The Argument from (apparent) Design

You can just see what each part is for

Two kinds of design argument:

1. Analogy: Similar effects probably have similar causes . (Ancient Greeks)

2. Inference to the best explanation. (William Paley)

3. Design *perception*?

E.g. Socrates' Design Argument

With such *signs of forethought* in these arrangements, can you doubt whether they are the work of chance or design?

Concerning sex organs being for the purposes of procreation, he concludes:

Undoubtedly these too look like the contrivances of one who deliberately willed the existence of living creatures.

-- as reported by Xenophon in *Memorabilia* (I, iv, 6-7)

1. Argument from Analogy

Premise: *If the effects resemble one another, then the causes probably do as well.*

- E.g. if several similar murders are committed in the same area, in a short space of time, then they were probably committed by the same person.
- If several pieces are music seem to have a similar style, then they were probably composed by the same person,

   etc.

What similarity is there?

1. Cameras and eyes have different parts that work together to do something useful.

2. The parts of cameras and eyes have purposes that are easy to see.

3. For a camera or an eye to carry out its function well, the parts have to be shaped and arranged very precisely to match each other.

∴ Cameras and eyes (e.g.) are similar in many respects

Main Argument

1. Cameras and eyes are similar in many respects, such as having precisely shaped, well-matched parts that work together to perform a useful function.
2. Cameras are designed by human engineers
3. If the effects are similar, then the causes are probably similar as well

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∴ Eyes were probably designed by something similar to human engineers

Argument from Analogy

- This is an inductive (probable) argument, and so has some degree of strength (e.g. strong or weak).

- The strength of the argument depends on the degree of similarity between the observed effects.

All these various machines, and even their most minute parts, are adjusted to each other so precisely that everyone who has ever contemplated them is filled with wonder. The intricate fitting of means to ends throughout all nature is just like (though more wonderful than) the fitting of means to ends in things that have been produced by us - products of human designs, thought, wisdom, and intelligence. Since the effects resemble each other, we are led to infer by all the rules of analogy that the causes are also alike, and that the author of nature is somewhat similar to the mind of man, though he has much larger faculties to go with the grandeur of the work he has carried out.

– Hume, *Dialogue,* pp. 215-216.

Hume's criticisms

1. There's no evidence from design that God is single, infinite, omnipotent, good, etc.
2. (God would be evil, in fact!)
3. Perhaps matter can produce order from itself? ("self-organization")
4. Who made the designer?
5. What's so special about *thought*?
6. We only have a sample size of 1.

The character Philo argues that while it might be reasonable to believe that the universe arose from something like design, there's no evidence of a single designer, or that the designer is perfect, infinite, etc. It is possible, says Philo, that

This world, for aught he knows, is very faulty and imperfect, compared to a superior standard; and **was only the first rude essay of some infant deity**, who afterwards abandoned it, ashamed of his lame performance: **it is the work only of some dependent, inferior deity**; and is the object of derision to his superiors: **it is the production of old age and dotage in some superannuated deity**; and ever since his death, has run on at adventures, from the first impulse and active force which it received from him."

Even just a stupid mechanic?

"If we survey a ship, what an exalted idea must we form of the ingenuity of the carpenter who framed so complicated, useful and beautiful a machine?

And what surprise must we feel, when we find him a stupid mechanic, who imitated others, and copied an art, which, through a long succession of ages, after multiplied trials, mistakes, corrections, deliberations, and controversies, had been gradually improving?"
(p. 220)

(Similar to Darwin's idea. But could it really happen?)

The problem of evil

The whole earth, believe me, Philo, is cursed and polluted. A perpetual war is kindled amongst all living creatures. Necessity, hunger, want stimulate the strong and courageous; fear, anxiety, terror agitate the weak and infirm. The first entrance into life gives anguish to the new-born infant and to its wretched parent; weakness, importance, distress attend each stage of that life, and it is, at last, finished in agony and horror. (p. 277)

Why not self-organization?

"For all we can know *a priori*, matter may have a source of order within it, just as mind does, having it inherently, basically, not acquired from somewhere else. When a number of elements come together in an exquisite arrangement, you may think it harder to conceive that they do this of their own accord than to conceive that some designer put them into that arrangement. But that is too quick and careless."

Some scientists (Stuart Kauffman, Brian Goodwin, Leo Kadanoff, etc.) have suggested theories along these lines. But most biologists are unimpressed with the (in)ability of self-organization to produce *functional* things.

Exquisite arrangements (but not functional)
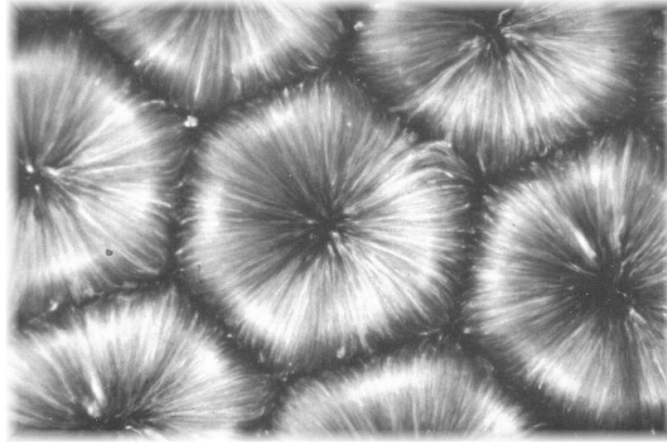
Regress problem?

- Thought precedes matter, according to the design theorist.

- But if the material world needs a designer, then surely God needs one even more! (And God's designer also needs a designer …)

  "If the material world rests upon a similar ideal world, this ideal world must rest upon some other; and so on, without end" (Hume, p. 219)

Similar to Dawkins

- Organized complexity is the thing that we are having difficulty in explaining. Once we are allowed simply to *postulate* organized complexity, if only the organized complexity of the DNA/protein replicating machine, it is relatively easy to invoke it as a generator of yet more organized complexity.... But of course **any God capable of intelligently designing something as complex as the DNA/protein machine must have been at least as complex and organized as that machine itself**... To explain the origin of the DNA/protein machine by invoking a supernatural Designer is to explain precisely nothing, for it leaves unexplained the origin of the Designer. (*The Blind Watchmaker,* p. 140)

Plantinga replies

1. "… this argument doesn't depend on the facts of biology; it is substantially independent of the latter."
   – So Dawkins would make the same argument, even if all genomes had "Made by Yahweh" written in them?

2. The tractors on an alien planet and the sophomore: "No doubt we'd tell him a little learning is a dangerous thing and advise him to take the next rocket ship home and enroll in another philosophy course or two."

3. As a logically necessary being, God isn't improbable, but has objective probability 1.

Inference to the Best Explanation

- Paley's argument is sometimes misrepresented as being an argument from analogy.

- The argument is actually an inference to the best explanation.

- Note that Paley doesn't use the premise (2) of the design argument from analogy, that cameras (watches, etc.) are designed.

- Paley *argues* that watches are designed, rather than using it as a premise.

Were there no example in the world, of contrivance, except that of the eye, it would be alone sufficient to support the conclusion which we draw from it, as to the necessity of an intelligent Creator. It could never be got rid of; **because it could not be accounted for by any other supposition** …

- An "inference to the *only possible* explanation"?

Paley's argument

1. A watch shows the marks of design, such as having parts with obvious purposes, etc.

2. Watches couldn't have come about any other way. (E.g. not by self-organization.)

∴ Watches are obviously designed

(And similar reasoning applies to living organisms.)

Inference to the best explanation

- IBE is a competition. We should believe the *best* explanation.

- There are two legitimate strategies in IBE arguments:
  - Show that your explanation is good (positive)
  - Attack the alternatives (negative)

- (Similar to political election campaign ads.)

Inference to the Best Explanation

- An explanation (of an object or event) is a story about what *caused* that object or event, i.e. how it came to exist or occur.

A good explanation is:

(i) **Adequate**: the proposed cause must be sufficient to *predict* the object or event.

(ii) **Plausible**: the proposed cause must be reasonably likely to exist, according to our general worldview.

Criticisms of Paley

- The most important criticism of Paley's argument today is that Darwin has provided us with a better explanation than design. (Evolution by *natural selection*.)

- Paley's design argument notes that living organisms are *functional* (they do stuff) and (therefore) complex and intricate.
    - What cause, other than an engineer, is thus "biased" toward making functional objects?

"Functional bias"

- Natural selection is also "biased" toward making functional structures (which will, of course, have to be intricate and complex).
  - Less-functional variants will be driven to extinction, in the "struggle for existence".

- The winners of this struggle will be:
  - suited to their environments ('adaptive')
  - full of parts that *seem* purposeful

- Stephen J. Gould: the essence of Darwinism and the modern synthesis is, "Natural selection *creates* the fit."

Negative criticisms of Paley

- Other criticisms argue that design is a weak explanation of life anyway.
    - Design theory does not predict evil, poor design, etc.
    - Supernatural causes like God are implausible.
    - Science is the project of giving *natural* explanations for empirical phenomena, so design theories are *unscientific*.

Some responses to criticism

- The design theory *does* account for the biological data fairly well, even cases of apparently poor design.
  - The "poor" design turns out to be good
  - The "poor" design *might* be good. We don't know everything.
  - Even poor design is still obviously design

- There is no adequate natural explanation for the origin of life itself.

Philosophers on selection

- Most philosophers believe that selection is an adequate explanation of biological function.

- E.g. Earl Conee (p. 74):

  "This natural sort of explanation [i.e. selection] **does work**. It gives an explanation of the machine-like organisation that we observe in things like molecules, marsupials and marshes."

  "… the two explanations [design and nature] **seem equally capable** of explaining the phenomenon in question."

- (Except for Tom Nagel, Peter van Inwagen, Jerry Fodor, Alvin Plantinga, and a few others.)

Plantinga's main response

- It has not yet been *shown* that the theory of natural selection predicts the emergence of novel functional structures.
  - That would require finding a very gradual "path through organic space" with monotonically increasing function.

"There is no attempt at the sort of serious calculation that would surely be required for a genuine answer. No doubt such a calculation and hence an answer to those questions is at present far beyond our knowledge and powers; no doubt it would be unreasonable to require such a calculation; still, the fact remains we don't have a serious answer."

Similar to Wolfgang Pauli on selection

As a physicist, I should like to critically object that **this model has not been supported by an affirmative estimate of probabilities so far**. … One would need to show that, according to the assumed model, the probability of de facto existing purposeful features to evolve was sufficiently high on the empirically known time scale. Such an estimate has nowhere been attempted though.

Pauli, W. (1954) "Naturwissenschaftliche und erkenntnistheoretische Aspekte der Ideen vom Unbewussten." *Dialectica* 8, 283–301, translated by Harald Atmanspacher and Hans Primas.

'TINA' argument for selection

- Biologists often argue that selection *must* be the source of functional bias in evolution, as no other physical mechanism could have such a bias.
  - "Selection or bust"
  - "Only selection explains adaptation"

- E.g. Other evolutionary mechanisms (e.g. mutation pressure, genetic drift, lateral gene transfer, phenotypic plasticity, symbiogenesis, self-organization) don't have any functional bias. *What else* could explain function?

Selection or bust …

The arguments from paleontological evidence for the importance of natural selection largely concern the observed long-term trends of morphological change, which are visible in many lineages. **It is hard to imagine what else but natural selection could be responsible for such trends**, unless one invokes supernatural or mystical forces such as the long popular but ultimately discredited force of "orthogenesis."

Adam S. Wilkins, review of James Shapiro's *Evolution: A View from the 21st Century*, in *Genome Biology and Evolution*, January 2012.

(Physical chemist) Michael Polanyi on "selectionism" (i.e. the modern synthesis)

"Arguments for the insufficiency of [the standard explanation of chemical adsorption] were rejected as unscientific, because no other principles of molecular interaction appeared conceivable.

This reminds me of the impatience with which most biologists set aside today all the difficulties of the current selectionist theory of evolution, because **no other explanation that can be accepted as scientific appears conceivable**."

("The Potential Theory of Adsorption", *Science*, vol. 141, 1963.)

E.g. Jerry Coyne

- Jerry Coyne is professor of biology at the University of Chicago, and author of *Why Evolution is True* (2009).

- On his blog (April 26, 2009) Coyne discussed a letter received from someone sceptical about the ability of selection to account for novelty (e.g. eyes).

- Coyne replied:

  "… we can … invoke the idea that **we know of no process other than selection** that could create such adaptive change. That is satisfying to scientists, but perhaps not so convincing to people like the gentleman who wrote me."

Begs the question?

- If the *only* good argument for natural selection being causally adequate is that no better (natural) theory exists, then does this beg the question against Paley?

- "Design is *not* the only possible explanation for life, because **assuming** there's a scientifically acceptable (non-design) explanation, it must be natural selection, and hence natural selection can also create life as we find it."

Other arguments for selection

- In the post referred to above, Coyne gives other arguments for the adequacy of selection.

- "Both Ken Miller and Richard Dawkins have written extensively and convincingly about whether selection can produce novel traits. The answer of course is yes, **as most biologists can see intuitively**. And I think it's easy to convince people of this with the compelling examples that Miller and Dawkins have used in *Only a Theory* and *Climbing Mount Improbable*, among other places."

Seeing selection in the fossil record?

"First, we say that we can see selection building adaptations over time. The evolution of whales from terrestrial artiodactyls, for example, took about 10 million years, and we can see it happen in the fossils.

But this begs the question, since the questioners are asking **whether this kind of change can be due to natural selection**, which is said to be ineffective over such periods."

(Agreed!)

Dawkins

Evolution, then, is theoretically capable of doing the job that, once upon a time, seemed to be the prerogative of God. But is there any evidence that evolution actually has happened? The answer is yes; the evidence is overwhelming. Millions of fossils are found in exactly the places and at exactly the depths that we should expect if evolution had happened.

(Dawkins reading, p. 7)

(N.B. Evolution *per se* is not in doubt. The question is the *mechanism*.)

"Huge stretches of time"

"Second — and most often — we evoke the huge stretches of time over which selection has had to work: millions and billions of years. Indeed, such spans of time are not easily grasped by even the minds of evolutionary biologists." (Coyne)

- But how do you *know* if (e.g.) 10 million years is enough time to evolve a whale from a land mammal? This is hand waving. (Most evolutionary transitions occurred quickly, within just a few million years – not "billions"!)

"immensity of time"

The fossils tell us that life has been evolving on Earth for more than 3,000 million years. It is almost impossible for the human mind to grasp such an immensity of time. …

… Think of the quantity of change involved in going from a wolf to a Pekingese [taking 1000 years?]; now multiply that quantity of change by a million. **When you look at it like that, it becomes easy to believe that an eye could have evolved from no eye by small degrees**. (Dawkins reading, p. 5)

N.B. Optimization vs. creativity

"In computer science we recognize the algorithmic principle described by Darwin – the linear accumulation of small changes through random variation and selection – as **hill climbing**. However, we also recognize that hill climbing is the simplest possible form of optimization and **is known to work well only on a limited class of problems**."

R. A. Watson, 2006, *Compositional Evolution*, MIT Press, p. 272.

(N.B. Watson thinks that adding sexual recombination, lateral gene transfer and symbiosis allows more problems to be solved.)

Coyne on mathematical modelling

"I think a good way to meet this criticism is through mathematical modelling. We simply make a model of the evolution of a complex trait (or better yet, several of them), basing it on reasonable estimates of selection pressures, mutation rates, etc. Then **we see how long it will take the model or the computer to construct the adaptation**. Then we extrapolate to how many such adaptations it would take to evolve a new "type" of creature, say a bird from a theropod dinosaur. If our theory is right, we should be able to do this, and find that selection can indeed create adapations in reasonable stretches of time."

Here's an example …

"As far as I know, **there has been only one attempt to do this**: Nilsson and Pelger's 1994 paper on the evolution of a complex camera eye from a flat, pigmented, light-sensitive eyespot."

(Nilsson, D.-E., and S. Pelger. 1994. "A pessimistic estimate of the time required for an eye to evolve", *Proc. Roy. Soc. Lond. B* 256:53-58.).

"What I would like to see, and what I think would be a great boon to furthering acceptance of evolution, is more models of the Nilsson and Pelger type. When we tell people that there's been sufficient time for everything to have evolved by natural selection, we need more hard models to back us up …"

Nilsson and Pelger's model

n = 0   n = 180   n = 500   n = 800

n = 1000   n = 1250   n = 1500   n = 1800
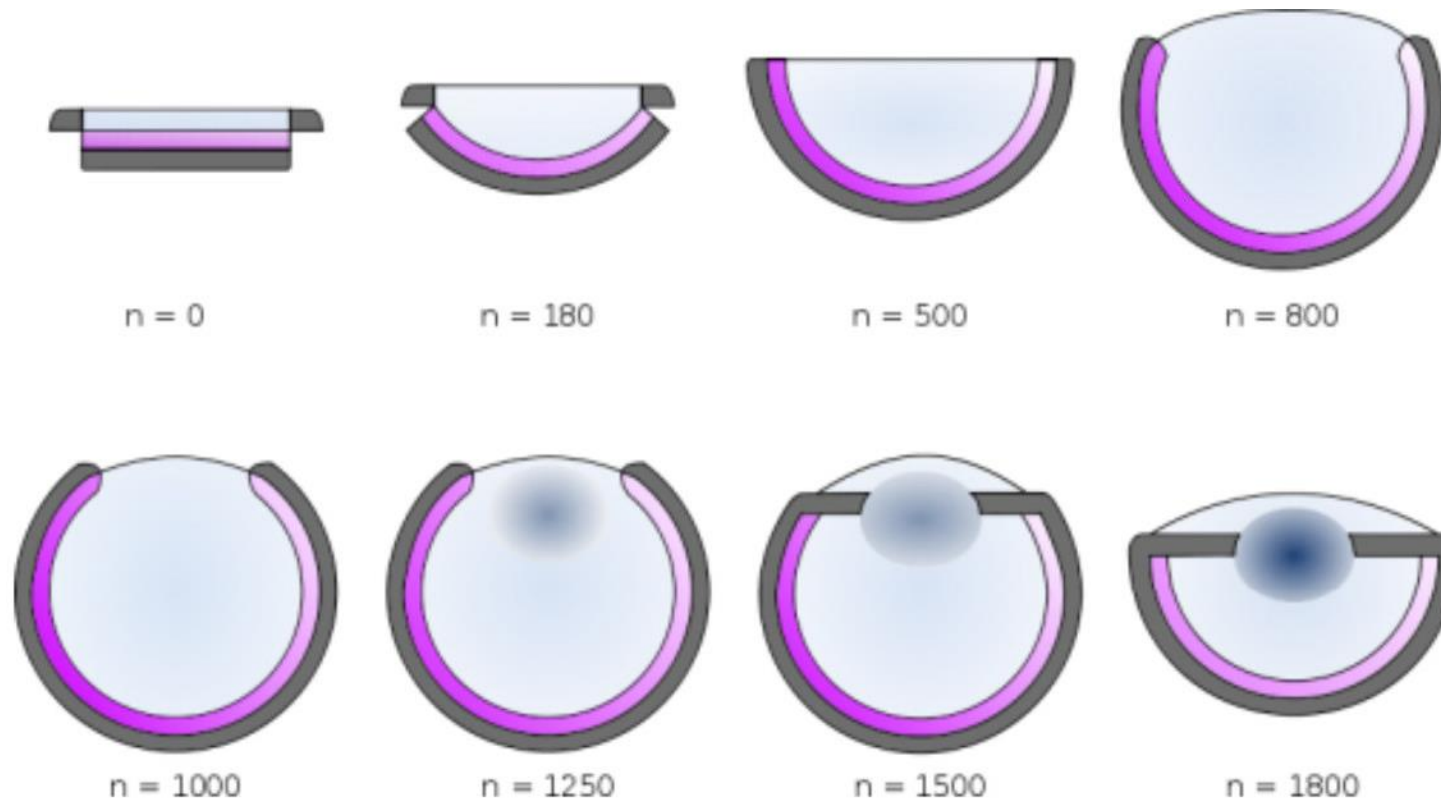
Nilsson and Pelger's model

- Nilsson and Pelger constructed a sequence of eye stages by hand. It is a sequence of phenotypes – there is no modelling of the genetic changes involved.

- So the model doesn't address Plantinga's "Big Question" of whether a probable sequence of *mutations* exists to underlie the sequence of phenotypes.

- Also, no new *components* appear during the Nilsson and Pelger sequence. All the parts are present and (sub-optimally) functioning at the start. So the hardest problem has been avoided.

Optimization of existing components
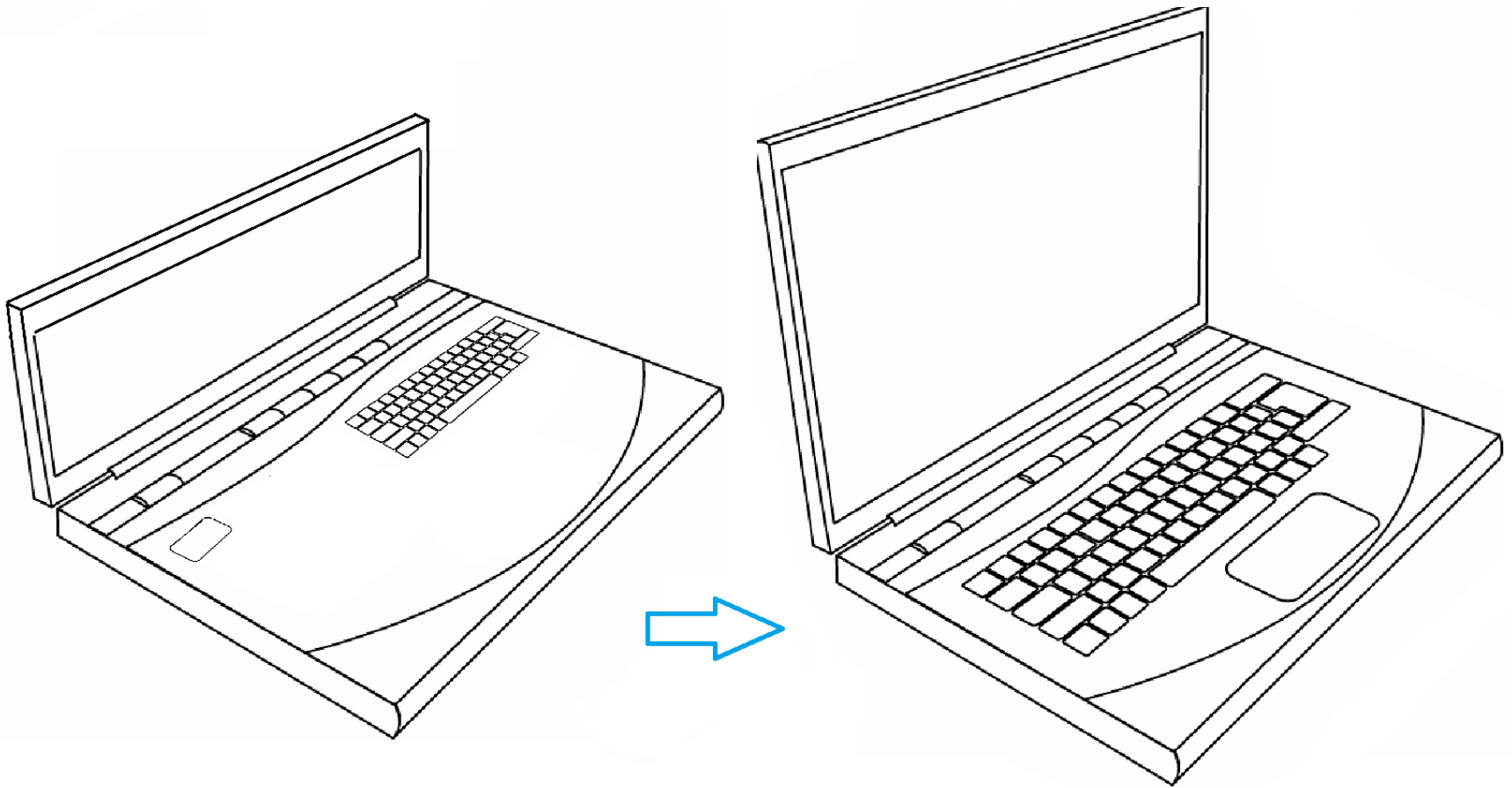
- N.B. In engineering, *optimisation* problems lend themselves to the method of trial and error, especially if the different parts of the system operate somewhat independently of each other.

- E.g. wing-shape optimization.
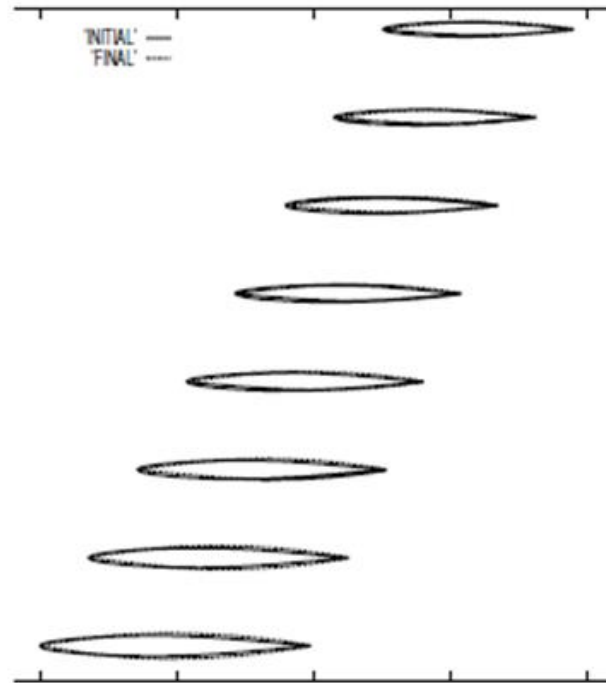
Mike Behe's "irreducible complexity"

- Behe argues that certain biological systems, as well as some machines, are "irreducibly complex".

- These are systems with many interacting, well-matched parts, where almost all the parts are needed for the system to function.

- Such a system is *not easily* built by a 'dumb' process like natural selection, he says. Because at certain points in the evolutionary process you might well need several parts to be added simultaneously.

- Natural selection works well when all the parts that need to be changed feel selection pressure, in the right direction.

- The worry about "irreducibly complex" systems is that no part feels *any* selection pressure until many of the 40 other parts are already at least roughly correct.

- One can imagine, however, scenarios in which the *function* of the system also changes over time, allowing parts to be added more gradually.

- Two versions of "irreducible complexity":

1. (Strong) We *know* that NS *couldn't* do it.
2. (Weak) It's *not clear that* NS could do it.

   Who has the *burden of proof* here?

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."

Coordinated changes

- *If* the evolution of a novel structure (e.g. a novel protein) requires two or more specific *simultaneous* changes (where each one is neutral or harmful by itself) then it is effectively impossible for this to occur by random mutation.

- In humans, for example, the appearance of even one such *particular* pair would require over 100 million years.

  (Durrett and Schmidt (2008), "Waiting for two mutations: with applications to regulatory sequence evolution and the limits of Darwinian evolution." *Genetics* 180: 1501–1509.)

From the abstract

- "… we examine the waiting time for a pair of mutations, the first of which inactivates an existing transcription factor binding site and the second of which creates a new one. Consistent with recent experimental observations for Drosophila, we find that a few million years is sufficient, but **for humans with a much smaller effective population size, this type of change would take > 100 million years**. In addition, we use these results to expose flaws in some of Michael Behe's arguments concerning mathematical limits to Darwinian evolution."

- This seems like a long time, but remember that this is for a *particular* pair of mutations, where the first one is neutral. If you just need any one of a large set of such pairs, then the time decreases (perhaps by a lot)
- E.g. it's very unlikely for Evelyn Adams to win the lottery twice within one year. But it's much more likely for *someone* to win it twice.
- Also, however, a lot more than two mutations are probably needed simultaneously to evolve a novel feature.

Conclusion

- There doesn't seem to be any good reason to answer 'Yes' to Plantinga's Big Question.

Functionality and physical laws

- According to the modern synthesis, once the conditions of evolution by natural selection obtain, **the system has a strong inclination toward increasing function** (along with the required increase of complexity).

- Do the underlying laws have a similar "bias" (inclination, tendency) toward increasing function?

Are the laws biased toward function?

- Yes
  - Then life emerged by self-organization.
  - We don't need selection.
  - (But self-organization of functional structures seems impossible.)

- No
  - Then life is extremely improbable.

Life needs "information"

"A central idea in contemporary biology is that of information. Developmental biology can be seen as the study of how information in the genome is translated into adult structure, and *evolutionary biology of how the information came to be there in the first place*." Szathmáry & Maynard Smith (1995)

"The apparent improbability of life-associated and technological complexities mirrors the amount of the extra information required for their formation. Every living thing and many nonliving products of human ingenuity illustrate this. **The more information required for something to be formed, the more improbable it seems.** Contrast, for example, a stone axe with a supercomputer, or a simple virus with the human being." (Mayfield, 2013, p. 13)

"… the essence of what evolution does is to **accumulate information**." (p. 3)

The Engine of Complexity

EVOLUTION AS COMPUTATION
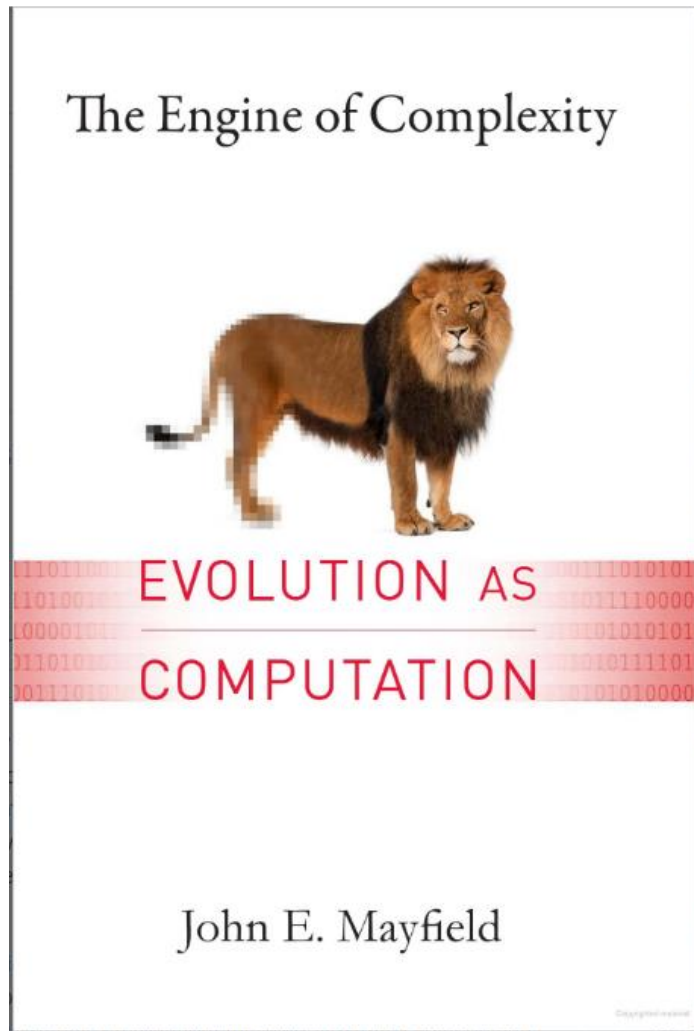
John E. Mayfield

Columbia University Press, 2013

John E. Mayfield is professor emeritus of genetics, development, and cell biology at Iowa State University. He has also taught at the California Institute of Technology, Carnegie-Mellon University, and Harvard University Biological Laboratories.

"When followed, instructions often lead to the formation of objects or actions that otherwise would be quite impossible to achieve because of their absurdly low probabilities" (p. 13)

The big problem

- Living organisms need information (instructions) to build them. (The laws of physics aren't enough.)
- So, mammals couldn't instantly appear on the prebiotic earth, due to an *information deficit*.

- Information deficits can't be overcome by reasoning.
  - The conclusion of an argument can only contain information that comes from the premises.
- So, information deficits can't be overcome by any physical process (beyond trial and error).

- But doesn't natural selection just clearly work? Can't we see it intuitively?

The Brownian ratchet

Perpetual motion machine?

It's hard to disprove
(even though it clearly can't work)

- Derek Abbott, Bruce R. Davis and Juan M. R. Parrondo, "The Problem of Detailed Balance for the Feynman-Smoluchowski Engine (FSE) and the Multiple Pawl Paradox", in *Unsolved Problems of Noise and Fluctuations,* edited by D. Abbott and L. B. Kish, American Institute of Physics, 2000.

"It is now well-known that Feynman's treatment was flawed …"

"An interesting question is to ask what happens if the ratchet has more than one pawl? It would appear *prima facie* that as the fluctuations in all the pawl springs are not totally correlated, then the chance of disengagement is reduced and therefore **the wheel will rotate in one direction**. This cannot be correct as it would then be possible to construct a machine that would disobey the Second Law."

Disprove creative selection?

- In a similar way, I think it is very difficult to know whether the mutation-selection mechanism can work, in principle.
    - (Unless it can be ruled out on very general grounds.)
- As Feynman said, "But actually, we have to look into the details ..."
    - For example, we have to consider not just gross anatomy but the underlying biochemistry.
    - We have to consider the construction of the phenotype through embryonic development
    - We have to consider the probabilities of the required mutations (and a lot more)