Easily the biggest challenge facing the ID community is to develop a fully-fledged theory of biological design. We don't have such a theory right now, and that's a problem. Without a theory, it's very hard to know where to direct your research focus. Right now, we've got a bag of powerful intuitions, and a handful of notions... but, as yet, no general theory of biological design.

Richard Dawkins

"Biology is the study of complicated things that give the appearance of having been designed for a purpose."

The Design Argument

Evolution couldn't have produced many of the structures in living cells because...

- these structures possess "irreducible complexity" (Behe)
- or
- these structures possess "complex specified information" (Dembski)

"Irreducible complexity is a special case of specified complexity"

David, No Free Lunch, 289

Touchstone Magazine 7/8 (2004), pp. 64

Paul Nelson

"The simpler the solution to a problem, the more intelligence and ingenuity it requires." (Mark Perakh)

- Intelligent design will result in simple, optimal, minimal, solutions to design problems.
- Unintelligent design will result in complex, sub-optimal, sprawling, redundant, solutions to design problems.

The MacGyver Principle

"Irreducible complexity is a special case of specified complexity" (Dembski, No Free Lunch, 289)

1996

1997
“Other than updating the list of my children in the Acknowledgements, there is very little of the original text I would change if I wrote it today.”


darwin.png

Charles Darwin

“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.”

“But I can find no such case.”

---

Michael Behe

- Claims that Darwinism cannot explain biochemical complexity
- “Irreducibly complex systems … cannot evolve in a Darwinian fashion”
- “Purposeful arrangement of parts” implies Design

---

Behe’s Neo-Paleyite Argument

- We infer design whenever parts appear arranged to accomplish a function
- The strength of the inference is quantitative and depends on the evidence; the more parts, and the more intricate and sophisticated the function, the stronger is our conclusion of design
- Aspects of life overpower us with the appearance of design
- Since we have no other convincing explanation for that strong appearance of design … then we are rationally justified in concluding that parts of life were indeed purposely designed by an intelligent agent

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Blood Clotting Cascade

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Immune Response
A Momentous Breakthrough

“The result... is a loud, clear, piercing cry of ‘design’. The result is so unambiguous and so significant that it must be ranked as one of the greatest achievements in the history of science. The discovery rivals those of Newton & Einstein, Lavoisier & Schrödinger, Pasteur & Darwin. The observation of the intelligent design of life is as momentous as the observation that the earth goes round the sun or that disease is caused by bacteria or that radiation is emitted in quanta” (233)

Michael “Call me Ishmael!” Behe

“[If random] evolution is true, there must have been a large number of transitional forms between the Mesonychid and the ancient whale. Where are they?”

Irreducible Complexity

“By irreducibly complex I mean a single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning. An irreducibly complex biological system, if there is such a thing, would be a powerful challenge to Darwinian evolution.” (39)
-testing-behe-is-difficult

He acknowledges the driving forces of evolutionary change:

- natural selection, genetic drift, founder effects, gene flow, meiotic drive, gene duplication, transposition ...

”The production of some biological improvements by mutation and natural selection – by evolution – is quite compatible with intelligent design theory.”

- i.e. design exists only when and where evolution cannot explain it

A biological trap

A mouse trap

Variation

Insectivorous Plants (1875)

“[The] six known genera... all capture insects. This is effected by Drosophyllum... solely by the viscid fluid secreted from their glands; by Drosera, through the same means, together with the movements of the tentacles; by Dionaea... through the closing of the blades of the leaf. In [this] last genera rapid movement makes up for the loss of viscid secretion... The parent form of Dionaea... seems to have been closely allied to Drosera, and to have had rounded leaves, supported on distinct footstalks, and furnished with tentacles all round the circumference, with other tentacles and sessile glands on the upper surface.”

Molecular Evidence Vindicates Darwin
“Features that strike us as odd in a design might have been placed there by the designer for a reason – for artistic reasons, for variety, to show off, for some as-yet-undetected practical purpose, or for some unguessable [sic] reason.”

“[T]here is no publication in the scientific literature – in prestigious journals, specialty journals, or books – that describes how the molecular evolution of any real, complex, biochemical system either did occur or even might have occurred.” (p. 185)

“Darwinists will not begin filling in plausible, testable scenarios for any of the irreducibly complex cellular systems.”

The Flagellum and ID

The flagellum ‘has a machinelike irreducible complexity, which is an empirical marker of design because it rules out step-by-step evolution through selection. Take one part away from the flagellum and its rotary system won’t work … its forty parts, all of them precisely shaped proteins, are prima facie evidence for an intelligence behind life, and the flagellum is just the tip of the iceberg. The cell is chock-full of such complex, multipart systems that continue to defy a step-by-step Darwinian explanation.’

Woodward, 2006, p. 11

Behe’s Logic

1. Observation: The cell contains biochemical machines in which the loss of a single component may abolish function.
2. Assertion: Any of these machines that are missing a part is, by definition, non-functional and leaves natural selection with nothing to select for.
3. Conclusion: These machines could not have been produced by natural selection.

Indispensable Bacterial Motor Parts

- 30* different protein parts ... for the motor’s structure
- 10* more protein parts ... for sensor and control circuitry
- 10* more protein parts ... to construct the motor

*These numbers may vary in different species of bacteria

Start with the 50-part bacterial flagellum. . . . And let’s take away 40 of the parts:

Leaving just 10. What’s left should be non-functional according to Behe.
“Any of these machines that are missing a part is, by definition, non-functional.”

Biochemical “Machine”
Individual Parts
Function Favored by Natural Selection
No function. Therefore, natural selection cannot shape components.

Biochemical System
Individual Parts:
New Functions Emerge from Combinations of Components
Components Originate with different functions.

The parts of the flagellum
Outside cell
Inside (cytoplasm)

Homologies of flagellum parts
Axial protein family
Type II secretion
Ion transport
Type II secretion
Signal transduction

Homologies of flagellum parts
Type II Secretion apparatus
F1F0-ATPase
Axial protein family
Type II secretion
Ion transport
Signal transduction
Number of peer-reviewed journal articles:

17

Out of these, the number that Behe has ever written about:

0

Creation of new copy allows evolution of new function while maintaining old function.

THE ORIGIN OF NEW GENES: GLIMPSES FROM THE YOUNG AND OLD

Gene Duplication in the Vertebrate Clotting System

Orange: Duplicates of core serine proteases.
Light Blue: Duplicates of the ceruloplasmin family.
Yellow: Duplicates of the transglutaminase family.
Dark blue: Duplicates of prekallikrein.

“We can look high or we can look low, in books or in journals, but the result is the same. The scientific literature has no answers to the question of the origin of the immune system.”

At Kitzmiller, Behe was presented with 58 articles and other books. His response?

“I am quite skeptical, although I haven’t read them, that in fact they present detailed rigorous models for the evolution of the immune system by random mutation and natural selection.”

Immune Response

At Kitzmiller, Behe was presented with 58 articles and other books. His response?

“I am quite skeptical, although I haven’t read them, that in fact they present detailed rigorous models for the evolution of the immune system by random mutation and natural selection.”
Leave the research to someone else

Q: And I’m correct when I asked you, you would need to see a step-by-step description of how the immune system, vertebrate immune system developed?
A: Not only would I need a step-by-step, mutation by mutation analysis, I would also want to see relevant information such as what is the population size of the organism in which these mutations are occurring, what is the selective value for the mutation, are there any detrimental effects of the mutation, and many other such questions.
Q: And you haven’t undertaken to try and figure out those?
A: I am not confident that the immune system arose through Darwinian processes, and so I do not think that such a study would be fruitful.
Q: It would be a waste of time?
A: It would not be fruitful.

William Dembski

"Behe’s challenge was not simply to find a Darwinian explanation for the origin of a biochemical machine, but to find a detailed Darwinian explanation for the origin of an irreducibly complex biochemical machine."


A Double Standard

"It’s not ID’s task to match your pathetic level of detail in telling mechanistic stories."

Eric Rothschild

"Thankfully, there are scientists who do search for answers to the question of the origin of the immune system. It’s our defense against debilitating and fatal diseases. The scientists who wrote those books and articles tell in obscurity, without book royalties or speaking engagements. Their efforts help us combat and cure serious medical conditions. By contrast, Professor Behe and the entire intelligent design movement are doing nothing to advance scientific or medical knowledge and are telling future generations of scientists, don’t bother."

Judge John Jones, III

"[Behe] was presented with fifty-eight peer-reviewed publications, nine books, and several immunology textbook chapters about the evolution of the immune system; however, he simply insisted that this was still not sufficient evidence of evolution, and that it was not ‘good enough’ … We find that such evidence demonstrates that the ID argument is dependent upon setting a scientifically unreasonable burden of proof for the theory of evolution."
Do the calculation: Your easy access to cutting-edge Intelligent Design technology

http://www.antievolution.org/people/dembski_wa/origprob.html

10^440 = “impossible”

Boston Review, Dec 1996

Allen Orr

“An irreducibly complex system can be built gradually by adding parts that, while initially just advantageous, become – because of later changes – essential. The logic is very simple. Some part (A) initially does some job (and not very well, perhaps). Another part (B) later gets added because it helps A. This new part isn’t essential, it merely improves things. But later on, A (or something else) may change in such a way that B now becomes indispensable. This process continues as further parts get folded into the system. And at the end of the day, many parts may all be required.”

The Puzzle of the Krebs Citric Acid Cycle: Assessing the Flies of Chemically: Toxic Reactions, and Opportunities for the Design of Metabolic Pathways During Evolution

Evolution Molecular Biology, 1994; 20 (6): 2683–2690

Evolving a Biochemical Pathway

... in 65 years (or less)

Evolution of a metabolic pathway for degradation of a toxic xenobiotic: the patchwork approach

Variation and evolution of the citric acid cycle: a genetic perspective
There is no publication in the scientific literature – in prestigious journals, specialty journals, or books – that describes how the molecular evolution of any real, complex, biochemical system either did occur or even might have occurred.

(p. 185)

Subphylum Chelicerata
- Class Merostomata (horseshoe crabs, eurypterids)
- Class Arachnida (spiders, ticks, mites)

Subphylum Crustacea
- Class Remipedia
- Class Cephalocarida
- Class Branchiopoda (fairy shrimp, water fleas, etc.)
- Class Maxillopoda (ostracods, copepods, barnacles)
- Class Malacostraca (isopods, amphipods, krill, crabs, shrimp, etc.)

Subphylum Uniramia
- Class Chilopoda (centipedes)
- Class Diplopoda (millipedes)
- Class Insecta

At the origin of life: "Intelligent design is quite compatible with the view that the universe operates by unbroken natural law, with the design of life perhaps packed into its initial set-up." [166]

Three billion years later: "Explicit design appears to reach into biology to a certain level, to the level of the vertebrae class, but not necessarily further" [220]
“Front loading” as a Mechanism

“Suppose that nearly four billion years ago the designer made the first cell, already containing all of the irreducibly complex biochemical systems discussed here and many others. (One can postulate that the designs for systems that were to be used later, such as blood clotting, were present but not ‘turned on.’...)” (*DBB* 227–8)

Vertebrate Classes

- Domain
- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

- Hyperoartia (Lampreys)
- Chondrichthyes (Cartilagenous fish)
- Actinopterygii (Ray-finned fish)
- Sarcopterygii (Lobe-finned fish)
- Amphibia (Amphibians)
- Sauropsida (Reptiles and Birds)
- Mammalia (Mammals)

Non–random mutation

- “Most mutations that built the great structures of life must have been nonrandom.” [82]

- “Random mutation does not account for the ‘mind-boggling’ systems discovered in the cell. So what does? If random mutation is inadequate, then (since common descent with modification strongly appears to be true) of course the answer must be nonrandom mutation.” [165]

Cats, Dogs & Elephants

*Medved*: “What you’re talking about really is the leaps, aren’t you. I mean the kind of random mutations, or allegedly random mutations, who [sic] create a new species.”

*Behe*: “Yeah, well I wouldn’t call it species. I’d, I’d go a little higher, maybe genus or something in biology. Biology has a number of levels and you might be able to get, say, from a wolf to a dog using random mutation and natural selection. But I don’t think you can get from a dog to a cat or a precursor organism and get from a dog to a cat or certainly to an elephant.”

The Michael Medved Show June 5th 2007.
"exquisitely purposeful arrangement of parts"
- astonishingly complex, coherent systems
- stupendously complex systems
- enormously complex cellular mechanisms
- startlingly complex pathway of flagellum assembly
- staggering complexity of modern biology
- tremendously complex elegant complexity
- stunning complexity
- enormously complex coherent molecular machinery
- elegant molecular outboard motors
- elegant immune system
- intricate genetic control programs
- stupendously intricate cellular machines
- sophisticated living machinery
- highly sophisticated, automated mechanisms
- ultrasophisticated molecular machinery

Plasmodium falciparum

"Here’s something to ponder long and hard: Malaria was intentionally designed. The molecular machinery with which the parasite invades red blood cells is an exquisitely purposeful arrangement of parts." (p. 237)

Natural Dys-Theology

Malaria kills between one and three million people a year, most of them children in Sub-Saharan Africa. It “was intentionally designed”.

Intra-Flagellar Transport (IFT)

The Eukaryotic Cilium
Behe: “Irreducible Complexity Squared”

“If IFT exponentially increases the difficulty of explaining the irreducibly complex cilium. It is clear from careful experimental work with all ciliated cells that have been examined, from alga to mice, that a functioning cilium requires a working IFT. The problem of the origin of the cilium is now intimately connected to the problem of the origin of IFT. [p. 94]

Jerry Coyne

“If ID were science, we could ... ask Behe to produce a complete step-by-step accounting of what God (sorry, the Intelligent Designer) did when He designed the cilia. And of course Behe would not be able to do that – nor does he even try. IDers never produce their own “scientific” explanation of life. They just carp about evolution. And as evolutionists explain one thing after another, IDers simply ignore these successes and move on to the ever-dwindling set of unsolved problems in which they continue to see the hand of God.”

“The Great Mutator” The New Republic 18th June 2007

Jerry Coyne

“So let us put some empirical questions to Behe, since his theory is supposedly scientific.

[1] Which features of life were designed, as opposed to evolved?

[2] How exactly did the mutations responsible for design come about?

[3] Who was the Designer?

[4] To what end did the Designer work?

[4] The Designer’s Goal?

› “What we sense, as elaborated through modern science’s instruments and our reasoning, is that we live in a universe fine-tuned for intelligent life.”

› “Parts were moving into place over geological time for the subsequent, purposeful, planned emergence of intelligent life.”
Rob Koons
Philosopher of Religion, UT Austin

"Dembski is the Isaac Newton of information theory, and since this is the Age of Information, that makes Dembski one of the most important thinkers of our time."

The Design Inference

- Level 1
  1. \( W \notin \mathcal{W}(s) \)
  2. \( \mathcal{W} \ni \mathcal{W}(s) \in \mathcal{W} \)
  3. \( \mathcal{W} \ni \mathcal{W}(s) \in \mathcal{W} \)
  4. \( \mathcal{W}(s) \ni \mathcal{W}(s) \in \mathcal{W} \)
  5. \( \mathcal{W}(s) \ni \mathcal{W}(s) \in \mathcal{W} \)

Conclusion: \( \mathcal{W}(s) \ni \mathcal{W}(s) \in \mathcal{W} \)

Requirements

- Contingency: There is a choice (vs. necessity)
- Complexity: Not so simple that the object can be explained by chance
- Specification: Object exhibits a pattern characteristic of intelligence
### Specification

- "Specification depends on the knowledge of subjects. Is specification therefore subjective? Yes."
- "Everything depends on what [one] knows, believes, determines, and provisionally accepts"
- Therefore, specification depends on current state of knowledge.
- Something is specified if an ID supporter says it is!
- This is ultimately a "God of the Gaps" type argument

### Measuring information

- Information is seen as a removal of possibilities (decrease in uncertainty)
- Information (surprisal, entropy) is given by:
  \[ I_x = - \log_2 p_x \]

### CSI and the information cut-off

- CSI is "any specified information whose complexity exceeds 500 bits of information"
- This is Dembski's Universal Probability Bound (UPB) as 500 bits has a probability of $10^{-150}$.
Cytochrome C

- Part of the electron transport chain (ATP production)
- Highly conserved across groups
- Weighs in at 233 bits, therefore not CSI, according to Dembski’s criteria
- Cyt-c could have arisen by chance.

Protein Binding Sites

- Human splice acceptor sites contain on average 9.4 bits of information.
- Below 500 bit limit, but clearly CSI.

What about the bad stuff?

- Viruses, oncogenes, and “jumping genes” cause diseases (e.g. ebola, avian flu, AIDS), cancers and genetic disruption
- All have information content beyond the 500 bit limit of Dembski.
- According to Dembski they must have been designed.

Evolving a Biochemical Pathway

...in 65 years (or less)

Evolution of a metabolic pathway for degradation of a toxic xenobiotic: the patchwork approach.

Why does the Designer care about Sphingomonas chlorophenolica?

Who designed the agent?
What is the “unit” of examination?

Section of DNA
Gene
Gene family
Functional group of genes
Whole genome
All genomes on Earth
All genomes in Universe?

Definitions “design” in purely negative terms.
Where is the cut-off between HP, IP & sp/SP?
How do you define “specified” particularly if it is highly sensitive to changes in current knowledge?

D? Yes
Yes
HP?
Yes
Regularity
No
No
IP?
Yes
Chance
No
No
sp/SP?
Yes
Design!
No

Dembski “Does The Math” (1997)

“Do the calculation. Take the numbers seriously. See if the underlying probabilities really are small enough to yield design.”

The Design Inference, p. 228.
"I show that undirected natural processes like the Darwinian mechanism are incapable of generating the specified complexity that exists in biological organisms."

How? By a calculation showing that the probability of spontaneous assembly of the proteins in the flagellum lies beyond the range of the "universal probability bound" ($1 \times 10^{-150}$).

The Probability Argument:

"I've pretty much dispensed with the EF. It suggests that chance, necessity, and design are mutually exclusive. They are not. Straight CSI is clearer as a criterion for design detection."

The challenge for determining whether a biological structure exhibits CSI is to find one that’s simple enough on which the probability calculation can be convincingly performed but complex enough so that it does indeed exhibit CSI. The example in NFL ch. 5 doesn’t fit the bill.

"The gain in information required the "death" of 32 organisms in each of 704 generations, i.e. 22,528 deaths. This is very inefficient, yet a site with a probability of 1 in 500,000,000,000,000,000,000 (I=68.76 bits) is generated in ~1000 generations. The entire human genome (~4,000,000,000 bits) could evolve in a billion years."

This does not consider sexual recombination or realistic population size.
Schneider looked for the evolution of 512 bits in a small \( (n=512) \) asexual population of creatures. He allowed one mutation per generation. He defeated the UPB in 15,000 generations.

\[
\text{UPB} = \text{No of particles} \times \text{Planck time} \times \text{Age of Universe}
\]
\[
\text{UPB} = 10^{80} \times 10^{45} \times 10^{25} = 10^{150}
\]

“All the probabilistic resources in the known physical universe cannot conspire to render remotely probable an event whose probability is less than this universal probability bound.” (Dembski, The Design Revolution, p. 87)

Living things create information (“specified complexity”) via environmental selection and random mutations. Living things and their environment are the “intelligent designer.”

Information theory approach is just probability “dressed-up” as the framework offers nothing new.

How do you assign the probability thresholds? What is the cut-off between CSI and CI, etc.?

The “Explanatory Filter” is a method for justification of belief rather than detection.

Organismal Biologists ... little time for abstractions, especially as no predictions are made.

Mathematicians ... little notice.

Philosophers ... negative due to problems with Explanatory Filter.

Number of papers using Dembski’s method?