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New design arguments: old Millian objections

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Abstract: An increasing number of natural scientists are doubling as natural theologians. I critically examine two recent defences of the design argument by biologists: *Darwin's Black Box* by Michael Behe and *Nature's Destiny* by Michael Denton. Each claims that recent findings in biology provide new evidence for belief in a supernatural designer. For the sake of argument, I grant both the validity and soundness of their arguments. What I then try to show is that even if we grant that the new biology supports a supernatural designer, J. S. Mill's objections, based on ordinary observation, still make it reasonable to doubt that the designer is the God of traditional theism – a being infinite in power, knowledge, and goodness.

Introduction

Natural theology is alive and well, occupying space outside as well as inside of philosophy and philosophical theology. Books by scientists from various disciplines constitute a new natural theology. One can find versions of the design argument that make use of the latest findings in astronomy, physics, biology, and biochemistry.[1] Framers of new versions of the design argument try to make the case that what contemporary science tells us is unintelligible unless the cosmos is a product of intelligent design.

Unfortunately, the assessment of the scientific core of these new design arguments is beyond the competence of most philosophers as well as laypersons. Despite the technical nature of much of the new natural theology, I believe that philosophers of religion have a role to play in the assessment of these arguments. While most philosophers of religion cannot claim to have the knowledge required to assess the scientific data, they can make judgements about the religious implications of the new arguments. For instance, one fundamental question is whether the arguments advanced, even if valid and sound – that is, even if the conclusions drawn about design are valid ones based on true premises – point to the existence of the God of traditional theism.

In this paper I will examine two of the new design arguments, focusing on their implications for understanding the nature of God. I will examine Michael Behe's

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Darwin's Black Box and Michael Denton's *Nature's Destiny* – two works that make use of data from biology and biochemistry to support the conclusion that the universe is a product of intelligent design.[2] What is distinctive about these defenders of the design argument is that they accept modern cosmology (the Big Bang theory) and the idea of evolution (though not in its Darwinian form) while arguing that the evidence for design in nature is undeniable. For Behe the very complexity of life – especially at the biochemical level – cannot be explained without positing a designer. Denton argues that all the evidence points toward beings like us as the *telos* of the cosmos. Both authors view it as overwhelmingly improbable that life is a product of mindless processes: they think that the scientific evidence compels us to assert the existence of a supernatural designer.

Ordinary lay readers of these books, to the extent that they understand them, may jump to the conclusion that the organizing intelligence which the authors affirm is the God of traditional theism, for example the God of Christianity. Is this inference warranted? This is the question that interests me. Even if we grant that these arguments establish that life is a product of a supernatural designer, does it follow that the designer is the God of traditional theism?

Even granting that design is undeniable, such an inference is, I will try to show, questionable. Accepting everything that the new natural theology says, we can still have reasonable doubts about whether the designer is the God of traditional theism. I will argue that the same objections which John Stuart Mill raised in the nineteenth century about the old natural theology apply to the new natural theology: namely that the empirical evidence can at most establish the probability of a limited deity, not the God of traditional theism.[3]

By traditional theism I mean the idea that God is all-knowing, all-powerful, and perfectly good. In order for an argument from design to qualify as an argument for the God of traditional theism, it is not enough to establish that the universe shows intelligent design. In addition, the argument must establish that the architecture of the universe reflects the work of an omnipotent, omniscient, and omnibenevolent designer. A reader of *Darwin's Black Box* might expect Behe's new design argument to provide evidence for such a God because the author acknowledges that he is Roman Catholic.[4] As we will see, he provides no such evidence.

The new design arguments

Behe, in *Darwin's Black Box*, argues that the evidence is overwhelming that life as we know it scientifically is a product of intelligent design. He asserts that ' design is evident when a number of separate, interacting components are ordered in such a way as to accomplish a function beyond the individual components '.[5] Behe tells us that one infers design because a number of separate components are ordered to accomplish a purpose that none of the components could achieve by

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itself.[6] We must infer intelligent design, according to Behe, when a system is irreducibly complex: in such a system interacting parts contribute to the basic function wherein removal of any one of the parts causes the system to cease functioning. Behe's thesis is that an irreducibly complex system cannot be produced by slight, successive modifications of a precursor system, because any precursor that is missing one of the parts is by definition nonfunctional.[7]

What is distinctive about Behe's design argument is that it appeals to evidence found in the realm of 'black boxes', by which he means phenomena whose inner workings cannot be seen by the unaided human eye.[8] A cell is an example of a black box because its complex inner workings can be viewed only by using an electron microscope. Now that the black box of cellular life is open, according to Behe, it is no longer enough to explain visible structures, such as whole eyes, because this ignores the staggeringly complicated biochemical processes below the level of observable anatomy. The discovery of black boxes in the biological world enables Behe to dismiss the sceptical arguments of philosophers such as David Hume and John Stuart Mill by pointing out that they relied on ordinary observation alone and had no real understanding of the level of complexity that exists at the cellular and molecular levels, levels at which we find 'black boxes within black boxes'.[9] It also enables Behe to challenge Darwinian explanation which knows nothing about black boxes.

The blood-clotting system is for Behe an example of an irreducibly complex system which defies Darwinian explanation because it is an irreducibly complex black box. The phenomenon of blood clotting requires extreme precision: a clot has to stop bleeding all along the length of a cut, sealing it completely – yet the blood clot must be confined to the cut or the entire blood system might solidify, killing the cut animal. Behe argues that it is impossible to explain the complex biochemical system that achieves the end of coagulation by appealing to the hypothesis of a Darwinian gradualist-mutation-driven-add-on process. The blood-clotting system is irreducibly complex because it is composed of several interacting parts all of which are necessary to achieve coagulation.[10] In the event of a wound, this system functions to form a barrier at the right time and place that is able to stop blood flow out of an injured vessel: in the absence of any one of the highly specialized protein components that make up this biochemical system, blood would not clot and the system would fail. Blood coagulation is, according to Behe, a paradigm case of the staggering complexity that underlies even apparently simple bodily processes: 'Faced with such complexity beneath even simple phenomena, Darwinian theory fails.'[11]

Behe's conclusion is that mindless or undirected evolutionary change by natural selection, working on occasional mutations, cannot produce such a system because its successful functioning requires that all the components be present at once to achieve coagulation. Behe compares the blood clotting system to a household mousetrap, something we know to be a product of human design. A

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mousetrap is irreducibly complex in this sense: if any part of the trap – the hammer, spring, catch, holding bar, or platform – is missing, it cannot function. If a system requires several such closely matched parts to function, we can conclude that it must have been designed as an integral unit: an interacting whole.[12] According to Behe, it makes no more sense to say all the components needed for coagulation happened to come together than to say all the parts necessary for the operation of a mousetrap happened to assemble themselves. As he sees it, things just don't happen that way unless someone or something is guiding the process: more specifically, both the mousetrap and the blood-clotting system need the guidance of an intelligent agent.[13]

For Behe the same is true of the eye, especially at the biochemical level. It is an organization of elements, the function of each of which is to contribute to the end of vision. The vertebrate eye is complicated enough at the anatomical level: it is an extraordinary mechanism, with the parts well-arranged for achieving sight. That is why it is difficult to see how the eye, even given a long Darwinian evolutionary process, could, in all its anatomical, not to mention its biochemical, complexity, be a product of unintelligent forces: that is, natural selection working on random variations. Darwin himself conceded as much: 'To suppose that the eye with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest degree.'[14] Despite this statement, Darwin tried to convince his readers that an evolutionary pathway led from the simplest light sensitive spots on simple organisms to the sophisticated camera-eye of humans. What Darwin did not explain was the starting point – the origin of the light sensitive spot on an organism. He could not explain the biochemistry necessary for vision to occur because, according to Behe, vision was for him a black box (something whose inner workings were then unknown).

> **Now that the black box of vision has been opened, it is no longer enough for an evolutionary explanation of that power to consider only the anatomical structures of whole eyes, as Darwin did in the nineteenth century… . Each of the anatomical steps and structures that Darwin thought so simple actually involves staggeringly complicated biochemical processes that cannot be papered over with rhetoric.**[15]

Behe concludes that insofar as the biochemistry of vision is irreducibly complex it can be explained, like all irreducibly complex systems, only by positing an intelligent designer. He maintains that when it comes to living things, we have, at the microscopic level, massive evidence of biochemical design. Indeed, he informs his readers that we can be as confident of this as we can that a mousetrap was designed.[16] Whether we are referring to the biochemistry of vision, blood clotting, the immune system, or any other irreducibly complex living system, we are, according to Behe, dealing with biological machines that can no more be explained by the hypothesis of undirected natural processes than can a mousetrap: 'Because

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the functions [of biochemical systems] depend critically on the intricate interactions of the parts we must conclude that they, like a mousetrap, were designed.'[17]

While endorsing the design argument of Behe, Michael Denton goes much further. In *Nature's Destiny*, Denton wants to drive the final nail into the coffin of the undesigned universe hypothesis. He believes that modern physicists and astronomers turned natural theologians, such as John Barrow, drove the first nails into this coffin.[18] Denton conceives of his work as adding a final biological dimension to the design argument, to complete what he takes to be the already powerful case provided by the purely physical sciences.

The design argument based on modern physics and astronomy is complicated, but its main elements, as Denton understands it, can be easily summarized. We are told that the laws of physics are supremely fit for life and that the cosmos gives every appearance of having been optimally designed to achieve that end. Even the age of the universe is a prerequisite for life as we know it; in Barrow's words: 'Billions of years of stellar alchemy are needed to create the building blocks of living complexity'.[19] That is, to arrive at the level of complexity described by Behe we need precisely the amount of time the Big Bang has given us. The four fundamental forces of nature – gravitation, the strong force, the electromagnetic force, and the weak force – are just at the proper relative strengths to allow atoms, stars, galaxies, and planets to form and for the elements necessary for life to emerge. If these forces had been slightly different, life would never have emerged anywhere in the cosmos. In sum, our type of carbon-based life can exist only in a very special sort of universe: namely *this* universe. As Denton puts it: 'With the evidence as it now stands, it is not surprising that there now exists a significant body of opinion within the scientific community prepared to defend the idea that the universe is in some way profoundly biocentric and gives every appearance of having been specially designed for life.'[20]

Denton's case is more general and more ambitious than that of Behe. Denton in effect endorses a strong version of what is called the *anthropic principle*.[21] The chemical properties of the carbon atom, the electromagnetic radiation of the sun, the percentage of oxygen in the atmosphere, the thermal properties of water, the capacity of proteins to be guided by DNA instructions, etc. appear to have been designed not only for life but for beings like ourselves.

> **All the evidence available in the biological sciences supports the core proposition of traditional natural theology – that the cosmos is a specially designed whole with life and mankind as its fundamental goal and purpose, a whole in which all facets of reality, from the size of the galaxies to the thermal capacity of water, have their meaning and explanation in this external fact.**[22]

Design: omniscience and omnipotence

Behe and Denton provide two new different design arguments – both of which are based on scientific findings about phenomena that are either below the

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level of ordinary observation (cells, molecules, atoms) or are in principle unobservable (the Big Bang). Behe, we have seen, concentrates on living systems that exhibit what he calls irreducible complexity and tries to show why such systems require intelligent design for their explanation. Denton goes further by trying to show that the cosmos in all its aspects exhibits evidence of having been designed for life in all its diversity and specifically for creatures like ourselves: beings capable of comprehending the cosmos. In opposition to fundamentalist creationists, both affirm the hypothesis of directed evolution, the idea that life as we know it is a product of a billions of years long process directed by a being they both call God.

The question that interests me is whether there is any reason to believe that the God of these new design arguments should be identified with the God of traditional theism. If, as Denton maintains, all available evidence supports the central proposition of traditional natural theology – that the human being was the ultimate goal of creation[23] – are we also supposed to conclude that this designer is the God of traditional natural theology? Denton does not provide a clear answer to this question. I will try to show that even if we accept the thesis of both Behe and Denton – namely that the scientific evidence, much of it invisible to the human eye, supports the idea of a designed universe – ordinary observation, observation, at the anatomical level, still provides a basis for reasonable doubts about whether the designer is the God of traditional theism.

In the remainder of the paper I will indicate why the observable world, even if it is the result of supernatural design, is not clearly the work of a God who is all-knowing, all-powerful, and perfectly good. I will argue that doubts about the existence of the God of traditional theism, raised by philosophers such as Hume and Mill,[24] who challenged the old natural theology, still apply to the new natural theology. In other words, there is nothing in the new natural theology, based on the findings of contemporary science, that gives us any new compelling reason to think that, even if there is a cosmic designer, this designer possesses *all* three attributes of the God of traditional theism: omniscience, omnipotence, and perfect goodness. So, while granting design, we must infer, as did Mill, the existence of a limited designer: a deity who lacks at least one of the attributes of the God of traditional theism.

In this section I will indicate what observations make it doubtful that the hypothesized designer is *both* omniscient and omnipotent. In the next section I will try to show why, even if we ignore questions raised about the designer's knowledge and power, the findings of everyday observation raise questions about the designer's goodness, the same kinds of questions that Mill raised in the nineteenth century.

It is important to be clear about the meaning of the term design as Behe and Denton use it. At its simplest, it means the arrangement of parts for the achievement of a purpose. As pointed out above, Behe argues that there are purposeful

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biological systems of such complexity that their organization requires as their cause an intelligent designer. Denton goes further by arguing that the entire cosmos appears to have been designed for the ultimate purpose of producing intelligent beings with a capacity to do science. I will not challenge their teleological conclusions – the idea that we cannot explain what science tells us about life and the cosmos by invoking the possibility of mindless self-organizing forces. (Clearly, there are many scientists who would assert this possibility.) For my purpose, I will grant that we are compelled by the scientific evidence to posit intelligent design. I leave it to philosophers of science to evaluate the thesis that the data of modern science point toward the need for teleological explanation. That is why I have not tried to develop and assess fully either Behe's or Denton's teleological reasoning.

I am interested in answering the following question: granted that the cosmos is a product of supernatural design, is there any basis for concluding that the designer is *both* all-knowing and all-powerful? Omniscience would seem to entail a knowledge of how best to design things to achieve a particular purpose (blood-clotting, vision, etc.); omnipotence would seem to entail the power to instantiate this design. If an omniscient and omnipotent being designed the cosmos disclosed to us by modern science, it seems reasonable to expect to find flawless design everywhere it is claimed that a perfect designer has directed evolutionary development. I will call this the argument from perfection.

How can we evaluate a structure or a system to determine whether its design is flawed or flawless? A plausible answer is this: we should examine the relationship of the parts to, and their efficiency in, the achievement of a purpose. So understood, it makes sense to evaluate a design on the basis of how well it achieves an asserted function or purpose. If the designer is both omniscient and omnipotent, we would expect a designed structure or system to be such that we cannot imagine how it could be improved. If we discover a structure or a system about which it seems reasonable to say that its purpose could have been better achieved in another way, then a question can plausibly be raised about the claim that the designer is *both* omniscient and omnipotent.

Consider, for example, human anatomy. According to Denton, human beings are what God had in mind from the beginning: we are the pinnacle and goal of the directed evolution, the *telos* of the Big Bang, why the Big Bang banged in the first place. Isn't it therefore reasonable to believe that if we are what an omniscient and omnipotent designer had in mind, our bodies should exhibit engineering perfection, a flawless design?

There are, however, features and functions of human anatomy that appear to show design flaws. Operating with the idea that a perfectly designed system or structure is one we cannot imagine improving, human anatomy seems to fall short. Consider, for example, the human eye. As we saw, even Darwin thought that the eye was a model of design perfection. Darwin, however, may have been too

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generous in his use of the word perfection. A number of biologists have in fact argued that the vertebrate eye, including the human eye, is not a perfectly designed structure. In evaluating the design of the eye, it must be kept in mind that the question is whether we can imagine a better design for it – in other words, whether the eye, judged by the *telos* of vision, shows any design flaws. If the goal of the designer of the human eye was unobstructed sight and acuity of vision, it can be argued that the human eye leaves much to be desired.

Some biologists have argued that there are in fact two flaws in the design of the human eye. One is that the neural wires going to the optic nerve extend in front of the photoreceptor cells of the retina, instead of, as would seem more functional, extending from the back of these cells to the optic nerve. The other design flaw in the eye is that the neural wires from the photoreceptor cells exit through the retina, creating a blind spot in the visual field. Kenneth Miller, a professor of biology, sums up the design flaws:

> **An intelligent designer, working with components of this wiring, would choose the orientation that produces the highest degree of visual quality. No one, for example, would suggest that the neural connections should be placed in front of the photoreceptor cells – thus blocking light from reaching them – rather than behind the retina. Incredibly, this is exactly how the human retina is constructed… . A more serious flaw occurs because the neural wiring must poke directly through the wall of the retina to carry the nerve impulses produced by photoreceptor cells to the brain. The result is a blind spot in the retina – a region where thousands of impulse-carrying cells have pushed the sensory cells aside.**[25]

Richard Dawkins, a Darwinian evolutionist and critic of the design argument, reaches the same conclusion about the design of the eye: that the photoreceptors are wired in backwards – a design plan, he tells us, that 'any intelligent human engineer would laugh at'.[26]

To formulate a variation on William Paley's[27] famous analogy, let us imagine that while walking along the beach we discover a video camera. We try it out and find that it does indeed work: it records what we see through the viewer. We would never doubt that it was a product of design. What would we conclude if, however, we discovered tiny, barely visible wires running across the lens, wires that, although they do not prevent the camera from recording a relatively good picture, do prevent it from recording the best possible picture, and, in addition, that there is a cable to the power system which actually protrudes from a section on the left edge of the camera lens, thus blocking out part of the recorded image? Although never doubting that it was a product of design, would we not conclude that the camera contained serious design flaws and thus that its maker, although capable of producing something that required great intelligence and skill, was limited in some way? It seems reasonable to reach a similar conclusion about the designer of the human eye.

Moving down human anatomy, to the pharynx, we encounter what appears to

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be another apparent design flaw: namely the way in which swallowing can sometimes interfere with breathing. Again, it might be conceded that human breathing and swallowing both involve impressive mechanisms. We would, however, expect that if the body was a product of a perfect designer then no human engineer would be able to conceive of how to improve upon the anatomical structures that make possible these functions.

The apparent design flaw resides in the juxtaposition of the breathing and swallowing channels. The flaw is revealed by the fact that it is sometimes necessary to perform the Heimlich Manoeuvre in order to keep people from choking to death. One reason that this manoeuvre needs to be performed on occasion is that food can, as we say, 'go down the wrong way'. This is because it is impossible for human beings to breathe in air and swallow food simultaneously. When we swallow food or drink, a lid called the epiglottis *usually* comes down over the trachea to prevent food from falling in and blocking the windpipe.

The placement of the trachea is, however, such that food can sometimes fall into it and end up in the wrong place. As Darwin observed: 'It is a strange fact that every particle of food and drink we swallow has to pass over the orifice of the trachea, with some risk of falling into the lungs.'[28] Isn't it reasonable to conclude that, from an engineering perspective, this is a design flaw, the evidence for which is the fact that people from time to time choke to death on food?[29] If the functions of swallowing and breathing were perfectly designed, wouldn't the oesophagus and trachea be so positioned that food could *never* go down the wrong way? Surely an omniscient and omnipotent being would have been able to conceive and implement such a design.

Other structures of human anatomy that have been judged to show design flaws include: the human spine because, despite great flexibility, it shows weakness, especially in the lumbar region, as is manifest in the pervasiveness of lower back problems;[30] the birth canal because it is too narrow in relationship to the size of the newborn's head, thus posing serious dangers for both mother and newborn;[31] and the appendix because it is a useless pouch that is vulnerable to infection (e.g., appendicitis).[32]

The apparent flaws in the design of these bodily structures in relationship to their respective ends – vision, swallowing, breathing, upright stance, childbirth, and excretion – raise questions about the nature of the designer. It is of course conceivable that the designer might be omniscient but not omnipotent, or contrariwise. That is, it is possible that the designer knew how to produce a body in which, for example, swallowing food would never interfere with breathing, but lacked the power to execute the superior design. Or it may be that the designer is omnipotent, but did not know how to arrange body parts in the most efficient way. In the face of apparent design flaws, the new design arguments seem no better than the old ones at making a case for a designer who is both omniscient and omnipotent.

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So, even if we grant Behe his black box argument – that at the biochemical level there is an irreducible complexity in all of the structures faulted above which can only be explained by invoking supernatural design – this does not help us to understand why there appear to be flaws at the anatomical level. Why, for example, if it takes supernatural intelligence to create the complex biochemistry involved in vision, something that Darwinian evolution supposedly can never explain, does the human eye at the anatomical level appear to be less than optimally designed?

The defence of the design argument

What do Behe and Denton have to say, if anything, about the apparent anatomical design flaws described above? Behe challenges the argument from perfection on three grounds. The first problem with this argument, according to Behe, is its demand for perfection.[33] The fact that a structure is less than optimal, in terms of the achievement of an end (e.g., vision), does not necessarily entail that its designer is incapable of creating an optimal structure. The human analogy he uses to illustrate this point is the commercial practice of built-in-obsolescence: 'the product is intentionally made so that it will not last as long as it might, for reasons that supersede the simple goal of engineering excellence'.[34] The argument from perfection, Behe contends, overlooks the possibility that the designer might have a number of motives for how he designs things, with engineering excellence oftentimes relegated to a secondary role.[35]

A second problem with the argument from perfection, Behe contends, is that it 'critically depends on a psychoanalysis of the unidentified designer', yet 'the reasons the designer would or would not do anything are virtually impossible to know unless the designer tells you specifically what those reasons are'.[36] So, features that strike us as odd might have been placed there for some as-yet-undetected good reason. Since we cannot fathom the motives of a supernatural designer, we should not waste time trying to do so. The most important consideration, Behe contends, is not the motive of the designer but whether there is compelling evidence of intelligent design, no matter how imperfect it may *appear*.[37]

A third problem, according to Behe, with the argument is that it is based 'solely on an emotional feeling of the way things ought to be'.[38] Who are human observers to set themselves up as judges of how eyes ought to be designed? To say that a design could be better is to make ourselves the measure of all things, operating with a limited human idea of what constitutes design perfection. Behe concludes that a more objective observer would simply conclude that the human eye was not designed by a being who was impressed with the argument from perfection.[39]

What can be said about Behe's various responses? To begin with, the idea that the designer chose goals other than design perfection seems to suggest that the designer is limited: that the designer cannot achieve both perfection in design and another end or set of ends. If a designer cannot combine the end of engineering

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perfection and other ends (assuming that the combination does not constitute a logical impossibility); if the designer is compelled to sacrifice such perfection in order to achieve other ends – then we have good reason to doubt that the designer is truly omniscient *and* omnipotent.

Behe's second and third responses to the argument from perfection seem to reduce to the view that the designer might have motives we cannot know and should not presume to understand. It is of course possible that the designer has a reason for what looks like a design flaw – a reason that, if we knew it, would enable us to see that there is no reason to question the designer's knowledge or power. But what possible motive could a perfect designer have for constructing an eye with a hole in it? The only basis we have for judging an organ or structure is how efficiently and well it achieves its purpose. How else can we evaluate design claims? If the function of an eye is vision, it does not seem unreasonable to say that a better-designed eye would be one without extruding neural wires that partially block vision.

It would be helpful if Behe could give us some idea of what reason a perfect designer might have for constructing an eye with a blind spot. One can of course contrive reasons to explain what appears to be a design flaw in the eye. Consistent with Behe's worldview, as we will see below, would be an account of the blind spot in terms of what is needed for successful predation: namely making a prey vulnerable to a predator. Such an account, however, I will try to show in the next section, raises questions about the goodness of a designer who creates a world of predator and prey.

As it turns out, Behe is not interested in showing that the designer is the God of traditional theism, but only that there is an intelligent designer. Those who read Behe expecting to find evidence for the Christian God of his Catholic faith will be disappointed. In fact he professes agnosticism when it comes to the issue of the nature of the designer: 'Inferences to design do not require that we have a candidate for the role of designer. We can determine that a system was designed and we can hold to the conviction of design much more strongly than a conviction about the identity of the designer.'[40]

So, all that Behe thinks the evidence supports is an hypothesis of directed evolution: evolutionary development that is *largely* guided by a supernatural designer. He allows that the evolution of life on earth may also involve mutations or chance events: he holds that 'the production of some biological improvements by mutation and natural selection is quite compatible with intelligent design theory'.[41] What is not clear is why Darwinian evolution plays any role in the emergence of living things. Why are some living systems products of design – e.g., blood clotting, the immune system, etc. – while other systems are left to chance development? Is it because part of the natural world is beyond the designer's control, or is it because the designer chooses to play with dice? Perhaps Behe needs to introduce random elements – mutations ' to account for such genetic

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problems as sickle cell anaemia and haemophilia, phenomena that suggest defective design unless they can be attributed to an area of undirected evolution.

What response does Michael Denton give to questions raised by the argument from perfection? Simply this: flaws are to be expected in a creature that is a product of evolution, even divinely directed evolution. In a section called 'Human imperfections', Denton states:

> **Our design is constrained due to our evolutionary origin. We suffer spinal problems because the spinal column was not designed originally for an upright stance. Childbirth is painful and difficult in humans because the relative size of the human infant's head at birth is far larger than in the case of any other primate. Because air and food both pass through the same passage, the pharynx, inevitably there is always the possibility of choking.**[42]

Doesn't Denton's view call into question the omnipotence of the designer and bring to mind Mill's point that a deity's resort to contrivance – the adaptation of means to an end – is itself a reflection of limitation?[43] If a bipedal animal was the anatomical goal of the designer – as Denton maintains – what does he mean when he states that the human spinal column was not designed originally for an upright stance? Why did Denton's designer have to use the spine of a quadruped to make a biped? Is the deity incapable of achieving ends more directly? Indeed, Denton apparently holds that the deity could bring human beings into existence only through a long process (taking billions of years) that required specific events and special conditions, including exploding supernovas, the positioning of our planet on the edge of an ordinary galaxy, at a specific distance from other galaxies, the extinction of over ninety per cent of all species, a long evolution from pre-humans who themselves had to become extinct, etc.[44]

Denton's designer apparently had to direct evolution through an enormous period of abiotic events and processes in order to produce biotic beings, and to eventually produce us. What conclusion should we draw about Denton's designer? Just this: Denton's God, far from being the God of traditional theism, appears to be closer to Plato's limited god who works with pre-existing material that is inherently flawed – material which the designer lacks the power to perfectly shape. Because the human body is composed of matter, it is necessarily flawed:

> **…the human body is a material object subject to the laws of nature like everything else in the cosmos. And as Plato pointed out, all material objects are imperfect to some degree. Even a geometric form like a triangle can only be imperfectly represented in the world of matter. All material objects from a sandcastle to a galaxy are subject to turnover and decay. Nothing lasts forever.**[45]

Thus, Denton's designer is constrained by laws of physics and by the nature of the matter generated by the Big Bang. Even though God is by hypothesis the cause of the Big Bang, it appears that once cosmic expansion begins, the designer can direct the material elements to produce living creatures only by operating within severe constraints of time and space (or spacetime). On Denton's view, life must be

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carbon-based (God apparently cannot bring about any other form of life), requiring for its creation an evolutionary process precisely like the one that occurred in the history of this cosmos: intelligent life can be brought into existence only through *one* chain of events. There is for Denton only one possible world in which beings like us can exist: this cosmos.[46]

This means that the anthropic principle cuts two ways. On the one hand, it calls for the acceptance of the conclusion that ours is a designed universe – a cosmos that points toward a designer who, from the beginning, had beings like us in mind. On the other hand, the principle demands that we believe in a designer who was incapable of designing beings like us without spinal problems, painful childbirth, the possibility of choking to death on food, a hole in the eye, etc.

In summary: a designer who requires the long process described by modern cosmology and evolutionary biology in order to produce life in general and human life in particular is limited in either knowledge or power, if not in both. Perhaps the designer knows how but lacks the power to more directly realize ends – e.g., human beings – or the designer has the power but lacks a knowledge of how to bring about ends in a more direct way.

Perfect goodness and the new design arguments

Perhaps there is some way of answering the above doubts about omniscience and omnipotence. Even if, however, we could somehow become convinced, despite what look like design flaws, that the designer is omniscient and omnipotent, we would then face another question. The question is this: is there any evidence that the designer of the new natural theology is perfectly good? I will try to show that what Mill cited as evidence of evil in nature still has currency and calls into question the goodness of any designer that is conceived as both omniscient and omnipotent. No discoveries in contemporary science, not even newly opened black boxes, seem to provide answers to the questions Mill raised in the nineteenth century about the goodness of the designer.

Neither Behe nor Denton seem concerned with this issue. Their primary concern is to show only that the idea of life emerging from mindless forces is unworthy of belief. As we saw above, Behe professes agnosticism on the question of the nature of the designer: his only mission is apparently to make the conclusion of intelligent design undeniable. From the premise that the cosmos is a product of intelligent design, it does not, however, necessarily follow that the designer is good in any ordinary moral sense. The question is whether the new natural theology provides *any* basis for concluding that the designer has the moral qualities attributed to the God of traditional theism. My thesis is that Mill's doubts about the goodness of the designer remain as reasonable as ever: that there are in fact compelling reasons to doubt that the designer of the natural world, if conceived as omniscient and omnipotent, can also be conceived as perfectly good.

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One of the most powerful arguments against the idea that nature is the work of a morally perfect designer – an argument which effectively challenged the old natural theology's attempt to defend belief in the God of traditional theism – is Mill's essay, 'Nature'.[47] Mill describes nature as a domain in which creatures are victims of violent predation, periodic starvation, poison by quick or slow venom, and a hundred other forms of hideous death and ingenious cruelty. He concludes that nature callously disregards both mercy and justice.[48] If Mill's view of nature seems excessively harsh, it must be kept in mind that he was responding to the ethical naturalism of such thinkers as Alexander Pope whose view of nature as a moral model is summed up by his famous phrase, 'Whatever is, is Right'.[49] Natural justice is for Mill a myth: violence and cruelty are the marks of nature, not peace and harmony, the latter being what he thinks one would expect from a truly good designer that had the knowledge and power to implement its will.

In this section I will focus on non-human nature – especially the animal world – because evil occurring there cannot, as in the case of the human world, be explained by a free-will hypothesis. The non-human animal world *should* directly reflect the will of the designer, if we assume the designer to be all-powerful and all-knowing. After all, since non-human animals have not freely chosen their patterns of behaviour, it seems reasonable to conclude that they can behave only in ways the designer has determined (programmed) them to behave.

It appears that some contemporary defenders of the design argument are so preoccupied with showing that Darwinian natural selection cannot explain the complicated 'intelligent' behaviour of animals that they lose sight of the need to defend the claim that the designer of these creatures is truly good. Consider, for example, the bombardier beetle's extraordinary system of defence. Francis Hitching, a critic of Darwinian theory, describes it well:

> **The bombardier beetle squirts a lethal mixture of hydroquinone and hydrogen peroxide into the face of the enemy. The two chemicals, when mixed together, literally explode. So in order to store them inside its body, the bombardier beetle has evolved a chemical inhibitor to make them harmless. At the moment the beetle squirts the liquid out of its tail, an anti-inhibitor is added to make the mixture explosive once again.**[50]

Behe supports Hitching's conclusion that the defence system of this creature poses serious problems for Darwinians. Darwinians, according to Behe, fail to see the need to posit intelligent design to explain the beetle's defence system and behaviour – how this creature combines the right amount of two chemicals at the right time in the right place in its body with the right inhibitor – until the time it needs to use the mixture for its defence, at which moment it must add the right enzyme in order make the liquid mixture hot enough to scald the attacker. Behe holds that a Darwinian explanation of the evolution of the extraordinarily complicated and finely-tuned chemical preparation necessary for this creature's de-

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fence against predators should be 'filed alongside the story of the cow jumping over the moon'.[51]

It never seems to occur to either Hitching or Behe to ask what kind of being would design a creature to explode a toxic chemical mixture in the face of another creature. It never seems to enter their minds that designing a creature so that it can expel from its rear an explosive toxic liquid in order to scald its target raises questions about the moral character of the designer. If the bombardier beetle exhibits a flawless design, it seems to be a viciously clever one. While the apologists for its designer might argue that the beetle's behaviour is only a defensive action against a predator, the question is: why, in the first place, does this creature need to defend itself? It never seems to occur to Behe to ask what sort of designer would organize animals into predator and prey relations – into attackers and defenders. The idea of benevolence does not come readily to mind when we think of a being that designs creatures to engage in chemical warfare.

In *Nature's Destiny*, Denton explains predator–prey relations by arguing that this is what we would should expect of life that approximates to the plenitude of all possible biological forms. This, he says, fits with the teleological thesis that the cosmos is uniquely prefabricated for life as it exists on earth. The plenitude of life, a kind of great chain of biological being, he tells us, is what we should expect 'if a program for the evolution of life has been written into the cosmic script from the beginning'.[52] He appears to believe that the designer could not produce beings like us without evolving all the other life forms. Given this, he concludes that life cannot exist without predator and prey. He tells us that a lion without herbivores for prey is as *impossible* as herbivores without plants for food.[53]

Denton's view, I argued above, amounts to an abandonment of the idea of omnipotence. If, however, we assume, as I do for the purpose of this section, the existence of a designer that is omniscient and omnipotent, then it seems reasonable to hold that such a being could have designed animals so that survival did not depend on attacking and consuming other animals. It is one thing to assert that even an all-powerful and all-knowing God cannot do what is logically impossible (e.g., make round squares); it is something very different to assert that an omnipotent and omniscient God was compelled to direct evolution to produce predator–prey relations.[54] Life without predation does not seem to be a logical, or even a biological, impossibility. As biologist Bruce Bagemihil points out:

> **Biologists have observed that eating – the consumption of one organism by another, is not a necessary component of life. Why, for example, don't all species manufacture their own food the way plants do? In fact, compared to the efficiency (and self-sufficiency) of photosynthesis, much more energy is squandered when one animal consumes another or consumes plant material. In nature, death itself seems to be elevated to 'lavish' proportion, often reaching a 'profusion' of its own.**[55]

If the designer of nature is omniscient and omnipotent, then we can only

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conclude that this being willed the kind of predatory behaviour that occurs throughout the natural world. In other words, if an omnipotent and omniscient God directed evolutionary development, then isn't it reasonable to conclude that the destructive behaviour we see in nature was by design? It is, however, difficult to reconcile the act of programming evolutionary development for predatory and destructive behaviour with a perfectly benevolent and just designer. The suffering of animals at the hands of ruthless predators – or even the suffering of predators at the hands of 'intended' prey (e.g., the bombardier beetle) – does not bespeak any clear sense of compassion or justice.

I should repeat an important point made above – namely that the predatory and destructive behaviour of animals cannot be explained in the same way that human violence can: it cannot explained in terms of a misuse of free will. If the designer is all-knowing and all-powerful, then prima facie it makes sense to conclude that animals behave precisely the way the designer intended them to behave; it makes no sense to say that they have freely chosen their destructive behaviour. What was for Aquinas[56] clear evidence of supernatural design in nature – namely 'intelligent' behaviour that cannot be attributed to the creatures that exhibit it – is also evidence that the designer alone is the author of the destructive behaviour we see everywhere in the natural world.

A peregrine falcon in what is called a stoop (a propelled free fall from on high) crashes feet first, at enormous speed, into a pigeon, breaking its back and then consumes it.[57] What would it be reasonable to assert about the moral nature of a designer who engineered this feat? On what grounds would we call the designer of this behaviour perfectly benevolent or just? And what would it be reasonable to conclude about the moral character of a designer who programmes animals to commit infanticide (e.g., male hanuman langur monkeys) and siblicide (egret nestlings)?[58]

Mill maintains that those who attempt to read the purposes of the creator from the creator's works ought not to shrink from the most honest conclusion: that 'if there are any marks of special design in creation, one of the things most evidently designed is that a large proportion of all animals should pass their existence in tormenting and devouring other animals'.[59] And if we try to discern why so many animals are designed to prey on other animals, Mill again has a plausible answer: 'The indications of design point strongly in one direction – the preservation of the creatures in whose structure the indications are found.'[60] So, if a designer gave the peregrine falcon the capacity to have acute high altitude vision and to stoop at 150 miles an hour, it appears that these impressive abilities exist to serve one purpose only – survival. As A. C. Ewing observes: 'The unpleasant features of the struggle for existence in nature are far from supporting the hypothesis for a good God'.[61]

If the designer of nature appears to have little interest in justice or benevolence, neither does this being seem to value truth. On the contrary, deception appears to be something that the designer endorses, because deception occurs throughout

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nature. We have overwhelming observational evidence that deception plays an important role in the struggle to survive. This presents a problem for those who would identify the designer of nature with the God of traditional theism – a God that is identified with truth, a God who, it is said, never deceives.

For example, the North American lampsilis clam has an ancillary structure growing on the surface of its shell that resembles a fish, an appendage that looks as though it has fins, a tail, and eyes. This is only a lure to attract large fish who, when they approach, are sprayed with 300,000 larvae, many of which parasitize the gills of the fish.[62] What kind of mind would design a creature with this kind of deceptive structure? Certainly not a mind that disapproves of deception.

Another fascinating example of deception in nature is the European cuckoo, a parasitic bird that is able to produce and deposit eggs that mimic – in size, colour, and shape – those of its intended host: for instance, a reed warbler. A deceived reed warbler hen will incubate the cuckoo egg along with its own. The cuckoo egg hatches prior to the others and the still blind cuckoo chick immediately pushes all the other eggs out of the nest so that it has the nest to itself.[63] The mother then feeds the killer of her offspring as if it were her own.

Since we cannot attribute the origin of the intention to deceive to irrational creatures – both predators and prey – that exhibit deceptive behaviour or deceptive morphology, we can only conclude that the postulated designer is the architect of deception in nature. Given the pervasiveness of deception in the natural world – including, to add to the examples already given, caterpillars that look like bird droppings to discourage predator birds from eating them, parts of flowers that fool male bees into pollinating them by looking and smelling like female bees, ravens that make phoney submissive gestures to rivals until the rivals draw near, alligator-snapping turtles with bright pink dummy worms attached to their tongues that lure unsuspecting fish into their mouths,[64] etc. – it certainly would be odd to argue that the designer of nature disapproves of deception. It appears in fact that deception is part of the design of nature.

As a final example of deception in nature, we can revisit the blind spot in the vertebrate eye, because there appears to be a design for deception even here. The vertebrate brain in effect makes up for what is missing in the visual field by 'inventing' an image. The brain of the vertebrate does not tell it that there is a blind spot in its visual field. On the contrary (if humans are representative) the vertebrate brain dupes the creature into thinking that it sees an image where there is only a hole; specifically, the brain invents an image that is continuous with what it does see. The result is that vertebrates see what is *not* there and do not see what *is* there.[65] Perhaps Behe is correct in arguing that an omniscient designer might have a reason for placing a hole in the eye. In designing a world full of predation, perhaps the designer intended for certain prey to be blind-sided by certain predators.

An all-knowing and all-powerful designer certainly could have directed the

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evolutionary process so that no being's survival depended on deceiving any other being. We can only conclude that the designer, if all-knowing and all-powerful, approves of deception: otherwise, nature's designer would not have made deception an integral part of survival behaviour – a distinct evolutionary advantage. If we judge deception to be evil, we must conclude that the designer of nature is evil.

In summary, it seems unreasonable to believe that a perfectly good designer (one that is also omniscient and omnipotent) would guide evolution to produce a world filled with widespread destruction and deception. Therefore, if nature was in fact designed by an omnipotent and omniscient being, there is reason to doubt that this being is perfectly benevolent and just. On the contrary, we might be tempted to agree with Mill that the animal world, *if* designed by an omniscient and omnipotent being, is 'the work of a demon'.[66] This is a tempting way to characterize any designer who would direct the evolutionary process to produce the devilishly clever European cuckoo.

Possible explanations and responses

As I pointed out above, Behe and Denton are silent on the goodness question: they seem indifferent to the problem of evil in nature. If the designer they have in mind does not possess one of the two attributes discussed earlier – omniscience and omnipotence – then of course there is not necessarily a problem of evil. It should be recalled that the question that interests me is whether any defender of a new design argument – one based on the findings of contemporary cosmology and biology – can defend the idea of a perfectly good, omnipotent, and omniscient designer any better than could a defender of the old design argument which philosophers such as Mill effectively discredited.

To the question of how we can reconcile our observations of natural phenomena with belief in an omniscient and omnipotent designer, one response might be that claims about flaws in design – design imperfections – are simply mistaken. Whether we are talking about the human spine or the vertebrate eye, it could be argued that, given our limited intelligence, we simply fail to see how these are in fact examples of engineering excellence. In response to this view, it should be pointed out that what I have listed as examples of design imperfections are in fact acknowledged to be so, by either Behe or Denton. Despite his claim about the undeniability of supernatural design in nature, Behe concedes that the vertebrate eye does not show engineering perfection. He simply asserts that the designer might have reasons or motives that make other things more important than engineering excellence. Denton, for his part, admits that human anatomy contains imperfections, the very ones sketched above. So, two leading scientific proponents of new-design arguments do not themselves claim that there really is design perfection in nature.

Assuming that we could somehow reconcile what appear to be design flaws

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with belief in an omniscient and omnipotent designer, the next question to be raised is how we can reconcile this belief with all the morally questionable things we observe in nature, things which Mill enumerated in his famous essay on nature. A defender of the new design arguments might respond this way: it is conceivable that goodness means something different for God than for human beings – that, for all we know, *divine* justice, benevolence, and truthfulness are consistent with all the predation, violence, and deception that we observe in nature. In other words, it might be argued that there really is no contradiction between believing in a God who is one with justice, benevolence, and truth and believing in a God who designed the peregrine falcon and the European cuckoo.

In answer to the claim that the moral qualities which apply to God are different from the moral qualities that apply to humans, it would be hard to improve upon Mill's response: If in affirming moral qualities of God we do not mean the same thing we mean in affirming them of human beings – except that they differ only in degree – 'we are neither philosophically nor morally entitled to affirm them at all'.[67] Mill explains:

> **If in ascribing goodness to God I do not mean what I mean by goodness; if I do not mean the goodness of which I have some knowledge, but an incomprehensible attribute of an incomprehensible substance, which for all I know may be a totally different quality from what I love and venerate… what do I mean by calling it goodness and what reason have I for venerating it?… . To say that God's goodness may be different in kind from man's goodness, what is it but saying, with a slight change in phraseology, that God possibly may not be good?**[68]

In sum, if justice and benevolence really mean something altogether different when attributed to God, then we have no basis for calling the designer just and benevolent, since we cannot really know what these terms mean.

What about deception within nature, something Mill does not address? If traditional theism tells us that God is no deceiver, what sense are we to make of what looks like deceptive morphology in nature? If the animals or plants that exhibit deceptive morphology are products of design, isn't the designer responsible for this? Or does deception mean something different in God's mind – so that what looks like a design for deception in nature is not really a design for deception at all? Is the designer not really responsible for the deception of the reed warbler when it designs the European cuckoo to lay an egg that resembles warbler eggs in size, shape, and colour? If this is not design for deception, then the term *deception* seems to have lost its meaning.

Other responses to the goodness question are of course possible. If defenders of the new design argument allow, as do Behe and Denton, for some chance variation to occur within a process of evolution that is largely directed from above, this could perhaps explain some of the structures and behaviours in nature that appear inconsistent with a perfectly good designer. But the question remains: why does the designer allow accidental variation at all, if it leads to suffering of the

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innocent: e.g., animals that have no sense of a larger purpose or the value of chance? There appears to be no ultimate *telos* that justifies their pain. Adding an element of chance begins to look like an attempt to save the hypothesis of directed evolution in the face of what ordinary observation and commonsense tell us are design flaws and evils.

Conclusion

The new design arguments, which are grounded in the findings of contemporary science, appear not to do any better against Millian objections than the old design arguments. There appears to be no compelling reason to believe that a designer of this cosmos, conceived as a director of evolutionary change, possesses all three attributes of the God of traditional theism. I conclude that the most we can say about the designer of Behe's and Denton's new natural theology is that this deity may possess, at most, two of the three characteristics of the God of traditional theism. So, even if newly-opened black boxes make intelligent design undeniable, they do not eliminate Millian doubts about the perfection of the designer. In other words, if there is a designer, this designer appears to be the limited deity that Mill posited in his critique of the old natural theology.

Notes

1. For works from the perspective of the physical sciences, see John D. Barrow and Frank Tipler *The Anthropic Cosmological Principle* (Oxford: Oxford University Press, 1986); John Barrow *The Artful Universe* (New York NY: Little, Brown, and Co., 1995); Paul Davies *The Mind of God* (New York NY: Simon and Schuster, 1992). Works from the perspective of biology will be my focus; see note 2.
2. Michael J. Behe *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York NY: Simon and Schuster, 1998); Michael J. Denton *Nature's Destiny: How the Laws of Biology Reveal Purpose in the Universe* (New York NY: Free Press, 1998).
3. John Stuart Mill *Theism* (New York NY: Bobbs–Merrill Co., 1957).
4. Behe *Darwin's Black Box*, 239.
5. *Ibid.*, 194.
6. *Ibid.*
7. *Ibid.*, 39.
8. *Ibid.*, 6.
9. *Ibid.*, 8–10.
10. *Ibid.*, 86.
11. *Ibid.*, 97.
12. *Ibid.*, 47.
13. *Ibid.*, 193.
14. Charles Darwin *The Origin of Species* (New York NY: The New American Library, 1958).
15. Behe *Darwin's Black Box*, 22.
16. *Ibid.*, 204.
17. *Ibid.*, 205.
18. Denton *Nature's Destiny*, xii–xiii, 16. Representative works by Barrow and Davies are cited in the first note.
19. Barrow *The Artful Universe*, 38.

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20. Denton *Nature's Destiny*, 16.
21. The strong version of this principle holds that the laws and constants of nature seem so fine-tuned for human life that it is likely that they were so designed: it asserts that the universe was designed to produce life like us. The weak version simply asserts that the fact that we are here shows that the universe required all the coincidences necessary for us to exist. See Timothy Ferris *The Whole Shebang* (New York NY: Simon and Schuster, 1997), 292–302.
22. Denton *Nature's Destiny*, 389.
23. *Ibid.*, xi–xix. Denton clearly sees his book as a contemporary version of the teleological argument, with the cosmic *telos* understood as 'an advanced carbon-based humanlike or humanoid life'. He believes current evidence points strongly in the direction that *homo sapiens* are central to the cosmic scheme.
24. David Hume in *Dialogues Concerning Natural Religion* (Indianapolis IN: Hackett Publishing Co., 1980) provides a critique of the design argument; since it is written in dialogue form, we cannot know for sure what Hume's position is. I have chosen Mill because he directly expresses his objections to the design argument and writes with an awareness of evolutionary theory.
25. Kenneth R. Miller 'Life's grand design', *Technology Review*, **97** (1994), 29–30.
26. Richard Dawkins *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* (New York NY: W. W. Norton & Co., 1996), 93.
27. William Paley *Natural Theology*: *Selections* (Bobbs–Merrill Co., 1963), 3–6.
28. Quoted in Elaine Morgan *The Scars of Evolution* (Oxford: Oxford University Press, 1990), 24.
29. This is Morgan's view in *The Scars of Evolution*, 124–140.
30. See Morgan *The Scars of Evolution*, 24–30; Timothy Anders *The Evolution of Evil* (Chicago IL: Open Court, 1994), 87–93.
31. See George Williams *The Pony Fish's Glow and Other Clues to Plan and Purpose in Nature* (New York NY: HarperCollins, 1997), 103–104.
32. This seems to fit what Darwin calls a 'rudimentary' organ, something that once had a function, yet remained even after it became useless. See Darwin *The Origin of Species*, 385–425. Darwin, in the *Origin*, allows for the possibility of a creator but never explains why the creator might design a world in which such organs exist.
33. Behe *Darwin's Black Box*, 223.
34. *Ibid.*, 223.
35. *Ibid.*
36. *Ibid.*
37. *Ibid.*, 224.
38. *Ibid.*
39. *Ibid.*
40. *Ibid.*, 196.
41. *Ibid.*, 228.
42. Denton *Nature's Destiny*, 260.
43. Mill *Theism*, 33.
44. Denton *Nature's Destiny*, 395. In an understatement, Denton says that 'the journey was long, the route often slow and tortuous…'.
45. *Ibid.*, 260.
46. *Ibid.*, 14.
47. Mill 'Nature' in *Nature and Utility of Religion* George Nakhnvikian (ed.) (New York NY: Bobbs–Merrill, 1958).
48. *Ibid.*, 18.
49. Alexander Pope 'An Essay on Man', in *The New Oxford Book of Eighteenth Century Verse* Roger Lonsdale (ed.) (Oxford: Oxford University Press, 1984), 238.
50. F. Hitching *The Neck of the Giraffe* (London: Pan, 1982), 68.
51. Behe *Darwin's Black Box*, 46.
52. Denton *Nature's Destiny*, 302–303.
53. *Ibid.*, 317.
54. *Ibid.*
55. Bruce Bagemihil *Biological Exuberance: Animal Homosexuality and Natural Diversity* (New York NY: St. Martin's Press, 1999), 254.

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56. Thomas Aquinas *Summa Theologica*, in *Basic Writings of St. Thomas Aquinas* Aton C. Pegis (ed.) (New York NY: Random House, 1945).
57. Bruce Brooks *On the Wing: The Life of Birds: From Feathers to Flight* (New York NY: Charles Scribner's Sons, 1989), 38–39.
58. Meredith F. Small 'Bringing back baby', *Natural History*, **108** (1999), 71; Lola Oberman 'The darker side of nature', *Bird Watchers' Digest*, **21** (1999), 70–71.
59. Mill 'Nature', 40.
60. Mill *Theism*, 39.
61. A. C. Ewing 'The argument from design', in David Stewart (ed.) *Exploring the Philosophy of Religion*, 3rd ed. (Englewood Cliffs NJ: Prentice Hall, 1992), 85.
62. Stephen Jay Gould *Ever Since Darwin*: *Reflections on Natural History* (New York NY: W. W. Norton & Co., 1977), 104–108.
63. Brooks *On the Wing*, 124–125.
64. For a detailed account of deception in nature, see the chapter titled, 'Deception in evolutionary perspective', in Loyal Rue *By the Grace of Guile: The Role of Deception in Natural History and Human Affairs* (Oxford: Oxford University Press, 1994), 82–127.
65. *Ibid*., 104.
66. Mill 'Nature', 40.
67. Mill 'The infinite goodness of God', in Paul Helm (ed.) *Faith and Reason* (Oxford: Oxford University Press, 1999), 249–253.
68. Mill 'The infinite goodness of God', 250.

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