

Fountain of Creation – Design vs. Meta-Design

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Abstract

Looking at the universe as a whole, focusing on its atomic building blocks, or studying life in its many forms reveals extremely sophisticated “machinery” that appears to work “in just the right way,” with components that are finely tuned to support one another’s functioning. This essay explores some philosophical options for the “design” that might lie beneath it all.

Introduction

As we gradually expand the realm of our “understanding” of the universe, and as we probe ever deeper into the mysteries of life itself, we cannot avoid being struck by how intricately the machineries of physics, chemistry, and biology are tuned to one another. A small change in the charge of the electron would lead to different atoms and a different periodic table. The associated changes in physics and chemistry might not lead to stable water molecules; and life as we know it would be impossible. Equally interdependent are the processes that permit the replication of the genetic code and the formation of thousands of important proteins. If one were to introduce a small change anywhere, the whole machinery that surrounds us might not work anymore.

This interdependence invites us to contemplate how all of this came into existence and why the universe is the way it is. What is responsible for its underlying design? When pondering these questions, science must yield to philosophy or religion. Every answer that we can come up with, involves some unexplainable act of creation, and many models associate an ingenious and wonderful level of design with this creative act. In this essay, I want to review the spectrum of possible design achievements that may be associated with the creation of the universe.

Background

The idea for this paper was triggered by Fred Brooks’ Turing Award lecture [1] on July 26, 2000. His talk “The Design of Design” presented enlightening insights about the structure of the design process itself, and emphasized how important it is to understand this process, if we hope to produce truly good designs. The last few minutes of his talk were devoted to some philosophical thoughts. Fred Brooks expressed his awe of the wonderful achievement by “the great designer” who created the universe with all its physical laws and sophisticated dependencies, for instance, the intricate molecules that make possible life – and, ultimately, intelligent beings, who can observe this universe and contemplate its design.

These inspiring thoughts fell on fertile ground, readied by some recent personal experiences. A few days earlier I had taken a stroll through the gardens of the Brueglinger Hof in Basel and sat for a while in front of its central fountain. I observed in fascination the constantly changing patterns of sheets of water generated by the rising central jet colliding with the water’s return path under the influence of gravity. I remembered a poem by C.F. Meyer [2] titled “Roman Fountain” (Fig.1a) that we had studied in school. Such a fountain conveys a wonderful symbol of the instantaneous yet continuous aspects of our existence.

Ever new, yet globally similar patterns develop; little pieces of art are created for a fraction of a second and then destroyed by the interplay of gravity and the collision with more up-surging water. The display also inspires thoughts of geometrical fractals. On rare occasions, a pattern of particular beauty and symmetry hangs in mid air for a fraction of a second, and then quickly disintegrates into a random constellation of water droplets. Might it be possible that our own universe is just one such lucky constellation – among a myriad of others with physical laws that do not permit any interesting developments, perhaps not even the formation of mass, stars, or planetary systems? Would anybody take notice of those universes?

Fred Brooks sees the genius of a great designer in the workings and ingenious interplay of all the physical laws – which are just right to enable stars, planets, water, life, and intelligence. However, earlier in his talk, he had emphasized the importance of “user feedback” for achieving good designs. He recommended trying out new designs as early as possible, opening up the emerging systems to the intended users, and letting them decide what works and what does not. Thus, in the end, “user acceptance” determines which designs will be pursued further and which ones will be abandoned. To me, this approach seems to add a strong Darwinian component to the design process. One might wonder whether the great machinery of the universe that we observe today is great “by design,” or whether it is great because all inferior designs have been weeded out by a process of selection based on “usefulness.” But who measures usefulness? What is the mechanism of selection that guarantees the survival of the best designs?

Different religious views will favor different interpretations concerning the design achievements underlying our universe and the act of its creation. Some fundamentalist religions favor a belief that the crowning achievement lies in the creation of all the artifacts as we see them today, including a set of physical laws that generally apply, unless the great designer chooses to make adjustments to the flow of the daily occurrences. Other philosophies see the creative achievement in the formulation of the eternal laws of our universe that enable the existence of life in all its wonderful richness [3]. An initial creative act may have set things up in the proper way, but after that, the universe evolved on its own along Darwinian principles. “Survival of the fittest” might then play the role of “user testing” and would guarantee that only “successful” results will survive in the long run. Of course, at any one moment, one can observe many less than perfect artifacts, but in due time, these will disappear in the competition with other, more successful variants.

This kind of thinking can be taken one step further. Perhaps our universe is not a sophisticated design after all, but is merely one of the more successful variants (in our view) of very many tries of other universes. Perhaps our universe is just like a droplet in the fountain described above. New universes may be born all the time, but only very rarely are the conditions just right, so that something “interesting” happens within them: For instance, the formation of stars, followed by the evolution of life and the emergence of consciousness, which then allows those beings to contemplate the structure of their universe. From this perspective, the great design achievement would be the establishment of this particular generative process itself.

The particular format of this BRIDGES presentation is the result of yet another coincidental experience. During my travel last summer, I was reading Nabokov’s novel “Pale Fire” [4]. It had been recommended to me as an example of a hypertext predating the existence of HTML [5]. I was intrigued by the combination of a poem, an introduction to it, followed by a rather extensive set of cross-referenced comments that tell the real story of the book. Here then is my attempt to combine philosophical thought, rational analysis, and visual imagery, with a poetic backbone describing a “Fountain of Creation.” I start out with the poem by Conrad Ferdinand Meyer (Fig.1a) and my attempt at a translation (Fig.1b) that captures the visual images as well as the rhythm and flow of the original master piece. This is then followed by a series of poetic “cantos” and some commentary – adopting the organization of Nabokov’s book. This is work in continuous progress. The cantos captured here represent the state of May 20, 2001. The latest versions will be presented at the conference.

Der Römische Brunnen	Roman Fountain
<p>Aufsteigt der Strahl, und fallend giesst Er voll der Marmorschale Rund, Die, sich verschleiern, überfließt In einer zweiten Schale Grund; Die zweite gibt, sie wird zu reich, Der dritten wallend ihre Flut, Und jede nimmt und gibt zugleich Und strömt und ruht.</p>	<p>High soars the jet, – then falls and fills a bowl of marble to its bound, which yields; – the rippled surface spills into a second stony round. This second overflowing urn then fills a third, – its surface sways; and each one takes and gives in turn, – and flows – and stays.</p>

Figure 1: (a) Poem by C.F. Meyer [2], (b) translation by C.H. Séquin.

The Cantos

In this paper, the *Cantos*, inspired by Nabokov's book [4], rather than graphical illustrations, provide some imagery to enhance the discussion of the philosophical issues raised. At the last moment, I decided to deviate from Nabokov's organization in which all commentaries are presented after the cantos. I found, in both instances, that the cantos were difficult to interpret before the commentaries had been read. Thus, here, I put the relevant commentaries next to the respective cantos.

Energetic Jet Fountain

Canto 1 describes a more energetic fountain than the Roman fountain in the classical poem by C. F. Meyer. This seems more appropriate when considering the violence of the Big Bang, and it gives the opportunity to form a wider variety of ephemeral water patterns. (Another model will be introduced in Canto 3.) The fountain I was observing on Sunday July 23, 2000 in the garden of the Bruegglinger Hof in Basel, has a powerful central jet that cuts through the masses of water on its downward path. The interplay of the rising beam and the falling sheets of water yields a more chaotic process than the staid calm picture of the Roman Fountain, and thereby creates much more fractured forms as well as a lot of splatter.

<p>Upwards soars a silver jet of liquid substance, blue and wet, a central column, fanning out in many branches from the spout; then spreading into fragile sheets and stretching into strings of beads. The sculpture has suspended state, then must revert, – disintegrate.</p>	<p>The lattice carved from silver streams is punctured by the rising beams; it twists and spreads and breaks apart, – a million drops are flung afar. They travel high and wide through space, then fall to earth in many ways, in soaring arches reach the ground, retiring in the fountain's pond.</p>
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Canto One: Energetic Jet Fountain

The View From Within.

As I was watching the interplay of the rising jet with the sheets of down-falling water, I was fascinated by the many different forms that were generated in an endless string of ever-changing patterns. Every now and then, some tiny droplets of water got flung far away and landed on my face. I was wondering what it would be like to experience the ride from inside one of these droplets on a timescale that compressed a whole lifetime into the few seconds it takes the droplet to travel through the air. Canto 2 takes a look at the inside of such a water world. It raises the notion that there may be life inside some of these water droplets and explores what it might be like to travel along with such a droplet.

In the second verse, the time scale is changed again. Now each droplet is viewed as a whole universe. An individual universe comes into existence with the separation of the droplet from the main jet, and it ends when it disappears in the pool at the base of the fountain. The seconds in the existence of a droplet are equated with the live of a universe from its “Big-Bang” beginning to its eventual demise. An interesting philosophical question is, whether the inhabitants of such a universe can be aware of the existence of the other universes.

<p>The liquid arch is more than H₂O, a mixture rich in mud and life. Each drop, a tiny world of goo, enjoys a parabolic ride. Within each flying cubby-hole, what views they might behold! But <i>can</i> they see beyond their drop, and recognize the fountain top?</p>	<p>Use a scale much more constrained: each drop defines a universe. Life, completely self-contained, knows nothing of the drop’s traverse. <i>Alone</i> each world must take its ride. Perhaps there is some life inside, that marvels why it does exist; – perhaps, it’s just a drop of mist.</p>
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Canto Two: *The View From Within*

Fireworks Analogy

The fountain in Meyer’s poem, or any fountain for that matter, seems like a model for a steady-state universe; the overall shape and flow of water stays more or less the same. There now exists strong evidence that there was an original Big Bang and that our universe will be expanding forever. With the recent discovery of a dark force that seems to overpower gravitational attraction [6], it seems most likely that our universe will spread out indefinitely and will end in a dark and cold state. Such a fate may be more appropriately represented by the imagery of fireworks that start with hot and intense action and then fade into puffs of smoke in a dark sky.

Again, one can try to see each little pellet of explosive power as a traveling space ship, or perhaps a whole star system or an even larger part of our universe. One can then ponder the question what the surrounding environment might look like from such a traveler’s point of view. As in the water world of Canto 1, an interesting question is how far one might see from one of these mini-worlds, and to what degree a traveler can understand the surrounding “machinery.”

<p>A sizzling plume of smoke and fire, billows high into the night. A blinding flash atop that spire makes blazing suns of brilliant light. Whirling patterns, shooting stars, different colors fight their wars; expanding, dancing fire rings, whirl away on smoking wings.</p>	<p>Countless pods of fire power crisscross the chaos in the sky, exploding too, just moments later, creating one grandiose display. Each tiny rocket is a barge among a thousand points of light, coasting through the void at large; – dying cinders fill the night.</p>
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Canto Three: *Fireworks Analogy*

Structural Evolution

These verses hint at the formation of stars and planets, and the formation of geological structures as well as complex molecules and biological structures. (Of course I did not attempt to describe all of evolution in Canto form!). The really interesting questions here are of a more philosophical nature. Can structure and complexity emerge without the guiding hand of a designer? There are several other issues that should also be addressed in a critical discussion.

<p>Swirls of dust and whirls of gas, clusters form, attracting mass. Space is warped and forces rise, drawing clumps to their demise. Pressure mounts, let's atoms fuse. Some glow emerges, – first diffuse. A point of light – a fire ball, exploding fast, devouring all.</p> <p>A spreading, whirling, broiling mass of thinning dust and heated gas; cooling drops of molten stone in circling orbits all alone. Comets crash – evaporate, bring ice and water to the plate. Sun and ice attack the crust, grind the stone to sand and dust.</p>	<p>A puff of wind – a few grains move, another puff – they form some mounds; a few more blows to form a groove, and further ridges, and their bounds. Dunes and valleys, mountains, canyons, all channel water into flow that carves away eroding bastions, forming caves in rock below.</p> <p>Glaciers grow and then retreat. Volcanos burst in giant plumes, lightning strikes, producing heat, mixing gases, blending fumes. Atoms dance and build new matter, joining pieces in a ladder; a twisted double helix strand lets life begin and make a stand.</p>
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Canto Four: *Structural Evolution*

Discussions

Design versus Meta-Design. Rather than spending 100% of an engineering team's efforts on the design of a desired artifact, one may devote a part of the available design resources for the construction of tools that make the design of such an artifact easier. Examples are: layout, testing and debugging tools for the construction of very large integrated circuits; the construction of an assembly line in the automotive industry. In the extreme this may result in systems that automatically produce the desired artifacts from a given set of parameter values. Examples from my personal experience are: modules to produce optimized logic circuits [7]; or *Sculpture Generator I* for prototyping Scherk-Collins toroids [8].

Structure from Chaos. Given an initial chaotic high-energy state of some plasma, where did the structure come from that we observe today in our universe? Where is its design plan? Is it necessary to have one? Given a large enough system, enough energy, and enough time, a chaotic sea of particles may arrange itself in such a way as to show some higher-level structure. Examples are: wind over desert forming sand dunes; wind over the sea forming waves; the waves near a sandy beach forming rippled patterns in the sand; paperclips hooking together in a box that is being shaken; small molecules lining up to form larger ones. If the internal physical conditions for a universe are just right, matter may form; a rich and varied set of elements may be produced; life may develop; consciousness may emerge, reflective, analytic, scientific thinking may appear, and eventually these beings will observe their home universe and ponder the philosophical issues of their existence.

Evolved Forms versus Engineered Designs. Well-engineered designs have a minimum of waste. Unnecessary features are pruned away to save material and fabrication costs. Evolved (life) forms often show appendices whose functions are not apparent and which may be the remains of earlier evolutionary phases. Examples are the appendix in the human digestive system; the (useless?) base pairs between the genes in the our DNA; unused blocks of code in large software systems; and – perhaps – the many star systems that do not carry any life forms at all.

Artifacts that “Survive.” How do we recognize intelligent designs, e.g., artifacts crafted by human beings a few thousand years ago? Primarily, because they exhibit shapes that are not likely to be produced by random effects. Examples are: small human figurines carved into stones and bones; the highly symmetrical pyramids built by many different cultures. (as an aside, we may ask ourselves, what “art objects” produced today will survive the next ten thousand years and will still be recognizable as designed objects rather than accidental shapes and constellations? Some of today's minimal paintings or installations seem to have little chance for survival – at best they may be interpreted as unfinished construction sites.) For those objects that we recognize as deliberate constructions, we are then likely to marvel at their symmetry, clever capture of some traits of nature, or ingenious working-together of individual components. Less well designed artifacts go unrecognized, unappreciated, and un-critiqued. A possible naïve conclusion may then be that all art objects produced by such an old culture may have been master-pieces.

Anthropic Principle. At the level of a whole universe, this leads to the weak anthropic principle. Only in a universe that has suitable physical laws and a suitable chemistry to create life, and a suitable biology to create intelligent conscious beings can the question be asked: “Where did all this come from and why is it the way it is?” These beings will then, of course, observe a very well “engineered” universe and may marvel about the greatness of its design. The less successful universes will go unnoticed and will not be criticized.

Attempts have been made to give humans an active role in closing the feedback loop to select – or rather, to define – “good” universes out of the spectrum of all possible universes [9]. All possible universes are declared to exist in an infinite set of overlapping quantum states. Through the power of our own observations, the wave function is then collapsed to exactly the kind of universe that allows life and fits us best. Unfortunately, there is no evidence whatsoever that such a mechanism actually exists!

Conclusions

The questions I have touched on can have no provable final answers. There is always a need for an initial act of creation or some creative entity for which we cannot state with certainty how it came into existence in the first place. The only way to “know” the truth would be through personal inspiration or religious beliefs.

With this essay, I wanted to point out that we have a wide range of choices for the nature of the initial creative act and for its underlying “design” effort. One’s personal preferences will depend on the environment that one grew up in and on the religious and philosophical influences that one has been exposed to. We may choose to see many instances of a very sophisticated design in the construction of our atoms and chemical elements and in the processes that enable and propagate life. However, as we get closer to the limits of our knowledge, we will always be frustrated by a lack of understanding of what lies beyond. Our inability to understand the underlying core design neither should be used to “prove” the existence of a very sophisticated design by a superior entity – nor the absence of any design at all. Again, depending on one’s background and upbringing, one or the other philosophical model may appear more comforting. The latter model may appear simpler and thus preferable, and it may be more easily describable without any internal inconsistencies. However, it still requires some creative act and a dose of meta-design to set up a generator that produces those countless numbers of universes.

If it looks plausible to you, the reader, that the original creative act consisted in setting up something like a “Fountain of Creation” alluded to in these pages, you may then let your imagination run free to contemplate the basic nature and the space-time shape of this fountain. Many participants of this conference will probably favor a recursive, self-similar structure – possibly fractal in nature – which readily may lead to the notion of “universes within universes.” And some of these universes may in turn contain their own fountains of creation...

I am looking forward to interesting discussions at the conference.

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