The Irreducible Complexity Concept has *Not* Been Falsified

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(Draft)

Abstract

The concept of irreducible complexity and its importance in the origins controversy was reviewed. All functional systems that require two or more parts to function properly are irreducibly complex. Although the best examples of irreducible complexity are the chemical elements, common examples include all machines, such as gasoline engines, and all consumer electric equipment, such as computers. After the irreducibly complex concept was first discussed, objections to the concept such as co-option were considered. The author concluded by using examples of irreducible complexity in the non-biological and biological worlds that these objections do not falsify the concept.

Introduction

The concept called irreducible complexity has been discussed at least since Aristotle. All objects that *require* two or more identifiable parts to function properly, or function at all, are irreducibly complex. One of the clearest examples is the atom. All atoms are irreducibly complex because they require more then one subatomic particle to function as an atom. Remove an electron and an ion results, remove a proton and another atom always results, and remove a neutron and a different isotope results. To obtain a carbon 12 atom, 6 protons, no more or less, 6 neutrons, no more or less, and 6 electrons, no more or less, are required. One less proton and you have boron, one more proton and nitrogen results. An important difference exists between atoms (uncharged particles) and ions (charged particles). Chloride ions are necessary for life, and chlorine atoms produce a highly poisonous element used in gas warfare.

Quarks, bosons, and leptons are all fundamental particles, the simplest known physical entity possible, and only entities that require a *single quark* or *lepton* to function are *not* irreducibly complex (and if quarks are found to contain sub-quark particles, even this statement is not true). *Anything* that requires two or more parts in order to function properly is irreducibly complex which means that everything is irreducibly complex except quarks, bosons, and leptons.

For this reason, the only way to refute the concept of irreducible complexity is to demonstrate that all objects can be reduced to a fundamental particle and still function properly. If a radio, a functional eye or ear, can be achieved, for example, by a single quark (the particle scientists now believe is irreducible)—or all, of the functions of an intelligent human, including the ability to reproduce with other humans, can be produced by a single quark, they are not irreducibly complex.

Irreducible complexity and Life

Irreducible complexity has recently become a central idea in the origins controversy (Braun, 2005). To understand why, it is necessary to review the current evolutionary view of biological origins. The standard orthodox evolution theory postulates that multimolecular mechanisms, such as the human eye, or bipedalism evolved by the

> progressive accretion of ancillary proteins onto some rudiment or foundation that was functionally useful but need not have been an organ of motility. This amplification took place, one gene at a time, under the guidance of natural selection: each modification conferred at least a small selective benefit (Harold, 2001, p. 204).

The problem is that, although scientists can mentally "construct schemes that sound plausible and account, in principle, for the origins of crawling motility, mitosis or the secretory pathway," they "have no better alternative to offer the inquirer, and in the absence of time travel we may never discover what actually happened" (Harold, 2001, pp. 204-205). It is clear, though, that design appears to exist everywhere in the natural world and IC is a clear indication of design (French, 1988).

Many examples of the irreducible complexity concept exist in, both the non-biological and biological literature. For example, Kurland *et. al*. discuss “the irreducible nature of eukaryote cells” (2006, p. 1011). A cell, the most complex machine in the known universe, has been an excellent example of irreducible complexity since the field of cytology began. The term *irreducible complexity* was used by Katz to refer to structures in the natural world that cannot be

> reduced to smaller or less intricate predecessor components.... [T]hese patterns are, in a fundamental sense, irreducibly complex, and our particular model of the generation of the human figure is an example of a pattern-assembly system that is irreducibly complex (Katz, 1986, p. 27).

One of the earliest recent scientists to use the term irreducible complexity in this way was Oxford University professor Michael Polanyi who titled his article published in *Science* “Life’s Irreducible Structure” (1968, p. 1308). He writes that although physics and chemistry are “reducible to the laws of inanimate matter … living things are not” (p. 1310). Polanyi recognizes life as one irreducible example as are machines in terms of the parts they require in order to function.

Lehigh University professor Michael Behe in his best-selling book *Darwin’s Black Box* illustrated the enormous difficulties explaining the evolution of the thousands of nanomachines and systems required for living cells by gradualistic mechanisms through natural selection of variations caused by genetic errors or changes called mutations. He has documented that in order for both living and non-living machines to function, a certain minimum number of parts are necessary, a fact that Behe concluded was due to irreducible complexity. Removal of one more part than the minimum number required, and the machine (or organism) will no longer function properly—or will not function at all (Behe, 2005, p. 33).

Given this problem, it follows that a slow gain of new information is impossible because life cannot exist to reproduce for selection to operate unless—and until—it has a certain minimum number of parts. Paley used this fact as evidence for a designer in the 1800s (Paley, 2005). Darwin recognized that, in his words, “if it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down" (1859, p. 189).

The example Behe used to illustrate the irreducible complexity concept was a common household mousetrap, a machine that will not function unless it has a certain minimum number of parts. If it has one fewer parts than this minimum, it does not catch mice less well, it does not catch *any* mice (Behe, 2005, p. 34). If a mousetrap doesn't function, it will not "die," but if an animal's physiology function's below the level required to survive it can no longer live. The independent parts can function properly only within the whole functional unit, producing the "whole is greater then its parts" phenomena. Critics have tried to refute Behe's example by noting that one can discard the base and fasten the remaining parts to the floor, and the mouse trap will still function. For example, Ruse concludes that

> Behe's example of a mousetrap is somewhat unfortunate, for it is simply not the case that the trap will work only with all five pieces in place. For a start, one could reduce the number to four by removing the base and fixing the trap to the floor (2003, p. 315).

The illustration of irreducible complexity with this claim is that the floor now serves as the base, which is still required as a frame to which the parts must be fastened in order for the system to function. Furthermore, even if one can reduce the number of parts, this does not falsify the concept—it is falsified *only* if the system can be reduced to a single part and still function as a household rodent trap. Others argue that holes in the ground can also catch mice. Holes in the ground, though, cannot function as a conventional house mousetrap, nor are holes effective in retaining mice—mice can easily crawl or dig their way out of holes. Holes also do not provide a good illustration of the evolution of mousetraps because holes require a very different design than a mousetrap.

A better example may be Berlinski's example of irreducible complexity, a Dixie Cup, which consists of a tube joined to a disk (2009, pp. 143-144). Without the disk the cup does not hold less water, it does not hold any water. Without the tube the disk likewise can not hold any water. Thus the two parts, the disk and the tube, form an irreducibly complex system.

A mechanical example of irreducible complexity is a television system. The original first working television system *must* have had a functional camera, a way of converting light shade variations into electrical signals, a method of broadcasting the signals into the atmosphere, a transmission receiver system to pick up the signal, and a system to convert the broadcast signal into an electron gun signal so as to paint the picture on a fluorescent screen in a cathode ray tube.

The history of television's invention by Philo Farnsworth illustrates that this system is useless until every component has been invented and perfected to the level required to function, a task which Farnsworth spent much of his life achieving (Stashower, 2002). Likewise, life requires a certain level of complexity before it can live at all—and until life is alive, it cannot do the things that are required to live, including respirating and reproducing required to evolve.

Classes of Irreducible Complexity

Irreducible complexity can be divided up into an *irreducible core*, the parts in the system that, if one part is removed, the entire system will no longer function. For a clock, all of the parts needed for it to run make up the irreducible core. The non-core parts may include the crystal, the second hand, and the clock case. What the core consists of depends on the demands put on the watch. If it were used to accurately time a foot race, the second hand would be part of the core required for the clock's specified function. If the watch is used in wet environments, the crystal and case become part of the core.

The demands put on a system is also called its basic function. The basic function of any system consists of three elements: (1) what the system does in its natural setting or context is known as the system's primary or main function; (2) the least number of parts required for the system to perform adequately in its natural setting; (3) the manner in which the system performs its primary function is the system's *mode of function*. Because the basic operation of a system includes its *mode* of function, the basic function is concerned not only with *ends*, but also with *means*. For example, glue and nails can perform the same primary function of fastening together wood, and do so equally well in certain cases, but how they work is completely different. In one situation glue may clearly be superior, in other situations nails, and in yet others both may function equally well (Dembski and Wells, 2007, p. 147).

Use of Irreducible Complexity Concept in Research

The principle of irreducible complexity is used daily in biochemical labs throughout the world. An example is *targeted gene replacements*, commonly referred to as *knockout genes*. This research technique removes or disables a gene, then the results of its removal on the organism's functions are evaluated (Old and Primrose, 1994). We know that the gene is required if its removal disables the function of one or more structures, such as ATP syntase.

This research technique is used both to determine the function of a gene and to evaluate if the gene is required in order for a certain structure to function properly. Another research technique is to remove select base pairs from a gene to determine which bases are critical and what role each section plays in a specific gene. Yet another technique is to use gene modifications called "natural knock-out genes" to determine the function of a gene or a gene section. Morange notes that critically important information has

> been obtained from a vast number of studies of natural genetic mutations in both animals and humans, and on the targeted inactivation of genes—"knockout" experiments.... The harvest of results they have produced is ... these findings were often completely unexpected and sometimes even contradicted existing models (2001, p. 4).

The Minimum Requirements Necessary for Life

The simplest forms of life are single-celled bacteria, but many simple life-forms are parasites that live off other life-forms. Viruses are simpler than the simplest known cell and are actually lack the structures required to be alive. They are, in essence, gene machines that transfer genes from a container (the virus protein body) into a cell or from one cell into another cell. A virus can reproduce only when its genes take over the host cell's reproduction machinery. Nonetheless, even viruses require a minimum number of parts to function.

Scientific articles about cell design now run into the millions, and, to many observers, this research has made the naturalistic explanation of the origin of living cells increasingly improbable. A non-parasite, non-viral, life-form requires many billions of parts, all of which must be properly assembled together to all the life-form to live. If any central component of any one of the many systems required for humans, such as the circulatory system, is absent or dysfunctional, the result is usually death—this "is one of the basic tenets of modern medicine" (Glicksman, 2006, pp. 1-2).

The system of producing parts for life is like producing parts for any mechanical system such as an automobile. The parts must both fit properly with the other parts that are part of the system, including the attachment points, and the set required must be functional as a unit. Furthermore, the parts must be appropriately finished and maintained to achieve functional coordination with the rest of the car. The tools that assemble the part must also be compatible with the part, as must the tools and parts used to repair the car. At the least it must provide a survival advantage to the organism. Otherwise will be invisible to natural selection, thus unevolveable. If nonfunctional it will be labeled by ubiquitin, cut-up by proteases, and recycled.

Criticism of the Concept

Ever since Professor Behe popularized the term *irreducible complexity*, the concept has been extensively debated (1996). Although critics have been able to propose systems in which one or more parts than assumed required can be removed and the system still function, this does not negate the concept. Often removing a part or two results in the unit not functioning as well, but even if it does work as well, this means only that the number of parts required is one less than previously assumed. It is still irreducibly complex. To falsify the concept, it must be demonstrated that a fully functional machine or organism can exist, not with one fewer part—but with only a *single* irreducible part. Until then the idea of irreducible complexity is valid, even if the number of parts, for example, required in a factory made machine, such as a sewing machine, can be reduced by one few part and still function properly.

Another criticism is the chemical elements can form naturally in stars and supernovas by nucleosynthesis, but this fact does not argue for the view that life can also form naturally. The point is that the elements form by the attraction of the subatomic particles caused by their internal electrometric and strong nuclear forces. Like crystals, the chemical elements can self assemble naturally, given enough force to push the subatomic particles close enough together to allow the strong nuclear force existing in all protons and neutrons to take hold and keep the protons together. This example can be explained by natural forces, and has provided a model for how the molecules of life could assemble, a model developed by Kenyon and Steinman, (1969) which has now been falsified.

Co-Option

The most common attempt to refute irreducible complexity is a concept called co-option. Co-option is defined as evolution of organs and structures by selecting existing parts, such as proteins, and assembling them in a unique way to produce a new structure. An example the bacterial flagellum utilizes ten similar proteins that are also used in the type III bacteria secretary system. Miller concludes from this finding that "irreducible complexity is nonsense" (1999, p. 150). A problem is this "solution" merely defers the problem.

Irreducible complexity exists all the way down to the fundamental particles. If the machine parts were co-opted to produce a new structure, the new structure is still irreducibly complex. Because most of the parts in a television transmission-receiver system are used in other devices does not disprove the fact that a certain minimum number of parts are required in order for a television to function.

Furthermore, the existence of the parts in another system does not explain the origin of a functioning system because the proper *assembly* of the parts is critical. This requires the existence of an assembly system and the necessary scaffold proteins and enzymes to properly assemble the correct parts in the proper location at the correct time. Furthermore, each part must be manufactured to the correct specifications and in the required number, amount, and time. They must then be moved into the proper location in the *order* needed and the *time* needed. The many complex enzymes required to assemble the parts at the correct place, and at the correct level, are also all necessary. All of these parts, including enzymes and scaffold proteins, are also irreducible complex.

Co-option does not refute the irreducible complexity concept but also only defers the problem. Even if co-option has occurred, the machine and its parts being co-opted must have been irreducibly complex to have functioned. Cornell geneticist Dr. John Sanford notes that "each *part* has no value except within the context of the *whole* functional unit, and so irreducible systems have to come together all at once, and cannot arise one piece at a time." He adds that in the case of a mousetrap, even if all of the pieces are sitting neatly next to each other on the inventor's workbench, they cannot properly assemble into a functional unit by chance—or by any feasible evolutionary mechanism. They must first come together simultaneously as a functioning system in the mind of the designer.

It is in the realm of *mind* that deep complexity first exists and becomes integrated (Sanford, 2005, p. 133). The mind plan and design is as result of information. As Richard Dawkins notes, the "difference between life and non-life is not a matter of substance but of information. Living things contain prodigious quantities of information" (2009, p. 405). And the only known source of information is mind. This information must then be translated into the behavior that manufactures the parts to the specifications and assembles them to produce a functional machine.

Co-option, which is universal in the mechanical and electrical worlds, clearly implies intelligent design. When designing a new product, the engineer often selects parts from the millions that already exist to achieve the required function. These parts are then modified and utilized by intelligence, often by highly trained engineers, to function together to achieve a working unit. Selection of the best components for a new application is typically so complex that highly trained individuals called manufacturing representatives are required to help determine the appropriate parts from the large number of parts available that fit the customer's specific application.

An evaluation of machines designed by humans reveals that co-option is extremely common—many mass produced standard parts are used in a wide variety of electrical and mechanical contrivances. Common examples of standard generic parts manufactured for a wide variety of uses include fasteners (screws, bolts, cotter pins, and rivets) and micro-switches. Many reasons exist for this practice, including lower cost, design efficiency, and reliability. Producing fifty million of one type of micro-switch compared to five million each of ten different types greatly lowers the cost for each unit. Also, utilization of a proven design with a proven reliability record is preferred over a new design that may potentially be superior but lacks a proven documented history.

It is also far easier (and much more practical) to design equipment by assembling existing parts, which is how many electrical and mechanical devices first appeared on the market. The early VCRs were a conglomeration of a wide variety of standard parts obtained from many different sources. Re-engineering allowed the parts to be combined, requiring fewer and fewer parts until a modern VCR-DVD uses a fraction of the parts required in the original design (and also weighs only about ten percent of the original).

The evolution of parts *in situ* is much easier to visualize, and would seem to require fewer steps than co-opting a wide variety of existing parts from different locations in order to produce a new structure. Science starts with creative imagination to produce a hypothesis. One *can* visualize (although still a "just-so story") the slow perfection of the parts *in situ* in a structure to improve its performance. Selecting existing parts so as to construct a new system is not only evidence of intelligence, but a scenario or mechanism in which Darwinian evolution could select individual parts to achieve a specified result is difficult even to imagine.

The mechanisms that produce most mutations are well understood, but, conversely, mechanisms that can systematically rearrange existing structural parts in order to produce new functional structures (or just rearrange parts to produce a new type of structure) are unknown. Mutations can at times produce beneficial modifications, but it is difficult even to produce a just-so story to explain how a naturalistic mechanism could cobble different existing parts together by co-option to produce new functional structures (Sanford, 2005).

The only plausible known mechanism that could select existing parts to construct a new structure is transposition (commonly called jumping genes), which only shuffles existing genetic information around; it does not shuffle the design plans and guidance system required to properly assemble a complete functional structure from many different parts. Understanding how co-option could function in life requires an understanding of the assembly instruction system used in life and how it functions. From what is known about assembly instruction systems that direct the building of living bodies, no known way exists to allow individual parts to be reshuffled around during evolution so that a new functional arrangement would systematically be produced. Even if one existed, cobbling parts together would invariably produce a harmful or non-functional structure, not a workable system that aided in survival. The only known possibility is the Hox gene mutations that have so far produced only negative results. Abnormal development in life has always produced abnormal bodies, not better bodies.

The co-option theory is also very problematic because a cell is an enormously complex, highly interconnected system consisting of many billions of parts. For this reason, a single change can adversely affect many systems. This high level of inter-relatedness in life works against evolutionary advancement because even if a mutation improves the function of one part in a unit, it often will cause dysfunction (or less effective function) in other systems. This concept, called pleiotropy, is a major reason why a defect in a single gene can result in so many different, body changes. Many mutations result in a wide variety of different adverse effects, many of them seemingly having little to do with each other.

Pleiotropy is a major reason why all drugs, without exception, produce side effects. When developing drugs, a major reason why many otherwise-very-effective drugs do not make it to market is because side effects are too common, too serious, or too intolerable. Co-option does not change the fact that "there are presently no detailed Darwinian accounts of the evolution of *any* biochemical or cellular system, only a variety of wishful speculations" (Harold, 2001, p. 205, italics mine). Even if a system existed that could produce new organs or structures by selecting from the existing parts, it would in most cases produce damaging or lethal macromutations.

Some Darwinists have proposed that this problem could in part be solved if two complete sets of genes produced the same structure, allowing one set to be modified to evolve a new specific structure and the corresponding gene frozen to maintain its previous function. If this condition existed, the excess structures produced would likely be problematic. The only exception are polyploid plants. In this scenario mutational change would normally be selected against. This illustrates the major problem that we have identified, viz., how could the original arrangement have been produced without intelligent design?

Another problem is that no evidence exists for the evolution of any of the original parts that were supposedly co-opted to explain the origin of new structures:

> Among these great innovations in design, the crucial inventions of nature, the earliest have left no trace of their development in the fossil record. The organization of living material in a cell with a cell wall and a nucleus, the transmission of the blueprint of its design and its means of self-construction and the very important device of sexual reproduction, all developed in minute organisms which have left little evidence (French, 1988, p. 19).

The basic parts must first exist in order for co-option to occur, and until their existence is explained, it is premature to claim that co-option of existing parts, or the movement of existing parts around, can explain the systems that use those parts.

Menuge tackles the objection that irreducible complexity can be produced via exaptation by listing five problems with this theory. Exaptation is a concept that includes co-option and preadaptation, referring to the evolution theory that a protein which evolved to serve one function can subsequently be co-opted to serve another role. The five conditions would *all* have to be met to overcome co-optional-based explanations of the origin of irreducible complexity. These include

1. **Availability**: the parts must be available for recruitment to produce the new structure. For a flagellum, the parts capable of performing the highly specialized tasks include all of

> the parts required to produce the paddle, universal joint, rotor, and motor, Even if they all serve some other function, or no function, they *all* must be available to produce the minimum number required for the structure to function.
>
> 2. **Synchronization**: the availability of these parts would have to synchronized so that at some point, either individually or in combination, they are all available at the *same* time.
>
> 3. **Localization**: every one of these selected parts must be transported so that they are available at the same "construction site," not necessarily simultaneously, but at least at the time they are required for the proper assembly of the new structures.
>
> 4. **Coordination**: the parts must be properly positioned in space and time so they can be properly assembled. Even if all the necessary parts are all available at the proper time, the vast majority of ways of assembling them will be non-functional or, worse, dysfunctional. This coordination usually requires complex machines such as spliceosomes, ATPsyntase, DNA polymerase, or an assembly jig system such as ribosome.
>
> 5. **Interface compatibility**: the parts must be mutually compatible, that is "well-matched" and capable of properly "interacting" to produce the required function. In the case of the flagellum, even if the required parts are assembled in the correct location and order, they also must interface correctly during their operation (2004, pp. 104-105).

Another problem is that structures such as bacterial flagellum contain thousands of proteins; each one in turn contains a few hundred or more parts; and each gene that produces these parts has about 50,000 component parts (Sanford, 2005, p. 135).

Conclusions

This review shows that everything that is part of the so-called material universe is irreducibly complex except possibly the fundamental particles such as bosons (force carrying particles) and femions (the fundamental matter particles divided into quarks and leptons such as electrons and nutrinos). Therefore life is irreducible complex all the way down to the fundamental particles. Organisms, organ systems, organs, tissues, cells, organelles, organic molecules, molecules and atoms are all irreducibly complex.

The gradualist and co-option models of evolution are accepted because of philosophical constraints, not because of empirical evidence. As Professor Harold admits, evolutionists "reject, as a matter of principle," not because of evidence, "the substitution of intelligent design for the dialogue of chance and necessity" (2001, p. 205). This philosophical constrain prevents or hinders scientists from researching all possible avenues to explain the origin of life, including intelligent design. To fully understand reality, science must be free to explore all research avenues. The scientific evidence reviewed above also falsifies Judge Jones's legal conclusion that

> Professor Behe's claim for irreducible complexity has been refuted in peer-reviewed research papers and has been rejected by the scientific community at large (*Kritzmiller v. Dover Area School District Case No 04cv2688*, p. 79)

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