Design Argument 2.0: The Engineering of Inner Space

Dr. Curtis Hrischuk
Ratio Christi
hrischuk@gmail.com

and

Dr. Fazale 'Fuz' Rana
Reasons to Believe
apologetics@reasons.org

Abstract: An intuitive argument for the existence of God is the Design Argument. This is an argument by analogy: that a Transcendental Engineer is the explanation for the well-designed Universe and various biological systems. Unfortunately, criticisms of this argument have caused it to be largely ignored today. This paper reformulates the analogical design argument to address these criticisms and make it more current. Instead of focusing on outer space and large biological entities, it centers on the microscopic inner-space of the simplest cell, developing a new analogy called "The Space Station LLEC". This analogy is buttressed by recent scientific research, as well as quotations from hostile scientific witnesses which support the view that the inner workings of the cell are well-engineered. The analogy is purposely given in a form that is understandable to the lay person.

1 Introduction

An airplane is a well-designed machine that is engineered by a fleet of engineers. Similarly, the Universe looks like a well-designed machine which implies that there is a Designer. This inference is commonly known as the "Design Argument" or "Teleological Argument." The earliest published version of this argument arose in 1802 when the Anglican natural theologian William Paley proposed an analogy which took the form of a parable, known as the *Watchmaker Argument*. The parable begins with a walk in the woods. Suddenly you stub your foot on a Rolex, diamond studded watch. Comparing the aspects of the watch with a stone, we find

> "that when we come to inspect the watch, we perceive—what we could not discover in the stone—that its several parts are framed and put together for a purpose, e.g. that they are so formed and adjusted as to produce motion, and that motion so regulated as to point out the hour of the day; that if the different parts had been differently shaped from what they are, or placed after any other manner or in any other order than that in which they are placed, either no motion at all would have been carried on in the machine, or none which would have answered the use that is now served by it.

> This mechanism being observed…the inference we think is inevitable, that the watch must have had a maker? that 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. [Paley]"

The Watchmaker Argument asserts that the purpose of the watch, evidenced by its intricacy, implies the mind and activity of a watchmaker. Then the same inference can be drawn that there is a Universe Maker, a Designer, because the Universe and the biological systems it contains, are far more complex and purposefully organized than a watch.

This argument by analogy has suffered through the years from neglect because of criticisms that have been raised by skeptics. One criticism is that there is only one Universe to compare with so it is not possible to assess how strong the analogy is. Another criticism is that analogies eventually break down so it is uncertain how to measure the strength of the argument. Perhaps the argument is weak because it is a weak analogy between a watch and nature?

Recently, the design argument has resurfaced in a different form known as the *Inference to the Best Explanation* (IBE), structured as a fine-tuning argument. Specifically, the Universe exhibits extreme fine-tuning, from the quantum through cosmological levels, and the best explanation for the fine-tuning is that it is designed. Although this approach has much merit, with new fine-tuning aspects being discovered, it loses persuasiveness because a lot of material must be covered to see the full breadth of the fine-tuning. There is no narrative to make the fine-tuning position easily accessible. A parable is needed to provide an easily grasped, intuitive, defensible analogy which can also incorporate the IBE position.

There are many occurrences where the power of a parable has altered cultural views. The power of a parable that resonates is strong. One needs to consider the impact of Antony Flew's missing gardener in *Theology and Falsification* [Flew] to understand that power. Similarly, Swinburne and Leslie have used a parable to explain how the anthropic principle and multiple universe hypotheses do not undo the fine-tuning argument [Swinburne].

A good place to start to construct a design argument parable is that of *Undirected Evolution*:[1] The whole of our experience is that complex things break into smaller parts, yet *Undirected Evolution* says that simple things become more complex and efficient.

There have been significant advances in the biological sciences in the last several decades which genuinely appear to be beyond the reach of chance but within the grasp of

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[1] The term "Undirected Evolution" is used here to refer to what is commonly referred to as neo-Darwinian Evolution. This phrase is chosen to highlight the purposeless, random nature of the evolutionary process that is not exposed by the current title, or that of the premises. For example, "Natural Selection" is really "Chance Selection" since Nature selects by chance activities. Think only of the most advanced ape being born in Africa only to die due to a brush fire, drought, a hungry lion that wanders by, etc.

biological engineering. This is not a new observation for Sir Francis Crick, co-discoverer of the genetic code, wrote: "An honest man, armed with all the knowledge available to us now, could only state that in some sense, the origin of life appears at the moment to be almost a miracle, so many are the conditions which would have had to have been satisfied to get it going. [Crick]" This comment was made thirty years ago when our biological knowledge was in its infancy. The case has only grown stronger for a "miracle." In essence, the parable moves from outer space (i.e., the Universe) to that of inner-space (i.e., the cell).

This paper is structured around a new parable which is the focus of the analogical argument. The parable is presented next, followed by a discussion about the strength of the analogy. Finally, a summary is given.

2 The Space Station LLEC Parable

A parable illustrates a simple truth that can be intuitively grasped. The parable for our purposes is:

> You wake up one day to find yourself on a space station called "LLEC". By your side there is a box that is labeled "Answer Box". You decide to give it a try. "What is the shell of the space station made of?" The answer is "An extremely thin wall that adapts to be maximally strong based on external conditions."
>
> Looking out a portal window you see that material is being docked and allowed into the station. You also see that refuse is being removed from the station. Machines that look like trains are taking the new material in and pushing the refuse out. The machines appear to be on tracks and able to handle loads of varying weight, managing the large loads by shifting transmission gears.
>
> Walking along you see several huge mechanic machines. Suddenly, a message rocket flies into the side of one mechanic and it begins making a second machine. Parts are provided to the mechanic by a flurry of part machines. This new second machine then sets about doing some work. Another rocket flies into the side of the mechanic and it proceeds to make a third machine. The third machine begins to do work, wobbles, teeters, and then veers off. Suddenly a police-like machine tags the errant machine. A disassembly machine appears, grabs the malfunctioning one, disassembles it, and provides its pieces to the mechanic. You ask the Answer Box "What happened?" It replies that "The mechanic receives messages to build different machines for different purposes. These messages have strict quality-control standards on them and so do the constructed machines. The environment can detect if a faulty machine is built."
>
> To your left there appears to be an assembly line to manufacture various other machines. At the end of the line is some sort of delivery apparatus that tweaks new machines and delivers them to locations in the space

station. As you continue walking along you just about step on a sanitary machine that scoops up some goop on the floor.

There are several power plant machines to your right. They take material in and produce energy batteries for use by the other machines. "Is there some sort of software that runs these machines?" you ask. The Answer Box replies, "Yes, let's go to the information center."

While walking, you ask, "What does the space station do?" The answer is "It carefully creates copies of itself by meticulous manufacturing processes." At the information center you see 23 very dense looking memory boxes. The Answer Box continues: "The information center's software data is 4.3 billion bits of information, about 1 CD ROMs worth of material. That software data controls the entire behavior of the space station. This is more software than in the original Microsoft XP. The information is stored using specialized compression techniques as well. From this information, the messages for the rockets are constructed. In some cases, a computer program (#1) created from this data will use additional data to create another computer program (#2) that finally creates a message rocket. In essence, a computer program in the data writes another computer program."

It continues: "Copying portions of this information to create the machines would be very error prone, except for the exceptional quality-control mechanisms. First, the information is stored in a format that minimizes errors, using a specific code with parity bits. Second, the message rockets go through several checkpoints during their construction to check for errors. Then the message is proofread and corrections are added, if needed. Fourth, final checks are done just before the rocket leaves the information center. This quality-control is important because message rockets can carry messages for 3 or 4 machines and these machines all need to run perfectly. The error rate is less than 1 bit error for every 10,000,000 bits read."

Finally you ask, "How did this marvelous structure come to be? Who designed this amazing space station?"

The Answer Box replies "It is a fortunate accident. It came about by chance processes with no apparent purpose."

Surely the reply given by the Answer Box seems strikingly over simplistic. Would you believe the Answer Box, that this space station is an accident and not well-engineered? What is the evidence that it is an accident? What is the evidence that it is well-engineered?

Perhaps the Answer Box is possibly believable. What if the engineering feat were a little more challenging? Let's say the space station was shrunk to one micrometer, about the size of a human hair. Surely that would be an impressive engineering feat.

> Still, let's up the difficulty level again: do not build the shrunken space station using metals, plastics, or any other normal construction material but only use biological material which easily degrades, reacts with external chemicals, and can be destroyed by sunlight or the presence of oxygen.
>
> Now, what reasonable justification is there that a "shrunken space station made of biological material that is the size of a human hair" is not well-engineered?
>
> By the way, the space station LLEC is really the "cell". The Answer Box is "the sciences."

This concludes the parable.

3 How Strong is the Analogy?

Using an analogy to make a point is not without some concern or danger. These types of arguments are insightful, punching through details to surface an underlying layer of truth. There are rules for judging the weight of such an argument and they are discussed next. However, it is first worth examining a quote from Bruce Alberts, who was the long standing President, National Academy of Sciences (not a friendly organization to Creationism). Dr. Alberts introduced an entire journal issue that was dedicated to discussing the machines of the cell with [italics added for emphasis]:

> "Indeed, the entire cell can be viewed as a factory that contains an elaborate network of interlocking assembly lines, each of which is composed of a set of large protein machines. …
>
> Why do we call the large protein assemblies that underlie cell function protein machines? Precisely because, *like the machines invented by humans* to deal efficiently with the macroscopic world, these protein assemblies *contain highly coordinated moving parts*. Within each protein assembly, intermolecular collisions are not only restricted to a small set of possibilities, but reaction C depends on reaction B, which in turn depends on reaction A—just as it would in a *machine of our common experience*.
>
> Given the *ubiquity of protein machines in biology*, we should be seriously attempting a *comparative analysis* of all of the known machines, with the aim of classifying them into types and deriving some general principles for future analyses. Some of the methodologies that have been *derived by the engineers who analyze the machines of our common experience* are likely to be relevant. [Alberts]"

There are some key points to draw from this quote. First, the quote was the impetus for some of the LLEC analogy's elements. Second, he says that the proteins are just like

machines invented by humans. Third, these protein machines are ubiquitous -- they are everywhere which militates against the notion that the design argument has few examples. Last, and most important, he says they are analogous engineering structures found, and expected in the future, between the machines human engineers create and those that exist in the cell.

There are rules for judging the weight of such an argument which have been clearly delineated by logician Patrick J. Hurley [Hurley]. The judging criteria he suggests are the first six items below and we add the last item:

1. Properties being compared must be relevant to the conclusion;
2. The greater the number of similarities the greater the conclusion's validity;
3. The greater the number of individual comparisons the more probable the conclusion;
4. The greater the diversity of things being compared the greater confidence about the conclusion;
5. Counter analogies, the characteristics that argue against meaningful comparison, need to be considered;
6. Disanalogy is important; comparing those things that make the compared items different and distinct; and
7. To stay relevant the analogy should grow stronger with time or, at the very least, not grow weaker.

The first four items are covered by the details of Table 1 which itemize and list the manner in which the analogy maps onto the biology of the cell. The "Space Station LLEC" analogy compares 17 different properties, with 20 individual comparisons. It has 37 similarities to the cell: 20 comparison items and 17 properties. There is a wide range of diversity in the things compared. More properties or comparisons can be added easily.

Analogy Component	Cell Component	Description
Space station wall	cell membrane that is 7 to 10 nm thick	The cell (plasma) membrane creates a protected environment inside the cell. The plasma membrane actively regulates the flow of materials into and out of the cell using protein machines that operate as pumps and conduits. Receptors in the membrane inform the cell's machinery of changes in the environment.
Machines	proteins	Large molecules made from amino acids. These molecules carry out machine-like processes necessary for the cell to operate
Train motors (including those with transmissions)	Dynein, myosin, and kinesin	Protein machines literally employing lever arms, ratchets, and gear-like mechanisms ferry cellular cargo along tracks inside the cell.
Mechanic machine	ribosome	The ribosome is a gigantic molecular machine made up of proteins and RNA that manufactures proteins in an assembly-line process.
Rocket	mRNA (messenger RNA)	mRNA is a chain like molecule that carries information from the information center of the cell (nucleus) to the Mechanic machine (ribosome) to be used by the cell's machinery to make protein machines.
Part providing machines	tRNA (transfer RNA) and translation factors	These biomolecules bind and ferry the appropriate amino acids to ribosomes for assembly into protein molecules.
Police like machine	Lysosomes, proteosomes	Proteosomes are large protein machines that destroy other defective protein machines. Lysosomes are organelles that ingest larger debris particles inside the cell and break them down so that their components can be recycled.
Assembly line	Endoplasmic reticulum	The endoplasmic reticulum is a network of membranes that contain an internal channel where proteins are processed and prepared in an assembly-line fashion for incorporation into the cell membrane, secretion into the extra-cellular environment or packed into membrane bound organelles like lysosomes
Delivery apparatus	Golgi apparatus	This organelle receives proteins from the endoplasmic reticulum and packages them so that they go to the correct cellular or extra-cellular location.
Sanitary machine	Peroxisomes	These organelles contain proteins that oxidize

Analogy Component	Cell Component	Description
		cellular debris, cleaning up the cell's interior.
Information center	cell nucleus	This large organelle houses chromosomes which contain the information needed to make protein machines. It also contains the biochemical machinery that regulates the production of the protein machines and regions that make key components of ribosomes which, in turn, are the machines that make protein machines.
Memory box	Chromosome	This protein DNA complex efficiently and compactly packages DNA inside the nucleus. The proteins that are part of the chromosome help regulate the access that a cell's machinery has to the information stored in DNA.
Software data	DNA	This molecule harbors information the cell's machinery needs to make proteins. It also contains information that controls the access that biochemical machinery has to the information.
Data	Extron	The piece of the DNA molecule that harbors instructions on how to make a specific region of a protein machine.
Software program 1 writes software program 2	spliceosome and introns	These regions of the DNA molecule (introns) are variably excised by the spliceosome and spliced together to form a variety of protein machines from the same region of the DNA molecule.
Compression	overlapping genes	Some of the information needed to make protein machines exist within the same overlapping regions of the DNA molecule
Storage format	genetic code	A set of rules that translates the information housed in DNA to information used to make proteins. These rules are highly optimized.
Rocket with 3-4 messages	polycistronic mRNA	mRNA that harbors information to make several protein machines. The information is harbored successively within polycistronic mRNA and codes for protein machines that work together to carry out a specific cellular operation.

Table 1: List of Analogies for the Space Station LLEC Analogy

Due to space constraints, the other judging criteria listed above, are just touched on here. The greatest analogical difference between the space station and the cell (i.e., *disanalogy*) is that the LLEC Analogy is too simple, since a cell has thousands of other protein machines which were not listed. This actually works in favor of the analogy.

Counter analogies are typically given as examples of "bad design", since a Transcendental Engineer should not produce bad designs. However, history has shown that what is often held up as a "bad design" is really a design that has many different trade-offs for the best overall function within a vast and changing environment. Usually new information or a higher level, macro examination eliminates the charge of a "bad design." Last, the analogy is expected to grow stronger as new scientific research uncovers new, highly advanced, integrated life-support systems of the cell.

Several criticisms of the analogical design argument are dispensed with next. The first two are Elliott Sober's review of Hume's views in *Dialogues Concerning Natural Religion* [Hume]. The third is that of Sober himself. The fourth is Robert O'Connor's [O'Connor] review of J.L. Mackie. They are:

1. *The analogy argument is supported only very weakly by its premises because the degree of similarity of organisms and watches is small.* This is addressed below.

2. *The design argument does not establish the attributes of the designer so the designer remains unknown.* The intent of the design argument is to show that God exists. Additional arguments can be used to add to the list of attributes. The Kalam Cosmological [Kalam] and the Ontological arguments [Ontological] are just two of many.

3. *A design cannot tell us what a transcendent Designer would be like since our inferences of a human designer do not apply to a Transcendent Designer.* This counter claim does not invalidate the design argument but only points out that all of Natural Theology's arguments for the existence of God need to be considered to form a coherent and comprehensive understanding of that God.

4. *A design argument requires that the order which supports a claim of design cannot be found in things that are known to not be designed.* This objection does not apply to the analogy because it is extremely difficult (perhaps impossible) to differentiate designed from non-designed characteristics within biological systems: the design argument includes the genetic code, chemistry, the information content, etc. Of course, if one presumes that there is no design then the objection reverts to a tautology and a fallacy. Also, it seems disingenuous to require this when man uses examples from nature as the basis for an engineering design. For example, if there were no birds or bats would the airplane wing have arisen?

The first objection above is negated because the biological objects being discussed do not simply appear to be like machines, software, motors; but they are in fact those very things. The prior quote from Bruce Alberts made this clear: he suggested finding biological motors and machines by using known engineered motors and machines as templates.

Let's take another approach and consider if it were our job to create a biological machine like a ribosome. We would adapt the existing ribosome to our needs and not start from scratch. Alternatively, the ribosome would be reverse engineered and then improved. Even if we started with no prior design and invented a ribosome, in each case, the

ribosome would be designed and would be indistinguishable from the ribosome found in nature. **If this is so, what criteria distinguishes the ribosome as a non-engineered entity if it is equivalent to one that is engineered, or the basis for another design, or a better engineered system than what we can achieve with available technology?** Simply put,

> "Biomotors and machines are not explanatory analogies. The motors and machines described in this chapter are motors and machines by definition. And, because machines stem from the work of a designer, these molecular-level machines must emanate from the work of an Intelligent Designer. The strong, close, and numerous analogies between biological motors and man-made devices logically compel the conclusion that these biomotors, and consequently life's chemistry, are the product of intelligent design. [Rana3]"

So, the reverse question must be answered by the skeptic, "What is it about these biological machines that should force us to consider that they are not 'machines'?"

The manner in which the individual machines co-operate to provide necessary life-support functions has the characteristics of engineering foresight: constructing individual building blocks which each have a specific function and then orchestrating them to satisfy a much higher level function. In particular, there are problems which are of the chicken-and-egg type, expressing a mutual dependencies between components that require all the components to simultaneously arise. For example, in the analogy, the life-support function is dependent upon the mechanic machine, part providing machines, rocket, and the software data all being simultaneously available and operational from the very genesis of the life-support function.[2] If there are no machines for reading and operating on the data then no machines are built. If there is no software data then no machines are built. But, the mechanic machine, part providing machines, etc. are themselves machines that need to be constructed from that very same software data.

How could this arise in a piece-meal fashion since there is mutual dependence? This is a circular conundrum whereby the machines and their pre-programmed co-operation (i.e., software data) must exist, be operational, be co-located, work in distributed synchrony, **all at the same instant**, for the life-support function to work. The similar process in a cell, (called *transcription* and *translation*) is even harder because it depends on other machines (key enzymes) to speed up chemical reactions so that the manufacturing process works. These enzymes are also machines that need to be constructed from the cell's software data. There are many chicken-and-egg problems which must be solved for the various life-support systems of the cell to function. The reader is referred to [Rana2].

Another point, emphasizing a major strength of the LLEC analogy, must not be overlooked. The machines and their pre-programmed co-operation (i.e., software data) must exist, fully-assembled and operational, be co-located, and work in distributed synchrony, **all at the same**

[2] Some critics may try to argue that a partial life-support function may provide some potentially beneficial survival capacity. This is not plausible with our scenario since a half a life-support system is really no life-support system at all.

instant, for the life-support function to work. The space station hull must be complete, protecting operations from the harsh environment (e.g., vacuum) of space. The "assembly line" must be functional, creating the machines to create other machines which manage station functions. The software, needed to boot the system and regulate its operation, must be in place – and must be monitored for quality-control by other software to detect and eliminate programming errors. Software is written in an executable computer language (a set of pre-determined symbols which define operations) which needs to be purposely pre-formulated for encoding the necessary coordinated operations of all the life-support systems. Again, these **space station life-support systems must be constructed, available, self-healing, and operational at the same time or the space station is not viable.**

In comparison, the cell has this same holistic quality: everything must be assembled, operational, and programmed properly or the cell cannot maintain its various life-support systems. The protective cell wall must be fully formed, with the necessary doorways for material to move in and out. The ribosome and supporting machinery must be assembled. The chromosome's information content (genes, introns, extrons, etc.) – i.e. the software program - must be available, as well as the many error detection and correction mechanisms. The genetic code serves as the computer language and it has no analog in physical nature since it is meta-information: a linguistic language which we only find associated with intentional forethought and engineering. **All of these things must coexist, be operational, and work together properly the first time or the cell's life-support systems fail.**

Clearly, this simultaneity of the occurrence of function speaks not only of a well-engineered product (i.e., the cell) but that the manufacturing process of that product must be well-engineered.

4 Summary

Why is the Universe tailored to support the existence of an advanced civilization? The design argument answers this by proposing that a Transcendental Engineer, who exists outside our physical dimensions, carefully engineered everything. Typically, this design argument uses an Inference to the Best Explanation strategy to explain the fine-tuning apparent in nature. This paper adds an analogical argument based on the engineering of the simplest biological cell, where the cell is compared to and shown to have many similarities with a space station.

This argument is not based on ignorance but on recent scientific data. As science uncovers more complexity and inter-dependencies in the cell, we predict a strengthening of the analogy.

Having shown how the biological machines in a cell are machines, the reverse question must be answered by the skeptic, "What is it about these biological machines that should force us to consider that they are not 'machines'?" We await a reply.

When looking at the cell holistically, we challenge the skeptics to produce an explanation why simple things should naturally become more complex. During my everyday life, I observe that complex things decay into smaller, simpler things. It is entirely unclear why it should be considered that simple things (e.g., chemical molecules) should grow into extremely complex things, such as a "*factory* that contains an *elaborate network of interlocking assembly lines*, each of which is composed of *a set of large protein machines*

[Alberts]", just by natural, chance processes. If this were so, we should be observing the generation of new life forms literally before our very eyes. We do not. We await an explanation.

The burden of proof has now shifted from the need to identify engineering in micro-biological systems (and by extension, macro biological systems) to identifying why these systems *should not be* determined to be engineered. We challenge the skeptic to elucidate clear criteria for identifying engineered (optimum or sub-optimum) components from non-engineered components. Without such a calculus the skeptic cannot withstand the charge of predetermined prejudice and bias.

There is a strong sense of engineering that is hard to escape.

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