

Cosmology and Design

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Abstract

Over the past decade, controversy over Design has centred on biological complexity and the origin and diversification of life. This is understandable, since molecular biology is advancing rapidly, and also because the most visible exponents of design have been those in the Intelligent Design (ID) movement, many of whom, like Michael Behe, are biologists. Interestingly, many high-profile Christians within the scientific community have rejected the ID package, but have strongly endorsed a more cautious design argument. Although certainly not insurmountable, these differing views present considerable challenges for Christian teachers attempting an honest, carefully nuanced discussion of the design implications of the biosphere.

Another hot area which has significantly informed the modern Design argument is that of astrophysics and cosmology. There has been much less controversy among Christians participating in this discussion, largely because the ID movement has not focused on this data.

This paper attempts to assist teachers by briefly articulating a form of the design argument which is generally accepted by thinking Christians and then by presenting some cosmological arguments within this framework. Some of these should be accessible to senior secondary Science students.

Introduction—The modern design argument

Arguments using the complexity and apparent purpose within the universe to justify belief in God go back as far as scripture, for example Psalm 19. They have also featured throughout the Christian era, with the high point of the genre often seen as the 1802 publication of Paley's, *Natural Theology*.¹ However, it was widely assumed that, over time, the attacks by Hume and Darwin fatally compromised such arguments. It has therefore come as a surprise to many that, due particularly to discoveries in molecular biochemistry and cosmology, a significant revival of Design has taken place over the last few decades. Such thinking urges that more has been claimed for naturalistic evolutionary mechanisms than could be demonstrated. Understandably, such revelations have been embraced by theists of every

persuasion, giving rise to a burgeoning literature on "Design".

A plausible design argument

Although all theists obviously acknowledge God as the cosmic Designer and Originator, there is considerable disagreement over the sense in which this is so and over the optimal formulation of the contemporary Design argument. This has given rise to a substantial range of approaches to the Design argument, the most visible variant currently being Intelligent Design. Perhaps the two most significant ideas advanced by ID are Behe's irreducible complexity² and Dembski's three-stage causal filters.³ Two other well-known authors within this movement are Johnson and Wells.⁴

While Intelligent Design clearly regards natural law as emanating from the designer, it also insists that these laws provide an inadequate explanation for some phenomena, and hence that the designer had to intervene in order to bring them about. Thus this agent is seen as acting contingently as well as through natural law. According to ID, the strongest evidence for a designer is seen in cases of contingency, that is, in those circumstances for which no natural explanation appears to be forthcoming.

For this reason, most Christians in the scientific community see the ID movement as straying perilously close to the old "God of the Gaps" argument.⁵ As science advances, providing more natural explanations, the room for such a Designer will be reduced until, like the Cheshire Cat, only His benign smile will remain! While endorsing ID opposition to the philosophical naturalism of contemporary science, they maintain that it is possible, in fact essential, to practice science as methodological naturalists.⁶ In other words, a Christian actually does coal-face science in a manner indistinguishable from that of his / her secular colleagues, in that they search for explanations *within* natural law.

As these Christians look at the universe, they do not expect to find objects stamped 'made by God', in the ID fashion. John Polkinghorne takes the view that the Creator's activity can be reasonably expected to be more subtle than that, just as His divine presence on earth was not so commanding of belief as to compel allegiance. In other words, while

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it would be “perplexing to theistic belief if there were no footprints of the Creator found at all, it would be surprising if they were of so unambiguous a kind as to overwhelm the free exploration of the human mind into the nature of reality”. On this basis, we might anticipate that we will find God to be neither totally hidden nor totally revealed in His works.⁷

In order to aid this discussion, the terms “natural” and “supernatural” may themselves require fundamental critique. John Polkinghorne suggests that what we interpret as natural laws is simply the continual outworking of God’s will in the universe. While this “Divine Will” is constant enough upon which to build science, it can be, and indeed has been, differently manifested in what we have commonly but misleadingly called miracles. In fact, all reality reflects God’s ultimate causality and can be regarded as either “natural” or “supernatural” as one chooses. Accordingly, God is as surely the Creator today as He ever was.⁸ Clearly, Polkinghorne’s suggestion effectively removes the divide upon which ID is based, the idea of “special” Divine intervention. A more detailed discussion of the taxonomy of the design landscape has been presented elsewhere.⁹

Cosmic design evidences

It is within this context that most Christians discern a valid design argument emerging from the compelling order and structure we observe in our cosmic tapestry. The richness of this tapestry is seen as most coherent and comprehensible when understood as the artistry of a Being of overwhelming power, morality, intelligence and aesthetics. It is to the examination of five of these cosmic footprints that we now turn.

1. The anthropic nature of the universe

It is almost 100 years since aspects of the fine tuning of our universe for life were highlighted by Harvard’s Laurence Henderson.¹⁰ A little later, following his discovery of the delicately balanced nuclear resonances giving rise to useful amounts of carbon, the basic building block of life, Fred Hoyle observed:

A commonsense interpretation of the facts suggests that a super-intellect has monkeyed with physics, as well as with chemistry and biology, and that there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me to be so overwhelming as to put this conclusion almost beyond question.¹¹

Since then, and particularly over the last three decades, many others have built on this foundation.¹² Denton’s *Nature’s Destiny* essentially updates Henderson’s earlier work and contains a great deal of data on the fine tuning of the universe for

life which is very accessible for secondary science students.¹³ Interestingly, most of these writers are non-Christian. The apparent customisation of the universe for life, and even for human existence, has become known as the *anthropic principle*. Martin Rees, the astronomer royal, has recently written a book elaborating on six of these securing coincidences.¹⁴ Let me mention the three most accessible of these examples, although there are many more such serendipities that could be noted.

1. In our universe the ratio of the strength of the electrical force to that of the gravitational force is 10^{36} , a staggeringly huge number. Stars are held together by gravity but radiate their energy by electromagnetic radiation: visible light, x-rays, radio waves etc. It transpires that if this ratio were slightly different on either side, stars would either not ignite as nuclear furnaces, or burn up far too quickly, in either case being unable to support life in the way our sun does.
2. Another of the six (dimensionless) numbers noted by Rees is the ratio of the actual density of the universe to the so-called critical density. The explosive force of the Big Bang tends to dissipate the fragments, hence the current expansion of our universe. However, this is opposed by the force of gravity, which tends to pull everything together. Sufficient mass density in the universe would just halt the expansion and turn it back on itself. It seems that the actual density of our universe is within 1 part in 10^{50} of this critical density. If the universe were not so finely balanced, it would have concluded well before this, with insufficient time to produce the higher elements in the fusion furnaces of stars and to scatter them around by supernovae, eventually to form planets such as ours, on which life could be nurtured. For, to the best of our understanding, we are made of the ashes of dead stars.
3. When, in 1963, Penzias and Wilson discovered the cosmic microwave background radiation, understood to be a vestigial remain of the Big Bang, it was thought to be completely even (or isotropic). This, however, presented a problem. If the mass was so evenly distributed within the early universe, how could galaxies have ever begun to form? Recent observations by the COBE and WMAP satellites have detected small lumps (or anisotropies) which answer this question, but present another. Why did the universe develop this small unevenness, at the scale of 1:100,000, without clumping

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up too much? This turns out to be another incredibly fine balancing act.

Clearly, our universe is unexpectedly bio-friendly, displaying an exquisite, and by no means necessary, compatibility with carbon-based life. It appears that the Big Bang was ignited in such a way as to produce just that universe which would allow the later nurture of life.

The secularist response has often been to dismiss the intrigue by claiming that since we wouldn't be here to wonder about it if it hadn't happened, retrospective evaluation of probabilities is pointless! This is sometimes called the *weak anthropic principle*. However, the weakness of this response has been frequently pointed out. For example, Ozolins¹⁵ suggests a rather unpleasant thought experiment in which one imagines a firing squad of 100 highly trained marksmen, all with the cross-hairs of their sights fixed on one's heart! One hears the signal to shoot, only to be astounded to find oneself still standing as the sound of firing dies away. While it is true that one would not be wondering anything if the outcome had been different, this does not obviate the need for an explanation. A firing squad of that size and expertise simply does not miss. Somebody important must have intervened.

Alternatively, some secularists have claimed a vast portfolio of parallel universes, all with different laws, in which our scenario just happens to be the "winning ticket", as it were, in a gigantic cosmic lottery. However, this rather prodigal replication of universes is pure metaphysical speculation and is currently beyond scientific verification.

2. The existence of complexity within our universe

Studies over the last two decades have considerably advanced our understanding of the nature and

emergence of complexity in our universe. Reality appears to exist as a tiered, somewhat fractal hierarchical structure which may be represented as shown in Figure 1, where only the right hand side contains life and sentience.

Each of these levels has an appropriate symbol set and syntax. At the lowest level, both matter and radiation are not only quantised but exhibit significant ontological uncertainty and unpredictability. As we ascend the hierarchy scale, we find more regularities emerging, although, as chaos theory has revealed, uncertainties persist even at higher levels. Although each level is clearly causally dependent on lower levels, considerable de-coupling between levels arises from what are called "emergent properties" where, in a sense, the whole is greater than the sum of the parts.

Atoms exhibit quite different behaviour to quarks. Molecules can have very different properties to their constituent atoms, for which reason most of Chemistry requires no deep knowledge of atomic physics, and almost none of particle physics, which is rather an advantage for Chemistry students! For example, explosive and corrosive sodium and chlorine become safely ingestible salt. Similarly, the reactive gases hydrogen and oxygen combine to form liquid water. Wetness is an emergent and macroscopic property. One cannot say that each water molecule is just a little wet. Indeed, it seems most reasonable to regard life itself as an emergent phenomenon. There is no evidence to support older vitalistic notions whereby "the little bits" are "alive".

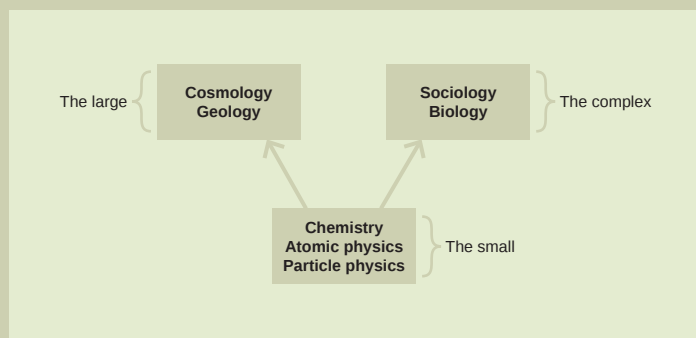
Further, we find that lower levels of the hierarchy contain quite small symbol sets. At the level of particle physics the subatomic 'particle zoo' is continually growing but still quite manageable. At the level of atomic physics there are only a few hundred naturally occurring atomic isotopes, grouped into just 92 chemical elements. However, at the next level the number of combinations of these basic entities becomes huge. For example, it is estimated that the number of possible bio-molecules is 10^{121} , i.e. more than the number of particles in the universe. In a similar manner, the entire ecosphere is based on endless variants of a single molecule, DNA. Clearly, genuinely complex systems are only possible at levels characterised by large possibility landscapes.

Further, it seems that complexity is closely related to chaotic dynamics, in that genuine complexity is only possible at the interface between uninteresting and sterile stability and wild and destructive chaos. Waldrop has explored the historical emergence of this realisation.¹⁶

Another apparently essential feature of complexity is the interplay between what are called bottom-up and top-down causalities. An underlying

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Figure 1: A representation of reality as a fractal hierarchical structure



bottom-up causality operating in nature has already been identified in the preceding discussion, in that each level of the hierarchical structure just discussed is obviously causally dependent on the adjacent lower level. However, the concept of bottom-up causality may be considerably broadened. Examples include:

- any response to natural law, such as a falling motion due to gravity;
- the expression of the genetic code, resulting in a particular cellular function or the development of a particular organ; and
- the death of an individual due to heart failure induced by clogged cardiovascular arteries.

Such bottom up causality might be expected from a universe developing from a Big Bang. However, our universe also displays top-down causality, in which action at a higher level changes the nature of components at all lower levels. Examples of top-down causality include:

- nucleo-synthesis in the early universe, where the H / He ratio was determined by the effect of the expansion rate on the cooling of the primordial gas;
- the extension of the 111 minute half-life of free neutrons to a much longer time when the neutrons are bound in nuclei;
- the alteration of the predominant ongoing genetic code by the adaptive processes of natural selection in response to environment;
- the quantum measurement process, in which the act of observation collapses the quantum wave function onto a single basis vector; and
- the effect of the mind on the body, e.g. volitional movement of the hand.

The simultaneous interplay of both types of causality produces cybernetic systems, in which bi-directional feedback alters system states. Interestingly, the outcomes or end-states of such systems are determined not by the initial conditions but by the specific nature of these feedback systems, which are designed into the system from without, usually in our experience, by an intelligence who must first conceive of the desired end-state. In this sense, end-states must first exist in the abstract before they can be physically realised in a complex system. This is very different to classical, bottom-up causality, the rather closed domain of classical Physics. (Interestingly not even Physics can completely characterise its own nature and activity within its own paradigm. It cannot, for example, predict what the next experiment will be!)

Ellis notes that much of the fine tuning of our universe for human life noted earlier seems to involve very specific outcome states for incredibly complex systems.¹⁷ Different hierarchical levels

interact through multiple feedback loops involving many different bottom-up and top-down causalities. If, as noted above, the end states of such systems depend more on these linkages than on the initial conditions, and if the linkages follow from an abstract conception of the end state, it seems reasonable to suppose that an intelligence sufficient to the task wanted us here and set up the required algorithms. This would seem to be one of the main messages of the Biblical creation account.

3. The highly relational nature of our universe

Somewhat related to the preceding point, the last 100 years has revealed a fundamental and previously unsuspected relational depth to physical reality. Classical Physics had simply assumed a classical Euclidian geometry, in which the absolute and independent nature of space and time were axiomatic. This realm provided location for interactions of matter and energy, each of which was understood to be absolutely conserved. However, Einstein's introduction of special relativity in 1905 and general relativity in 1915 revealed a deep nexus between space and time, such that physicists now speak of the four dimensional continuum of "space-time". Further, in such a relativistic universe there is no intrinsic difference between matter and energy: rather they are related by the famous equation $E = mc^2$. Even more breathtaking is Einstein's realisation that matter-energy cannot exist independently of space-time and vice versa. There is no such thing, for example, as empty space-time. John Archibald Wheeler's famous encapsulation of general relativity: "Matter tells space how to curve and space tells matter how to move," beautifully illustrates this symbiosis.¹⁸ It also articulates an unexpected relationship between the fundamental bottom-up effect of matter on space-time and the top-down effect of space-time on the motion of matter. The relativistic world is indeed much less absolute and much more relational and interdependent than the Newtonian.

It is the same for Quantum Theory. We find, for example, that in most instances the mechanism by which atoms are bonded together to form a molecule is through cooperatively sharing electrons. The "atomic orbitals" give way to hybridised "molecular orbitals" in which it cannot be said that every electron belongs to just one atom.

The subatomic world has even stranger linkages, such as the Einstein-Podolsky-Rosen (EPR) effect, in which any change to the state of a particle which has been earlier associated with another particle, produces instant ontological change in that second particle. Einstein felt that this effect was so spooky that he thought there was something wrong with

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quantum mechanics. However, this “non-locality” or “entanglement”, as it is sometimes called, has now been convincingly confirmed by experiment. As Polkinghorne points out, this is quite different from simply an epistemological effect. Suppose, for example, that both of us take a ball unseen from a bag known to contain two balls, one white and one black, and go our separate ways. If you later look at your ball and find it to be black, you at least then know that mine is white, and there is nothing remarkable about that. The EPR effect, however, is more akin to my ball spontaneously changing colour to black if you paint yours white, no matter how far we may have separated!¹⁹ This non-locality is intrinsically relational: it is not something wrong with quantum physics. In so many ways, nature seems to fight back against a crass reductionism. Could it be that such cosmic relational richness is simply a reflection of a Creator so intrinsically relational as to be best pictured as three in one?

4. The unexpected intelligibility of the universe

It has been pointed out that our understanding of our universe far exceeds any conceivable survival necessity. We can penetrate both the subatomic world, down to the smallest particles, and the vast reaches of space-time. Although many features of the small and the large may be considered counter intuitive, nevertheless, we can understand them.

Since the time of Galileo, we have increasingly realised that Mathematics is the key to such an understanding, both for the microcosm within and for the cosmos without. Indeed, the Nobel prize-winning physicist, Paul Dirac, told his students that if they had to choose between a theory that had no obvious factual support but possessed great mathematical elegance, and one that seemed compatible with the facts but was mathematically clumsy, they should always choose the former. The facts would appear in due time!²⁰ Dirac demonstrated the truth of his maxim by an astonishingly fruitful life of scientific discovery. Now, it may be true that such mathematical beauty is easier to recognize than describe, also that Mathematics is a rather austere form of aesthetic pleasure; nonetheless, it is one of the manifestos of modern Physics that Mathematics is a reliable guide to physical reality.

Speaking of mathematical comprehensibility, Einstein remarked that the “most incomprehensible thing about the universe is that it is comprehensible”.²¹ Science is just glad that things are that way, but a deeper metaphysical instinct within us asks, why?

Ellis, with Penrose, takes the view that Mathematics is essentially discovered, not created. In this sense pi, the Pythagoras law, and Mandelbrot

sets were waiting there to be revealed.²² Many scientists believe in this transcendent aspect of Mathematics strongly enough to believe that any other civilisations existing within our universe must surely have discovered such mathematical entities. Thus, in their search for extra terrestrial intelligence, they look out for such signals; hence, the search for primes, Julia sets and Fibonacci series in our SETI.

A related and most interesting question is whether Mathematics controls or simply describes Physics. Both options have problems. If Mathematics controls, then how? If Mathematics simply describes, then why so well? For the theist a comprehensive and satisfying synthesis comes through the recognition that these two realities have a common origin in the rationality of God, who is the ground of both our rational thinking within and our discovery without. Polkinghorne observes:

The universe is shot through, in its rational beauty, with signs of mind. Could it be that science is only possible in this deep way because the universe is a creation and we are creatures in the image of its Creator?²³

5. Our universe being the realm of consciousness, values and aesthetics

Without doubt, the most amazing feature of our universe is consciousness, particularly self-consciousness. Through humanity, the universe is now aware of itself. We are stardust contemplating the stars. Although they are bigger, we have no trouble persuading ourselves that we are more significant. Size and significance are certainly not the same thing! Of course, although we come to consciousness at least once a day, and have been studying it for years, we have little understanding of it beyond identifying its seat in the brain. Sometimes we speak of this ignorance as the mind-brain problem. Polkinghorne notes that we really do not know much about even the simplest mental sensation, such as seeing green or feeling hungry. He goes on to say that while he does not rejoice in our current ignorance, neither does he wish to capitulate to premature reductionist claims that we are just computers made of meat. It seems clear that we are something more interesting than that and thinking is much more than computation.²⁴ In this sense, humans are causally effective in a different way to machines.

In a similar way the existence of moral values cries out for explanation. We intuitively know that it is not right to betray our national interests or to torture children. The physical world is inescapably the arena of such moral imperatives and ethical choices. Once again, these innate instincts go well beyond any demonstrated evolutionary necessity. Theistic belief,

however, provides an intelligible explanation in terms of a universal moral code emanating from a moral Creator. God is much more like father than like force. Thus the bringing into being of humanity in God's moral image, although relatively late in the timescale of the universe, yields a vital clue to the nature and purpose of evolving natural history.

Our universe is also the carrier of beauty. We have a very persuasive sense that our experiences of beauty are encounters with reality at a deep level. Music, for example, is more than a neural response to airwaves. The same is true of religious experiences, which are widely attested. These cannot be simply dismissed as epi-phenomenal curiosities or incredibly happy accidents.

Conclusion

As Paul Davies has pointed out, this universe, like the little bear's porridge, seems to be just right.²⁵ When Robinson Crusoe saw the footprints on the sand he knew he was not alone. I suggest that although perhaps not as definitively, we too can discern footprints in the features and complexities of our environment and infer that we have company. At the very least, this paper demonstrates that the Christian worldview does not necessarily involve believing six impossible things before breakfast, as the White Queen asserted to Alice that she had once done! **TEACH***

Endnotes

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