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Dare a Scientist Believe in Design?

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On Cone Snails and Venom

Conus cedonulli is, literally, the "I yield to none" cone. In the eighteenth century this handsomely patterned shell became the most celebrated and sought-after molluscan rarity. Two specimens were known in Europe in the early 1700s, one of which became the prize the King of Portugal's collection. In 1796 the other was auctioned for 243 guilders at a sale in which Vermeer's masterpiece, "Woman in Blue Reading a Letter," fetched a mere 43 guilders!

Cone shells, *cedonulli* among them, are considered among the most "advanced" molluscs because their anatomy includes a toxic harpoon that can spring out of the apex end of the shell. In some species the sting can be deadly even to humans.

Our first reaction upon hearing about the cone shells may well be: what wonderful design! And we may be even more impressed and probably puzzled to learn that the exquisite pattern on the shell is, during the animal's lifetime, covered by an opaque periostracum, rendering the pattern virtually invisible and therefore perplexingly useless either for survival or sexual attraction. To think in terms of deliberate design is an almost intuitive response, yet such thoughts have become strangely taboo in contemporary scientific circles. *Conus cedonulli* thus becomes a jumping off place for consideration of the question, "Are there intimations of design in the universe?" and a related and perhaps more daunting query, "Dare a scientist believe in design?"

Consider what happened when a report on studies of the mollusc toxins appeared in *Science* magazine (along with an illustration of both *Conus cedonulli* and the Vermeer painting).[1] 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."[2]

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."[3]

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.

Design and Technology

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."[4] "Who gave white bears and white wolves to the snowy regions of the North, and as food for the bears the whale, and for the wolves, birds' eggs?" asked Johannes Kepler two centuries earlier.[5] "Great is our Lord and great his virtue and of his wisdom there is no number!" he exclaims in answer, "Use every sense for perceiving your Creator."

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."[6]

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, wisely remarks that it is futile to attempt to clarify the concept of teleology without discriminating between different types of end-directed processes. There are some kinds of inanimate natural processes that do have an end point, for example, the fall of a stone or the cooling of a heated piece of metal. There are also goal-directed processes in genetically controlled organisms:

> 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, with a purpose and predetermined goal ascribed to everything in nature, is not supported by scientific evidence.[7]

So much then, for a role for the Creator in modern biology. G. G. Simpson, writing in a more visceral fashion, declared, "Man was not the goal of evolution, which evidently had no goal. He was not planned, in an operation wholly planless."[8]

The Universe from a Dot of Energy

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 powerful feeling of awe. In our own age, science has opened up truly remarkable vistas. In the microscopic world of the atom there are marvels to stagger the imagination. At the other end of the scale, astronomers plumb the world of the large, delineating our Milky Way as a giant pinwheel galaxy containing over 200 billion stars—roughly 35 for every man, woman, and child on earth. And beyond our own stellar system,

countless other galaxies are scattered out to the fringes of the universe, roughly 14 billion light-years away.

These are discoveries of the 20th century, some of them scarcely fifty years old. Yet nothing is quite as astonishing as the scientific scenario that has now been outlined for the first moments of creation. During the past few 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 10^{-43} second. At that point, at a second split so fine that no clock could measure it, the entire observable universe is compressed within the wavelike blur described by the uncertainty principle, so tiny and compact that it could pass through the eye of a needle. Not just this room, or the earth, or the solar system, but the entire universe squeezed into a dense dot of pure energy. 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.[9]

It's an amazing picture, of pure and incredibly energetic light being transformed into matter, and leaving its vestiges behind. It's even more astonishing when we realize that the final fate of the universe, whether it will expand forever or fall back on itself to a future Big Crunch, was determined in that opening moment.

Now the paragraphs you've just read were written just over a decade ago, and today we know there are a couple of things wrong with them. First, Robinson Jeffers' poem says that the nebulae like charging spearmen *again* invade emptiness. Jeffers' younger brother, Hamilton, was an astronomer at Lick Observatory, and from his brother he may have learned about the once-popular cosmological theory of an oscillating universe, in which a universe

could have formed over and over again. Today the observational evidence favors a universe that will expand forever, so the oscillating model has fallen into disfavor.

Second, that dense dot of pure energy that could pass through the eye of a needle brings up a very interesting problem. How does the dot know when to explode? In 10^{-40} second light cannot travel very far, not even across an atom, much less across the eye of a needle. There is no way for one side of the dot to know when the other side started to expand! An intriguing solution to this conundrum was suggested two decades ago, named by Alan Guth, one of its inventors, the "inflation" scenario. In this sub-theme to the Big Bang, at a very early instant, just as the gravitational force separated out from the other basic forces of the universe, for a moment gravitation acted repulsively and the space expanded by billions of billions of billions of times—actually even more than this—with the result that the entire part of the universe now visible to us was once exceedingly tiny and entirely connected at the speed of light.

The Universe on a Knife Edge

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—so much so that cosmologists have even given it a name: the anthropic principle. The discussion arose originally when some physicists noticed that even small variations in some of the constants of nature would have led to a universe in which life could not exist. For example, had the original energy of the Big Bang explosion been less, the universe would have fallen back onto itself long before there had been time to build the elements required for life and to produce from them intelligent, sentient beings. Had the energy been more, it is quite possible that the density would have dropped too swiftly for stars and galaxies to form. The balance between the energy of expansion and the gravitational braking had to be right to 1 part in 10^{59}—an incredible ratio. These and many other details were so extraordinarily right that it seemed the universe had been expressly designed for humankind.

Today we would say that this incredible balance was not an accident, or, one might argue, direct evidence of God's designing hand in the opening moment of the universe, not what Aristotle might have called a "fact-in-itself," but now a "reasoned fact," a phenomenon with an explanation, for this balance must inevitably follow as a consequence of that split second of enormous inflation. Does that mean that this evidence for God's being and presence in our universe has gone away? A "fact-in-itself" might call for God's fine-tuning hand in the history of the universe, while the march of science has negated the necessity of such a role. But a "reasoned fact" still resonates with the magnificence of God's original designs that have made such a universe possible. It is the difference between contingent events and fundamental planning for the nature of the universe itself. Let me return presently to this idea, and to the anthropic principle, the principle that the universe is somehow extraordinarily, and in fact necessarily, congenial for the origin of intelligent life.

On Carbon and Resonance

One of the first scientists to consider how the environment itself made life possible was the Harvard chemist L. J. Henderson. In 1913, 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, from the nature of the hydrogen bond to the structure of DNA, 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.

Carbon is the fourth most common atom in our galaxy, after hydrogen, helium, and oxygen. 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 the late Fred Hoyle, who together with Willy Fowler found this remarkable nuclear arrangement, said that nothing shook his atheism as much as this discovery. Occasionally Fred Hoyle and I sat down to discuss one or another astronomical or historical point, but I 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 in the November 1981 issue of the Cal Tech alumni magazine, where he wrote:

> Would you not say to yourself, "Some supercalculating 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]

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 differed on lots of questions, but on this we agreed: a common sense and satisfying interpretation of our world suggests the designing hand of a super-intelligence.

Design and Biology

Impressive as the evidences of design in the astrophysical world may be, however, I personally find even more remarkable those from the biological realm. As Walt Whitman proclaimed, "A leaf of grass is no less than the journey work of the stars."[11] I would go still farther and assert that stellar evolution is child's play compared to the complexity of DNA in grass or mice. Whitman goes on, musing that:

> ...the tree toad is a chef-d'oeuvre for the highest,
> And the running blackberry would adorn the parlors of heaven,
> And the narrowest hinge in my hand puts to scorn all machinery,
> And the cow crunching with depress'd head surpasses any statue,
> And a mouse is miracle enough to stagger sextillions of infidels.

Even Hoyle, by his allusion to the biology, seems to agree that the formation of, say, DNA, is so improbable as to require a superintelligence. Such biochemical arguments were popularized about forty years ago by Lecomte du Noüy in his book *Human Destiny*. Du Noüy estimated the

probability of forming a 2000-atom protein as something like one part in 10^{321}. He wrote, "Events which, even when we admit very numerous experiments, reactions, or shakings per second, need an infinitely longer time than the estimated duration of the earth in order to have one chance, on the average, to manifest themselves can, it would seem, be considered as impossible in the human sense."[12]

Du Noüy went on to say, "To study the most interesting phenomena, namely Life and eventually Man, we are, therefore, forced to call on anti-chance, as Eddington called it; a "cheater" who systematically violates the laws of large numbers, the statistical laws which deny any individuality to the particles considered."[13]

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 that du Noüy and Hoyle are an aggravation to their assumptions about the meaninglessness of the universe.

Scientists and Their Beliefs

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 seem to 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.

But once again I return to my central question, "Dare a scientist believe in design?" and I pause to remark on the somewhat curious status of "belief" within science. Some years ago I conducted a workshop for a rather diverse group of Christians, and I asked, "Can a theist believe in evolution?" I got a variety of responses, but it didn't occur to any of them to challenge what it might mean to *believe* in evolution. Does that mean to have faith in evolution in a religious sense? I have heard one leading paleontologist announce himself as a "devout evolutionist" when asked his faith, and I guess that is a possibility. But when pressed, most scientists would, I think, claim only that they accept evolution as a working hypothesis.

In everyday, non-philosophical usage, most people, scientists included, would say they believe in the results of science and that they believe the results of science to be true. Yet, and this is the anomalous part, most scientists would be mildly offended at the thought that their beliefs constituted an act of faith in a largely unproved but intricate system of coherencies. 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, newfound acceptance of the heliocentric cosmology. The battle had long before been won by a persuasiveness that rested not on proof but on coherency.

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, even if this cannot be proven with a tight logical deduction.

Nevertheless, there has been a persistent criticism that arguments from design will cause scientific investigators 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? And so we come face to face with our original query: "Dare a scientist believe in design?"

Kepler

There is, I shall argue, 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. Now 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: The Sun at the center was the image of God, the outer surface of the star-studded heavenly sphere was the image of Christ, and the intermediate planetary space represented the Holy Spirit. These were not ephemeral notions of his student years, but a constant obsession that inspired and drove him through his entire life.

Writing to a favorite correspondent, Herwart von Hohenburg, he said, "Copernicus piously exclaimed, 'So vast, without any question, is the Divine handiwork of the Almighty Creator.' ...Yet we must not infer that bigness is of special importance; otherwise the crocodile or elephant would be closer to God's heart than man."[14] To his teacher Michael Maestlin back in Tübingen he wrote, "For a long time I wanted to be a theologian; for a long time I was restless. Now, however, behold how through my effort God is being celebrated in astronomy!"[15]

Today Kepler is best remembered for his discovery of the elliptical form of the planets' orbits. This discovery and another, the so-called law of areas, are chronicled in his *Astronomia Nova*, truly the New Astronomy. In its introduction he defended his Copernicanism from the point of view of that the heavens declare the glory of God:

> If someone is so dumb that he cannot grasp the science of astronomy, or so weak that he cannot believe Copernicus without offending his piety, I advise him to mind his own business, to quit this worldly pursuit, to stay at home and cultivate his own garden, and when he turns his eyes toward the visible heavens (the only way he sees them), let him with his whole heart pour forth praise and gratitude to God the Creator. Let him assure himself that he is serving God no less than the astronomer to whom God has granted the privilege of seeing more clearly with the eyes of the mind.[16]

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.

Darwin

In the centuries that followed, many scientists took inspiration from the idea that the heavens declared the glory of God, but God's hand appeared less and less in their physical explanations. In a sense, one of the fundamental consequences of the scientific revolution, in which the ancient geocentric universe gave way to a vast heliocentric plan governed by gravitation, was the secularization of the natural world.

Darwin's theory was of a quite different sort from Newton's. He sought some fundamental explanation for patterns of similarities as well as differences within the biological kingdoms, and a way to understand the remarkable adaptation of the organisms beyond a simple attribution to God's designing hand. Darwin's explanation eventually relied on historical contingency rather than mechanical necessity. As such, his theory lacked

the compelling predictive power that arises from the necessity of gravitation, or of conservation of angular momentum, or of any number of other physical laws. What it lacked in sheer predictive power it achieved in its immense explanatory power, a spectacular new coherency of understanding.

With the secularization of the physical world that followed in the wake of the scientific revolution of the sixteenth and seventeenth centuries, the community became divided between the deists, who put God outside the universe as the Spirit who set it all into motion according to physical laws, and the theists, who still maintained an active role for God within the world. This was, of course, a theological or philosophical option, not a decision required by any scientific observations of the world itself. After Darwin's evolutionary theory was raised to a philosophy, with its inherent denial of design, the apparent choice swung more sharply from deism/theism to atheism/theism. Science remained a neutral way of explaining things, neither anti-God nor atheistic. Many people were (and are) extremely uncomfortable with a way of looking at the universe that did not explicitly require the hand of God. But it did not mean the universe was actually like that, just that science generally has no other way of working.

Nevertheless, high random opportunism (as opposed to design) has been raised to such a level of scientific orthodoxy that some of our contemporaries forget that this is just a tactic of science, an assumption, and not a guaranteed principle of reality. Few, however, have enunciated the mechanistic credo so stridently as the evolutionary biologist and historian of science William B. Provine, who has recently written:

> When Darwin deduced the theory of natural selection to explain the adaptations in which he had previously seen the handiwork of God, he knew that he was committing cultural murder. He understood immediately that if natural selection explained adaptations, and evolution by descent were true, then the argument from design was dead and all that went with it, namely the existence of a personal god, free will, life after death, immutable moral laws, and ultimate meaning in life. The immediate reactions to Darwin's *On the Origin of Species* exhibit, in addition to favorable and admiring responses from a relatively few scientists,

an understandable fear and disgust that has never disappeared from Western culture.[17]

Provine, in defending the gospel of meaninglessness, goes on to say that if modern evolutionary biology is true, then lofty desires such as divinely inspired moral laws and some kind of ultimate meaning in life are hopeless.

Christian Biochemistry

I'm not sure why Professor Provine has such fear and loathing of design, but apparently, despite the example of Kepler (and of Newton and many others), he is still afraid that the arguments from design may block the march of science. Such a view is perhaps not totally unfounded. Let me explain.

Several years ago I participated in a remarkable conference of theists and atheists in Dallas. One session considered the origin of life, and a group of Christian biochemists argued that the historical record was non-scientific since it was impossible to perform scientific experiments on history. Furthermore, they amassed considerable evidence that the current scenarios of the chemical evolution of life were untenable. One of the atheists aligned against them, Professor Clifford Matthews from the University of Illinois at Chicago, conceded that their criticisms had considerable validity. Calling their book on *The Mystery of Life's Origins*[18] brilliant, he summarized their arguments with respect to the standard picture of chemical evolution as saying, "(1) the evidence is weak, (2) the premises are wrong, and (3) the whole thing is impossible." Of course, he did not accept their final conclusion that a new kind of science was required.

I soon found myself in the somewhat anomalous position that to me, the atheists' approach was much more interesting than the theists'. That particular group of Christian biochemists had concluded that ordinary science didn't work in such a historical situation, that is, with respect to the origin of life, and they attempted to delineate an alternative "origin science" in which the explicit guiding hand of God could make possible what was otherwise beyond any probability. The real reason I admired the atheist

biochemists so much was that they hadn't given up. They were still proposing ingenious avenues whereby catalytic effects in the chemistry made the events far more likely. "Let us not flee to a supernaturalistic explanation," they said, "let us not retreat from the laboratory."

Now it might be that the chemistry of life's origins *are* forever beyond human comprehension, but I see no way to establish that scientifically. Therefore it seems to me to be part of science to keep trying, even if ultimately there is no accessible answer. Apparently this reasoning has some cogency, because the ringleader of the group, Charles Thaxton, at least partly backed off of this position, and today we don't hear much about origin science. But meanwhile, a new generation has reclothed some of these same ideas under the name "intelligent design." Using some of the same evidences that impress me, from both the physical and biological realms, they press the case still further and argue that some of the evolutionary steps make sense only when taken in a large bundle, a form of macroevolution that demands the explicit involvement of both a designing mind and a designer's hand. My theological presuppositions do incline me to be sympathetic to this point of view, but as a scientist I accept methodological naturalism as a research strategy.

On Amish and Six-Fingered Dwarfs

Let me digress for a moment to describe a particular case that has been intriguing me recently. As an introductory footnote, I should say that all four of my paternal great great grandfathers were Amish ministers, which enhances my fascination with this situation among the highly inbred population of Amish in Lancaster County, Pennsylvania. Among this group there is the occasional appearance of a rare pathology known as six-finger dwarfism. There are approximately 75 known cases, about half of which were still-born, and the remarkable circumstance is that in every instance both parents could trace their ancestry to a single Amish couple who immigrated to Pennsylvania around 1750. In other words, each parent carried the mutant recessive gene inherited from either the mother or the father in that original couple—there is no way, of course, to know which one carried it to America. Two years ago the single altered nucleic acid in the

DNA was discovered. Just one substitution is enough to cause a host of changes including the production of a sixth finger.

I cite this case for several reasons. First, it shows how intricate and extraordinary the control mechanisms are in the DNA, and how cautious we have to be in making claims about how macroevolutionary changes can or cannot occur. Secondly, it shows just how ambiguous our interpretation of physical events must necessarily be. Was that mutation an accident? Was God surprised? It's hard to believe that it was somehow foreordained in the Big Bang itself. The fundamental integrity of atoms could, to put it in human, anthropomorphic language, have been planned and designed in the beginning, but with regard to the mutation itself, the two obvious theological choices are either that God's hand is continually at work disguised in the ambiguity of the uncertainty principle, or that the purposes of creation are general and not specific, so that God is learning as the process goes on.

Transcendence

Am I contradicting myself to say, on the one hand, that the resonance levels in carbon and oxygen point to a superintelligent design, and on the other hand, that science must continue to search for underlying reasons why the resonance levels are that way and not some other way? I think not, for even if it is shown that those levels had to be the way they are because of some fundamental, invariable reason, there is still the miracle of design that led it so, choice or not. Even if it would no longer be a "fact-in-itself," but a reasoned fact, the design would still be there. Thus, I see no reason that an appreciation of the astonishing details of design should prevent us from trying to search further into their underlying causes. Hence I'm not prepared to concede that arguments from design are necessarily contra-scientific in their nature.

Perhaps part of Provine's outrage came because he was responding to Phillip Johnson, Professor of Law at Berkeley, who is an articulate legal champion of the right to believe in God as Creator and Designer, and a critic of an evolutionary process running entirely by chance.[19] Earlier I mentioned the incredible odds calculated by Lecomte du Noüy against the chance

formation of a protein molecule. Since we do have proteins, and since a mechanistic science has been highly successful, the overwhelming reaction has just been to ignore du Noüy, since he is so obviously wrong. But is he? For science to overcome the odds, it is necessary for us to postulate catalysts and unknown pathways to make the formation of life from inert matter enormously easier, and it is of course precisely such pathways that are the challenge of science to find. But is not the existence of such pathways also evidence of design? And are they not inevitable? That is what materialists such as Provine do not want to hear, but as Hoyle says, the numbers one calculates puts the matter beyond question.

So, while I worry about from those Christian biochemists who postulate some new kind of "origin science," or their successors who argue for "intelligent design," I do think a science totally devoid of the idea of design may be in danger of running into a blank wall. And this brings me to ask again, is the idea of design a threat to science? and I answer no, perhaps design might even be a necessary ingredient in science.

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. As Kepler once said of astrology, the stars impel, but they do not compel.[20] 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*,[21] 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. And if that purpose includes contemplative intelligent life that can admire the universe and can search out its secrets, then the cosmos must have those properties congenial to life. For me, part of the coherency of the universe is that it is purposeful—though probably it takes the eyes of faith to accept that. But given that understanding, then the anthropic principle that states that our universe must be congenial to life also becomes the evidence of design. This brings to mind a few lines in Whitman's *Leaves of Grass:*

> A child said *What is the grass?* fetching it to me with full hands;
> How could I answer the child? I do not know what it is any more
> than he.
>
> I guess it is the handkerchief of the Lord,
> A scented gift and remembrancer designedly dropt,
> Bearing the owner's name someway in the corners,
> that we may see and remark, and say *Whose?*[22]

So, just as I believe that the Book of Scripture illumines the pathway to God, I also believe that the Book of Nature, with its astonishing details—the blade of grass, the *Conus cedonulli*, 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.[23]

Notes

1. B. M. Olivera, *et al.*, "Diversity of *Conus* Neuropeptides," *Science,* 249 (20 July 1990), pp. 257-63.

2. Marcia Barinaga, "Science Digests the Secrets of Voracious Killer Snails," *Science,* 249 (20 July 1990), pp. 250-51.

3. James L. Carew, "'Purposeful' Evolution" (letter), *Science,* 249 (24 August 1990), p. 843.

4. William Paley, *Natural Theology; or, Evidences of the Existence and Attributes of the Deity Collected from the Appearances of Nature* (Edinburgh, 1816), Chapter 5, section 5, p. 61.

5. Johannes Kepler, *Harmonies of the World,* in *Great Books of the Western World,* Vol. 16 (Chicago, 1952), p. 1085.

6. J. J. Rousseau, *Profession of Faith of a Savoyard Vicar* (1765), quoted in Alan Lightman and Owen Gingerich, "When Do Anomalies Begin?" *Science,* 225 (7 February 1992), pp. 690-95.

7. Ernst Mayr, "The Ideological Resistance to Darwin's Theory of Natural Selection," *Proceedings of the American Philosophical Society,* 135 (1991), pp. 123-39, on. p. 131. One clause has been inserted from Mayr's Craaford Prize Lecture as edited in *Scientific American,* 283 No. 1 (July, 2000), p. 82.

8. George Gaylord Simpson, *The Meaning of Evolution* (Mentor Edition, New York, 1951), p. 143.

9. Robinson Jeffers, "The Great Explosion," in *The Beginning and the End and Other Poems* (New York, 1963).

10. Fred Hoyle, "The Universe: Past and Present Reflections," in *Engineering and Science*, November, 1981, pp. 8-12, especially p. 12.

11. Whitman, "Song of Myself," stanza 31, in *Leaves of Grass* (Boston, "1891-2 edition").

12. Du Noüy, *Human Destiny*, (New York, 1947), p. 35.

13. *Human Destiny*, p. 38.

14. *Johannes Kepler Gesammelte Werke*, 13, nr. 107, (16 December 1598), pp. 144-58; my translation based on the one by Carola Baumgardt, *Johannes Kepler Life and Letters* (New York, 1951) pp. 48-49.

15. *Johannes Kepler Gesammelte Werke*, 13, nr. 23, (3 October 1595), pp. 256-57; from Gerald Holton, "Johannes Kepler's Universe: Its Physics and Metaphysics," *American Journal of Physics*, 24 (1956), pp. 340-51, especially p. 351.

16. Slightly abridged and modified from my translation in *Great Ideas Today 1983*, (Chicago, 1983), pp. 321-22.

17. *First Things*, No. 6, October 1990, p. 23.

18. Charles B. Thaxton, Walter L. Bradley, and Roger L. Olsen, *The Mystery of Life's Origin: Reassessing Current Theories* (New York, 1984).

19. See also Phillip E. Johnson, *Darwin on Trial* (Washington, D.C., 1991).

20. Kepler, *Harmonice mundi* (Frankfurt, 1619), IV, Ch. 7.

21. Milton K. Munitz, *Cosmic Understanding: Philosophy and Science of the Universe* (Princeton, 1986).

22. Whitman, "Song of Myself," stanza 6, in *Leaves of Grass* (Boston, "1891-2 edition").

23. End of Book V, Chapter 9 of *Harmonice mundi*, Johannes Kepler Gesammelte Werke, 6, p. 362; my translation is based on the ones by Charles Glenn Wallis in *Great Books of the Western World*, Vol. 16, and by Eric J. Aiton, A. M. Duncan and J. V. Field, *Memoirs of the American Philosophical Society*, 209, (Philadelphia, 1997).