

Article

The Role of Non-Adaptive Design Doctrine in Evolutionary Thought

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Abstract: Charles Darwin's theory of evolution was, to a certain extent, influenced and shaped by external factors, including the milieu of ideas in the early-nineteenth century, regarding how the natural world should be understood. Therefore, these ideas and their influences have received considerable attention. The role of non-adaptive design ideas, however, has not been fully explored. In particular, Darwin's requirement and rejection of the religious doctrines of adaptive and non-adaptive design, respectively, are important and often unappreciated. Here, I analyze these ideas and how they influenced Darwin's theory of evolution. I find they played an important role in both his theory development and justification, revealing a core theological belief in Darwin's theory; namely, that the creator would not create non-adaptive designs. This paper explores this belief and its context.

Keywords: non-adaptive design; Charles Darwin; evolution



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1. Introduction

One of Charles Darwin's strong arguments for his theory of evolution, as presented in *On the Origin of Species* (hereafter, *Origin*), was from non-adaptive structures and behaviors. This evidence was so powerful that, according to Darwin, it could lead directly to a conclusion of common descent:

Thus, we can hardly believe that the webbed feet of the upland goose or of the frigate-bird are of special use to these birds; we cannot believe that the similar bones in the arm of the monkey, in the fore-leg of the horse, in the wing of the bat, and in the flipper of the seal, are of special use to these animals. *We may safely attribute these structures to inheritance.* (Darwin 1859, pp. 199–200, emphasis added)

Here, Darwin gives two examples of non-adaptive structures: the webbed feet of certain non-aquatic species, and similar bones that perform different functions in different species. In both cases, the structures did not appear to be optimized, or specially adapted, for each particular species. For Darwin this forced the conclusion that the structures were inherited via common descent. However, this argument entailed a theological doctrine. To appreciate this, we must consider both how evolution and how independent creation explain these non-adaptive structures.

Regarding evolution, Darwin's explanation for the origin of these structures was complicated by two other problems: complex structures and trifling characters. In order to explain how complex structures (such as the eye) and trifling characters (such as the color of the skin and hair of quadrupeds) evolved, Darwin would need to expound upon the capabilities of natural selection to create such incredible complexity and detail. Yet, non-adaptive structures, such as similar bones that perform different functions in different species, somehow escaped natural selection's watchful eye. Darwin's explanation—that "there will be no tendency to alter the framework of bones" (Darwin 1859, p. 435)—could be seen as having it both ways. In other words, natural selection was both highly capable, and yet limited or constrained, depending on the example at hand.

Regarding independent creation, Darwin argued that the problem was much more serious. For example, regarding the similar bones, Darwin concluded that “Nothing can be more hopeless than to attempt to explain this similarity of pattern in members of the same class, by utility or by the doctrine of final causes” (Darwin 1859, p. 435). Here, Darwin was following Richard Owen who had persuasively made this argument against final causes as an explanation for similar structures across different species (Owen 1849, p. 10), thus providing Darwin with a strong hand.

Therefore, the argument is contrastive. The evidence powerfully argues for evolution by virtue of ruling out the alternative—independent creation. As Elliott Sober has pointed out, even if the evidence does not particularly favor common ancestry, it becomes powerful if it is highly improbable on the alternative (Sober 1999, 2008, 2009). Darwin repeatedly appealed to various examples of non-adaptive structures as powerful confirmations of his theory. As Stephen Jay Gould observed, “Odd arrangements and funny solutions are the proof of evolution—paths that a sensible God would never tread but that a natural process, constrained by history, follows perforce (Gould 1980, p. 20). Therefore, we can delineate Darwin’s argument as follows.

1. Species are either independently created or evolved.
2. If a creator designed the species, then they would be strictly adaptive.
3. The species are sometimes observed to be non-adaptive.
4. Therefore, the species were not designed, but rather must have evolved.

In other words, non-adaptive designs did not provide direct evidence for evolution, but rather provided indirect evidence by virtue of falsifying creation. Darwin had many examples which fueled this powerful argument. However, there was one glaring vulnerability. As many commentators have observed, the strength of this argument relies on an underlying theological claim about how a creator would design the species (Nelson 1996; Hunter 2001; Dilley 2012; Hunter 2014). Specifically, the argument implicitly assumed a utilitarian creator who would design and create only perfectly adapted species. The vulnerability with Darwin’s argument was in the premise, “If a creator designed the species, then they would be strictly adaptive.” The argument entirely hinged on this premise. Allow for a non-utilitarian doctrine, and the argument fails. In other words, because the argument’s premise was theological, it was vulnerable to a theological rebuttal. Additionally, such a rebuttal had been provided long before Darwin.

Eighteenth- and nineteenth-century British natural theology found evidence for a divine creator throughout the natural world. Often this evidence was of the form of finely adapted structures. Here, the argument was straightforward: intricate function and adaptation imply a designer. However, non-adaptive structures could also serve as evidence for a designer. To understand this category of evidence for design one need look no further than Jesus’ invitation to “consider the lilies” (Matt. 6:28). Here, the evidence is not from function or adaptation, but from an aesthetic value such as beauty or delight in the eye of the beholder. Natural theologians appealed to such evidence. They also appealed to other non-adaptive design categories such as order, harmony, variety, and joy brought about in the creature possessing the structure. In other words, the creator could design creation to fulfill a range of non-adaptive purposes, such as beauty, variety, harmony and order.

What if webbed feet in non-aquatic species and similar bones were part of a larger plan that transcended mere utilitarianism? Beyond this, certain biblical passages described designs simply as the result of God’s sovereign choice, without providing any rationale. For example, in the closing chapters of the book of Job, God rebukes attempts to rationalize His creation. The general theme follows the rhetorical question: where were you when I created the world? At certain points, God presents what seem to be suboptimal, and even non-adaptive, designs as examples of His handiwork, such as the obstinate donkey that ignores the shouts of the driver, and the foolish ostrich that leaves her eggs unprotected such that they are trampled underfoot (Job 39). This latter case was yet another one of Darwin’s examples of non-adaptive designs serving as evidence for his theory:

several hen ostriches, at least in the case of the American species, unite and lay first a few eggs in one nest and then in another; and these are hatched by the males. . . . This instinct, however, of the American ostrich has not as yet been perfected; for a surprising number of eggs lie strewed over the plains, so that in one day's hunting I picked up no less than twenty lost and wasted eggs. (Darwin 1859, p. 218)

Ostrich eggs strewn over the plains was an example of disutility. This and other obvious examples of non-adaptive instincts and behavior, while not strengthening the evidence for his theory in a direct sense, nonetheless provided yet more evidence for evolution in an indirect sense:

I do not pretend that the facts given in this chapter strengthen in any great degree my theory; but none of the cases of difficulty, to the best of my judgment, annihilate it. On the other hand, the fact that instincts are not always absolutely perfect and are liable to mistakes . . . and is plainly explicable on the foregoing views, *but is otherwise inexplicable*,—all tend to corroborate the theory of natural selection. (Darwin 1859, p. 243, emphasis added)

In formulating this argument, Darwin was well aware that he had made a significant theological commitment. He had firmly staked his theory to the utilitarian doctrine that God would design a world of perfect adaptation. For Darwin, non-adaptive design categories simply did not exist. God would not design for purposes such as beauty, variety, harmony and order. If this were not so, it would deal a fatal blow to his theory:

The foregoing remarks lead me to say a few words on the protest lately made by some naturalists, against the utilitarian doctrine that every detail of structure has been produced for the good of its possessor. They believe that very many structures have been created for beauty in the eyes of man, or for mere variety. This doctrine, if true, would be absolutely fatal to my theory. (Darwin 1859, p. 199)

Here, Darwin makes it clear that he requires a strictly utilitarian, adaptive, creation/design doctrine. The non-adaptive explanations that natural theologians had advanced—such as that structures have been created for beauty in the eyes of man, for mere variety, or to delight man or the Creator (this last item was added in the sixth edition)—would be “absolutely fatal” to Darwin's theory. In this passage Darwin makes clear that his theory is contingent on a theological claim about the mode of creation.

Peter Bowler has explained that “Darwin's theory is utilitarian in that it makes adaptation the driving force of evolution: species get new structures because these structures are useful” (Bowler 2009, p. 145). However, this description of Darwin's mechanism as utilitarian misses Darwin's theological commitment. Yes, the mechanism can be characterized as utilitarian, but the utilitarian doctrine runs at a deeper level through Darwin's theory. It would be more instructive to model Darwin's theory as *theologically utilitarian*. This theological commitment to a particular mode of creation is a key requirement for Darwin's theory, as the falsity of this theological claim “would be absolutely fatal” to his theory of evolution.

Regarding this passage, Owen Anderson interprets Darwin as referencing his mechanism of adaptive change. Anderson writes Darwin's “explanation operates on the utilitarian claim that changes occur to benefit a species, and that by projecting current forces into the past we must appeal to great spans of time to explain what we now see. Darwin himself noted that any problems with utilitarianism will translate into problems with his theory” (Anderson 2012, p. 150).

Darwin would not have recognized Anderson's reconstruction, for it is precisely the opposite of Darwin's assertion. Darwin was not referencing mechanism as Anderson asserts, but rather *creation*. Nor was Darwin making a general statement that “problems with utilitarianism will translate into problems with his theory.” That would make no sense given that Darwin then immediately, and triumphantly, presented non-adaptive

designs observed in nature (such as the upland goose's webbed feet) as powerful proofs of his theory. Not only did problems with utilitarianism *not* translate into problems with Darwin's theory of evolution as Anderson asserts; in fact, Darwin's very point here is the reverse: non-adaptive designs were a powerful proof text of his theory, as evidenced in the remainder of the passage. Anderson's rendering of Darwin here illustrates an important misunderstanding of Darwin and evolutionary thought.

As this paper explains, from a religious perspective, Darwin requires adaptive design. In other words, simply put, if the creator designed the species, then they would be perfectly adapted. Hence, Darwin requires a strictly adaptive design doctrine. However, from an empirical perspective, Darwin argues forcefully that non-adaptive designs were observed in nature. Religion mandated the utilitarian design doctrine, but nature revealed non-adaptive designs.

Darwin requires this theological conditional because the alternatives, which allowed for non-adaptive design categories, were an existential threat to his theory as they would nullify his powerful evidence. Darwin then argues strenuously that such perfect adaptation is not observed. Darwin emphasizes this conclusion repeatedly, here and elsewhere in *Origin*. Repeated design patterns used for different functions, and rudimentary structures, were two favorite proofs, but there were many others as well, such as the upland goose's webbed feet. Here, Darwin is triumphant and confidently concludes that inheritance is the proper explanation for such designs.

Anderson cast Darwin as addressing mechanism but, in fact, Darwin is making a much more powerful claim about design. This passage is not addressing mechanism. Rather, Darwin's point is that creation/design requires adaptive structures, but nature falsifies this expectation with a long list of non-adaptive structures. These claims Darwin is making are non-trivial and need to be examined with more than a passing glance. They raise deep questions about the nature of adaptation, the historical role of non-adaptive designs in natural theology before Darwin, theory laden-ness, the limitations of knowledge, the demarcation criteria, theory evaluation, and the role of theology in science.

This paper explores Darwin's statement that his theory requires a theological doctrine; namely, that the creator would not create non-adaptive designs. This paper does not argue for or against the reliance upon, or use of, theological doctrines in science, in general, and it does not argue for or against Darwin's theological reliance, in particular. Simply put, this paper makes no philosophical claims, one way or another, about the reliance on theology of a scientific theory. As far as this paper is concerned, the impact of theological claims on the truth value of a scientific theory may be positive, negative or neutral. Furthermore, this paper does not investigate the biographical genesis of Darwin's theological reliance, and it does not suggest or argue Darwin should have shifted his views, or otherwise not relied theology. Additionally, more general treatments of natural theology, its proponents, and its interaction with Darwin's thought and evolutionary theory are beyond the scope of this paper. This paper is narrowly focused on the role of adaptive and non-adaptive design in evolutionary thought.

2. The Non-Adaptive Designs of Natural Theology

After his voyage around the world, from December of 1831 to October of 1836, Darwin began a series of transmutation notebooks where he recorded his early ideas on evolutionary theory. Over twenty years later Darwin finally published his mature ideas on the subject. Darwin's (1859) final theory of evolution was the result of a complex development process involving scientific research as well as other influences. A major external influence on Darwin's theory development was the milieu of existing ideas regarding how the natural world should be understood. John Reiss has stated that the argument of design was "a critical intellectual background to Darwin's theorizing" (Reiss 2009, p. 121), and similarly Dov Ospovat concluded that Darwin's contemporaries "shaped the development of Darwin's theory" (Ospovat 1981, p. 4).

Those existing ideas in Darwin's day have been approximately divided into two categories: an adaptation view in which the natural world is best understood as efficiently and perfectly adapted to functional needs, and a Platonic view in which the natural world is best understood in terms of patterns. Key words associated with the adaptation view include: function, teleology, final causes, final adaptation, perfect adaptation, and utilitarian design. Key words associated with the Platonic view include: form, ideal plan, unity of plan, structural patterns, archetype, morphology, typology, and limited perfect adaptation.

In Darwin's day the Platonic view was emerging and gaining strong support. As has been documented (Bowler 1977; Reiss 2009; Ospovat 1981) it had continental influences including Etienne Geoffroy Saint-Hilaire as well as the German Naturphilosophen, and offered a range of diverse ideas. The adaptation view had influences from Georges Cuvier, but otherwise was a traditional element of British natural theology, tracing back to more than a century earlier in John Ray and Henry More. The adaptation view's most prominent exponents were John Ray at the end of the seventeenth and beginning of the eighteenth centuries, and William Paley a century later, toward the end of the eighteenth and beginning of the nineteenth centuries. However, with reference to their influence on Darwin's theoretical development, Ray's and Paley's views are often presented in a simplified form. Traditional natural theologians are often portrayed as overly emphasizing perfect adaptation and utilitarian design. For example, John Dillenberger wrote that, "Ray and Paley were so busy ascribing purpose and usefulness to everything that the agony and disproportionate character of human suffering did not seriously enter their horizon" (Dillenberger 1973, pp. 186–87). Similarly, Bowler writes:

Paley's argument from design was essentially utilitarian: it stressed the usefulness of each character as it contributed to the adaptation of the species to its environment. Each example of adaptation in each species could be treated separately as an illustration of the Creator's benevolence. (Bowler 1977, p. 31)

Even more so, John Reiss explains that for British natural theology "the entire universe was seen as a single great system, in which everything was adapted to everything else" (Reiss 2009, p. 144), and that "since this adaptedness was a result of God's action, it was necessarily perfect" (Reiss 2009, p. 129). Or again, Ospovat wrote, "perfect adaptation had the status not of a postulate of natural theology, nor of an element in a particular ideology, but of a fact apparent to all who took the trouble to observe organisms" (Ospovat 1981, p. 36).

These examples illustrate that contemporary scholarship has often inaccurately portrayed natural theology as overly emphasizing perfect adaptation and utilitarian design. It is true that natural theologians emphasized adaptation, and it certainly was an important theme in the literature. Nonetheless Ray and Paley did reckon with the problem of evil and responded with more than merely a passing glance. Following Ralph Cudworth, Ray worried about the world's "errors and bungles," and proposed the so-called *Plastick Nature* (Ray [1717] 1977, p. 51). It was an imperfect intermediary between the creator and creation, helping to explain the origin of nature's evils. Ray also explained that God could have a more active role in natural evil, such as using insects "as Scourges, to chastise or punish wicked Persons or Nations, as he did Herod, and the Egyptians" (Ray [1717] 1977, p. 375).

For his part Paley offered a "scale of being" concept called the *Doctrine of imperfection*, which suggested that creation is better replenished by different orders of beings rising one above another in gradation, and this implies a gradation of imperfections. Such a scale of being was appointed for "reasons of wisdom and goodness" (Paley 1809, p. 494). Paley also offered a second theodicy, where natural evil arises when the many different natural laws, which normally work for good, sometimes inadvertently "thwart and cross one another" (Paley 1809, p. 470).

These examples show that the natural theologians were not so singularly focused on perfect adaptation as is sometimes suggested. In addition to their explanations of natural evil, the natural theologians departed from adaptive design by strongly emphasizing the

importance of *non*-adaptive designs. Specifically, in addition to, and alongside of, perfect adaptations, the natural theologians consistently presented as powerful signs of the creator, non-adaptive elements such as beauty, harmony, order, elegance, mere variety, and the delight they would engender. These non-adaptive elements were not presented as last-minute additions in response to critics. Nor were they tangential side bars. They were presented alongside and equally important to, the many examples of perfect adaptation. For Natural theologians everything from perfect adaptation to disutility and evil served their purposes. They appeared to have no qualms in having it both ways in this regard. For example, in 1715 George Cheyne wrote:

In a word, There is not so much as a supernumerary, superfluous or useless Atom in the whole great and complicated Machine of the Universe; every Age discovering new final Causes, and every the least Object displaying some new Utility or Beauty, to those who seek out the Works of the Lord, *and take pleasure therein*. (Cheyne 1715, p. 147, emphasis added)

Cheyne places beauty and delight alongside utility. Similarly, in 1750 Griffith Hughes wrote:

In each of these may be traced the Workmanship of a Divine Architecture, each formed in Number, Weight, and Measure; without Defect, without Superfluity, exactly fitted and enabled to answer the various Purposes of their Creation, to execute the Will of their Creator, *to minister to the Delight and Service of Man, and to contribute to the Beauty and Harmony of the universal System*. (Hughes 1750, p. 61, emphasis added)

Again, for Hughes beauty, harmony and delight are on par with functional adaptation. This sentiment is even more obvious in the prominent works of Ray and Paley. A search of Ray's *The Wisdom of God* for terms such as beauty, elegance, variety, order and delight finds more than a hundred pages with at least one of them mentioned. Of course, some occurrences are in passages unrelated to my point. However, in many of those passages Ray is appreciating and praising non adaptive designs. For example, Ray extolls the great number and variety of designs evident throughout creation which, as Bowler put it, "seemed to have been created merely to display the versatility of their Designer" (Bowler 2009, p. 40). Another example of non-adaptive designs for Ray was flowers:

These beside the Elegancy of their Figures, are many of them endued with splendid and lovely Colours, and likewise most grateful and fragrant Odours. Indeed such is the Beauty and Lustre of some Flowers, that our Saviour saith of the Lilies of the Field (which some, not without Reason, suppose to have been Tulips) that "Solomon in all his Glory was not arrayed like one of these". (Ray [1717] 1977, p. 88)

Here, Ray extolls the shapes, colors, and smells of flowers. In another example, Ray makes a general conclusion about the world's non-adaptive aspects, and our ability to appreciate them:

Methinks, by all this Provision for the Use and Service of Man, the Almighty interpretatively speaks to him in this manner: I have now placed thee in a spacious and well-furnished World, I have endued thee with an ability of Understanding what is beautiful and proportionable, and have made that which is so, agreeable and delightful to thee; (Ray [1717] 1977, p. 161)

From scourges to the beautiful and delightful, Ray's natural theology embraced more than merely a utilitarian doctrine of creation. These same points apply to Paley's *Natural Theology* as well. Paley even posits a *principle of beauty*, and suggests it is illustrated in the rare coloration change of the tulip's corolla. Paley concludes it should not be interpreted as a utilitarian design but rather beauty intended for display:

In plants, especially in the flowers of plants, the *principle of beauty* holds a still more considerable place in their composition; is still more confessed than in

animals. Why, for one instance out of a thousand, does the corolla of the tulip, when advanced to its size and maturity, change its colour? The purposes, so far as we can see, of vegetable nutrition, might have been carried on as well by its continuing green. Or, if this could not be, consistently with the progress of vegetable life, *why break into such a variety of colours?* This is no proper effect of age, or of declension in the ascent of the sap; for that, like the autumnal tints, would have produced one colour on one leaf, with marks of fading and withering. It seems a lame account to call it, as it has been called, a disease of the plant. *Is it not more probable, that this property, which is independent, as it should seem, of the wants and utilities of the plant, was calculated for beauty, intended for display?* (Paley 1809, pp. 199–200, emphasis added)

Here, Paley explicitly argues *against* a utilitarian interpretation. Or consider Paley's sometimes maligned "It is a happy world after all . . ." vicarage garden passage. Desmond and Moore characterize it as an ode to adaptation: "It was good, life was happy, because all beings *were adapted* to their surroundings." (Desmond, 90 emphasis added) However, in fact, it was the exact opposite. Not only did the passage not appeal to adaptation, it went out of its way to point out the very lack of use or purpose exhibited in the garden. It was good and life was happy, not as evidenced by adaptation but the very lack of it. As Paley writes, for newborn flies it is their "*gratuitous activity, their continual change of place without use or purpose, testify their joy, and the exultation which they feel in their lately discovered faculties.*" (Paley 1809, pp. 456–57 emphasis added)

Finally, Adam Sedgwick, at the midpoint of Darwin's two-decades of theory development, responded to Robert Chambers' use of abortive and rudimentary organs. Chambers had argued that such apparently useless, non-adaptive, structures are better understood as the result of some general law rather than specific design of the Almighty:

After what we have seen, the idea of a separate exertion for each [plant species] must appear totally inadmissible. The single fact of abortive or rudimentary organs condemns it; for these, on such a supposition, could be regarded in no other light than as blemishes or blunders—the thing of all others most irreconcilable with that idea of Almighty Perfection which a general view of nature so irresistibly conveys. On the other hand, when the organic creation is admitted to have been effected by a general law, we see nothing in these abortive parts but harmless peculiarities of development, and interesting evidences of the manner in which the Divine Author has been pleased to work. (Chambers 1844, pp. 197–98)

Those "abortive or rudimentary organs" contradicted the adaptive design principles. Chambers argued those organs arose from law, not design. It was a powerful argument, but it was firmly committed to adaptive design as the only option to be disproved. Chambers ignored the non-adaptive design ideas presented by Ray, Paley, and the other natural theologians, and Sedgwick would right the matter. He attacked Chambers' *Vestiges* with a more than 400-page rebuttal, added to his 1833 *Discourse* as a Preface (Sedgwick 1833). Sedgwick specifically addressed Chambers' abortive or rudimentary organs:

These general views help us also to explain and rationalize certain well-known phenomena, such as abortive or rudimentary organs. These organs may have a muscular use which in some cases we do not comprehend. However, this may be, they form a part, and an essential part, of a great scheme; and they help us to understand the pattern of nature's workmanship. One use, at least, they have; they tend to complete the order and plan of nature: and this, moreover, we may venture to affirm, that *the Author of Nature manifests, in examples without number, a love of order and harmony and beauty, which is altogether independent of our conceptions of mere vulgar use.* (Sedgwick 1850, p. 212, emphasis added)

Here, Sedgwick explained that abortive or rudimentary organs may be non-adaptive because they are part of a greater order and plan of nature. Furthermore, they may be for

the purpose of harmony or beauty. This non-adaptive view, Sedgwick notes, is independent of the material, or “vulgar” as Sedgwick puts it, utilitarian concept.

Chambers had criticized the utilitarian side of natural theology, and in this strategy, he was not alone. Others, with higher scientific standing did the same. Most notably, Richard Owen argued forcefully that similarities between species, such as the pentadactyl pattern, made no sense on utilitarian design. His reasoning was simply that the various machines and instruments made by man, which we know are examples of final causes and utilitarian design, show no such similarities. “There is no community of plan or structure between the boat and the balloon,” and so under utilitarianism we likewise should not expect similarities between animals, Owen concluded (Owen 1849, p. 10).

The fact that such similarity of pattern does exist across the species led Owen to reject adaptive design in favor of the Platonic view. He showed how an abstract plan of creation could be built into natural theology “as an alternative to the utilitarian view of design.” (Bowler 1977, p. 35).

Examples of disutility were important for Darwin as well, and he cited Owen to reinforce the right conclusion: “Nothing can be more hopeless than to attempt to explain this similarity of pattern in members of the same class, by utility or by the doctrine of final causes. The hopelessness of the attempt has been expressly admitted by Owen in his most interesting work on the ‘Nature of Limbs.’” (Darwin 1859, p. 435).

However, in focusing on natural theology’s adaptive design view, critics such as Chambers were vulnerable to precisely the sort of attack Sedgwick mounted. For in addition to the adaptive design argument, natural theology also entailed a non-adaptive view. This meant that if one’s theory of origins incorporated the failure of the adaptive design argument, without acknowledging and reckoning with the non-adaptive view, then one would be vulnerable to just the sort of attack Sedgwick mounted against *Vestiges*. This was a serious threat and Darwin would not leave himself with such a vulnerability.

3. Darwin’s Requirement of Adaptive Design

It is sometimes said that Charles Darwin overthrew natural theology by demonstrating that natural selection could produce nature’s complex structures. Therefore, there was no need to appeal to a designer, as the natural theologians had argued. For example, John Hedley Brooke writes that “Darwin’s theory of evolution by natural selection . . . showed how nature could counterfeit design . . . giving rise to new and well-adapted species having all the appearance of design” (Brooke 2002, p. 171). Similarly, Michael Ruse writes, “Pure Paley is also no longer possible in light of Darwinian evolution; natural selection rules out the necessity of an appeal to an intervening God” (Ruse 2003, p. 331). Or as science writer Carl Zimmer explains, “As a young man Darwin had admired Paley, but now he showed how natural designs could come into being without a designer’s direct control” (Zimmer 2001, p. 49).

This is a curious claim because Darwin made no such demonstration, nor did he claim to have done so. Regarding natural theology’s favorite example, the eye, Darwin presented a caveated thought experiment which he ended on a conciliatory note: “I have felt the difficulty far too keenly to be surprised at any degree of hesitation in extending the principle of natural selection to such startling lengths” (Darwin 1859, p. 188). Elsewhere Darwin’s claims of how natural selection could produce complex structures were no stronger. For the serial homologies (similarities within a species, rather than across different species), for example, Darwin made what was a common argument in *Origin*: that they were inexplicable on the ordinary view of creation because they provided no particular utilitarian benefit. However, the most positivistic claim Darwin could muster was that “On the theory of natural selection, we can satisfactorily answer these questions” (Darwin 1859, p. 437). However, even this was too confident and by the sixth edition Darwin downgraded “satisfactorily” to “to a certain extent”:

On the theory of natural selection, we can, to a certain extent, answer these questions. (Darwin 1872, p. 384)

Darwin was not the only one cautious about such claims. Readers were not left with such a conclusion either. There were harsh critics such as the eminent John Herschel. Herschel was by no means adverse to a naturalistic origin of the species, but he was unimpressed with Darwin's attempt, labelling it the "Law of Higgeldy-piggeldy" (Desmond and Moore 1991, p. 485). Furthermore, such skepticism was not limited to opponents. Many who accepted the idea of evolution nonetheless did not accept natural selection. Even Darwin's friend and staunch supporter, Thomas Huxley, remained skeptical of natural selection (Lyons 2012).

Therefore, it is not surprising that, as Kenneth Waters has observed, natural selection did not play a dominant role in Darwin's strong arguments for evolution. Indeed, in some evidence, such as the lack of eyes in cave fish, Darwin explicitly ruled out natural selection as a cause. As Waters concludes, natural selection can be removed from "many of Darwin's arguments about the superiority of his 'view' compared to the alternative of independent creation" (Waters 2009, p. 133).

Arguments from natural selection could be weak for several reasons. For example, they could be speculative, or they could be ambiguous. Regarding the problem of how electric fish could have evolved, Darwin agreed that "it is impossible to conceive by what steps these wondrous organs have been produced" (Darwin 1859, p. 192), and that the electric organs "occur in only about a dozen fishes, of which several are widely remote in their affinities" (Darwin 1859, p. 193). Given this wide distribution of electric organs in fish, Darwin reasoned that natural selection produced them independently. Using a teleological, active voice, Darwin explained how natural selection:

working for the good of each being and taking advantage of analogous variations, has sometimes modified in very nearly the same manner two parts in two organic beings, which owe but little of their structure in common to inheritance from the same ancestor. (Darwin 1859, p. 194)

This example shows the flexible and speculative nature of Darwin's arguments for natural selection. Even though it was impossible to conceive of how the electric organs evolved, and their distribution defied expectations (i.e., the electric organs occurred in fish which were "widely remote in their affinities," rather than occurring in a group of similar fish species), given its flexibility natural selection could be employed to explain their origin. By the sixth edition Darwin had added to this passage an argument from ignorance which shifted the burden of proof to the skeptic:

The electric organs of fishes offer another case of special difficulty; for it is impossible to conceive by what steps these wondrous organs have been produced. However, this is not surprising, for we do not even know of what use they are. . . . Beyond this we cannot at present go in the way of explanation; but as we know so little about the uses of these organs, and as we know nothing about the habits and structure of the progenitors of the existing electric fishes, it would be extremely bold to maintain that no serviceable transitions are possible by which these organs might have been gradually developed. (Darwin 1872, p. 150)

Here, Darwin required the skeptic to prove a negative (i.e., "to maintain that no serviceable transitions are possible") and to produce information about the progenitors of the existing electric fishes.

On the other hand, unlike these weak arguments from natural selection, Darwin presented a long sequence of powerful contrastive arguments for evolution. In these arguments, Darwin would identify an observation that was unlikely, or otherwise could not be explained by independent creation. These arguments were powerful because they ruled out independent creation, often by showing how biological designs and patterns across species did not fit the expectations of adaptive design. Independent creation, rather than evolution, was the focus of these arguments and, as Waters points out, they did not entail natural selection. Three examples here will suffice, though Darwin supplies many more (Hunter 2014).

In the island of St. Helena, the plants and animals introduced by man outcompeted the native species. Under adaptive design this was unexpected if the native species were designed to maximize their function:

In St. Helena there is reason to believe that the naturalised plants and animals have nearly or quite exterminated many native productions. He who admits the doctrine of the creation of each separate species, will have to admit, that a sufficient number of the best adapted plants and animals have not been created on oceanic islands; for man has unintentionally stocked them from various sources far more fully and perfectly than has nature. (Darwin 1859, p. 390)

Infertility was a rather obvious sign of lack of utility:

It cannot be maintained that species when intercrossed are invariably sterile, and varieties invariably fertile; or that sterility is a special endowment and sign of creation. (Darwin 1859, p. 481)

Some organs were just plainly inefficient or useless and obviously violated adaptive design principles:

On the view of each organic being and each separate organ having been specially created, how utterly inexplicable it is that parts, like the teeth in the embryonic calf or like the shrivelled wings under the soldered wing-covers of some beetles, should thus so frequently bear the plain stamp of inutility! (Darwin 1859, p. 480)

These were powerful arguments against the doctrine of adaptive design. As such, Darwin presented them as powerful arguments for his theory of evolution. Elliott Sober has characterized such contrastive reasoning as *Darwin's Principle*. Sober has investigated Darwin's arguments in detail (Sober 1999, 2008, 2009). Darwin's Principle is, as Sober notes (Sober 2008, p. 190), a common and important type of reasoning for Darwin and later evolutionists. The reasoning has the form of a likelihood ratio which compares two hypotheses by computing the ratio of the conditional probabilities of an observation given the respective hypotheses. As the above examples illustrate, the likelihood ratio favors evolution not in the case of adaptive designs, but for *non*-adaptive or deleterious designs. It is not that useless designs are likely under evolution, but rather that they are highly unlikely under independent creation and adaptive design (Hunter 2014). For Darwin these were the crucial proofs of evolution and they were independent of evolutionary mechanisms, such as natural selection.

Utility, on the other hand, did not play a significant role in Darwin's arguments for evolution. It is true that Darwin argued that adaptive characters can serve as evidence for common ancestry (Darwin 1859, pp. 427–28) but the strength of the argument derived from comparative anatomy, not utility, per se.¹ Indeed utility, and the attendant complexity of functioning, adaptive structures, was a favorite evidence for natural theologians and design, and more often a problem for Darwin to explain (such as the evolution of the eye, as discussed above).

The weakness of Darwin's arguments (i) for natural selection and (ii) from adaptive designs meant that Darwin relied on strictly non-adaptive design in his powerful arguments. Darwin repeatedly argued that disutility, or non-adaptive design, was strong evidence for his theory by virtue of its falsifying creation (Hunter 2014). In those arguments it was a given that creation theory entailed a strictly adaptive design doctrine. If the species were independently created by an all-wise, all-powerful creator, then the species would be perfectly adapted to their environments.

¹ Darwin argued that similar adaptive characters in species of different lineages conceal blood relationship because they evolved independently and so are analogous. On the other hand, similar adaptive characters in species of the same lineage reveal "true affinities." The structure of Darwin's argument evolved over time. In his first edition, Darwin argued that adaptive characters found in different species in the same lineage provided powerful evidence of common ancestry by virtue of the many other characters also shared in common by the species (Darwin 1859, p. 428). By the sixth edition, the adaptive characters were powerful evidence by virtue of their great consistency throughout the whole family (Darwin 1872, p. 374). Regardless of how the evidence was interpreted, in both cases Darwin concluded that "we cannot doubt" that such adaptive characters were inherited from a common ancestor, not by virtue of the utility, but from comparative anatomy.

This, of course, was a theological premise. Darwin's assumption was that by disproving the utilitarian design doctrine, evolution would be the only remaining explanation. However, if an alternate non-utilitarian, non-adaptive creation doctrine was in play, it would undermine Darwin's most powerful arguments. Of course, this non-utilitarian, non-adaptive creation doctrine was not an option for Darwin as it would undercut his arguments from disutility. Furthermore, in their long history of allowing for both adaptive and non-adaptive designs, the natural theologians were clearly having it both ways. Whatever the utility or lack thereof, the natural theologians could find in it a powerful design argument. It was a tautology that Darwin was keenly aware of and criticized: "On the ordinary view of the independent creation of each being, we can only say that so it is;—that it has so pleased the Creator to construct each animal and plant." (Darwin 1859, p. 435).

Nonetheless, the non-adaptive design facet of natural theology was a threat to Darwin and, left unaddressed, Darwin, like Chambers, would be vulnerable to rebuttal. Better to own it rather than risk an accusation of ignorance of an explanation that had already been provided. Therefore, it is not surprising that Darwin addressed non-adaptive design in *Origin*. As quoted in the Introduction above, Darwin wrote in Chapter 6 that his theory is contingent on the utilitarian doctrine. Simply put, the theory of creation must not allow for non-adaptive designs, otherwise Darwin's theory fails. Darwin had many persuasive examples of non-adaptive structures to draw from and he reiterated a few of the strongest examples in that passage.

Darwin argued that useless or inefficient structures must have been inherited via the evolutionary process:

However, by far the most important consideration is that the chief part of the organisation of every being is simply due to inheritance; and consequently, though each being assuredly is well fitted for its place in nature, many structures now have no direct relation to the habits of life of each species. Thus, we can hardly believe that the webbed feet of the upland goose or of the frigate-bird are of special use to these birds; we cannot believe that the same bones in the arm of the monkey, in the fore leg of the horse, in the wing of the bat, and in the flipper of the seal, are of special use to these animals. We may safely attribute these structures to inheritance. (Darwin 1859, pp. 199–200)

Webbed feet for non-aquatic species, and similar bones for different species with different needs, were obvious signs of disutility. Such inefficiencies were for Darwin obvious falsifications of the utilitarian design doctrine and therefore proofs of his theory. No creator worth his salt would have created such designs independently, and therefore they must have arisen by natural selection and inheritance.

Darwin had just finished admitting that his theory required utilitarian design doctrine. He then proceeded to take that for granted and reiterate his powerful proofs of inheritance and evolution. Such was the power and persuasiveness of examples of disutility in nature.

Darwin's interaction with non-adaptive design was complex. He was a utilitarian in the theological sense. God would create according to perfect adaptation. That is, if the creator were to intervene in each case, and specifically design each species and each structure, then such designs would exhibit perfect adaptation. Darwin repeatedly appealed to this standard as the only model for divine creation. Non-adaptive design, in the theological sense, must be false. Order, beauty, variety, delight, and so forth must not be a part of the divine intent. There must not be non-utilitarian, non-adaptive design categories. In this metaphysical sense, utilitarian, adaptive, design assumptions were implicit in Darwin's thinking. As Ospovat put it: "After 1859 Darwin's theory contributed to the complex process, already well under way, by which [the view that organisms are perfectly adapted] lost currency. However, for many years, and in some respects throughout his life, Darwin shared his contemporaries' belief in harmony and perfection" (Ospovat 1981, p. 3).

On the other hand, Darwin strongly held that in practice, the utilitarian design doctrine had failed. The natural world did not live up to the adaptive design principles. Therefore, Darwin both required and rejected adaptive design, in the theological and empirical senses,

respectively. That is, from a metaphysical perspective, the adaptive design principles were true. If the creator were to have directly created the species, these principles would be the standard. However, from an empirical perspective, strictly adaptive design was not observed.

Simply put, Darwin argued that non-adaptive design was theologically false but scientifically true. Additionally, as Darwin explained, his theory of evolution entailed these claims. That is, non-adaptive design categories, if true, “would be absolutely fatal to my theory”. Darwin’s theory of evolution was contingent on non-adaptive design being false. Under creation, the designs of the species must strictly be adaptive. Darwin was explicit here—his theory entailed a deep theological doctrine, from which he was able to make powerful and conclusive arguments for descent with modification, in spite of the weaknesses of his mechanism, natural selection.

4. Conclusions

Beginning in the early-nineteenth century and continuing to today, British natural theology is often reduced to a one-dimensional position of requiring a strictly adaptive design, where the creator’s objective is that everything in the natural world is perfectly adapted to its environment. However, in fact, from early on and continuing to the mid-nineteenth century, the movement not only acknowledged and reckoned with the problem of natural evil, but also identified non-adaptive design categories, such as order, beauty, variety, and the delight that these things engendered in the observer.

Darwin was aware of natural theology’s non-adaptive design arguments and understood the threat that this type of thinking posed to his theory. As with other naturalists, his thinking and his new theory of evolution were influenced by, and incorporated, the perceived failures of adaptive design. Importantly, his theory entailed and required a theological doctrine; namely, that the creator would not create non-adaptive designs. On this point Darwin was clear. He required a strictly utilitarian, adaptive, creation/design doctrine. The non-adaptive explanations that natural theologians had advanced—such as that structures have been created for beauty, for mere variety, or to delight man or the Creator—would be “absolutely fatal” to his theory.

This paper highlights Darwin’s complex interaction with non-adaptive design which historians have not always recognized. For Darwin and his theory, utilitarian design was both required and rejected, in two different senses. The utilitarian doctrine ought to be true in the sense that if God created the world, it would be perfectly adapted. However, the utilitarian doctrine was not true in the sense that to an observer, the world does not appear to be perfectly adapted. These non-adaptive designs furnished the proof to Darwin that a creator did not independently create the species, and thus his theory must be true. Therefore, according to Darwin his theory of the origin of species hinged on theological assumptions about what a creator would and would not do.

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