, which describes the wonders of nature and pays a great deal of attention to minute details; and at the same time, as a follow-up to the *Origin*, it illustrates the idea of the modification of species that Huxley among others has interpreted as antiteleological.

Therefore, the relation between the *Orchids* and the *Origin* is an ambiguous one: on the one hand, it manifests a movement from general hypothesis to particular facts; it can be an illustration or an application of the general doctrine of modification of species (note that Darwin does not refer here explicitly to the theory of natural selection); but on the other hand, it has a strong appeal not only to teleology but to the theological argument from design.

##### 4.2. Contrivances and their Contriver

What is the meaning of the word “contrivance” in the title of the *Orchids*? When contrivances are around, natural theology is not far. The word does not only emphasize the teleological nature of the organisms, it also brings back the whole framework of physico-theology: William Paley’s argument from design, which ties closely together the observation of a design and the inference of a powerful designer. Michael Ghiselin has suggested that the word “contrivance” in the title indicates a kind of “satire on natural theology”. But saying so, he strongly contradicts a

long tradition which has been asserting that, with the *Orchids*, Darwin somewhat brought teleology – if not design – back into biology. For instance, according to Michael Ruse, the title of the *Orchids* “flags the fact that it is teleological through and through” [19: 121].

However, if the presence of some sort of “design” (teleology or perfection) in anatomical structures is undeniable, the question of the argument from design is different: Darwin, relying on natural selection as a mechanism producing economy, acknowledges the existence of apparent design or perfection in natural beings; but does he infer a God from this teleological features? One has to distinguish here several kinds of natural theology. William Paley gives the traditional account of the argument from design: a perfect contrivance is a sufficient indication of a perfectly wise Contriver, in so much as its features are perfectly adapted to its functions. With Augustin-Pyramus de Candolle, Nature is depicted as a nicely dressed table and Paley’s argument *from perfect designs* is turned into an argument *from symmetry*: it is not only the purposefulness or the usefulness of an organ, or the perfect adaptation of means to ends which is an indication of a Creator; even rudimentary organs, deprived of any purpose, indicate an intelligent order if they follow a symmetrical disposition: and wherever order reigns, there is some intelligence who has taken care of it.

In the case of the Darwinian view of nature, order and perfect adaptation of means to ends are still a central focus of the theory but they have to cope with many exceptions. The Darwinian mechanism of natural selection attempts to account for perfection, notwithstanding a certain amount of disorder, which has also to be taken into consideration. Does this imply that Darwin is clearly apart from any theological framework and that the *Orchids* cannot be a Bridgewater treatise in its full sense, but only a satirical form of it?

#### 4.3. Clémence Royer or Darwin as a new kind of natural theology?

The same year the *Orchids* was published, the first French translation of the *Origin* was made available to the public: it is Clémence Royer (1830–1902)’s translation of the third English edition. To the book, is added a very vehement preface, whose final words (“I believe in progress”) are quite famous [39: 63–64]. If someone clearly stood against Christian theologians, and against the idea of a revealed truth, it is certainly Royer. Historians have generally claimed that she was rejected by Darwin for being too much of a radical: in fact, Darwin’s reaction to her translation of the *Origin* was rather positive, Darwin seeming intrigued by the force of character of this “odd” woman:

“Mad<sup>elle</sup> Royer [...] must be one of the cleverest and oddest women in Europe: is ardent deist and hates christianity, and declares that natural selection and the struggle for life will explain all morality, nature of man, politicks etc. etc.!!! She makes some very curious and good hits, and says she shall publish a book on these subjects, and a strange production it will be.” (Darwin to Asa Gray, 10–20 June 1862) [40: 241].

Royer is a strong opponent to Christian clerics, but she nonetheless remains a theist. How does she read Darwin? As to the final causes, Royer’s interpretation is that Darwin rebukes the traditional arguments of the teleologists, but at the same time, she claims that Darwin maintains some kind of inverted teleology:

“Mr. Darwin’s book may be, among those I’ve read, the one which gives the strongest incentive to believe in God, the only book who succeeds in apologizing for the world as it is; it’s an eloquent theodicy in action, which leaves far behind all former attempts of the theologians and of those rhetorical philosophers that Voltaire (to whom everything was permitted in matters of language) called the *final-causers* (*cause-finaliers*).” [39: 33–34].

Thus, according to Royer herself, Darwin does not destroy all kinds of natural theology, only that of the “final-causers”. While rejecting finalism, Darwin proposes a new kind of justification of the world; a new explanation of the harmonies and beauties of the natural world, explained by law – but also an explanation for nature’s defects and blunders. Royer claims that the *Origin* is the base for a new kind of natural theology, which gives also an account for dysteleological features. Darwin’s system clearly evinces that nature is made of both perfection *and* imperfection mixed together, all unplanned effects of blind mechanical or natural causes. The absence of consciously designed contrivances in Darwin’s *Origin* does not entail the end of natural theology: the overall view of nature remains ultimately redemptive. Royer, being an “ardent theist” in the words of Darwin himself, thinks that Darwin proposes the foundation of a new kind of argument from the creatures to the Creator: not an argument from Design (Paley), not an argument from symmetry (Candolle), but an argument from dysteleology.

Other readers of Darwin will give a similar analysis. Strikingly enough, French palaeontologist Albert Gaudry also gives a teleological reading of the *Origin*. In the *marginalia* to Royer’s translation of the *Origin*, he states the following: “Everything that is said on *natural selection* [in Royer’s translation: “*élection naturelle*”] proves the direct intervention of the creator (words crossed out by Gaudry) of God [...] Without this intervention, all [those pages] have no meaning. [...] Reading this book proves God’s continual action” [quoted in 41: 49]. Similarly, the American Alexander Grant considers Darwin both as an Epicurean philosopher *and* a new natural theologian: “the [Darwinian] theory is the theory of Epicurus, with the atheism removed”, since “there is nothing atheistical in Mr. Darwin’s work; on the contrary, it might be described as a system of natural theology founded on a new basis” [42: 275, 281]. For Darwin, everything, whether good or bad, is the result of “designed laws” (Darwin to Asa Gray, 22 May 1860, [12: 224]). Such an expression is hard to understand: Darwin undoubtedly rejects the mere operation of “brute force” or “chance” and operates a reformation of teleology; but once teleology is maintained as the indirect outcome of the laws, is it possible to get rid of Divine Providence?

#### 4.4. Asa Gray and the flank-movement

Harvard botanist Asa Gray, commenting on Royer's interpretation of the Darwinian theodicy, constructs an alternative between their two readings:

"...either she is right, or I am right. I.e. there is design in nature or there is not. The no-design view, if one can bring himself to entertain it may well enough lead to all she says, and we may very much admire how *collission* and destruction of least favored brings about apparently orderly results – *apparent* contrivances or adaptations of means to ends. On the other hand, the implication of a designing mind must with it a strong implication of design in matters where we could not directly prove it. If you grant an intelligent designer anywhere in Nature, you may be confident that he has had something to do with the 'contrivances' in your *Orchids*." (Asa Gray to Charles Darwin, 2–3 July 1862) [40: 292].

Gray misses the point when he opposes his own reading of the *Origin* with Royer's: she is not so far from him.

As to the *Orchids*, Gray adds: "[I] am amused to see how your beautiful flank-movement with the *Orchid*-book has nearly overcome his [George Bentham's] opposition to the *Origin*." This military simile of the "flank movement" is rather intriguing. Gray being a teleologist himself, this cannot be meant, for sure, as an attack against teleology. So Gray's letter supports the idea that the *Orchids* could be interpreted as an answer to some objections with which the *Origin* and its doctrine of the modification of species or the descent with modification was initially met. To the overall enemies of Darwin, the *Orchids* shows what kind of science can be held under the Darwinian paradigm. Among those adversaries of the *Origin*, Bentham had been "greatly agitated" (Hooker to Darwin, 20 December 1859) [43: 437]. As President of the Linnean Society of London, he delivered the Society's Anniversary address on 24 May 1862, in which he declared:

"I do not refer to those speculations on the origin of species, which have excited so much controversy; for the discussion of that question, when considered only with reference to the comparative plausibility of opposite hypotheses, is beyond the province of our Society... But we must all admire that patient study of the habits of life, with that great power of combining facts, which has revealed to us so much of surprising novelty in the economy of nature. The wonderful contrivances for the cross-fertilization of *Orchids*, so graphically detailed in Mr. Darwin's new work, and which rival all that had been previously observed in the singular economy of insect life, had been hitherto unsuspected even by those botanists who had specially devoted themselves to that family." [quoted in 40: 294].

If the *Orchids* are a flank-movement, it is because it leaves the highly debated sphere of the origin, and it restrains its scope to the area of mere observation: it leaves the general mechanisms and pays attention to details. The *Orchids* does not deal with hypotheses, but with facts that

belong intrinsically to the "province" of the naturalist. It is for instance the opinion of the French translator, Louis Rérolle (1849–1928):

"The work here translated has, no doubt, a more restricted scope, since it merely studies one single vegetal family, from the perspective of the phenomena of fecundation. We have seen how the eminent English naturalist, in his other works, leaves a large space for interpreting facts, reasoning and judging as philosopher, formulates some hypotheses that can be combated but whose grandeur must be acknowledged; it will be fair to appreciate this, also in a book where, without losing its other merits, he [Darwin] seems to be especially exact observer and ingenious experimenter." [44: 1–2].

But at the same time, the emphasis on the "wonderful contrivances" brings back most forcibly teleology in nature. And as such, it is not so much an aggressive flank-movement against enemies, than rather a smart move, a friendly hand given to his adversaries. According to Gray, "natural selection is not inconsistent with natural theology" [45: 72–145]. Therefore, the *Orchids* are a "flank movement", insofar as it opens the door for a providential interpretation of nature. As a consequence, it refutes any accusation that the theory of natural selection should be intrinsically materialistic and atheistic. If naturalists as different as Huxley and Gray joined in praising the *Orchids*, it is because their understanding of it greatly differed.

The meaning of the "flank-movement" has been at the heart of the polemic between J. Lennox and M. Ghiselin. For Lennox, "the enemy is not said to be, and *cannot* be, teleology *per se*... [...] the enemy are the authors of the *Bridgewater Treatises* and their followers." [32: 494] The first part of Lennox statement (Darwin teleologist) is true in the sense that he acknowledges designs and contrivances in nature; and that his interpretation of the organic forms strongly relies on a principle of usefulness. But the second part of the sentence is false. The enemy is not so much the *Bridgewater* treatises, as the special creationism. Darwin opposes his view to special creations, but his theory of the modification of species by laws of descent is susceptible of being interpreted as a new ground for physico-theology, as Royer, Grant or Gray suggest. They claim that there is a natural theology, which is truly Darwinian, even though Darwin did not intend to produce anything like it.

Natural theology (or physico-theology) is not synonymous with the theory of special creations. It only refers to any kind of inference from natural facts to the Creator: it is a theological discourse grounded in scientific results (whatever they be). In Darwin's natural theology, God had no foreknowledge of the particular forms that life would take. Everything is operated by the designed laws of nature, which may be the true meaning of brute force. And the proof of God's existence can be based on the apparent perfection resulting from the blind, cruel, severe but legal and designed elimination of imperfections.



**Table 1**  
Some various readings of Darwin's *Orchids* [18].

	For promoting teleology	For undermining teleology	For having founded a new natural theology
Darwin praised	Federico Delpino Argyll (Darwin mocked for not acknowledging it)	T.H. Huxley (for having distinguished two kinds of teleology)	Clémence Royer (laws of progress) Asa Gray
Darwin criticized	Alphonse de Candolle, or A. Kölliker (Darwin puts too much emphasis on the principle of utility).	Von Baer	Al. Grant (it is unsatisfactorily mixed with an Epicurean framework)

## 5. Conclusion

Was Darwin successful in convincing his readership that the descent with modification was no mere fancy of his own mind? It is clear that his botanical work, especially that on the structures of orchids, has been widely read and acclaimed, without implying any acceptance of natural selection or even evolution [10]. In 1878, the Parisian *Académie des sciences* will end up electing Darwin as a corresponding member to the Botany section. This fact highly irritated M. Ghiselin, who considered it was “a conventional symbol of the curious history of evolutionary biology in France” and the evidence that “evolution was accepted most reluctantly, and natural selection even now seems to baffle the French mentality” [46]. But one could also take it as a positive mark of interest for Darwin's botanical work, rather than as a sign of disinterest for evolution.

I claim it is due to two different smart “flank-movements”: a switch from “imaginary examples” to empirical studies, in other terms, from Romantic transformism to botanical morphology; and an insistence on contrivances that is highly suggestive of teleology. Leaving open a space for design in nature, the *Orchids* blurred the ultimate meaning of Darwin's theory on species, and could be read as collecting indications of a Designer: many of Darwin's contemporaries were more satisfied with the *Orchids* than with the *Origin*, both because of its richness of empirical data and its compatibility with the traditional rhetorics of the ends of Nature.

Huxley had commented on Kölliker's interpretation of the *Origin*, saying, with some perplexity: “It is singular how differently one and the same book will impress different minds” [4: 82]. This diversity of readings creates various Darwins, some more “heterodox” than others: Huxley was most forcibly struck on his first perusal of the *Origin* “that Teleology, as commonly understood, had received its deathblow at Mr. Darwin's hands” [4: 82] while Kölliker argued that Darwinism was a utilitarian and teleological theory. It is striking that Royer, without having communicated with Kölliker, also interprets the blind process of natural selection as a “law of progress”. This means that natural selection is for her a “theodicy in action”: a justification of the world insofar as it transforms the apparent imperfection of the cruel mechanisms of nature into a process of improvement and a means to reach a higher degree of perfection.

Dealing with “contrivances”, Darwin's *Orchids* were on a slippery slope that inescapably led from *teleology* to *theology*. The two questions should nonetheless be treated

distinctly: teleology deals with the utility and adaptation in the organisms and theological assumptions are traditionally attached to it. But even without teleology in the classical sense of design (intended order and perfect adaptation of means to ends), the Darwinian framework served as the ground for a new kind of natural theology, the selection of useful structures being understood as a “law of progress”. We can sum up those various readings of Darwin's *Orchids* in reworking a chart previously proposed by John Beatty [18:124] (Table 1).

If we now turn back to the four different tenets identified in the introduction of this article, the strength and originality of Darwin's theory is that it can account for the first two points (teleology and dysteleology) together, without seeing any contradiction between them. He refutes the third tenet (the argument from design), but many readers think that his system is compatible with the fourth one: not only is it a natural theology, but a real “theodicy” in the Leibnizian tradition, a justification for the moral imperfection of the natural world. Natural selection is thus understood as a redemptive feature in the history of nature.

If Darwin could claim that natural selection is the hidden bond that his fellow naturalists were “unconsciously seeking”, many of his contemporaries do not hesitate to claim that a natural theology is the implicit conclusion of Darwin's system – a conclusion that he was probably neither “consciously” nor “unconsciously seeking”.

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