Is There a Role for Natural Theology Today?

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In crossing a heath, suppose I pitched my foot against a stone, and were asked how the stone came to be there; I might possibly answer, that, for any thing I knew to the contrary, it had lain there forever: nor would it perhaps be very easy to show the absurdity of this answer.

But supposing I had found a watch upon the ground, and it should be inquired how the watch happened to be in that place; I should hardly think of the answer which I had before given, that for any thing I knew, the watch might have always been there. Yet why should not this answer serve for the watch as well as for the stone? Why is it not as admissible in the second case, as in the first?

For this reason, and for no other, viz. that, when we come to inspect the watch, we perceive that its several parts are framed and put together for a purpose . . .. Th[e] mechanism being observed (it requires indeed an examination of the instrument, and perhaps some previous knowledge of the subject, to perceive and understand it; but being once, as we have said, observed and understood), the inference, we think, is inevitable, that the watch must have had a maker: there must have existed, at some time, and at some place or other, an artificer or artificers, who formed it for the purpose which we find it actually to answer; who comprehended its construction, and designed its use.[1]

Whether you have read this passage before or not, I'm sure you recognize it as the famous argument from design that introduces William Paley's *Natural Theology*; or, *Evidences of the Existence and Attributes of the Deity Collected from the Appearances of Nature*. Paley's Evidences, written nearly two hundred years ago, continues to have its modern repercussions, as witnessed by the title of the best- seller from the Oxford biologist, Richard Dawkins: *The Blind Watchmaker.* Dawkins writes, "When it comes to complexity and beauty of design, Paley hardly even began to state his case."[2] But he also declares that Paley's argument "is wrong, gloriously and utterly wrong,"[3] and the subtitle of his book boldly states, *Why the evidence of evolution reveals a universe without design*.

As an astronomer, I have always been intrigued by some of the astonishing details of the physical world, to say nothing of the intricacy and complexity of the biological domain. To me, looking out at the universe through the eyes of faith, these data have seemed to be impressive evidences of design and purpose. I propose to sketch briefly the modern scientific scenario of the creation of the universe and the origin of the

elements, pointing out at least two wonderful episodes where it appears, on the face of it, that a designing hand has been at work.

Yet science today eschews any hint of design or purpose in its description of the world. Thus, my scientific scenario will be grist for two more specific questions: Dare a scientist believe in design? and, Is there a role for natural theology today?

Modern Science Rejects Teleology

That it is unfashionable in scientific explanations today even to hint at purpose or design is made clear repeatedly, and not just in such avowedly atheistic polemics as exemplified by Dawkins' subtitle. Reductionism is the name of the game.

A few years ago *Science* magazine carried a report on the toxins of certain cone shells, which I happened to notice because my wife and I are avid shell collectors. A supplementary news article, entitled "Science digests the secrets of voracious killer snails," remarked that "the great diversity and specificity of toxins in the venoms of the cone snails are due to the intense evolutionary pressure on the snails to stop their prey quickly, since they can't chase it down."[4]

Very promptly a letter to the editor objected that this language implied that some real pressure was driving the snails to develop the toxins. "The reality is that those snails that produced toxins that immobilized their prey quickly tended to obtain food more often than those possessing slower-acting or no toxins, and thus over time the population of cone shells became dominated by those possessing the fast-acting agents. There was no pressure! In the vernacular, `If it works, it works; if it don't, it don't.'"[5]

The response shows clearly the current philosophical orthodoxy about the non-directed nature of evolution. It also typifies the enormous change of view that has occurred over the past century with respect to the wonders of the biological world. What is now seen as the zigzag, largely accidental path to amazing organisms with astonishing adaptations was in earlier times routinely interpreted as the design of an intelligent Creator. The long neck of the giraffe, which so well adapts the creature to an environment where food is available high off the ground, would have been seen, in William Paley's words, as a "mark of contrivance, in proof of design, and of a designing Creator."[6]

Even Jean Jacques Rousseau, not best known as a theist, declared, "It is impossible for me to conceive that a system of beings can be so wisely regulated without the existence of some intelligent cause which affects such regulation. . . I believe, therefore, that the world is governed by a wise and powerful Will."[7]

The notion of design suggests, of course, the existence of a goal-directed or end-directed process, what can aptly be termed teleology. Ernst Mayr, a leading evolutionist who has written very clearly on the modern philosophy of evolution, remarks that there are different types of end-directed processes. "The third category, organic adaptness, is not directed toward an end but rather an adaptation to the environment in the widest sense of the word, acquired during evolution, largely guided by natural selection. The fourth teleology, the cosmic one, is not supported by scientific evidence."[8] So much then, for a role for the Creator in modern biology.

"Man was not the goal of evolution, which evidently had no goal," wrote G. G. Simpson in a more visceral fashion. "He was not planned, in an operation wholly planless."[9]

Astonishing Details of the Universe

Yet, despite the articulate denials of cosmic teleology by the leading evolutionists of our age, there still remain enough astonishing details of the natural order to evoke a feeling of awe-beginning with the remarkable scenario that the cosmologists have woven together concerning the earliest moments of the

universe. During the past two decades knowledge of the world of the smallest possible sizes, the domain of particle physics, has been combined with astronomy to describe the universe in its opening stages. The physics ultimately fails as the nucleo-cosmologists push their calculations back to Time Zero, but they get pretty close to the beginning, to 10e-43 second. At that point, at a second split so fine that no clock could measure it, the entire observable universe is compressed within a dot of pure energy, a wavelike blur described by the uncertainty principle, so tiny and compact that it could pass through the eye of a needle. And then comes the explosion. "There is no way to express that explosion" writes the poet Robinson Jeffers,

. . . All that exists
Roars into flame, the tortured fragments rush away from
each other into all the sky, new universes
Jewel the black breast of night; and far off the outer nebulae
like charging spearmen again
Invade emptiness."

It's an amazing picture, of pure and incredibly energetic light being transformed into matter, and leaving its vestiges behind. "But," you may well ask, "how do we know this story is plausible? Or is it just a strange kind of science fiction?" I have not time here to outline the systematic steps, starting with the ancient Greek astronomers, in laying out the scale of ever larger reaches of the cosmos, and culminating in our own century with the measurements of the realm of galaxies, where the distances are so vast that they are reckoned in millions and billions of light years. Added to this is the remarkable discovery that the more distant the galaxy, the faster it is rushing away from us. These data arrived on the scene just as the cosmologists had begun to speculate on the large-scale properties of the universe, and out of this confluence of theory and observation arose the concept of the expansion of the universe. It was a picture of quite awesome beauty: from a super- dense state, "All that exists roars into flame, the tortured fragments rush away from each other into all the sky" in Robinson Jeffer's phrase.

Let us, for a moment, run time backward in mind's eye, and inquire what happens as the universe is squeezed back together and its density increases. The total of the mass and energy remains the same, but the temperature rises as the matter-energy is compressed. Finally the temperature becomes so high, and the mean energy of the components so great, that the presently-known laws of physics no longer apply.

Now let us run the clock forward again. In the first microseconds the high-energy photons vastly outnumber particles of matter, but there is a continual interchange between the photons and heavy particles of matter and antimatter. Einstein's famous E=mc^2 equation helps describe how the energy of the photons is converted into mass and vice versa. By the end of the first millisecond, the creation of protons and antiprotons is essentially finished, and the vast majority have already been annihilated back into photons. As the universe loses its incredible compression, the average energy per photon drops, and during this first second electrons and antielectrons (called positrons) are repeatedly formed and annihilated, finally leaving about 100 million photons of light for every atom.

The thermonuclear detonation of the universe is now on its way, and in the next minute fusion reactions take place that build up deuterium and helium nuclei. After the first few minutes the explosive nuclear fireworks are over, but the headlong expansion continues, and the cosmic egg gradually cools. The left-over radiation, redshifted into the microwave region of the spectrum, is ours to observe, and those photons have been observed by looking out every direction into space, the fossil evidence of the primeval fireball of the Big Bang. "It was like seeing the face of God," declared astronomer George Smoot in an over-enthusiastic response to the especially accurate data from the COBE satellite. This observed background radiation is one piece of evidence supporting the contemporary scientific picture of creation. The other is the observed abundance of helium and of deuterium, which match well the predicted amounts that would be formed in that cosmic explosion.

This picture, by itself, seems quite mind boggling, but there is something else that astrophysicists began to notice a few decades ago. The universe seems quite finely balanced between the outward energy of

expansion and the inward pull of gravitation. Had the universe exploded with somewhat greater energy, it would have thinned down too fast for the formation of galaxies and stars, the astrophysicists concluded. Had the energy been somewhat less, gravity would have quickly got the upper hand and would have pulled the universe back together again in a premature Big Crunch. Like the Little Bear's porridge, this universe is just right.

Let me be just a little more specific. According to this scenario, only two elements-hydrogen and helium-are produced in any abundance in the Big Bang itself. In order to get the carbon, oxygen, and iron needed for the formation of life, a very long period of cooking in stellar interiors-some billions of years-is required. So, to have a life-bearing universe, it must be very old and very large.

It sometimes seems a little intimidating to be on such a small speck of a planet in such vastness of space, but according to our modern understanding, this immensity is a requirement for us to be here. Not just that: it looks as if the entire universe has been tuned-shall I say designed?-for the emergence of intelligent life. And these facts have not escaped notice. The evidence of design appeared so striking that cosmologists even gave it a name: the *anthropic principle*. The initial energy balance of the universe and many other details were so extraordinarily right that it seemed the universe had been expressly designed to produce intelligent, sentient beings. Such was the original context that led to the anthropic principle.

Unique Properties of Carbon

I shall return to the idea of the energy of the universe being so finely balanced, but first I wish to examine another evidence of design. One of the first scientists to consider how the environment itself made life possible was the Harvard chemist L. J. Henderson. Early in this century, after Darwin's emphasis on the fitness of organisms for their various environments, Henderson wrote a fascinating book entitled *The Fitness of the Environment*, which pointed out that the organisms themselves would not exist except for certain properties of matter. He argued for the uniqueness of carbon as the chemical basis of life, and everything we have learned since then reinforces his argument. But today it is possible to go still further and to probe the origin of carbon itself, through its synthesis deep inside evolving stars.

Let me sketch briefly how stars spend their lives in order to explain where elements like carbon and oxygen come from. Most of the time stars get their energy by converting hydrogen into helium. But when the available hydrogen has been exhausted, the core of the star pulls together under the irresistible tug of gravity, the temperature increases, and finally the formerly inert helium becomes a fuel, fusing into carbon and later into oxygen. If the star is massive enough, a whole sequence of higher elements will be generated.

Eventually, however, there comes a place where the atoms no longer yield up nuclear energy for powering the star; instead, they *demand* energy. This happens when the chain has gone about a quarter of the way through the list of elements, approaching the element iron. When the star has burned the atoms to this point, it swiftly falls into bankruptcy, and the star is about to become a supernova. Gravity resumes its inexorable grasp, and within a split second the core of the star collapses, squashing the electrons and protons into a dense sphere of neutrons. On the rebound, the neutrons irradiate the lighter atoms, and in a colossal overshoot, they build up the heavier elements including the gold and uranium. From the cosmic debris come the building blocks for future stars and planets, and even for you and me. We are, in a sense, all recycled cosmic wastes, the children of supernovae.

Now back to carbon, the fourth most common atom in our galaxy, after hydrogen, helium, and oxygen. Carbon is made in the cores of stars long before they reach the supernova stage, although it is the later explosion that spews the element back into space where it becomes available for a subsequent generation of stars and planets. A carbon nucleus can be made by merging three helium nuclei, but a triple collision is tolerably rare. It would be easier if two helium nuclei would stick together to form beryllium, but beryllium is not very stable. Nevertheless, sometimes before the two helium nuclei can come unstuck, a third helium nucleus strikes home, and a carbon nucleus results. And here the details of the internal energy levels of the

carbon nucleus become interesting: it turns out that there is precisely the right resonance within the carbon that helps this process along.

Let me digress a bit to remind you about resonance. You've no doubt heard that opera singers such as Enrico Caruso could shatter a wine glass by singing just the right note with enough volume. I don't doubt the story, because in the lectures at our Science Center at Harvard, about half a dozen wine glasses are shattered each year using sound waves. It's necessary to tune the audio generator through the frequency spectrum to just the right note where the glass begins to vibrate-the specific resonance for that particular goblet-and then to turn up the volume so that the glass vibrates more and more violently until it flies apart.

The specific resonances within atomic nuclei are something like that, except in this case the particular energy enables the parts to stick together rather than to fly apart. In the carbon atom, the resonance just happens to match the combined energy of the beryllium atom and a colliding helium nucleus. Without it, there would be relatively few carbon atoms. Similarly, the internal details of the oxygen nucleus play a critical role. Oxygen can be formed by combining helium and carbon nuclei, but the corresponding resonance level in the oxygen nucleus is half a percent too low for the combination to stay together easily. Had the resonance level in the carbon been 4% lower, there would be essentially no carbon. Had that level in the oxygen been only half a percent higher, virtually all of the carbon would have been converted to oxygen. Without that carbon abundance, neither you nor I would be here now.

I am told that Fred Hoyle, who together with Willy Fowler found this remarkable nuclear arrangement, has said that nothing has shaken his atheism as much as this discovery. Occasionally Fred Hoyle and I have sat down to discuss one point or another, but I have never had enough nerve to ask him if his atheism had really been shaken by finding the nuclear resonance structure of carbon and oxygen. However, the answer came rather clearly about a decade ago in the Cal Tech alumni magazine, where he wrote:

Would you not say to yourself, 'Some super- calculating intellect must have designed the properties of the carbon atom, otherwise the chance of my finding such an atom through the blind forces of nature would be utterly minuscule.' Of course you would . . .. A common sense interpretation of the facts suggests that a superintellect 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 so overwhelming as to put this conclusion almost beyond question.[10]

Natural Theology: Evidence, not Proof

A few years ago I used the carbon and oxygen resonance in a lecture, and in the question period I was interrogated by a philosopher who wanted to know if I could quantify the argument. Clearly my petitioner was daring me to convince him, despite the fact that I had already proclaimed that arguments from design are in the eyes of the beholder, and simply can't be construed as proofs to convince skeptics. So now I hasten to dampen any notion that I intended the resonance levels in carbon and oxygen nuclei to demonstrate how to *prove* the existence of God.

Even William Paley, with his famous watch and his conclusion that it pointed to the existence of a watchmaker, said that "My opinion of Astronomy has always been, that it is not the best medium through which to prove the agency of an intelligent creator; but that, this being proved, it shows, beyond all other sciences, the magnificence of his operations."[11]

For me, it is not a matter of proofs and demonstrations, but of making sense of the astonishing cosmic order that the sciences repeatedly reveal. Fred Hoyle and I differ on lots of questions, but on this we agree: a common-sense and satisfying interpretation of our world suggests the designing hand of a superintelligence. Impressive as the evidences of design in the astrophysical world may be, however, I personally find even more remarkable those from the biological realm.

The game plan for evolutionary theory, however, is to find the accidental, contingent ways in which these unlikely and seemingly impossible events could have taken place. The evolutionists do not seek an automatic scheme-mechanistic in the sense that Newtonian mechanics is determined-but some random pathways whose existence could be at least partially retraced by induction from the fragmentary historical record. But when the working procedure becomes raised to a philosophy of nature, the practitioners begin to place their faith in the roulette of chance and they find Hoyle an aggravation to their assumptions about the meaninglessness of the universe.

Despite the reluctance of many evolutionary theorists, there does seem to be enough evidence of design in the universe to give some pause. In fact, scientists who wish to deny the role of design have taken over the anthropic principle. Briefly stated, they have turned the original argument on its head. Rather than accepting that we are here because of a deliberate supernatural design, they claim that the universe simply must be this way *because* we are here; had the universe been otherwise, we would not be here to observe ourselves, and that is that. As I said, I am doubtful that you can convert a skeptic by the argument of design, and the discussions of the anthropic principle seem to prove the point.

Natural Theology: Coherency

So this leads back to my central question: Is there a role for natural theology today? If you can't convert skeptics, what's its use? Is it all *mere* rhetoric? And I would answer, "Of course it's rhetoric, but rhetoric is not mere rhetoric." In the twelfth century, logic and rhetoric were equally esteemed components of the medieval curriculum. In some pursuits logic was more suitable, whereas in others, such as ethics, rhetoric led the way. In the following century, the time of Thomas Aquinas, logic began to gain the ascendancy. Today, common opinion places logic on a pedestal, while "mere rhetoric" is a term of opprobrium.

Actually, surprisingly little in science itself is accepted by "proof." Let's take Newtonian mechanics as an example. Newton had no proof that the earth moved, or that the sun was the center of the planetary system. Yet, without that assumption, his system didn't make much sense. What he had was an elaborate and highly successful scheme of both explanation and prediction, and most people had no trouble believing it, but what they were accepting as truth was a grand scheme whose validity rested on its coherency, not on any proof. Thus, when a convincing stellar parallax was measured in 1838, or when Foucault swung his famous pendulum at 2 a.m. on Wednesday morning, January 8, 1851, these supposed proofs of the revolution and of the rotation of the earth did not produce a sudden, new-found acceptance of the heliocentric cosmology. The battle had long since been won by a persuasiveness that rested not on proof but on coherency, and what persuaded people of that coherency was the cogency of the essentially rhetorical arguments mustered in its favor.

Now if we understand that science's great success has been in the production of a remarkably coherent view of nature rather than in an intricately dovetailed set of proofs, then I would argue that a belief in design can also have a legitimate place in human understanding even if it falls short of proof. What is needed is a consistent and coherent world view, and at least for some of us, the universe is easier to comprehend if we assume that it has both purpose and design.

Just as I would try to persuade my hearers that the awesome details of the natural world make more sense, have more coherence, in a theistic framework, there are those who polish their rhetoric to make the contrary case, as Dawkins puts it, to allow atheists to be intellectually fulfilled.[12] Dawkins gives a lively and articulate defense of natural selection as the agent that has very gradually led to sentient, questioning beings. When I saw the subtitle of his book, *Why the evidence of evolution reveals a universe without design*, I guessed, quite wrongly, that he introduced some empirical evidence against the role of design. He might, as Darwin frequently did, have defended the notion of imperfect design, or he might have argued from the stupefying percentage of species that have gone extinct, that if a designer was at work, he was at best clumsy and inefficient. But no, Dawkins seems to feel that by defending the view that a mechanistic process could have brought about humankind, his case against design had been made.

But we can look at the same data and come to opposite conclusions. He is no more able to prove the non-existence of a Creator than I, by arguments from design, can prove the existence of a super-intelligent Designer and Creator. It's as if someone from a far different age or culture were to hear what he might take as a cacophony of sounds, but to us that same onrush of notes would be a Mozart symphony. We hear the same notes, but come to opposing interpretations. I would like to think that hearing the sounds as a Mozart symphony is closer to reality. With respect to natural theology, it is not a tight logical deduction, but, in Pascal's memorable words, "the heart has its reasons that reason does not know."[13]

Natural Theology: Alleged Weaknesses

I, having made the leap of faith, find the arguments from design very illuminating; nevertheless, there are two issues worth facing before giving even a qualified endorsement to a modern-day natural theology. On the one hand, there has been a persistent criticism that arguments from design will cause scientific investigators of Christian persuasion to give up too easily. If the resonance levels of carbon and oxygen are seen as a miracle of creation, would a Christian physicist try to understand more deeply why, from the mechanistic view of physics, the levels are that particular way and not in some other configuration? Might it not be potentially detrimental to the faith to explain a miracle? On the other hand, what if the scientific explanation changes, and an argument suddenly loses its efficacy? Is faith now undermined?

Consider once more the design of the Big Bang, the observation that the universe seems so closely balanced between too much and too little energy of expansion. During the past decade this narrow balance has been the focus of ever greater attention, and cosmologists versed in the intricacies of the general theory of relativity found that the situation was more acute than they had earlier imagined. If the universe has too little energy to expand forever, its global geometry corresponds to what mathematicians call Riemannian or spherical space. If it has an excess, the global geometry is called Lobachevskian or hyperbolic space, and if it hangs in the balance in between, the familiar Euclidian geometry holds and the space is referred to as flat even though the universe has more than two dimensions.

The wonderful discovery was that in the very earliest stages of the expansion, the universe had to be incredibly flat to maintain its present near-flatness. Even a tiny departure one way or the other would cause a runaway situation that would bend the space one way or the other. And-hold your breath-the flatness required was one part in 1.0e60, that is, one followed by 60 zeros.

To the cosmologists, this looked like more than just good luck or a super-intelligent designer who tuned the universe this way. It seemed that some fundamental property *required* the universe to be this way. I won't go into the splendid scenario schemed up to make this happen, called inflation. It would derail us to consider its technical aspects or some of its fascinating ramifications, such as the fact that this theory can't be empirically demonstrated and simply must be believed because of its beauty. But in a sense it punctures the notion of a Creator, who, with a kind of cosmic roulette, picks just the right starting conditions to enable us to arrive on the scene. Of course, it can make us turn in awe at a Designer who built the inflationary epoch into the plans for creation, and perhaps all we have to worry about is whether, in fact, the Designer had a choice in the matter.

If natural theology is mistakenly viewed as a source of proof for the Divine in the universe, then inevitable changes in scientific ideas pose a serious threat. However, if natural theology deals with hints and coherencies, not proofs and forced convictions, then I think it is on safe and reasonable ground. But what about the other criticism, that belief in design could deter investigators from pushing their inquiries to the limit? In other words, dare a scientist believe in design?

There is, I believe, no contradiction between holding a staunch belief in supernatural design and being a creative scientist, and perhaps no one illustrates this point better than the seventeenth-century astronomer Johannes Kepler. He was one of the most creative astronomers of all time, a man who played a major role in bringing about the acceptance of the Copernican system through the efficacy of his tables of planetary motion. One of the principal reasons Kepler was a Copernican arose from his deeply held belief that the

sun-centered arrangement reflected the divine design of the cosmos. Kepler's life and works provide central evidence that an individual can be both a creative scientist and a believer in divine design in the universe, and that indeed the very motivation for the scientific research can stem from a desire to trace God's handiwork.

Conclusions

In reflecting on these questions I have attempted, in a somewhat guarded way, to delineate a place for design both in the world of science and in the world of theology. There is persuasion here, but no proof. However, even in the hands of secular philosophers the modern mythologies of the heavens, the beginnings and endings implied in the Big Bang, give hints of ultimate realities beyond the universe itself. Milton Munitz, in his closely argued book, *Cosmic Understanding*,[14] declares that our cosmology leads logically to the idea of a transcendence beyond time and space, giving lie to the notion that the cosmos is all there is, or was, or ever will be.

Munitz, in coming to the concept of transcendence, describes it as unknowable, which is somewhat paradoxical, since if the transcendence is unknowable then we cannot know that it is unknowable. Could the unknowable have revealed itself? Logic is defied by the idea that the unknowable might have communicated to us, but coherence is not. For me, it makes sense to suppose that the superintelligence, the transcendence, the ground of being in Paul Tillich's formulation, has revealed itself through prophets in all ages, and supremely in the life of Jesus Christ.

To believe this requires accepting teleology and purpose. But I think that the philosophers might rightfully point out that purpose transcends design, that is, there can be purpose without design; God could work God's purposes even in a universe without apparent design, or with designs beyond our finite comprehension. It would be possible to be a theist and a Christian even in the absence of observed design.

Nevertheless, just as I believe that the Book of Scripture illumines the pathway to God, so I believe that the Book of Nature, with its astonishing details-the blade of grass, the Conus geographus (with its lethal harpoon), or the resonance levels of the carbon atom-also suggests a God of purpose and a God of design. And I think my belief makes me no less a scientist.

To conclude, I turn once again to Kepler, who wrote, "If I have been allured into brashness by the wonderful beauty of thy works, or if I have loved my own glory among men, while advancing in work destined for thy glory, gently and mercifully pardon me: and finally, deign graciously to cause that these demonstrations may lead to thy glory and to the salvation of souls, and nowhere be an obstacle to that. Amen."[15]

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