Biology in the service of natural theology: Paley, Darwin, and the Bridgewater Treatises

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[-] Abstract and Keywords

In his Natural Theology (1802), the eighteenth-century Anglican theologian William Paley compares a watch with objects in nature, arguing that “every manifestation of design, which existed in the watch, exists in the works of nature...” Charles Darwin read Paley's Natural Theology as a young man and offered natural selection as an alternative, naturalistic explanation of Paley's explanandum: the appearance of design in nature. Many of Paley's successors diverged from him in their approach to the living world. This chapter examines some of these alternative approaches and the extent to which the literature of natural theology had trodden the path between Paley's watchmaker and Darwin's natural selection prior to the publication of the latter's Origin of Species. In particular, it focuses on the Bridgewater Treatises, a series of eight highly popular works published in the 1830s, which illustrate the far-reaching development that took place in natural theology in Britain during the early nineteenth century.

Keywords: William Paley, Charles Darwin, natural theology, Bridgewater Treatises, Britain, natural selection, design in nature, Origin of Species

In The Blind Watchmaker, Richard Dawkins quotes from the eighteenth-century Anglican theologian William Paley's Natural Theology (1802) the famous analogy between a watch and objects in nature. “[E]very indication of contrivance,” wrote Paley, “every manifestation of design, which existed in the watch, exists in the works of nature; with the difference, on the side of nature, of being greater or more, and that in a degree which exceeds all computation.” Since in the one case the manifestations of contrivance lead us to conclude that this is an artifact that must have had an artificer, so should they also in the other. This argument provides the foil for Dawkins's own. “Paley's argument is made with passionate sincerity,” Dawkins asserts, “and is informed by the best biological scholarship of his day, but it is wrong, gloriously and utterly
wrong." The analogy between watch and living organism is specious, he claims. In the wake of Darwin's *Origin of Species* (1859), we know that the appearance of design is the outcome of natural selection, which, "[i]f it can be said to play the role of the watchmaker in nature,...is the blind watchmaker."¹

Dawkins's argument here is not new. Indeed, the perception that Darwin turned Paley on his head is as old as Darwin's theory itself. Darwin read Paley's *Natural Theology* as a young man and was imbued with a sense of the perfect adaptation of structure to function in living organisms. In the 1830s, it became one of the objectives of his work on a theory of species' origins to account for such functional adaptation. Natural selection (p.89) seemed to Darwin to provide an alternative, naturalistic explanation of Paley's *explanandum*: the appearance of design in nature. In his autobiography he famously wrote: "The old argument of design in nature, as given by Paley, which formerly seemed to me so conclusive, fails, now that the law of natural selection has been discovered." Yet this contrast between Paley's watchmaker and natural selection provides a very impoverished characterization of the role of biology in natural theology—and of natural theology in biology—in the intervening years.²

First published more than half a century before the *Origin of Species*, Paley's *Natural Theology* was hardly the height of contemporary theological or biological sophistication. Its presupposition of a created order that had come into being a matter of a few thousands of years earlier as a result of divine fiat was scientifically outmoded, as was its attempt to explain animal and plant morphology solely in terms of functional adaptation. In the interim, scientists and theologians had striven to develop natural theologies more in keeping with the progressive accounts of the history of creation emerging within the new science of geology and in astronomy, and with the new "philosophical" approach to natural history, which sought to identify the laws of life, rather than merely to describe and classify living beings. While Darwin used the phrase "Paley and Co." to refer to natural theologians, many of Paley's successors diverged from him in their approach to the living world.³ It will be the object of this chapter to examine some of these alternative approaches and to explore the extent to which the literature of natural theology had trodden the path between Paley's watchmaker and Darwin's natural selection before the publication of the *Origin of Species*. In particular, I will focus on the *Bridgewater Treatises*, a series of eight extremely popular works published in the 1830s, which nicely illustrate the far-reaching development that took place in natural theology in early nineteenth-century Britain.

**Introducing natural theology**

Since the Paleyan stereotype is so prevalent, it will be helpful to begin by defining natural theology and briefly considering its place in British culture in the first half of the nineteenth century. In its strictest sense, the term describes the attempt to identify truths about God and human religious duties by the use of unaided (or "natural") reasoning—that is, without the aid of any supposed revelation of God by himself. This form (p.90) of theological discourse has a long history and, by the Middle Ages, the arguments of natural theology had achieved considerable philosophical sophistication. The arguments took three main forms: the *ontological argument*, in which the existence and attributes of God were deduced from the very possibility of conceiving of such a perfect being; the *cosmological argument*, in which the existence and attributes of a divine first cause were inferred from the existence of the cosmos; and the *teleological argument*, in which the existence and attributes of a divine designer was inferred from the appearances of design in nature. Of course, we recognize Paley's argument as the last of these, but it is worth
remembering that even in the nineteenth century natural theology extended beyond the argument from design.

It was in Britain—and later in the Anglophone world more generally—rather than on the continent of Europe, that natural theology became most strongly linked with the sciences from the late seventeenth century onward. Especially in the wake of the scientific achievements of Isaac Newton, numerous British works of natural theology were published that not only offered support to Christian doctrine but also thereby demonstrated to contemporaries the religious, and indeed the political, utility of the new mechanical philosophy. In the eighteenth century this developed into a resilient tradition, which historian John Brooke attributes particularly to the manner in which, in the distinctive sociopolitical conditions of eighteenth-century England, natural theology was valued as providing a means of mediating between individuals from different Christian traditions, and hence an integrative basis for both civil society and intellectual debate. For Brooke, the observation that natural theology served functions beyond its stated theological purpose accounts in part for its continued prevalence in nineteenth-century Britain, despite the devastating philosophical critiques published at the end of the eighteenth century by David Hume and Immanuel Kant. Natural theology continued to offer a means of mediating between scientific practitioners from different religious traditions, but it also provided an opportunity for those who were religiously committed to integrate their scientific researches with their individual religious commitments. As such, the project of natural theology undoubtedly shaped both the practice and the cognitive content of science. In addition, natural theology provided scientific practitioners with a means of manifesting the religious value and safety of their work at a time when fear of a revolution similar to that recently experienced in France was genuine, and concern was widespread that the sciences might provide support for revolutionary materialism. Indeed, in the hands of some, natural theology became a powerful means of enlisting science against political reform, since, it was argued, the existing state of affairs was natural, and thus designed by God. As we shall shortly see, however, natural theology was politically ambivalent.

While natural theology certainly continued to fulfill important functions in early nineteenth-century Britain, it is important to observe that by no means all the references to design in nature that are to be found in nineteenth-century writings on the sciences were intended to be read as contributions to natural theology. The unwary might readily consider a reference to the creator having employed coral polyps to “construct and rear mighty fabrics in the bosom of the deep” to be a specimen of natural theology. Yet the author of such an account might be one of those for whom, while the study of nature must always be combined with reference to divine agency, knowledge of the creator must always come first from the Bible, rather than from any form of natural theology, strictly so called. Certainly, that was the position of William Kirby, the naturalist from whom the quotation is taken. References to design in nature of this sort could function in many different ways. Often, indeed, their purpose was merely to link the sacred and the secular, so that those engaged in reading about the sciences would not find their minds taken away from the life of devotion to God. They might also, however, serve other purposes—for instance, clarifying Christian doctrine concerning God’s role as creator—that were still far from being a natural theology as such.
In the light of this, it is worth reflecting that perhaps the backward projection of the Darwinian antithesis between natural selection and Paley’s version of the design argument has had a tendency to incline historians to overemphasize the prevalence of natural theology in early nineteenth-century science. Certainly, early nineteenth-century Britain witnessed a significant retreat from natural theology among many Christians. The evangelical revival, for instance, contributed to such a reassessment. Associated first with John Wesley and the Methodists and subsequently with older dissenting groups and with Anglicans such as William Wilberforce, evangelicalism brought a new emphasis on the transforming power of the Gospel found only in the Bible. With their natural reason perverted by Adam’s fall from grace, evangelicals claimed, humans were ill equipped to understand God by themselves, but the message of the Bible brought both understanding and salvation. Such a scheme seemed to leave little scope for a natural theology, independent of revelation, though some evangelicals still found a limited place for it. This did not, however, mean that evangelicals were reluctant to identify instances of design in nature. On the contrary, they particularly emphasized that a “Christian tone” needed to be infused into all secular learning, the sciences included, and references to design in nature were often part of this.7

There were other reasons, too, for Christians to be critical of natural theology. Particularly in the years following the French Revolution of 1789, various forms of religious radicalism became a matter of concern to Christians in Britain. Yet, while the radical political activist Thomas Paine (1737–1809) inveighed against Christianity and the absurdity of the Bible in his widely read Age of Reason (1794–95), he also used the arguments of natural theology to defend his deistic belief in a remote but real creator God. Many Christians, notably evangelicals and members of the Anglican High Church party, were not only quick to see that natural theology was no answer to prominent religious dissidents such as Unitarians or Paine’s deists, but also that it could actually lead skeptics to rest contented with a religion far removed from the Bible or Church tradition. The truth of Christianity needed to be fought on these grounds, not on the grounds of natural theology.8

It was in this climate, however, that William Paley’s Natural Theology was published to great acclaim. As we shall see, it was intended to be a natural theology in the strictest sense of the term, forming the logical foundation of Paley’s whole theological system, prior to the introduction of the evidences of the Christian religion. Designed to complete his set of theological treatises for the use of Cambridge undergraduates, it was written accessibly and with great clarity. Partly in consequence, it reached a far wider audience, running to ten editions in the first four years. Moreover, it continued to sell well for more than half a century, with over 90,000 copies in print in Britain by the publication of Origin of Species in 1859. By dint of its continued production and use, it thus became something of a classic—read by succeeding generations in different ways, but widely familiar within British culture.9

In this chapter, however, I will place Paley’s work in contrast with the much less well-known Bridgewater Treatises (1833–6). This series of eight works was published in fulfillment of a bequest entrusted to the president of the Royal Society by the eighth Earl of Bridgewater, Francis Henry Egerton (1756–1829), for the production of a work:

(p.93) On the Power, Wisdom, and Goodness of God, as manifested in the Creation; illustrating such work by all reasonable arguments, as for instance the variety and
formation of God’s creatures in the animal, vegetable, and mineral kingdoms; the effect of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature.

The eight authors selected, with the assistance of the Archbishop of Canterbury and the Bishop of London, were leading men of science, who between them produced detailed accounts of the several sciences, considered in relation to the question in hand. Despite being expensively produced, the treatises sold well, with over 60,000 copies of the several titles in print by 1850. After Paley's work, they were thus the most widely circulated books on natural theology in the period prior to the publication of *The Origin of Species*, and they were widely read and discussed.10

The *Bridgewater Treatises* appeared to a generation of historians as mere adjuncts to Paley's work. This view received its canonical form in Robert M. Young's suggestion that there was, during the first six decades of the nineteenth century, “a relatively homogeneous and satisfactory natural theology, best reflected in William Paley's classic *Natural Theology* (1802),” which formed an important component of a “common context” of intellectual debate. On this view, the *Bridgewater Treatises* were merely “an attempt to codify this tradition in the light of detailed findings in the several sciences.”11 As we will see, however, the *Bridgewater Treatises* not only developed new perspectives on natural theology quite distinct from that of Paley, but their authors by no means shared a common approach. On the contrary, they developed a range of approaches, and my object here will be to outline some of their divergences from Paley and to indicate the growing biological sophistication of their natural theologies.
William Paley's *Natural Theology*

In the dedication to his *Natural Theology*, William Paley (1743–1805) announced that it was the completion of a comprehensive system of theology, but that his works had been written “in an order, the very reverse of that in which they ought to be read.” The son of a Yorkshire headmaster, Paley had shone as a student at Cambridge, and for a decade he had been a well-regarded college fellow and lecturer. It was by drawing on his Cambridge lectures in ethics that, in 1785, having taken up a clerical career, he published his *Principles of Moral and Political Philosophy*. This became a set text in Cambridge almost straight away, and continued to be used in university examinations until 1857. Paley had also instructed his Cambridge undergraduates in the evidences of the Christian religion, and the historical credibility of the New Testament became the subject of his *Horæ Paulinæ* (1790) and *A View of the Evidences of Christianity* (1794). The latter was studied by Cambridge undergraduates, Charles Darwin included, for almost a century. When Paley completed his *Natural Theology* in 1802, he had thus completed a systematic introduction to Christian theology. The student might now encounter in sequence “the evidences of natural religion, the evidences of revealed religion, and an account of the duties that result from both.”

Paley's system was theologically orthodox, but both his theological principles and his friends were latitudinarian (that is, tolerating latitude in doctrine and placing confidence in reason over and above Church tradition or biblical authority), and his project to found a system of Christian theology on the philosophical arguments of natural theology was expressive of this. It was this theological rationalism that later led some High Church and evangelical critics to express serious reservations about the tendency of *Natural Theology*. Although the work was published in 1802, Paley's latitudinarian mind-set was somewhat at odds with the theological temper of the new century. While Darwin himself read *Natural Theology* as an undergraduate at Christ's College, it was very much less used in Cambridge education than Paley's other works. Nevertheless, as we have seen, the work was immensely successful. In part, this must be attributed to the easy and attractive style of Paley's prose. *Natural Theology* was based on sermons he had delivered over the preceding two decades, and its accomplished use of rhetorical forms rendered it a compelling read. Moreover, while its account of the design argument merely restated a familiar analogy in a persuasive manner, the substance of the work illustrated the argument with lively examples drawn in many cases from the sciences.

Paley's Statement of the argument from design as an analogical argument is sufficiently well known not to require much description. Starting with the *disanalogy* between a stone and a watch, Paley spent two chapters describing the inferences that any reasonable person would draw on encountering the latter while crossing a heath. The rational inference from the obvious contrivance in the watch was that it had been made by someone who had designed it for its use. This would be the case whether or not one had ever seen a watch being made, found that the watch did not work properly, failed to understand the use of some of the parts, or even found that the watch contained within it a mechanism to produce another watch just like itself. Only after considering these potential objections, did Paley introduce the analogy between the watch and the works of nature. Could anyone, he asked, reasonably doubt the inference from the design in the watch to the existence of a maker? Yet this was logically equivalent to the absurd position of the atheist, he concluded. Natural objects are like human artifacts in exhibiting design, he claimed, but since human artifacts exhibit design because they are made by a designer, and since like effects have like causes, one can infer that natural objects too are likely to be the product of a designer.
It is important to note, at this point, that the inductive inference Paley urged his readers to make was necessarily only a probable one. Amassing additional evidence could contribute to the strength of the argument, but ultimately conviction was not merely a matter of reasoning. Recent commentators have consequently emphasized that natural theologians were adept in the use of rhetoric, which appealed to “the imagination and the emotions as well as to the faculty of reason.”\textsuperscript{15} As Matthew Eddy has shown, a key part of Paley's rhetorical approach was his presentation of “a long chain of related examples,” which was intended to lead the reader to “a series of inductive assents.” The argument was, Paley famously asserted, “cumulative.”\textsuperscript{16} Moreover, Paley selected his examples so as to maximize the probability of his argument. In particular, his preference was for examples drawn from the living world, both because here the analogy with human mechanism was strongest, and because the large number of individual parts on which the proper functioning of the whole depended increased the probability of their not having arisen by chance. At the start of his short chapter on astronomy Paley argued that, while the subject raised the mind that was convinced of God’s existence to “sublimer views of the Deity” than any other subject, it was “not so well adapted, as some other subjects are, to the purpose of argument.” The movements of the heavenly bodies were quite unlike human mechanism, and they seemed not to involve a mechanism involving carefully adjusted parts. Much more powerful in argument was an organic mechanism such as the eye, which so much resembled a human contrivance (such as a telescope) and involved a visible adjustment of parts to achieve a particular end.\textsuperscript{17}

\textbf{(p.96)} \textit{Natural Theology} was thus dominated by examples drawn from the sciences of life. Paley introduced his analogical argument in six chapters, and a further five at the end were given over to considering the divine attributes and to concluding remarks. Of the remaining sixteen chapters, fourteen related to living organisms (almost exclusively animals), with only two devoted to the physical sciences. Paley's approach to living beings was to conceive of them in mechanistic terms, as functioning wholes, the various parts of which were mutually adapted. Usually implicit, but sometimes explicit, in his account were the mutual adaptations of whole organisms and their surroundings. Moreover, underpinning the entire analysis was a belief in the unchanging character of living forms. Current species had been created by God at the outset, some few thousand years previously, and had remained unchanged since. In this regard, of course, Paley was in good company. While he was clearly familiar with the evolutionary theorizing of Darwin's grandfather Erasmus (1731–1802) and made some reference to the impossibility of species transmutation in \textit{Natural Theology}, Paley was hardly at odds with scientific orthodoxy in considering the order of living beings to be static. Moreover, while he did not draw heavily on the very latest scientific findings, his account relied on such familiar sources as James Keill's \textit{Anatomy of the Humane Body Abridg'd} (1698) and Oliver Goldsmith's \textit{An History of the Earth, and Animated Nature} (1774).\textsuperscript{18} Even as Paley was writing, however, the scientific debate about the history of living beings was entering a period of rapid change. By the time the authors of the \textit{Bridgewater Treatises} contributed to the literature of natural theology some thirty years later, they had to respond both to significant developments within the sciences and to a culture in which both the sciences and natural theology were viewed rather differently.

\textbf{The Bridgewater Treatises}

Given the classic status that Paley's \textit{Natural Theology} had acquired by the 1830s, with around 40,000 copies in print, it is perhaps not surprising that historians have been inclined to see the \textit{Bridgewater Treatises} as mere extensions and amplifications of Paley's \textit{Natural Theology}. Moreover, there is some justification for this view. Several of the authors of these works expressly stated that they saw themselves working within a Paleyan tradition. Yet, of course,
classic works have a tendency to be appropriated by those who come after, and an obeisance to the great master can hide a more (p.97) revisionist intent. Certainly some of those who first read the Bridgewater Treatises saw in them important departures. One reader of the Bridgewater Treatise on astronomy and physics by Cambridge man of science William Whewell (1794-1866) considered it “surprising how much new light ha[d] been thrown” on the subject of natural theology since Paley's time. And, as we shall see, even the most Paleyite of the Bridgewater authors modified Paley's approach to take account of important developments in the sciences of life.19

The author apparently most in Paley’s thrall was the distinguished Edinburgh-educated surgeon, Sir Charles Bell (1774–1842), who received a “handful of gold” for a work on Lord Bridgewater's favorite topic, “the human hand.” In the early 1830s, Bell also produced with the Whig Lord Chancellor Henry Brougham an extensively annotated edition of Paley's Natural Theology. Here, the very first sentence, asserting the disanalogy of watch and stone, was annotated with a page-long footnote, beginning:

The argument is here put very naturally. But a considerable change has taken place of late years in the knowledge attained even by common readers, and there are few who would be without reflection ‘how the stone came to be there.’ The changes which the earth’s surface has undergone, and the preparation for it’s present condition, have become a subject of high interest; and there is hardly anyone who now would, for an instant, believe that the stone was formed where it lay.20

Not surprisingly, the author of the Bridgewater Treatise on “geology and mineralogy,” the Oxford reader in these subjects William Buckland (1784–1856), was quick to make the same point. The inception of the new sciences of geology, and more especially paleontology and comparative anatomy, provided a new set of phenomena from which instances of design might be derived. Of course, these could be seen as mere extensions of Paley's approach. However, as we shall see, Bell and Buckland not only developed Paley's notion of functional adaptation in new ways, but they also introduced a temporal element strictly absent from the latter's Natural Theology.21

If these authors are to be found diverging from their acknowledged master, how much more so were those who were altogether more circumspect about Paley's approach? Bell and Buckland sought to historicize and to refine Paley's emphasis on adaptation to function as the primary determinant of animal and plant structures. By contrast, the author of the (p.98) treatise on “animal and vegetable physiology”—London physician and secretary of the Royal Society Peter Mark Roget (1779–1869)—drew on the latest, controversial researches in comparative anatomy to move far beyond Paley's teleology. Roget suggested that there were higher morphological laws at play in nature. God had made species according to a “general plan of creation,” and by attending to this, Roget meant to give the subject “that unity of design, and that scientific form, which are generally wanting in books professedly treating of Natural Theology, published prior to the present series; not excepting even the unrivalled and immortal work of Paley.”22

Roget’s morphological laws were not the only laws featuring prominently in the Bridgewater Treatises. In his treatise on physics, William Whewell observed that the “peculiar point of view” of modern science was “that nature, so far as it is an object of scientific research, is a collection of facts governed by laws.” Whewell’s aim in his Bridgewater Treatise was to “to show how this view of the universe falls in with our conception of the Divine Author.” In so doing, he developed an approach that was by no means entirely original, but was certainly at odds with Paley's. Others of the authors, too, wrestled with the extension of scientific naturalism, seeking to
establish in chemistry, geology, and physics that the attribution of phenomena to natural laws did not undermine the evidence of divine design. The mathematician and designer of calculating engines Charles Babbage (1791–1851), who wrote an unofficial ninth *Bridgewater Treatise*, took this approach furthest of all, extending the notion of divinely instituted natural law even to the origin of new species.23

As we shall see, these developments make the simple antithesis between Paley's watchmaker and Darwin's natural selection rather inadequate as a characterization of history. However, a further aspect of the *Bridgewater Treatises* is deserving of discussion at this point; for it is questionable to what extent these were meant by their authors to be works of natural theology at all. Certainly, the wording of Lord Bridgewater's bequest placed a relatively untaxing requirement on the authors: they were to write on the attributes of God as “manifested” in the creation. However, no prescription required that the authors attempt to infer the attributes, much less the existence of God, independently of the Christian revelation. Indeed, noting that the bequest referred to using arguments based on “the whole extent of literature,” the septuagenarian parson naturalist William Kirby (1759–1850), who wrote the *Bridgewater Treatise* on the “history, habits and instincts of animals,” considered that this gave him free reign to indulge (p.99) his habit of uniting “the study of the word of God with that of his works.”24 When the Hebrew scriptures were deciphered according to an almost Kabbalistic system of interpretation, he argued, they revealed fundamental truths about nature. Kirby's treatise was admittedly unusual in this regard, drawing on the theological system of his fellow High Churchman John Hutchinson (1674–1737), which by this time was generally viewed as a historical curiosity. Yet, as we have already seen, there were many in the churches who were dubious about the epistemological validity of natural theology and about its apologetic usefulness in converting deists or radical Christians. These sentiments were more widespread among the Bridgewater authors than might at first appear.

The more theologically sophisticated among the authors were explicit about their concerns. Thomas Chalmers (1780–1847), a noted writer on political economy and a leading member of the Evangelical party in the Church of Scotland, had caused controversy in the 1810s by arguing that natural theology was at best useless, and at worst a distraction from the evidences of Christianity. By the time he wrote his *Bridgewater Treatise* on “the adaptation of external nature to the moral and intellectual constitution of man,” he had become convinced that a limited natural theology was possible, but that it was only such as to lead people “to conceive, or to conjecture, or to know so much of God, that, if there be a profest message with the likely signatures upon it of having proceeded from Him—though not our duty all at once to surrender, it is at least our bounden duty to investigate.” Whewell also showed signs of a serious discomfiture with a rationally constructed natural theology, which manifested themselves in his frequent recourse to rhetorical formulations when referring to indications of design. “Does not this imply clear purpose and profound skill?” he asked. “On any other supposition such a fact appears altogether incredible and inconceivable.” Moreover, he viewed his obligations as an author in terms far removed from those motivating Paley's *Natural Theology*. “The subject proposed to me was limited,” he announced: “my prescribed object is to lead the friends of religion to look with confidence and pleasure on the progress of the physical sciences, by showing how admirably every advance in our knowledge of the universe harmonizes with the belief of a most wise and good God.”25
Even some of those authors who seem most Paleyite on first inspection appear to have fallen short of Paley's high aspirations. John Kidd (1775–1851), the Oxford Professor of Physic, had some flattering things to say about Paley's *Natural Theology* in his *Bridgewater Treatise* on “the adaptation of external nature to the physical condition of man.” Yet he nonetheless considered that it was unnecessary to develop a formal natural theology, since unbelief was intellectually absurd and arose from immorality. His limp and unimpressive conclusion after 300 pages of examples of anthropocentric adaptations was that “whether from chance, (if any philosophical mind acknowledge the existence of such an agent as chance,) or from deliberate design—a mutual harmony does really exist between the corporeal powers and intellectual faculties of man, and the properties of the various forms of matter which surround him.” Similarly, the arch-Paleyite Charles Bell confessed to his readers, somewhat shamefacedly, that “from at first maintaining that design and benevolence were every where visible in the natural world,” circumstances had gradually drawn him “to support these opinions more ostentatiously and elaborately than was his original wish.”

None of the *Bridgewater Treatises*, with the possible exception of William Buckland's on geology, exhibited the confident Enlightenment rationalism of Paley's *Natural Theology*. Moreover, with the exception of Whewell and Chalmers, the Bridgewater authors were theologically ill equipped to provide a detailed or satisfactory alternative analysis. As several of the authors expressed it, they saw their brief as being to demonstrate the compatibility of modern science with orthodox Christianity at least as much as to use modern science to support a rationally constructed natural theology on which to base Christian belief. Similarly, few within the mainstream churches now felt quite so sure as Paley had been of the power of reason, unaided by revelation, to discover the existence and attributes of God. Rather, religious reviewers of the *Bridgewater Treatises* often valued them as providing a compendium of “safe” science, free from radical taint and combined with religious views. Nevertheless, in treading their sometimes ambiguous paths between natural theology and a theology of nature, the Bridgewater authors did, as we have seen, make important departures from Paley's approach, and it is to these that we now turn.

Cuvierian teleology and progressive creation

As we have seen, Paley's version of the design argument gave fundamental importance to the functional adaptation of the parts of animal bodies both to each other and to external conditions. Yet in the thirty years between the publication of *Natural Theology* and that of the *Bridgewater Treatises*, this ultra-teleological approach to anatomy had been advanced far beyond Paley's account by the commanding researches of the French comparative anatomist Georges Cuvier (1769–1832) and his disciples. Paley was not a naturalist, but a theologian, and, although he included a chapter on comparative anatomy in his *Natural Theology*, the focus there had been chiefly on the more superficial resemblances of organisms. By contrast, Cuvier had transformed natural history by showing how the deep structure of animals revealed patterns of relationship between them, based on common solutions to the problem of functional adaptation. In so doing, he gave to teleological anatomy a vastly more developed scientific form and status. Cuvier began to codify his new approach around the time that *Natural Theology* was published, and by the 1810s it was being incorporated wholesale into British natural history. Thus, when such Bridgewater authors as Charles Bell and William Buckland emphasized functional adaptation in their treatises, it was Cuvier's work and principles, not Paley's, on which they drew. For this reason, it would be more accurate to describe teleologists of the type represented by Bell and Buckland as “Cuvierians” than as “Paleyites.”
The application of the teleological principles of Cuvierian comparative anatomy to Paley's argument is well exemplified by Bell's *Bridgewater Treatise* on the hand. Bell explained that the human hand could not be studied in isolation, as a "superadded part," since "the whole frame must conform to the hand, and act with reference to it." This was Cuvier's principle of the *correlation of parts*, which maintained "the adaptation of any one part to all the other parts." Furthermore, the human frame itself ought properly to be studied in comparative perspective, in order to comprehend "a greater design." Cuvier had posited that only four fundamental animal body plans could conform to the *conditions of existence*, in terms both of their internal consistency and of their adaptation to the environment. His four "embranchements" or divisions of the animal kingdom represented the only viable solutions of a functional conundrum, and they had no larger significance than that. Yet in the work of Bell the existence of such types was itself seen as an indication of divine agency. Bell clearly considered that the existence of a "great plan of creation" provided evidence of design that was to some extent independent of functional adaptation. Indeed, even Paley, whose argument was so largely teleological, found in the common body plan of vertebrates an argument in favor of the unity of the deity. Nonetheless, for Bell, the real beauty of the vertebrate system—on which his account focused—was that "by slight changes and (p.102) gradations hardly perceptible, the same bones are adjusted to every condition of animal existence." In this emphasis on the perfect adaptation of organs to their function in the body, and of organisms to their function in the environment, Bell's *Bridgewater Treatise* presented contemporaries with one of the most accessible English accounts of Cuvierian comparative anatomy.

Despite the extent of their debt to Cuvier, Bell and Buckland can, in their continuing emphasis on functional adaptation, reasonably be characterized as using recent developments in natural history to extend Paley's basic perspective. In one key respect, however, they diverged very markedly from Paley. The natural history of Cuvier involved a comprehensive historicization of the living world. In his pioneering work on vertebrate paleontology and stratigraphy Cuvier had concluded that the physical history of the earth was punctuated by a series of catastrophic "revolutions," which resulted in the extinction of species now known only through fossil forms. In Britain, both Cuvier's account of geological revolutions and his use of characteristic fossils to identify strata had, from the early 1810s, served to underpin an extensive program of stratigraphic and paleontological research. Moreover, while some (including Buckland in the 1820s) were anxious to identify the most recent of Cuvier's catastrophes with the biblical deluge, the new geology clearly presupposed an earth and a living creation much older than that implied by conventional biblical chronology.

In one respect, the historicization of nature presented a new opportunity for natural theologians, and it was an opportunity that Bell and more especially Buckland readily seized. Cuvier's paleontology enshrined teleology as the primary principle of fossil reconstruction. Just as at present, he claimed, the extinct forms represented by fossils would always be found to be functionally adapted, both in terms of the correlation of parts within individual animals and in terms of their overall adaptation to their conditions of existence. To Buckland, who was dubbed the "English Cuvier" for his exceptional ability to conduct fossil reconstructions on teleological principles, this was a godsend. The new science of geology had faced significant opposition from various religious quarters, and Buckland took the opportunity of his *Bridgewater Treatise* to demonstrate that, while not to be found in Paley, the subject had an important and distinctive contribution to make to natural theology. In his preface he asserted that the subject extended
“into the Organic Remains of a former World” the same approach that Paley had pursued in regard to living species. Using Cuvier’s methodology, he reconstructed individual fossil specimens with the intention of displaying their functional adaptation. His pièce de résistance was his account of the fossil ground sloth Megatherium, which even Cuvier had considered to be ill adapted. Buckland’s widely applauded reconstruction of the habitat and habits of this huge, ungainly creature demonstrated that the animal’s structure was actually perfectly adapted to function (see Figure 4.1).

While it was very much in Buckland and Bell’s interests that this development of a paleontological version of the functionalist argument should appear to be a mere extension of Paley’s work, their substitution of a historicized account of creation for Paley’s static one was a major departure. Buckland’s announcement in his Bridgewater Treatise that “millions of millions of years” might have elapsed between the original creation and the first day in the Genesis narrative became, as one commentator put it, “quite as much a newspaper subject as would an horrid murder or a glorious victory.” Since Buckland’s work provided the first and most prominent synthesis of a kind of progressivist geology that had been developed in England in the 1810s and 1820s, he prefaced it with a lengthy chapter in defense of the congruence of progressive creation with the Christian scriptures. The main body of Buckland’s text began with the earth as a nebulous cloud of gas and dust, and moved through a series of geological epochs to the present era. Within each epoch, the characteristic fauna and flora were, Buckland asserted, perfectly adapted to their environment. Geological catastrophes brought each epoch to an end, wiping out many species, as evidenced by the abruptness of the mineralogical and paleontological changes between geological formations, but these had natural causes. It was only at the commencement of each new epoch, when the planet was repopulated with new, perfectly adapted forms, that the “direct agency of Creative Interference” came into play. Thus, while Buckland still relied on miracles to account for the origin of new species, God’s creative activity had been radically historicized and placed within a context in which much of the progressive history of the earth was to be understood as a consequence of natural laws—a theme to which we will return below.

Geoffroyan morphology and the idealist argument

Bell and Buckland’s treatises clearly had much in common with Paley’s earlier approach, notwithstanding their endorsement of a progressive account of creation. However, it is misleading to see this as the exclusive, or even the predominant, outlook of the Bridgewater
Treatises. Some years ago historian Dov Ospovat identified what he called the “Bridgewater variety” of the concept of perfect adaptation, typified by Bell, which emphasized the strict adaptation of structure to function. Yet Ospovat’s contrasting variety of the concept of perfect adaptation, the “doctrine of ‘limited perfection,’” found one of its earliest exponents (as Ospovat himself (p.105) recognized) in Roget’s Bridgewater Treatise. This was the notion that, while organisms are perfect,

they are created by laws, and they are only as perfect as is possible within the limits set by the necessity of conforming to these laws. Since the creator’s laws are good and well-conceived, adaptation is the general rule. But an animal may possess an organ that serves no function, though it is useful to another animal of the same type.32

As this implies, Roget still made common cause with Paley in his Bridgewater Treatise in citing many instances of functional adaptation in the organic realm as evidence of design. In his opening chapter on “final causes” he argued that animal and vegetable morphology, physiology, and development could not be accounted for by material laws, but only in terms of means and ends. In his second chapter, however, he developed a morphological, idealist argument that was to run alongside the teleological, functionalist argument of the first. He was prepared, in explaining the variety of animal form, to go beyond the narrow confines of functional adaptation:

Even when the purpose to be answered is identical, the means which are employed are infinitely diversified in different instances, as if a design had existed of displaying to the astonished eyes of mortals the unbounded resources of creative power. While the elements of structure are the same, there is presented to us in succession every possible combination of organs, as if it had been the object to exhaust all the admissible permutations in the order of their union.33

This “law of variety” was counterbalanced by another law, that of “conformity to a definite type.” By this, Roget meant that “the formation of all the individual species comprehended in the same class, has been conducted in conformity with a certain ideal model, or type, as it is called. “ Roget strove to relate this to teleological concerns, arguing that “amidst endless diversity in the details of structures and of processes, the same general purpose is usually accomplished by similar organs and in similar modes.” Specifically, he linked it to Cuvier’s principle of the correlation of parts, which he called the “laws of the co-existence of organic forms.” Yet in reality, Roget had gone far beyond Cuvier’s strictly functionalist embranchements in positing the existence of an “ideal model, or type.” The taxonomic classes represented “parts of one general plan” which “emanated from the same Creator.” The morphological resemblances of (p.106) organic forms thus provided an argument for the existence of God that was quite independent of their functional adaptation.34

In developing this new, idealist approach to natural theology, Roget was responding to contemporary developments in the sciences quite as much as Bell and Buckland. In the 1820s, the London medical schools were buzzing with radical new approaches to comparative anatomy that British students had encountered on visiting Paris after the end of the Napoleonic Wars. In particular, Cuvier’s great Parisian rival, the deist Étienne Geoffroy Saint-Hilaire (1772–1844), had urged the need for a more philosophical approach to natural history. Animal form needed to be accounted for not in terms of final causes (what is it for?) but in terms of efficient causes (how was it made?). Geoffroy’s view was that animal morphology was not determined by function, but obeyed certain fundamental laws of organization that were to be explained materialistically. In London’s medical schools, the importation of such views had a political edge.
Those engaged in supporting the “philosophical anatomy” of Geoffroy were often those marginalized by the Anglican-dominated medical establishment—the corrupt medical corporations and the Anglican universities of Oxford and Cambridge. The naturalistic morphology of Geoffroy Saint-Hilaire, like the transmutation theory of Jean-Baptiste Lamarck (1744–1829), provided a radical alternative to the top-down view of creation associated with Cuvier and his acolytes. God allowed lowly species and the socially excluded alike to rise naturally; in neither case had he fixed the scale by divine fiat.35

Roget’s appropriation of Geoffroyan anatomy was extensive, but by wielding his idealist argument in place of Geoffroy’s materialism he was able to disarm it of those radical connotations that led Bell and others of the Bridgewater authors to attack Geoffroy in intemperate terms. Furthermore, this radical departure in the literature of natural theology was to become more than a momentary one. In particular, as the London-based comparative anatomist Richard Owen (1804–92) rose to prominence in the 1840s, he gave greater sophistication and authority to the idealist version of natural theology. Owen was even prepared to consider that the historical development of life on earth, though expressive of underlying divine ideas, might take place according to natural laws. Moreover, while Roget was the only one of the Bridgewater authors to offer a developed idealist natural theology, it is notable that William Kirby joined him in invoking the “quinary” system of classification developed by the entomologist William Sharp MacLeay (1792–1865) as evidence of a divine plan. According to MacLeay, the plant and animal kingdoms were naturally divided into five basic divisions, each of which fell into five classes, and so on, in turn, through the subsidiary taxa. Each of MacLeay’s assemblages of five groups was naturally arranged in a circular pattern, with those having the greatest morphological similarity being most closely connected in the taxonomic arrangement. Kirby had been one of the leading advocates of this quinary system in the 1820s, and in his Bridgewater Treatise he suggested that the divine plan of creation revealed by such morphological resemblances manifested design quite independently of teleological considerations.36

While the works of Bell and Buckland provided clear expositions of Cuvierian teleology, it would be more accurate to represent the Bridgewater Treatises as a point of departure between teleological and idealist perspectives than as the apotheosis of the former. That the series has generally been seen in teleological terms perhaps reflects the extent to which contemporary radical morphologists, seeking a clearly identifiable target, tarred all the volumes with the same brush. The Edinburgh surgeon and doyen of radical morphology, Robert Knox (1791–1862), coined the epithet “Bilgewater Treatises” in order to ridicule the “ultra-teleological school,” but this memorable phrase has perhaps inclined historians to overemphasize the extent to which the series embodied the teleological approach, at the expense of the idealist innovations of Kirby and, more particularly, Roget.37

Natural law and the nomological argument
As we have seen in the preceding sections, several of the Bridgewater Treatises referred certain of the designed phenomena of nature to the action of natural laws, rather than to miraculous action on the part of the creator. Throughout the series, the expanding scope of naturalistic explanation since the time of Paley was clearly seen to be a potential source of public concern, and the authors responded in several ways. Thomas Chalmers, for instance, gave strictly mathematical form to Paley’s observation that phenomena that could be explained by a few simple laws did not present such a strong argument for design as when a large number of independent phenomena were seen to have been separately adapted to achieve a given purpose.
His answer, however, was to point out that, even when phenomena could be explained in terms of general laws, there were still the initial “collocations of matter” to be explained. A similar distinction was made by Whewell in his *Bridgewater Treatise* on physics, but he went much further, seeking to make natural laws central to the project of natural theology.

As we have seen, Paley’s God was a watchmaker—an artisan who could be known through the analogy between his creation and human artifacts. Consequently, Paley produced a catalog of God’s mechanical handiwork, dominated by the contrivances in living organisms. Whewell’s was a far less anthropomorphic argument. He insisted that in our conceptions of divine purpose and agency we must “go beyond the analogy of human contrivances.” We are, he continued, “led to consider the Divine Being as the author of the laws of chemical, of physical, and of mechanical action, and of such other laws as make matter what it is;—and this is a view which no analogy of human interventions, no knowledge of human powers, at all assists us to embody or understand.” Despite his protestations, however, Whewell did apply an anthropomorphic analogy to the deity, while cautioning that it should not be pushed too far. In place of Paley’s artisan God he substituted a divine legislator. The world was governed by general laws, he explained, and just as a stranger in an unknown land might learn about the nature of its human government from the laws that were in force, so the cosmic stranger might learn about the nature of divine government by studying natural laws. This nomological conception of design had the advantage that it pushed Whewell’s own subject matter into the limelight. Only in two departments of research—astronomy and meteorology—had science been able “to trace a multitude of known facts to causes which appear to be the ultimate material causes, or to discern the laws which seem to be the most general laws.” These, then, were the parts of natural philosophy “in which we may hope to make out the adaptations and aims which exist in the laws of nature; and thus to obtain some light on the tendency of this part of the legislation of the universe, and on the character and disposition of the Legislator.”

Whewell thus seemed remarkably sanguine about the advance of naturalistic explanation. Most importantly, he applied his argument to the naturalistic account of the formation of the solar system developed by Pierre-Simon Laplace (1749–1827), which he christened the “nebular hypothesis,” since it posited the condensation of nebulous matter under the influence of gravity. If the hypothesis were true, Chalmers had written, it would weaken “the argument for a designing cause in the formation of the planetarium.” Whewell, by contrast, considered that “it only transfers our view of the skill exercised, and the means employed, to another part of the work.” Both the laws, and the “primordial conditions” on which they operated, would equally evince design. Whewell’s self-proclaimed purpose in his treatise was, after all, to show “that the notion of design and end is transferred by the researches of science, not from the domain of our knowledge to that of our ignorance, but merely from the region of facts to that of laws.” His influential treatment of the nebular hypothesis, while eschewing any consideration of the merits of the theory itself, still served to turn its atheist potential in favor of design, and thus to domesticate it.

A similar approach was also to be found in Buckland’s geological treatise, which, as we have seen, provided a strikingly naturalistic account of the physical history of the earth. Following Whewell, Buckland considered that, if true, the nebular hypothesis would only “exalt our conviction of the prior existence of some presiding intelligence.” Later he observed of the material components of the earth:
If the properties imparted to these Elements at the moment of their Creation, adapted them beforehand to the infinity of complicated and useful purposes, which they have already answered, and may have further still to answer, under many successive Dispensations in the material World, such an aboriginal constitution so far from superseding an intelligent Agent, would only exalt our conceptions of the consummate skill and power, that could comprehend such an infinity of future uses under future systems, in the original groundwork of his Creation.  

Yet, as we have seen above, Buckland attributed the repopulation of the planet at the start of each epoch to “the direct agency of Creative Interference.” Moreover, he considered one of the primary objectives of his Bridgewater Treatise to be the demonstration that geological evidence was utterly opposed to all existing theories of species transmutation. In this respect, too, Buckland found himself in agreement with Whewell. In an anonymous review of the first volume of Charles Lyell’s Principles of Geology (1830), Whewell had written that by uncovering the “distinct manifestation of creative power transcending the operation of known laws of nature” that was to be found in the repopulation of the earth at the start of each epoch, geology had “lighted a new lamp along the path of Natural Theology.” Whewell’s position on the possibility of a law-like account of the origin of species is notoriously complex, but both he and Buckland were (p.110)
reluctant to extend their nomological arguments in this direction, and, indeed, the other Bridgewater authors were also in practice implacably opposed to the transmutation of species (see Rupke, Chapter 6, this volume). \(^42\)

The possibility was, however, confidently articulated as being consistent with divine creation in the unofficial *Ninth Bridgewater Treatise* (1837) of mathematician Charles Babbage. Piqued by comments in Whewell’s treatise regarding the sceptical tendencies of “deductive reasoners,” Babbage wrote a bizarrely fragmentary work to demonstrate that mathematicians could also contribute to natural theology. The first and most important of his arguments used his famous Calculating Engine to suggest that natural laws might be predetermined by the creator to change at specified intervals. Drawing on the enormous prestige of his Engine, Babbage described how he could set it to count up to one hundred million in intervals of one, before suddenly changing to a different number series involving different intervals (see Figure 4.2). He then applied the notion of changing laws (p.111) from his Calculating Engine to the phenomena of nature, particularly the origin of new species, observing:

To call into existence all the variety of vegetable forms, as they become fitted to exist, by the successive adaptations of their parent earth, is undoubtedly a high exertion of creative power...But...to have foreseen all these changes, and to have provided, by one comprehensive law, for all that should ever occur, either to the races themselves, to the individuals of which they are composed or to the globe which they inhabit, manifests a degree of power and of knowledge of a far higher order.\(^43\)

This assertion was certainly radical, and Babbage’s work received extensive criticism, but it was one that led to extensive discussion among men of science about the law-like origin of new species.
Putting Darwin back in the picture

Within seven short years, Babbage's invitation to offer a naturalistic theory of species change within a theistic framework had been answered by the anonymously published *Vestiges of the Natural History of Creation* (1844). Written by an outsider to specialist science—the Edinburgh publisher Robert Chambers—the work not only used Babbage's theological rationalization to justify a theory of species transmutation, but also excerpted to the same end the paragraph quoted from Buckland above. Nor was Chambers the only one to take up the challenge. Darwin's notebooks from the 1830s suggest that, as a still-devout theist, he too was convinced that “the Creator creates by laws” as he formulated his transmutation theory. Indeed, despite the subsequent erosion of his belief in God into a somewhat vacillating form of agnosticism, Darwin used an excerpt from a *Bridgewater Treatise* in a prominent position opposite the title page of the *Origin of Species* in support of this view. “But with regard to the material world,” he quoted from Whewell, “we can at least go so far as this—we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws.” Of course, the strategic nature of Darwin's quotation is plain to see. Yet the notion that natural theology, or at any rate a theology of nature, might in this way be found consistent with natural selection motivated a number of Christian evolutionists in the later nineteenth century.  

The binary opposition between Darwin's theory of evolution and Paley's static and miraculously created living world manifestly obscures the new forms of natural theology that were developed in the *Bridgewater Treatises* and other works to accommodate progressive creation and naturalistic explanation. In addition, it obscures the development of an idealist natural theology in Roget's *Bridgewater Treatise* and elsewhere that was intended to replace Paley's narrow emphasis on functional adaptation as the sole determinant of the anatomy and physiology of living beings. While some of the Bridgewater authors, such as Bell and Buckland, used Paley's strictly teleological notion of perfect adaptation to oppose naturalistic theories of species origins, Roget's move away from strict teleology to some extent opened the door to such theories. In the philosophical anatomy of Roget, Richard Owen, and others, the search was on for the general laws governing animal and plant morphology, including its functional adaptation. This was also Darwin's quest, as indicated by the heading “Zoonomia,” or laws of life, in his first transmutation notebook. Moreover, while Darwin's approach was in many ways very different from that of the philosophical anatomists, it has been argued that he shared certain key ideas—such as the belief in the “limited perfection” of functional adaptation—with such naturalists.

My object in this chapter has been to explore some of the divergences and developments within natural theology in early nineteenth-century Britain (particularly in relation to the sciences of life) that are obscured by the simplistic Paley–Darwin dichotomy. I have focused on the *Bridgewater Treatises* both because they were widely circulated books of great significance at the time and because their diversity serves to undermine facile generalizations about the literature of natural theology. What we have seen is that several of the works contributed in a limited but nonetheless significant degree to the development of a historical and causal science of life—what later came to be called “biology”—and to reassuring a large public that such developments were consistent with Christian belief. Historians have long known that Darwin in a curious sense owed a debt to Paley for clearly stating his *explanandum*. In another sense, however, Darwin also owed a debt to the *Bridgewater Treatises*. By adapting natural theology to a progressive and law-like view of the history of the creation, the series unwittingly helped to prepare an audience to receive Darwin's theory. Perhaps, after all, it is not so ironic that Darwin
described his 1862 book on the adaptations of orchid flowers to ensure cross-pollination—a book greeted by the president of the Linnean Society as a remarkable (p.113) exemplar for the new field of “biology”—as being “[l]ike a Bridgewater Treatise.”

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Notes:


(27.) Topham, “Science.”


(30.) Anon., “Geology and Mineralogy Considered with Reference to Natural Theology,” *Spectator* (1836) 9: 946–7 (947).

(31.) Buckland, *Geology*, vol. 1, 21, 586.


(33.) Roget, *Animal and Vegetable Physiology*, vol. 1, 48.

(34.) Roget, *Animal and Vegetable Physiology*, vol. 1, 49–52.


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(41.) Buckland, *Geology*, vol. 1, 40n, 580–1.


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