Human design methods: a solution to the evolution vs natural design controversy?

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Abstract

Is evidence for design an argument against evolution? Immediately this brings to mind the familiar 'argument for design', and it seems that if this is successful then evolutionary theory is undermined. (Conversely, if evolutionary theory is right, then the universe was not designed.) For a more accessible approach to this question, we start with an investigation of the design methods employed by those who create human artefacts, since this is something that can be observed directly. It seems that human design methods are (or can be) evolutionary, and thus that there is no reason why evolutionary theory should be incompatible with the universe's having been designed. One possible objection is the moral issue, but we argue that this arises due to a misunderstanding. We conclude that evidence of design is not an argument against evolution, but neither is it conclusive proof of God's existence. Rather, it should be viewed as part of a wider inference to the best explanation of the nature and existence of the universe.

The argument for design

The question that we have chosen to address is whether evidence for design is an argument against evolution. Clearly, this alludes to the well-known 'argument for design':

1. The order in nature (displaying both function and complexity) is analogous to the order in human artefacts.
2. From similarity of effect, we can infer similarity of cause.
3. The order in nature far outweighs (in both complexity and functional adaptation) the order in human artefacts.

(*from 1, 2 & 3*) 4. We can therefore infer that the origin of natural objects is analogous, though far superior, to the origin of human artefacts.

5. We know from experience that human artefacts are the products of intelligent designers.

(*from 4 & 5*) 6. We can therefore infer that the order in nature is the product of a designer whose intelligence resembles, though it far outweighs, the intelligence of any human being.

Crudely, this argument may be paraphrased as 'if there is design[1] in the universe, then God exists'.

[1] Though notice that, at this stage, we will usually find it more helpful to refer to nature's 'order', than to its 'design'. By 'order' we mean the undeniable complexity, and apparent teleology, that is observable throughout nature. These are the aspects of the world that are usually compared with human technology, in the argument for design – but we prefer not to refer to them *as* 'design', so that we avoid begging the question of the design*er*'s existence.

Thus it has often seemed to those who agree that the universe *does* display evidence of apparent design, that if the design argument is valid, then evolutionary theory must be wrong. Of course this conclusion depends on the unwritten additional premise, that God's existence is incompatible with evolution – but before discussing this, we briefly consider the validity of the design argument itself. Perhaps its most famous detractor was the philosopher David Hume (1711-1776). We discuss his objections in what we see as the most helpful order, rather than the order in which he presented them.

Hume pointed out that even if we are justified in inferring like causes from like effects, we may only infer a cause *adequate* to the effects. (Cf. the fact that a 1lb weight, on the higher end of a pair of kitchen scales, allows us to infer that the object on the other side weighs more than a pound, but not that it weighs more than a stone.) Thus, given the many examples of *dis*order in the universe, it is not at all obvious that any designer we could infer from observing the world, would have the attributes of the Judeo-Christian God at which the design argument aims. The crux of this sort of objection is the problem of evil; as such it is tangential to this paper.

A second group of Hume's criticisms turn on the weakness of the analogies on which the design argument rests: the question how we can infer anything about the origins of a unique thing; the problem of *how much* like a human the alleged designer is supposed to be (so similar that he is finite? corporeal?); the poverty of the argument's central analogy, between artefacts and natural objects. An additional question (not Hume's) is whether the observed 'order' might be merely subjective: imposed by our intrinsic desire to categorise and explain. The problem to what extent cultural and natural objects can be compared, is discussed in some detail in the following two sections.

Finally, Hume invoked some alternative explanations of the origins of the universe. Might not 'the curious adapting of means to ends, throughout all nature,' (*Dialogues*, Part 2) have had *many* designers, or have been 'born' in a manner analogous to that of a living organism? He added that, in any case, the design argument leaves open the question who designed the designer – and if the designer needs no explanation, then why should the world? Isn't it at least as plausible that the order in the universe arose by chance, without a designer, as that its alleged designer is self-explanatory? To modern eyes, this passing comment is resonant of the battle that would begin a century later, between Christianity and the claim that the world's order could be explained by science. It seems that from the earliest stages of debate, 'natural' explanations have been set against theological ones. We argue, below, that this a false dichotomy: that evolution, in particular, is compatible with design.

Human design methods

The design argument turns on the claim that nature's order looks 'designed' – but it is not entirely clear what, if true, this claim would involve. For a more accessible approach to this question, we turn first to the methods employed by designers of human artefacts. This approach also stands up to Hume's empiricist criticism, that humans have never observed the creation of a universe, and thus can infer nothing about it. What can be learned from the design methods that *are* observable?

> 'Engineering design is the process of converting an idea or market need into the detailed information from which a product, process or system can be made' (K M Wallace, *An introduction to the design process*, Cambridge University Engineering Department, 1989, p.1).

Wallace emphasises the need for a systematic approach to design. Intuition, inventiveness and insight all play their part in what is, after all, a very human activity – but they are supported and enhanced by disciplined methodology. Once the initial demand has been perceived, the question arises how to meet it. As a general strategy for problem solving, it is useful to reduce complexity by splitting the overall challenge into manageable sub-problems, to be tackled independently (though in context – solutions to individual problems will influence each other), and then combined. This

approach is evident in each of the four stages, detailed below, into which Wallace breaks down the design process.

The first stage begins with market research, to discover a gap in a range of products. The example that we shall use throughout this section, in order to root Wallace's rather abstract exposition in reality, concerns a gap in the Brazilian vehicle market. Consider a situation in which several small businessmen and farmers, in Brazil, need a small goods vehicle in order to transport their products, tools, etc. – but no suitable vehicle is currently available.

Importantly, there will be no one 'correct' plug for this hole in the market: design problems are by their nature open-ended, though some solutions will of course be better than others. The best way to begin to achieve an acceptable solution, is to define the task in a clear 'problem statement'. What Wallace calls 'divergent thinking' (i.e. an open mind) will be used in preparing this statement: information is gathered from a variety of sources, and considerations raised from disciplines other than the one particularly relevant branch of engineering. A solution-neutral statement of the problem can then be formulated, in order to identify the true needs without making assumptions about how they should be met. In the case of our example, a first version might be something like: 'to provide transport for small amounts of goods, over poor quality roads'. In our case, it is not possible to be any more 'solution-neutral' than this: such a problem would only be addressed by a car manufacturer, and therefore certain criteria are unavoidable (the new vehicle will use roads, will not fly, etc.).

After this, 'convergent' thinking will be used to elaborate the target specification: the designer needs to limit the search field by detailing the precise requirements and constraints. Relevant considerations will be function, safety, economics and time scales. With the resources available, compromises often have to be made in later stages of the design. One way of focusing on the best compromise is to identify requirements as 'demands' or 'wishes'. Demands provide criteria for selection: they *must* be fulfilled, or the solution scrapped (e.g. meeting the relevant government regulations). Wishes provide criteria for evaluation: they are desirable but not essential (e.g. exceeding the regulations).

Having clarified the task, the second stage is conceptual design: the generation of concepts with the potential to meet the requirements. Solution principles will be created for all the sub-functions of the product (vehicle type, engine, etc.), and studied to see which can be combined with each other. Ideas will be generated via brainstorming, the study of existing devices, 'and useful ideas can be obtained from the study of natural systems' (Wallace, p.10). Here, once again, divergent thinking will be used – this time to generate as many ideas as possible. Going back to our example, there is already so much established (no car manufacturer starts from *scratch*) that there are limited options for innovation. Typical choices will be between a pick-up or van, based on an existing vehicle or not, etc.

Following this, convergent thinking will come back into play, as the best solution is selected. The 'pass' criteria detailed in the target specification will be used to evaluate the possible solutions. Combinations of sub-functions will be scrapped if they fail to meet a demand, and the remainder evaluated against the wishes (weighted according to importance), with a view to determining which will 'provide the maximum competitive advantage' (Wallace, p.11). Notice that here, as at *any* stage of the design process, cost analysis may override engineering considerations.

Following the first two stages of the process, the selected solution must be presented to other people in a way that convinces them to move it to the next stages. The third stage is embodiment design, in which the concepts undergo a structured development. In the case of vehicle design, layout drawings and clay models, etc. will help to discover which concepts won't work in practice. Again there will be a trade-off between the divergent thinking needed to suggest possible ways of meeting the target specifications (e.g. engine size, front/rear wheel drive, suspension lay-out, etc.), and the

convergent thinking that will select between the possibilities that do meet the demands, on the basis of the wishes met.

The final stage is detail design: specification of the shape, dimensions, materials and tolerances of each component. Again these will be evaluated against the target specifications – in a vehicle's case, by testing prototypes and using computer aided engineering (CAE). Thus it can be seen that at this stage, as in all the others, the design process is iterative. There are feedback loops between evaluation and details, perhaps even going back to the embodiment stage, if deeper problems arise.

In summary, then, the design process, which seems *prima facie* to be the harnessing of imagination to practicality, is underpinned by a methodology that is iterative and in many senses mindless. It moves from a perceived demand, through clarification of the problem in a solution-neutral statement, and the generation and initial selection of concepts with the potential to meet the requirements, to a structured development and detail design of the end product. At each stage of the process, selections will be made between possible solutions, according to the demands and wishes laid down in the target specifications. An option may be rejected when it is still an idea ('How about a pick-up truck?'), whilst it is being developed as part of the embodiment design ('Perhaps a 1.3 litre engine will give us the power we need.'), or even when it has reached the final stage of detail design ('Let's try the engine from our existing pick-up, in the prototype.'). It may be rejected on the basis of economic as well as engineering considerations. If at *any* point it seems that the end result will not be viable, then losses will be cut and the project abandoned.

'Design evolution'

It is clear that there are analogies between the design process, described above, and biological evolution. We can see that, depending on the 'pass' criteria laid down in the problem statement, a design evolves via an iterative process of divergent and convergent thinking, in the next three stages. This could then be viewed as analogous to the way in which, depending on the fitness criteria that are laid down by the environment, etc., a species evolves via natural selection. Such analogies are interesting to explore, and give the sort of intellectual satisfaction that is the result of discovering any familiar pattern in an apparently different field. The suggestion that evolution is not restricted to biology, but may also take place in the mental and cultural worlds, is appealing if hardly original. To what extent, though, are we justified in pursuing the 'design evolution' hypothesis? Is it helpful to talk of designs 'evolving', as though that process really did mimic the evolution in the natural world? In order to discover whether Darwinism illustrates a process that is also displayed in engineering, we need to know whether we can meaningfully apply to this area the basic requirements for evolution: what would replication, variation or selection *be* in relation to engineering?

We argue, below, that the analogy can be justified, between the evolution of designs and an evolutionary picture of the natural world – and that a result of pursuing this analogy may be the reconciliation of biological evolution with natural Design. Given this conclusion, it is perhaps ironic that the model of cultural evolution that we follow is derived from Richard Dawkins' 'meme' hypothesis. Dawkins memorably claimed that 'Darwinism is too big a theory to be confined to the narrow context of the gene' (*The Selfish Gene*, 1989, p. 191). What is its *essential* feature? It is the differential survival of replicators – *any* replicators. Whatever the type of replicator involved, he said, their variation under conditions of restricted resources would lead to a form of evolution. As an example of an alternative medium, he suggested culture, and called his purported cultural replicators 'memes'. What we expound, below, is a specific application of his meme hypothesis: to engineering. Indeed, we shall refer to the units of our hypothesised selection as 'design memes', in order to acknowledge our debt to Dawkins.

Possible examples of design memes may be the concept of a cantilever, the idea of using concrete as a road surface, the design of the 'whale-tail' on a Porsche 911, or a particular way of using a CAE package. The significant fact about any of these examples, is that the meme is the *information*

contained in the blueprint for a design, rather than the end product itself. This may be illustrated by analogy with biology, which refers to genes 'for' bodily features (blue/brown eyes, etc.). In the same way, we might speak of design memes 'for' artefacts' features (torsion bar/leaf spring suspension, etc.). The 911's whale-tail, for instance, is the end product of a successful design meme 'for' a whale-tail.

Notice that, although design evolution may for convenience be referred to as 'analogous to' genetic evolution, this should not be taken to imply that the former is theoretically dependent on the latter. Whilst it is true that in the chronological order of theoretical development, the design evolution hypothesis has been inspired by the theory of genetic evolution, this is not the order of explanatory dependence. Rather, both are examples of a more abstract, generally applicable theory of the evolution of replicators under conditions of competition. Thus a design meme (if it exists at all) is not, strictly speaking, an analogue of a gene. Rather, it is a different token of the same type of entity: a replicator. Similarly, design evolution is (if true) a different example of the same type of process as neo-Darwinism, rather than a simple analogue of it. The two processes have the same description at a sufficiently functional, abstract level. Nonetheless, because we are already familiar with genetics, we can use it to illuminate what we might call 'design memetics'. In other words, although we should not expect the particular details of biological evolution to carry over into design evolution, it seems reasonable to exploit our knowledge of neo-Darwinism as a guide to what the essential elements of design evolution might be. This sort of comparison between two phenomena is far from unique in science, where it is quite common to find different tokens of the same type of process realized within different media (cf. the fact that wave properties such as diffraction, interference, refraction, etc. may all be observed in water waves as well as in electromagnetic and sound waves). Design memes have in common with genes, the fact that both embody information which is replicated, varied and selected, producing a form of evolution that is observable in their phenotypic effects.

Nonetheless, of course this does not answer the question whether there are any grounds for *accepting* the hypothesis of design evolution. Are there aspects of engineering design that can realistically be characterized as replication, variation and selection?

It seems fairly uncontentious to suggest that there is variation amongst the designs that engineers produce. Even within the same model of a car, for example, there will be several choices to be made by the potential customer: hatchback/saloon/estate, diesel/petrol, variety of engine sizes, variety of colours, etc. Moreover, when explaining the design process, above, we said that engineers use divergent thinking in order to produce as many options as possible, in their search for a solution. Thus variation is apparent, not only in the end products, but also in the concepts that arise in the design process. In fact, the open-ended nature of design problems ensures that there will always be variety amongst the solutions proposed.

In nature, variation occurs through the mutation and recombination of genes. Recombinations are limited by the need for alleles to correspond, resulting in a range of possible recombinations that is limited, though rich, with respect to any given gene pool. In contrast, genetic mutation is popularly referred to as 'random', but this term must be used with great care. It is context-dependent, and used to indicate that its subject is free from a specified form of causal control. If used independently of any context, i.e. without specifying from which kind of control a process is free, then the term becomes confusing and perhaps even meaningless. Genetic mutation is random-with-respect-to-increased-fitness, but this is not equivalent to the claim that all changes are equally likely, which would imply that genetic mutations somehow fall outside the realm of induction and are not limited by natural law. In fact, the mutations that can occur are limited by the nature of what already exists – e.g. by genes' mutation rates and by embryology.

Clearly, mutations in engineering concepts are also 'random' – not in the sense that they spring, as if by magic, into the engineer's mind, but in that they are random with respect to their 'fitness' for the target specification. If this weren't the case, then an engineer would be able to latch onto the appropriate solutions straight away, without the time-consuming and costly business of testing them at the embodiment and detail design stages. Moreover, just as the consequences of genes' mutations are limited by the relevant embryology – 'Genes can mutate till they are blue in the face, but no mammal will ever sprout wings like an angel unless mammalian embryological processes are susceptible to this kind of change' (Dawkins, *The Blind Watchmaker*, 1986, p. 311) – so the effects of design mutations will be limited by the processes of translation into reality. An engineer, employed by a major car manufacturer, will be restricted in the innovations that he can incorporate in his designs, by the existing manufacturing practices of that company. For instance, in the case of most major car manufacturers he can design fibreglass vehicles until he is blue in the face, but he will not be able to have them built. Clearly, too, recombinations of existing engineering concepts may be responsible for a new overall design – and just as genes must correspond with the alleles that they replace, so an existing concept may only be replaced by one that controls the same aspect of reality (trivially: the engineer may replace his vehicle's petrol engine with a diesel engine, but not with a spare wheel).

Given that there is variation amongst these purported design memes, are there methods of transmitting them, which might be regarded as replication? There are two aspects of replication: the preservation and the transmission of information. Engineering designs are preserved in the forms of blueprints, of prototypes, of CAE models and even of ideas in the minds of individual engineers. Such representations of information must fulfil various conditions if they are to count as replicators: they must, for instance, be able to interact with other such representations, and to exert some form of control over their environment. They are transmitted by being taught, mimicked, communicated, learnt ... all of the usual processes of cultural transmission. There is nothing controversial here. Designs are replicated in the minds of the general public via advertising, and in somewhat more detail in the minds of other engineers, via blueprints, etc.

Perhaps more controversially, designs need to be particulate, if they are to count as replicators and be subject to evolutionary change. If replicators blended with each other, then evolution by selection would be impossible. We think that our hypothesised design memes can largely be counted as discrete, on the same grounds that Mendel decided that the factors controlling his pea-plants' characteristics were independent and indivisible: observation of their effects, which are either present or absent. Each time it is replicated, an aspect of design runs the risk of embellishment, corruption or diminishment, but this is no different from the risk that each gene runs of mutation during replication. With reference to cultural evolution, engineering seems to be an area in which it is especially easy to observe the definite presence or absence, in an artefact, of any given design. A car either has or has not air bags, drum brakes, front wheel drive, etc.

Evolution needs not only replication and variation, but the replication *of* variations, to offspring. Clearly, 'offspring' does not here refer to biological but to cultural descendants - and it seems obvious that the variations *are* transmitted. A young designer will be influenced in his practices, and restricted in his starting points, by the company that he joins. Furthermore, just as the variations that you inherit from your biological parents may develop differently in you, depending on the nature of your environment, so the variations that you acquire from your cultural predecessors (more experienced engineers, lecturers, etc.) may develop differently in the context of your mind and environment. A safety engineer who hears about a novel innovation like side impact protection bars, may decide after analysis that they do not improve occupant safety - but still he is aware of their existence and able to re-transmit that information. (If he tells me that side impact bars don't work, then he also tells me that they exist.) What matters from the point of view of evolution, is simply that variations are replicated.

In design as in biology, then, variations exist and are passed on to the next 'generation'. In order for evolution to occur, the third factor that we need to find, in design, is selection. Is it true that the 'population' of designs increases at a swifter rate than its resources? The answer to this must depend on the nature of its 'resources' – what is it that a design meme needs, in order to be successful? It will be popular and long-lived, if it meets the various criteria laid down by the humans who want to make use of it. In other words, the resource on which it depends is, ultimately, human beings' attention. Without this, no effort will be put into moving it from the conceptual to the embodiment and detail design stages - or even if it does make it so far, the consumers at whom it is aimed will not select it from the many alternatives at their disposal.

In general, it is obvious that ideas/concepts develop and change at a much faster rate than that of biological evolution, and that the attention of each human brain is limited. In order to maintain some sort of grip on day-to-day reality, we have to choose between the skills, theories, etc. on which we might focus our efforts and keep available in memory. With particular regard to design memes, the competition for attention seems to be a consequence of the open-ended nature of design problems. A design will be long-lasting and wide-spread, only if it succeeds in capturing the attention of enough people to the extent that they regard it not only as a worthwhile focus for their money, time, effort, etc. - but also as a *more* worthwhile focus of attention than its rivals. Factors that come into play in their decision may include its compatibility with existing features of their lives, the relative importance of those existing artefacts/opinions/practices, the external environment, etc. Artefacts' capacity to survive and be replicated is affected by their efficiency (or at least their *perceived* efficiency) in fulfilling their intended use.

The 'fitness' constraints that are imposed on any particular design will be laid down by the initial problem statement, which specifies the conditions that a design must meet if it is to succeed in the practical and commercial worlds. Convergent thinking will then play the part of selection, as the engineers choose between their possible solutions. Demands may be compared with 'life or death' criteria in the biological world, and wishes with the conditions that will determine an organism's quality of life: it will not live without meeting the demands; it will be better or worse than its rivals, as a result of the 'wishes' that it fulfils. Moreover, just as the engineer's ideas may never see fruition, if they are over-ruled by considerations from other disciplines (e.g. economics), so a genetic mutation may fail to be translated to the phenotype, as a result of embryological restrictions. In particular, recall the emphasis that is placed again and again, by writers on biological evolution, on the fact that natural selection is never forward-planning: if a mutation is harmful *now*, then that organism may die before procreating, and the mutation will never be selected (even if in the long run it may have been helpful). Similarly, if at *any* stage a design doesn't meet its budget requirements, then everything stops (even if in the long run it was the best engineered design).

So it seems that there is competition, between design memes, for the limited resource of human attention. Since we have already argued for the existence and replication of variations amongst design memes, it seems that a form of evolution must be played out in engineering design. At a far greater pace than genes, design memes vary, are replicated and selected - and thus they evolve. The preservation of those designs with the best fit to their environment, and the extinction of those without, should be expected.

Evolution and design reconciled

If the arguments above are valid, then we are justified in portraying human design methods as evolutionary. Ideas and designs are reproduced, vary and are selected according to the relevant criteria, and the result is a panoramic variety of increasingly complex human artefacts. The culmination of this process is now being attempted in research establishments around the world: can artefacts be designed to display intelligence?

Thus the account that we offer, of the design of human artefacts, seems to us to be a working, observable example of the compatibility of evolution with design - not just in principle, but in practice. Human design can be described in intentional, psychological terms: the new front-end for the model 'xyz' car was design by John, because he wanted to make the 'xyz' more crashworthy in frontal impact, he wanted to keep his job, etc. This provides an answer to the 'why?' questions that might be asked about the novel design. The 'how?' questions, though, are answered rather differently. The new front-end was designed using the four-stage process described above, through which novel designs for that part of the car were tested against the 'pass' criteria laid down in the problem statement. One of them was selected from the variety of proposed solutions, and the end result is a front-end that is intellectually descended from, though a significant evolutionary improvement upon the existing design.

For our claim that much of this process is mindless, it does not matter that the evolution of design memes is dependent on human minds. This is simply because thoughts and other representative media (language, blueprints, etc.) are the province of memes. Without the active stimulation of human minds, design memes may find safe havens in these media (in libraries, perhaps), but will neither replicate nor evolve. This is no different from the fact that genes are the units of biological selection, but depend on interaction with the environment and the mechanisms of embryology, in order to replicate and evolve.

Our claim is that there is a real and helpful parallel to be drawn, between Darwinism and the evolution of human artefacts. In particular, we maintain that the distinction between the 'why?' and the 'how?' questions, for human artefacts, has a deep significance for the natural world. We can see from the human case, that there is no contradiction at all between the following two statements:

(a) The front-end has evolved so as to fulfil the 'pass' criteria laid down in the problem-statement. That evolution may be described as mechanical: given the problem statement, an iterative process of selection determined which design will be chosen from the suggested options.

(b) John's purposes, in creating his design, are not reducible to any of the following: the problem-statement; a description (no matter how detailed) of the means by which the front-end was either designed or built; a description (no matter how detailed) of the front-end itself. We have to seek out John himself, if we want to discover his purposes.

Why, then, should there be any contradiction between the following two statements?

(c) Humans have evolved with the best fit to their current environment. That evolution was a mechanical process: given the environmental conditions, natural selection determined which genes survived.

(d) God's purposes, in creating humans, are not reducible to any of the following: the fitness criteria according to which they evolved; a description (no matter how detailed) of human phylogeny or ontogeny; a description (no matter how detailed) of humans themselves. We have to seek out God Himself, if we want to discover His purposes.

Looking back to Hume's comments on the argument for design, we would argue that our conclusion attacks both his second and his third group of criticisms. We have denied that the analogy between artefacts and natural objects is weak: rather, it is plausible that both come about by a similar process. As a result it seems that evolution – the most popular 'alternative' to God's creation of the universe – can be seen, instead, as one of His *methods* of creation.

Nonetheless, in the following sections we briefly touch on two areas that show how much care must be taken with this conclusion.

The moral issue

Some people (including the philosopher J S Mill) have objected to the idea that God might have used evolution as a method of design, on the grounds of natural selection's 'wastefulness'. How could a loving God have instituted a process so harsh and almost universally destructive, as the struggle for survival? Engineering methods are not as wasteful, in physical terms, as is Darwinism, because many designs are scrapped whilst still at the conceptual stage. On the other hand the fact that, relatively speaking, just as many replicators are eliminated and time wasted in both, may be seen as missing an important ethical *dis*analogy between the two types of selection: whilst 'unfit' variations are eliminated in both biological and engineering evolution, in the biological case it is *lives* that are wasted. Seen from this viewpoint, evolution may be intellectually reconcilable with Design, but the two will never be morally compatible.

We offer two replies to this objection. The first is a question: is there really any difference between the claim that many of God's creations have died on the way to man's creation, and the simple observation that all (biological) life is mortal? Perhaps the objection can be rephrased, in such a way that the violence inherent in 'nature, red in tooth and claw' is highlighted – but that just takes us back to the problem of evil.

The second 'reply' is actually to agree with the objection. We have argued, against Hume, that there are enough comparisons to be made between artefacts and natural objects, for the theory of evolution to be compatible with Design – but we should now like to emphasise a point on which we firmly agree with him. We think that Hume was right to claim that the argument from design does not by itself justify a belief in the Christian God. Evolution's compatibility with Design should not be enough to pacify Christians, without additional evidence about the sort of Designer being claimed. Would *you* thank an incompetent creator for your existence? This point is familiar to all Christians in science. An accurate scientific theory may hint at the 'potter's mark', but it no more establishes the existence and characteristics of our God, than it diminishes the 'gaps' that He is permitted to fill. In other words, we are not excused from seeking out His nature and purposes, by the intellectual reconciliation of His existence with a scientific theory about our origins.

Inference to the best explanation

We seem to have come full circle. In reply to Hume's criticisms of the argument for design, we argued that Creation is not an alternative to, but compatible with the theory of evolution. Now, though, we have claimed that this fact does not rescue the argument from design after all. It tells us that evidence of design is not necessarily an argument against evolution, but it does not establish the fact that evidence of design *is* an argument *for* the Christian God.

We think that the problem lies in the title of the 'argument for design'. We think that it is not an argument at all, in the sense of a logical progression from premises to conclusion. If it were, then why is it still being debated after all these years? Of course it is possible to imagine circumstances in which the premises are true and the conclusion false – so if it is proposed as a logical argument, then it is simply invalid.

Fortunately, this is only to be expected. A logical argument, by its very nature, would be inappropriate in this area. As mentioned above, a valid argument is defined as one in which it is impossible for its conclusion to be false, when all its premises are true. Another way of putting this, is to say that its conclusion tells us nothing new, for it cannot go beyond the premises. How, then, could a logical argument from premises about the observed world, validly tell us anything about God, who is beyond that world?

Instead, we suggest that the argument for design should be treated as *in*ductive. Such arguments take us from the particular to the general, past to future, observed to unobserved (e.g. 'All observed

swans have been white, so all swans are white.'). Their weakness is that they are not logically valid. Their strength is that they are able to take us beyond the information contained in the premises.

We advocate, then, that evidence of design (i.e. the interpretation of natural order as the product of Design, based on our observations of human design) should be taken as part of a wider 'inference to the best explanation'. As scientists explore the intricacies of the natural world, and share with the general public a sense of wonder at the night sky, they may be moved to interpret the beauty, complexity and 'curious adapting of means to ends', as marks of a benevolent Creator. Such a feeling will add, for instance, to answered prayers, or the moral, spiritual and empirical truths that we find in the Bible, and form part of a wider inference to the best explanation of all of these phenomena.

We conclude that the theory of evolution has, for historical reasons and with the help of its present-day atheist advocates, been given undue prominence in the question of Christianity's validity. As a scientific theory, it provides no more or less evidence of God's existence and characteristics, than does any other hypothesis. When scientists explain how the physical world exists from moment to moment, telling us in the minutest detail about the underlying causes of physical objects' properties, no-one sees it as an 'alternative' to God the Sustainer. Why, then, should a scientific account of human origins be seen as an 'alternative' to God the Creator?

Nonetheless, because of the theological significance that evolutionary theory has been accorded, it is important to notice that, as part of the evidence from which we infer our own explanation of the origin and purpose of our world, Darwinism is not opposed to Creation.

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