Why (and How) Intelligent Design Fails

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Note: This is a series of overheads on intelligent-design creationism. It originated with my talk, “Intelligent Design Is Neither,” presented at the conference, *Science and Religion: Are They Compatible?* in Atlanta, Georgia, in October, 2001. I have presented revised and updated versions at the University of Colorado, the University of Denver, Sigma Xi, Café Scientifique, Truman State University, the Colorado School of Mines, several churches and one synagogue, and elsewhere. I will shortly (as of this writing on July 8, 2006) present the material at the conference, *Exploring the Borderlands: Science and Religion in the 21st Century*, at the Jefferson Center for Religion and Philosophy, August 4-6, 2006, in Ashland, Oregon. The overheads in this file are far more than I will use in a single 1-hour talk or seminar, but they are organized to form what I hope is a coherent whole.

From the Conference *Science and Religion: Are They Compatible?*

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For only $149* (we're holding the line on costs), you can come to Atlanta and hear thought-provoking talks critiquing (or, in some cases, defending):

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We'll also feature meetings of local groups; a concurrent session on Science, Religion, and African Americans; and a session on Science and Islam. We'll have the pleasure of entertainment and education at the hands of nationally known physicist and showman **David G. Willey**, and—

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*The registration fee will be only $79 for students who are currently enrolled in classes (copy of current student identification required).

Make plans now to be in Atlanta, at the Atlanta Airport Marriott (just **$89 a room** per night, single or double, with free airport shuttle service, free parking, and first class service), on Friday through Sunday, November 9-11.

What is intelligent-design creationism?

(and why am I bothering you with it?)

Religion disguised as science?

Crank science?

A device to get religion into the schools?

The successor to creationism?

The wave of the future?

All of the above?

None of the above?

Let's see . . .

Important distinction

Creationism, whether old- or young-earth

- Complete nonsense
- Based on *misunderstanding Hebrew Bible*

Intelligent-design creationism recognizes

- Descent with modification
- Vast age of earth

But is it science?

- Alas, no

Matt's demarcation criterion

Pseudoscience is like pornography

[I know it when I see it. — Potter Stewart]

How does science progress?

Do scientists look at big load of data, infer theory

(induction)?

If not, what?

How did Newton get $1/r^2$ law? Kepler, elliptical orbits?

The big secret:

They guessed

How science works (more or less)

Theorists *guess* at theory

Compute *consequences* of guess

Make predictions

Experimentalists *test predictions*

OR

Experimentalists find unexpected result

Theorists *guess* at new theory

Compute *consequences* ...

Good scientific theory

Is *precise*, *testable* (falsifiable in principle)

Is *fruitful*:

Suggests experiments

Leads to new knowledge

Is evolution "just a theory"?

Theory is *not* hunch, speculation

("I have a theory that stress causes cancer")

Scientific theory *is*

Systematically organized knowledge

Applicable in *wide variety of circumstances*, especially

System of assumptions, principles, procedures

To *analyze*, *predict*, *explain* nature or behavior of

physical, chemical, biological, psychological, ...

phenomena [after AHD]

So is evolution "just a theory"?

Answer 1: Wrong question

Descent with modification is observed fact

Theory of evolution is best explanation of that fact

Answer 2: Yes, organized body of knowledge, etc.

Explains wide range of biological phenomena

Is intelligent-design creationism a theory at all?

Or is it *pseudoscience*?

Some properties of pseudoscience

Denies *known scientific fact*

Over-relies on *ad hoc* hypotheses to explain failures

Homeopathy (dilutes “medicines” zillions of times):

The water *remembers*, because

Electromagnetic radiation stays in the water

Creationism:

The earth is 10,000 years old

God put the *fossils* in the earth for some reason we do not know, OR

Genesis 1 written in *logarithmic time* (Gerald Schroeder)

Properties of pseudoscience (cont.)

Tries to *prove that*

Not *find out whether*

Says everyone's wrong but us

Implies *conspiracy* by opponents

Compares "discoveries" to those of Copernicus

But is intelligent design science?

Whether or not God exists is a *fact*

Science deals in *facts* and *evidence*

Only *objective scientific evaluation* can find God's putative footprints

Faith (or *belief*) is blind alley

Stifles rigorous investigation

Intelligent-design creationists *believe they have found* evidence *for a creator*

Do *not* deny scientific fact (age of earth, descent with modification)

Rely on defensible hypotheses

Unless theism ruled out *a priori*

But

Over-rely on *ad hoc* hypotheses

Try to *prove that*

Not *find out whether*

Say everyone's *wrong* but us

Charge *conspiracy* by opponents

Do not make specific, testable *predictions*

So is it science already?

2 out of 6, so

No, not really:

Not *fruitful*

Has much in common with pseudoscience

Unfair criticisms of Intelligent-design creationism

Religiously motivated

Genetic fallacy: It could still be right

Based on *analogy*

So is gas theory: Molecule = billiard ball

Cannot predict

Retrodictions equivalent (mildly controversial statement)

Explanatory ability all that matters

Predicts (apparently incorrectly) we will not find gradualism in certain systems

Argument from design all over again

Yes, tho they claim to *look for* design, not *assume* it

Fair criticisms

Analogies no good

Failure of imagination

Case overstated

And how!

Elevates one level of reality (molecular biology) over others

Gives short shrift to *self-organizing systems*

False dichotomy between evolution & intelligent design

Everyone's wrong but us

~~Imply~~ Charge *conspiracy* by opponents

The peppered moth (*Biston betularia*)

or How *evolution deniers* operate

Britain, mid-1800's: air pollution, soot

Moths evolve black (melanic) form for camouflage

1950's: Clean air acts

Moths evolve back

Kettlewell's release-recapture experiments

Released moths in morning

- Recaptured (in traps) in wee hours of next morning
  - More melanic in polluted area
  - More *typica* in unpolluted area

2002: Journalist charges fraud, cites

- Sudden increase in recapture rate
- "Threatening" letter from mentor

Response

Increase in recapture rate followed increase in no. of moths released

More moths released as more hatched — no control over hatching

Moon affected recapture rate

Letter received *after* increase in recapture rate

Letter to Kettlewell from E.B. Ford

Received *after* increase in recapture rate

"It is disappointing that the recoveries are not better ... However, I do not doubt that the results will be very well worth while ...."

Hooper's interpretation:

"Now I do hope you will get hold of yourself and deliver up some decent numbers."

Physical model (Young and Musgrave)

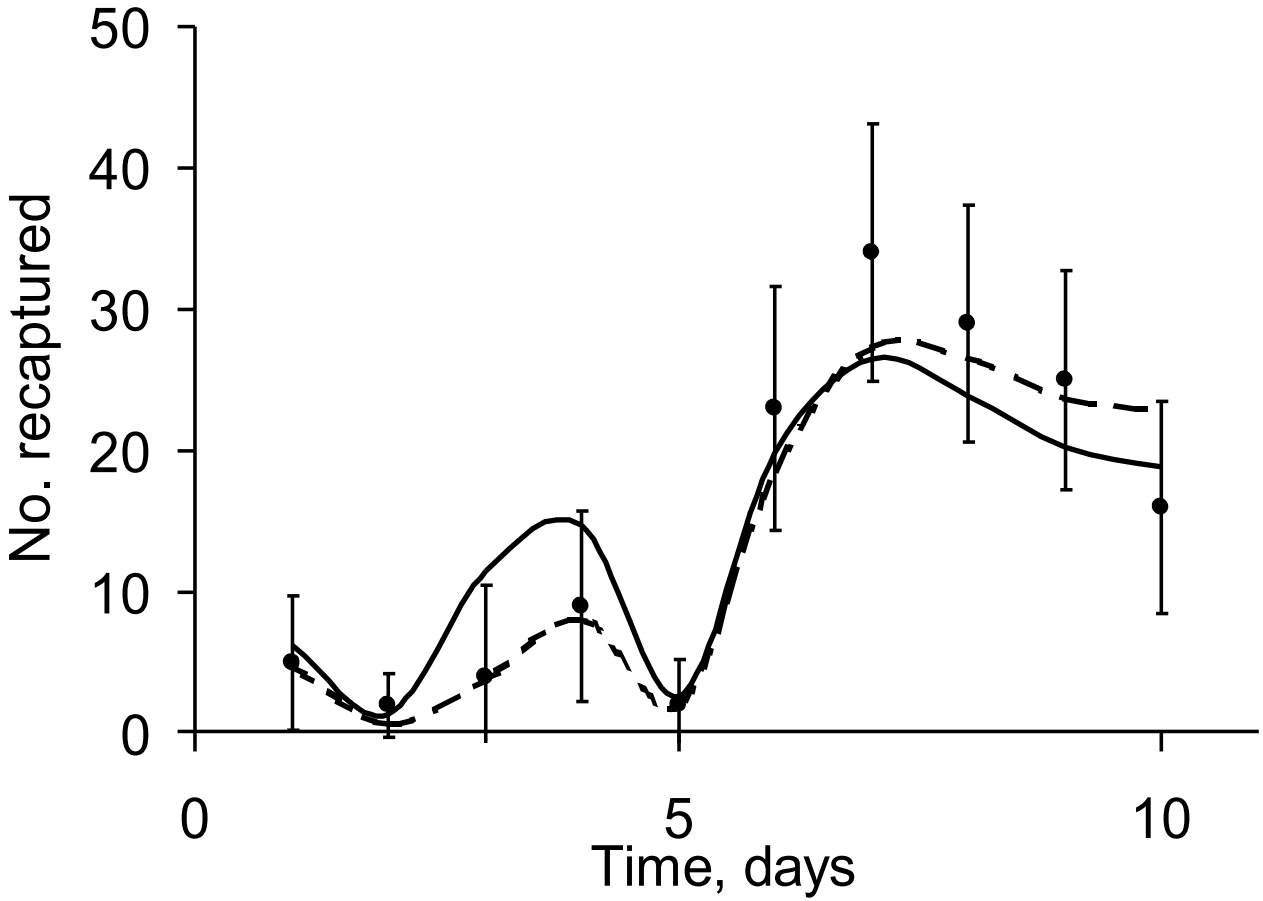
Calculated mean 1- and 2-day recapture rates from Kettlewell's data

Added effect of moonlight on recapture rates (regression analysis)

Estimated *standard uncertainty* of data points and compared with data

Agreement between theory and experiment

Dashed curve passes through *every* error bar



Solid curve – no moonlight

Dashed curve – moonlight

95 % confidence intervals

[Young & Musgrave, 2005]

Intelligent-design creationism in Physics

Big Bang and fine-tuning of *fundamental constants*

We do not know nearly enough:

- Maybe not so fine-tuned anyway
- Constants may be interrelated
- Which constants?
  - Depends who's choosing

Anthropic principle (strong anthropic principle)

Universe is here *so that* we will be here to see it

Utterly circular

Possibility of infinite number of universes (comes out of physics theory [not a hat!])

Have to prove our universe unique, unlikely

Natural Explanations

Requirements for life presumably include

Long-lived universe

Supernovas (to create heavy elements)

Victor Stenger examined random combinations of 4 fundamental constants:

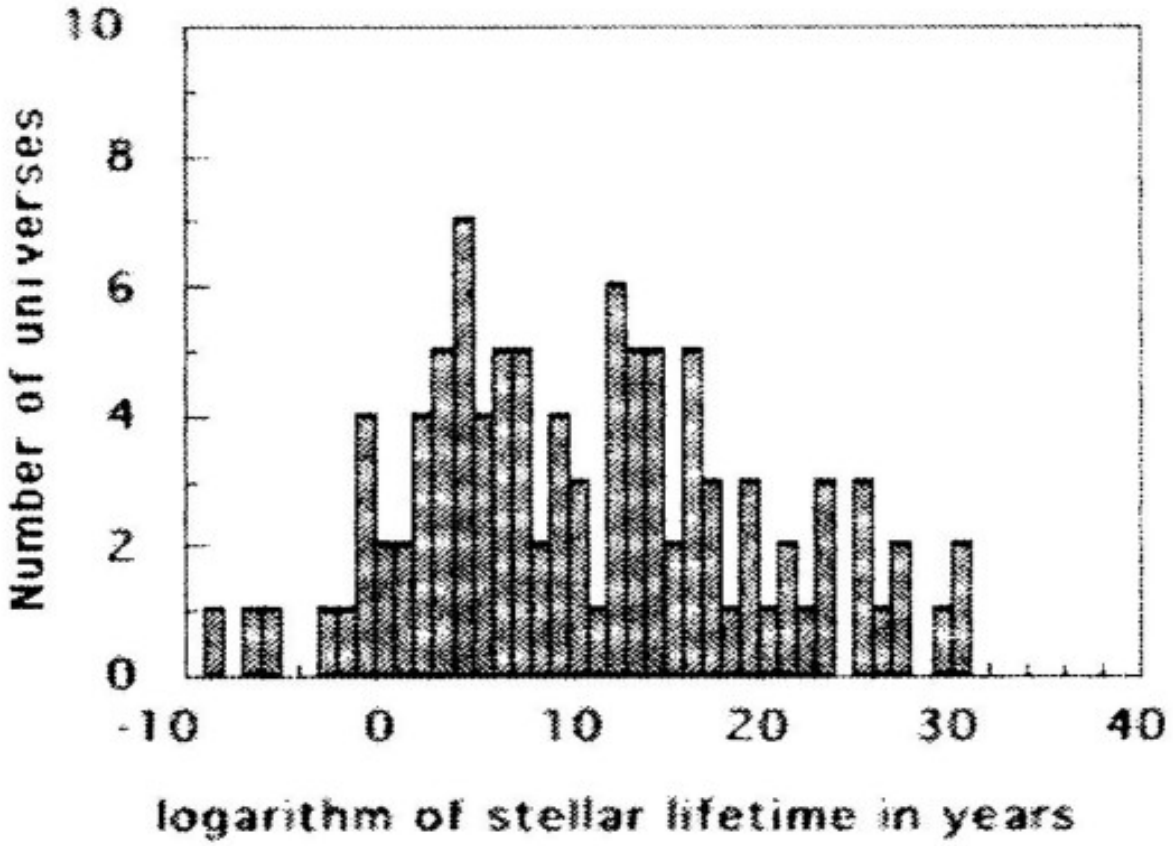
Masses of electron, proton

Strong, weak nuclear forces

Calculated average lifetimes of stars

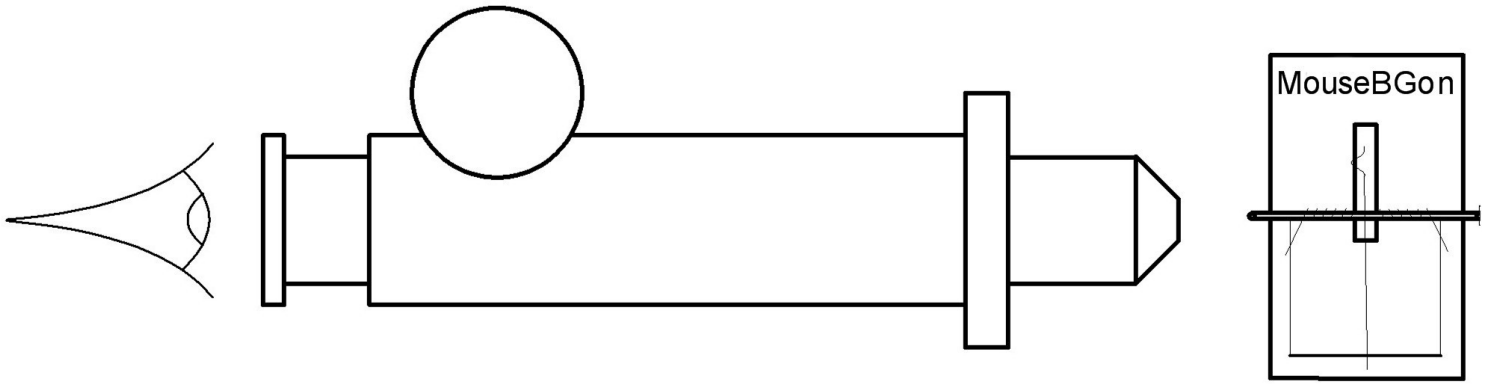
Half of stars have lifetimes over 10 billion years

So nothing (obviously) special about our constants



Where it's at today

Biology



Nixon-like statement:

I am not a biologist

Irreducible complexity (I)

System has 3 or more well-matched interacting parts

Cannot work without any one of those parts

Cannot have evolved gradually

Standard example or analogy is the mousetrap (Michael Behe)

Problems with mousetrap analogy

Mousetraps propagate by blueprints

Exact specifications

Finite changes, if any

All *mousetraps* of given generation identical

Mice propagate by recipe

Not blueprints

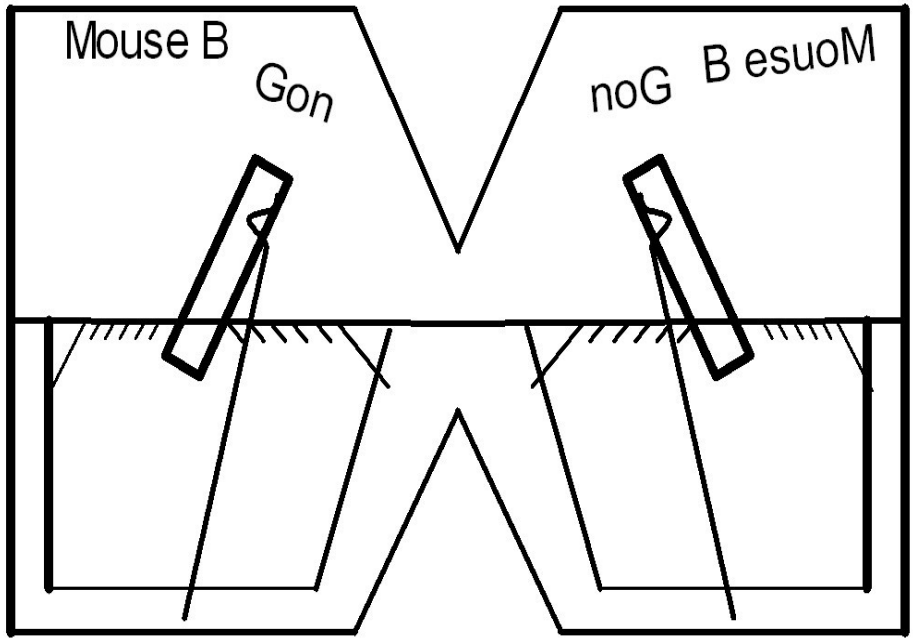
Possibility of *error*

Infinitesimal changes

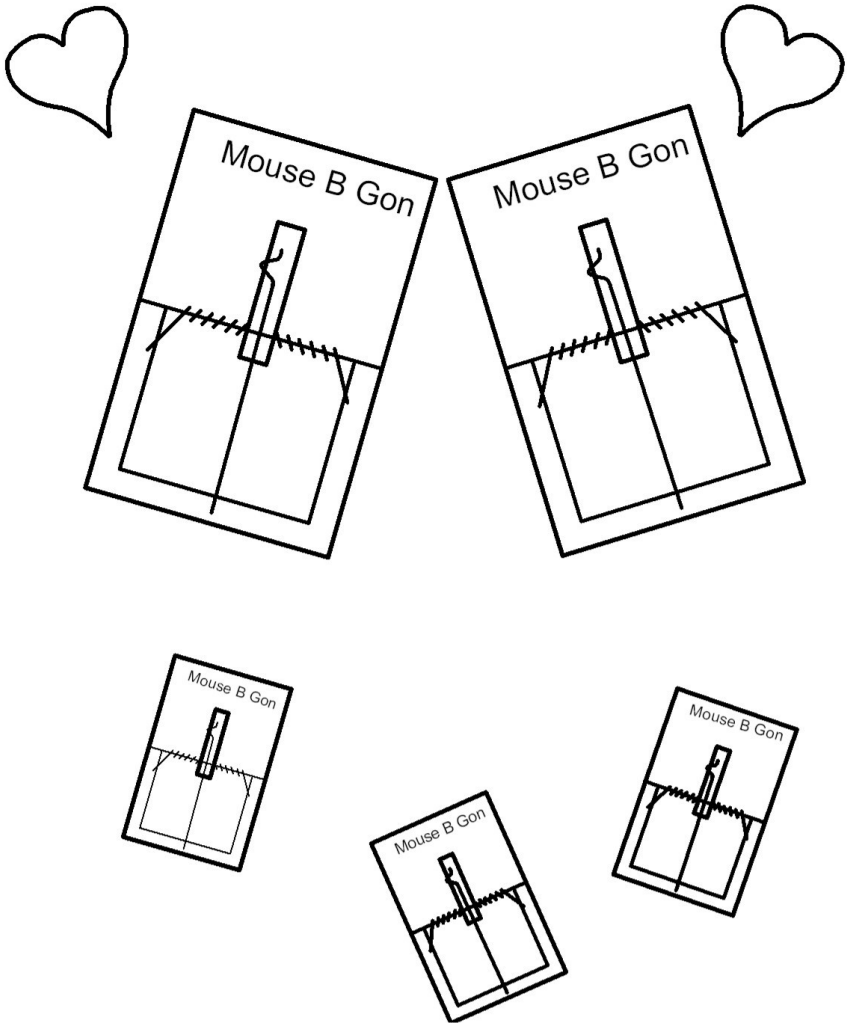
All *mice* of given generation different

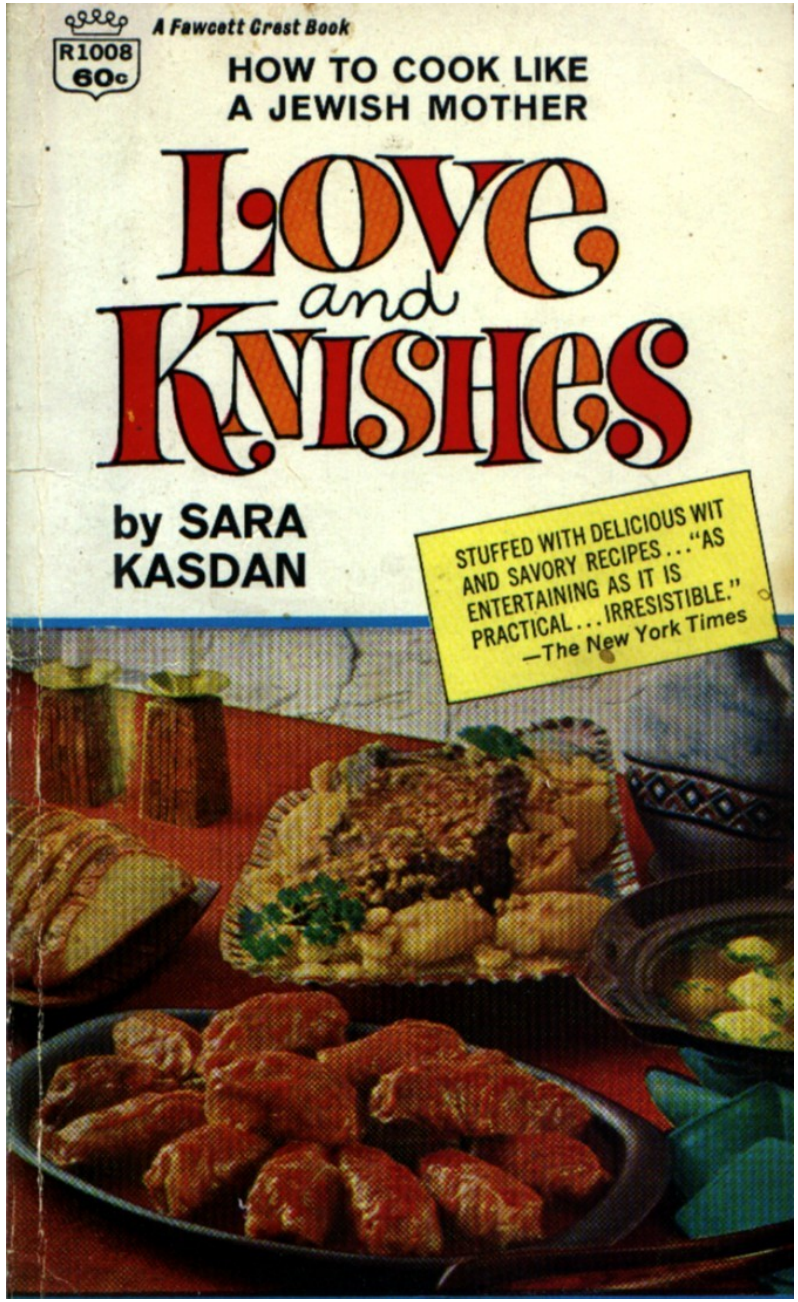
Mousetraps do not ...

... commit mitosis ...



... or commit matrimony ...





...or reproduce by passing a

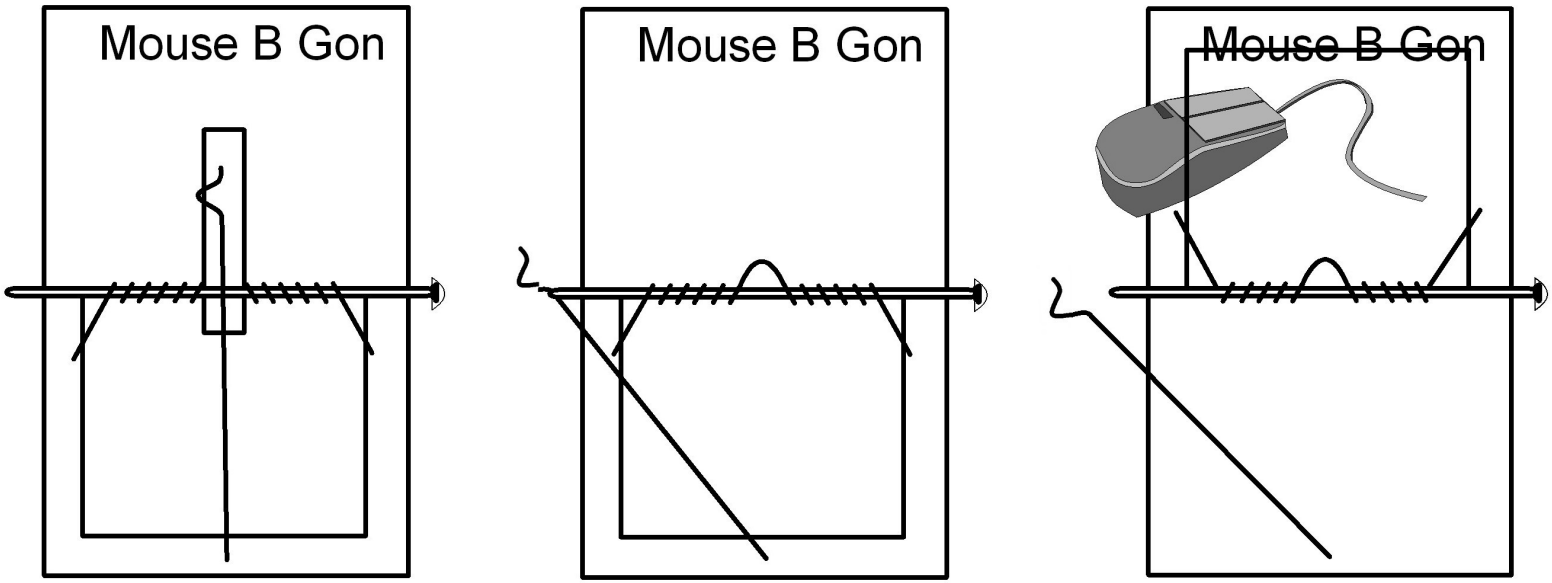
(sometimes flawed)

cookbook on to their

descendants

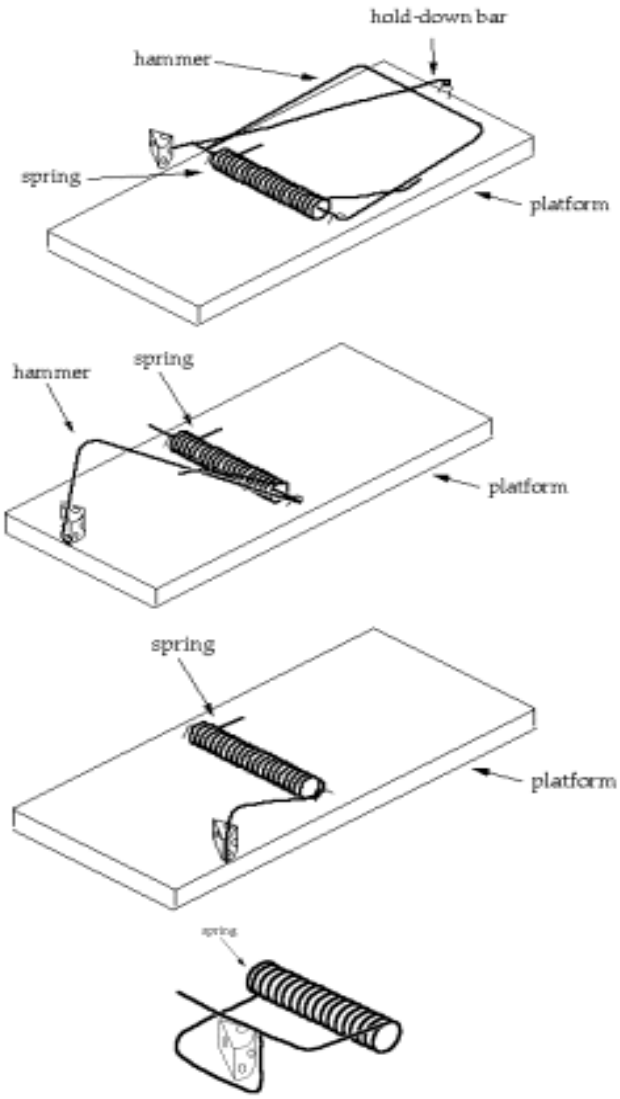
But worse

Irreducible complexity is red herring



Parts can be removed, modified, trap still made to work

John MacDonald's mousetraps



Removed parts one by one

Work upward — mousetrap evolves, parts coevolve, become irreducibly complex

Irreducible complexity is *expected result of evolution*

And worse

Irreducible complexity is often indicator of *bad design* not good design

Good design uses *redundancy* so system will function if damaged

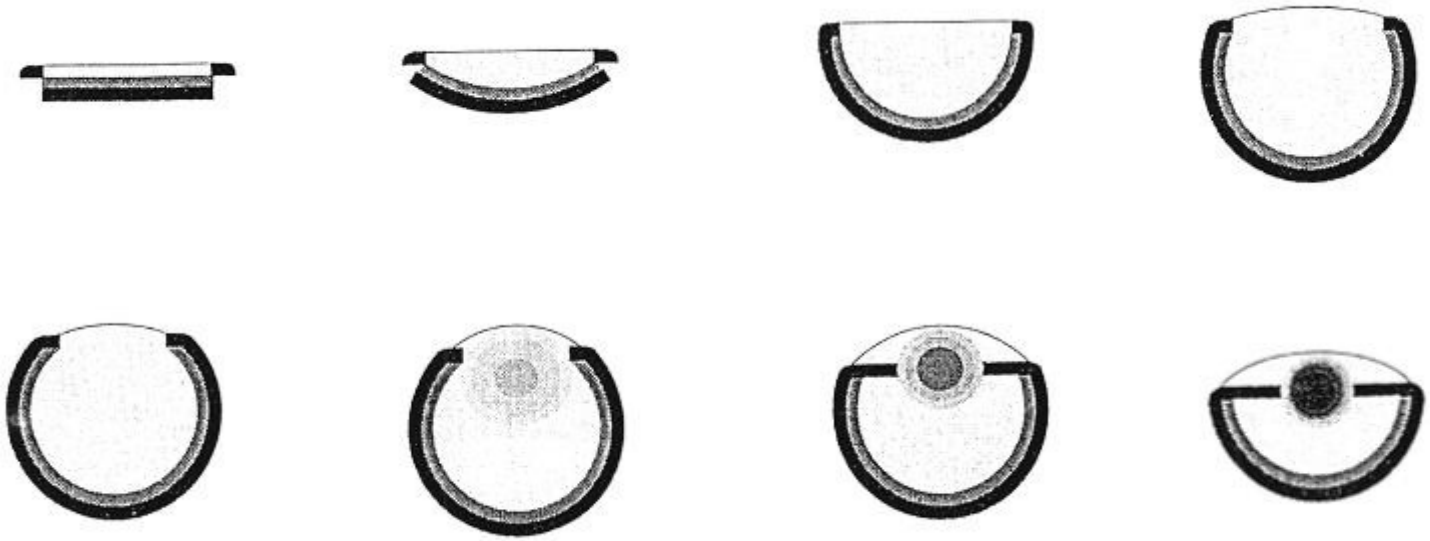
Irreducible complexity (II)

The *What-good-is-half-an-eye (ha, ha, ha)?* argument:

Eye has many parts	Fact
Cannot work with any one missing	Well, uh, ... (aphakia, achromatopia)
Could not have evolved by gradualism	Supposition (*ad hoc* hypothesis)
God did it!	Leap of faith

Discredited by research into evolution of eye

Stages of evolution of eye



[Nilsson and Pelger]

Reconstructed from phylogenies (no fossils)

Simulation shows “camera eye” can evolve in 300,000 years

So *move down* a notch to the cell

Irreducible complexity (III)

Flagellum has many parts	Fact
Cannot work with any one missing	For argument's sake: Fact
Could not have evolved gradually	Supposition (*ad hoc* hypothesis)
God did it!	Leap of faith (about which they are somewhat coy)

Intelligent-design creationism is the old God-of-the-gaps *argument in molecular clothing*

Flagellum

Set of well-matched interacting parts

Motor — Shaft — Propeller

that contribute to the *basic function*

So is irreducibly complex

But is it?

No *one* flagellum, no one basic function

Used for adhesion, parasitism

Many kinds of motility systems

Eubacterial and archaebacterial flagella not homologous (no common origin)

Archaebacterial flagella have 2 parts, are homologous to secretion systems

Secretion → gliding motility → rotating swimming–secretory system (= flagellum)

Behe's other poster child

Blood clotting system ─ not exactly irreducibly complex

Cetaceans lack Factor XII

Don't bleed to death at birth

Knockout mice lacking fibrinogen (clot maker),

plasminogen (clot buster) survive in lab

Don't bleed to death at birth

And besides, biologists have good idea how system evolved,

based on phylogeny

How blood-clotting system may have evolved

Plugging up with blood cells (low blood pressure)

Plugging + coagulation (crustaceans)

Plugging + multistep coagulation cascade (horseshoe crabs)

And remember:

Irreducible complexity is expected result of evolution

Thanks to Ian Musgrave, U of Adelaide;

Pete Dunkelberg, Valencia Community College;

Nick Matzke, NCSE, for their advice.

Levels of reality

Electron, atom, molecule, crystal, ...

Emergent properties result from

Self-organization

1 water molecule is not wet

Assembly of water molecules wet, viscous, etc.

Wetness, viscosity are emergent properties

Levels more or less independent of each other

Atomic physics irrelevant if you want to design water wheel or pipe network

No one level is more fundamental than any other

↑ Organism ↑ Organ ↑ Cell ↑ Organelle ... ↑ Molecule

God-of-the-gaps argument

Find gap in knowledge

Exploit it, claim God did it

Inherently nonfalsifiable

- Drop back 1 level when caught
  - Falsified at level of organism (eye), so
  - Drop back to level of cell (flagellum)

At cellular level

- *False dichotomy* between design & natural selection
- Combination of self-organization & natural selection?

Dembski's Error

Genome contains complex, specified *information – a meaningful message*

Complex: Requires >500 bits to describe

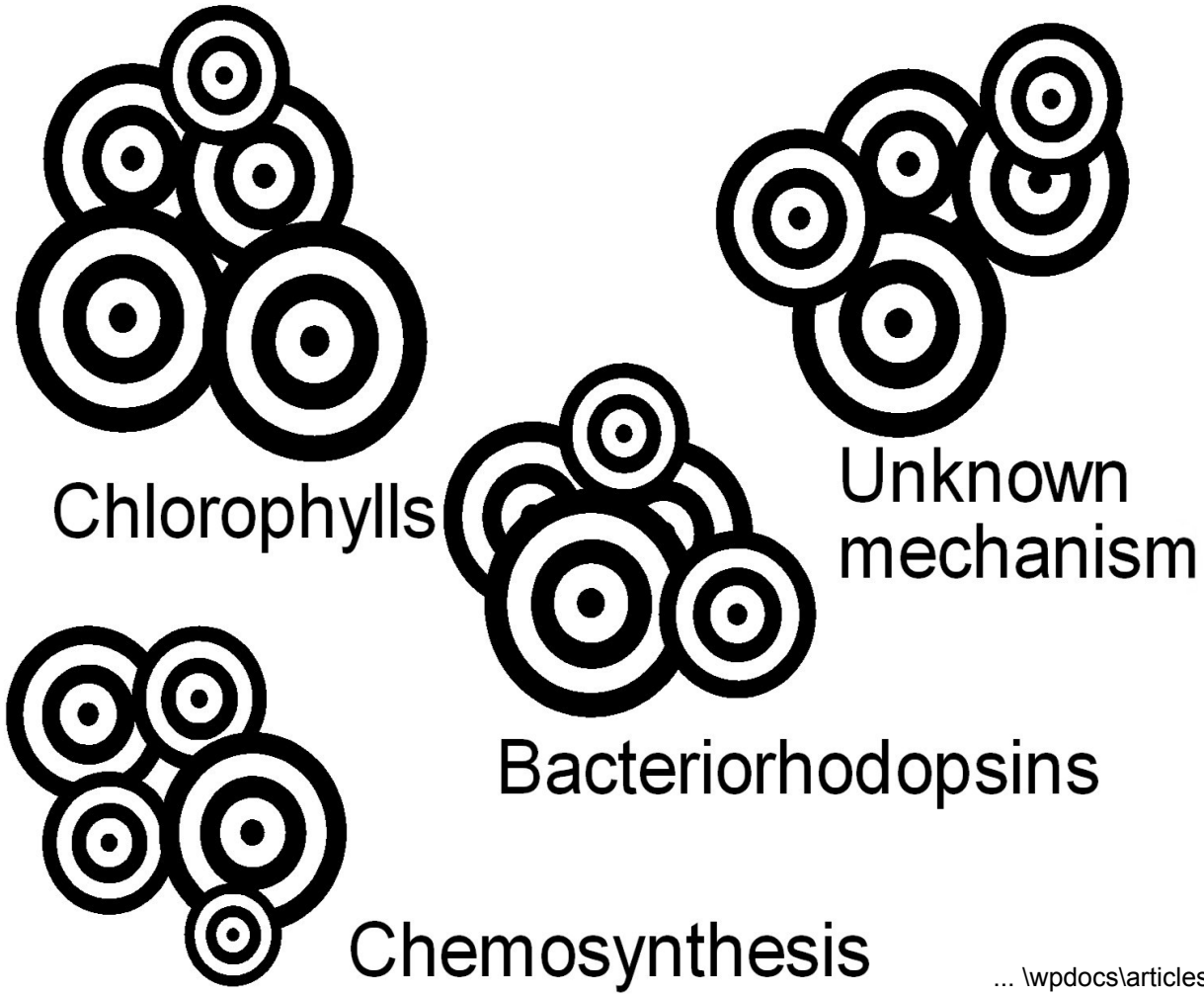
Specified: Conforms to a recognizable pattern

(meaningful message)

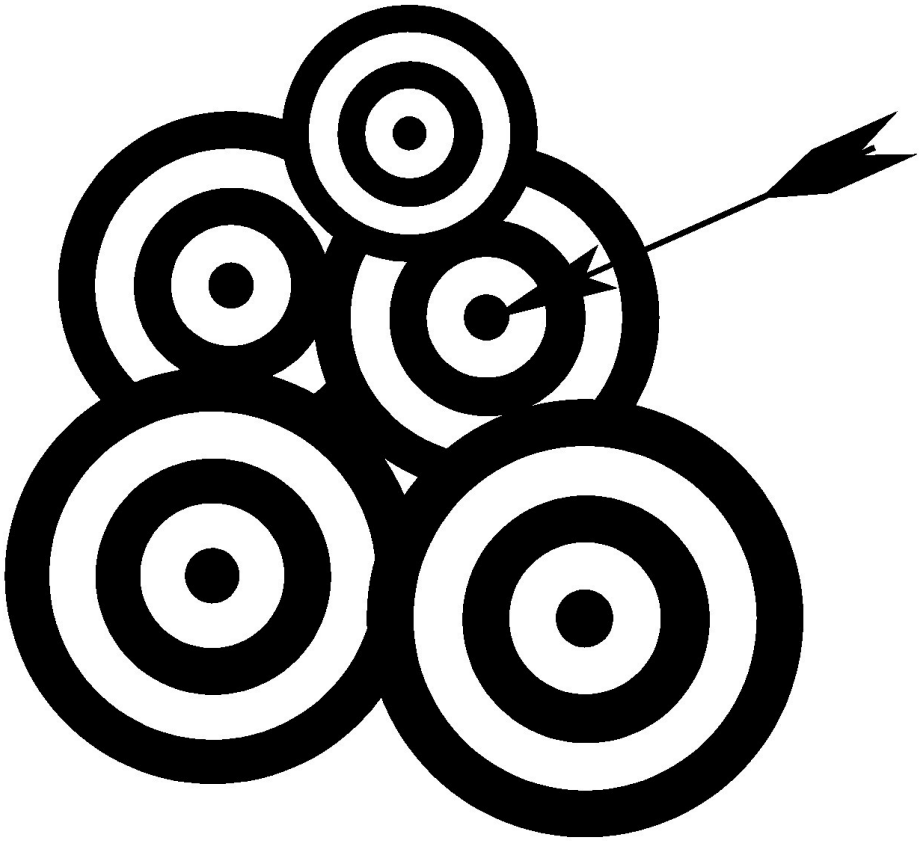
Dembski's Example of the Archer

Archer repeatably hits target → Design

What Dembski's target really looks like



Dembski's idea of a bull's-eye



How did specified information get into the genome?

According to Dembski:

Any event can be explained by one and only one of

Physical law or *regularity*

Chance

(False dichotomy between law and chance)

Design

Uses *explanatory filter* to “show” that

Complex, specified information cannot be created by

natural processes

Dembski's Explanatory Filter

High probability → Law

↓

Intermediate probability → Chance

↓

Low probability → Design

How high is high? *Doesn't say*

How high is intermediate? *Doesn't say*

How low is low? 10^{-150}, or *500 bits*

Dembski: Evolution unaided cannot generate 500 bits of

meaningful message

Quantity of information on single typed page

Side information

Archeologists do not use explanatory filter

- They use *side information* (Dembski's term):
  - Knowledge of designer, typical artifacts
  - Recognizable tool marks
  - Paint
  - Drawings
- Build circumstantial case

Pattern recognition

How do we know an arrowhead is an artifact?

- We compare with other similar specimens known to be arrowheads
- We do not do pattern recognition but *pattern matching* using side information

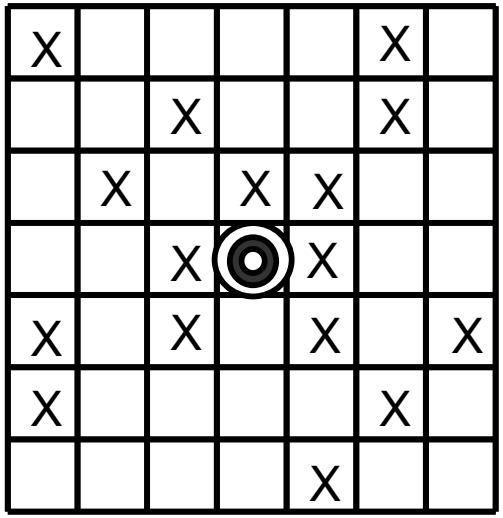
How would future alien archaeologist know that weathered bust of William Dembski was artifact if it had never seen human face before?

- Not with explanatory filter!

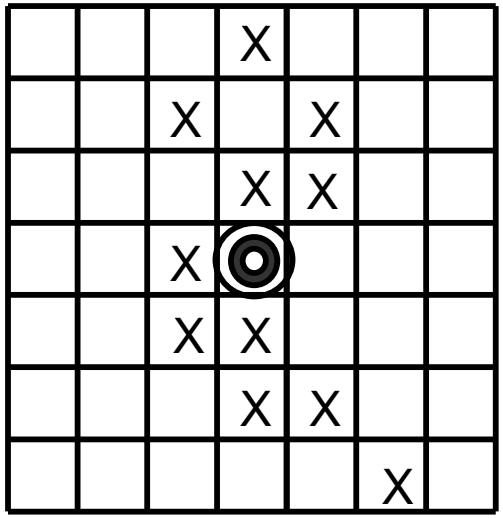
Why naïve probability arguments fail

Lob balls randomly at target

Expect random distribution:

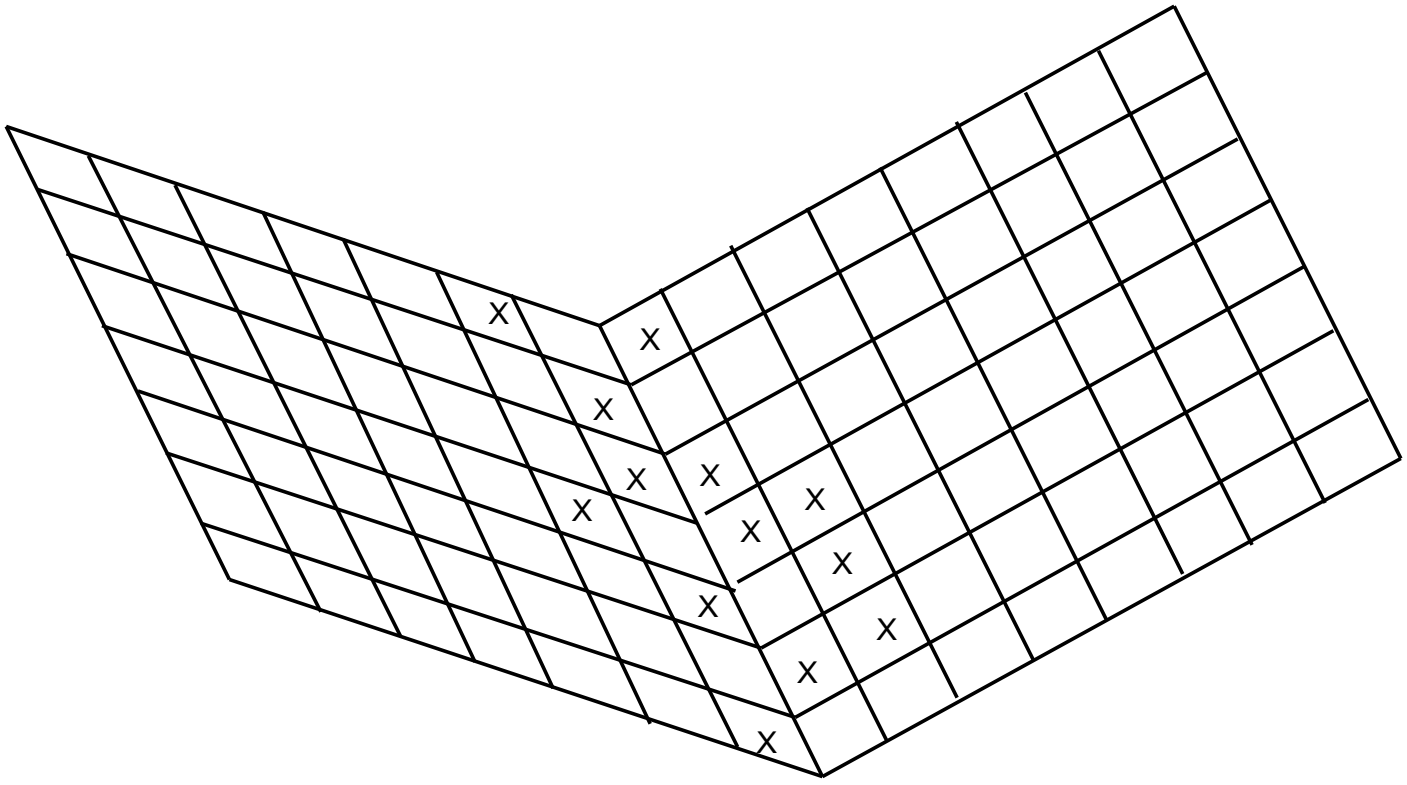


Get ordered pattern:



How can it happen?

The invisible hand



Probability alone is not enough

How to generate structures

Dembski thinks

Random mixing —Small probability→ Structure

Alas,

Random mixing → Uniform mixture

In fact,

Random mixing + Other processes → Structure

The Argument from SETI

Rhetorical question:

If you were looking for ETI, what would you look for?

Rhetorical answer:

Complex, nonrandom radio signal

Rhetorical AHA:

Aha! Gotcha!

Reply:

SETI tacitly searches for more or less human intelligence

So does Dembski's explanatory filter

Entropy

Toss 5 coins

2^5 = 32 possible combinations:

H H H H H

H H H H T

H H H T H

H H H T T

etc., etc., and so forth

All combinations are equally likely

Communications

I send you info about coins:

1 bit for each coin

5 bits altogether

5 is *entropy* of communication channel

Coin-tossing machine

2 coins get stuck *by chance*

T ***H*** T H ***H***

H ***H*** H T ***H***

T ***H*** T T ***H***

H ***H*** H H ***H***

There are now only $2^3 = 8$ *combinations*

I now need to send only 3 bits

2 bits of information *reside in the coins* (entropy reduced by 2)

Information in system has been *increased by chance*

Natural selection

Ensemble of coin-tossing machines

They can reproduce (advanced alien civilization made them)

Survival advantage to increasing (say) *H*

Odds are 1 in 32 of tossing all H

But, in later generations,

2 coins stuck on *H* *Odds are 1 in 8*

3 coins stuck on *H* *Odds are 1 in 4*

4 coins stuck on *H* *Odds are 1 in 2*

5 coins stuck on *H* *Odds are 1 in 1*

Fitness has been improved, and the “genome” is specified

Specified complexity (Dembski)

Specified information with >500 bits

Cannot be created by natural causes

Not within time allowed (age of earth)

How can you generate specified complexity in excess of 500 bits in a short time?

Dembski says you can’t

Well, you can!

Incorporation of one organism into another

- Mitochondria
- Chloroplasts
  - Widely accepted to have been independent organisms and incorporated into cell

Gene duplication followed by mutation

It's easy to do

Duplication of genes

400 bits + 300 bits = 700 bits

or

100 bits + 100 bits = 200 bits

200 bits + 100 bits = 300 bits

⋮

500 bits + 100 bits = 600 bits

... 700, 800, ..., who knows?

Agglomerated complexity (I can make up terms too)

2 or more units that have

Less than 500 bits each and

Add up to *more than 500 bits*

Without knowing detailed history, impossible to distinguish

specified complexity

from

agglomerated complexity

I can't You can't Dembski can't

Argument from CSI is falsified

Dembski's God of the gaps is filled

Natural selection gradually *modifies* genome using

combination of law and chance:

Law = coin-tossing machine

Chance = coin sticking on *H randomly*

Separating law and chance is a false dichotomy

Thanks to

Chris Debrunner, CSM, and

Vic Stenger, U of Colorado,

for their help!

Fitness functions

Definition of *fitness*:

Ability to survive and reproduce (roughly)

Example: Shrew has nearly optimum weight for its shape, habitat, life style (so does elephant)

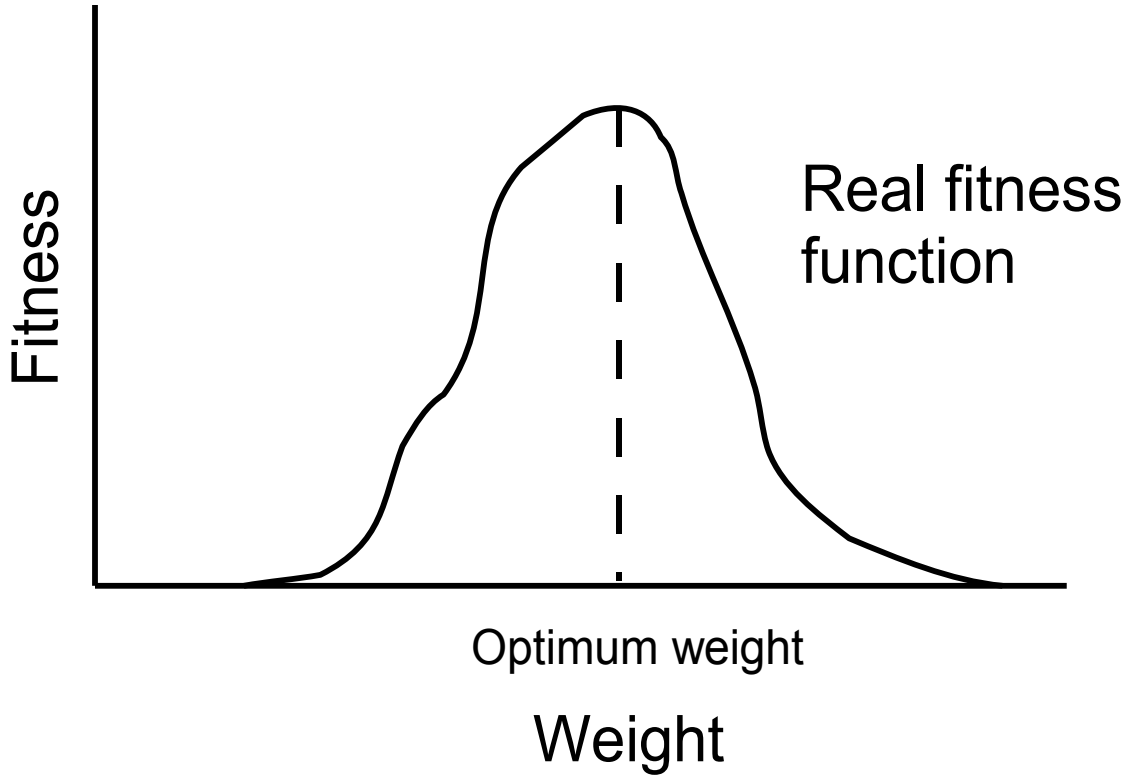
Too small → inability to survive drought (say)

Too large → inability to find enough food (say)

Fitness function is smooth but bounded

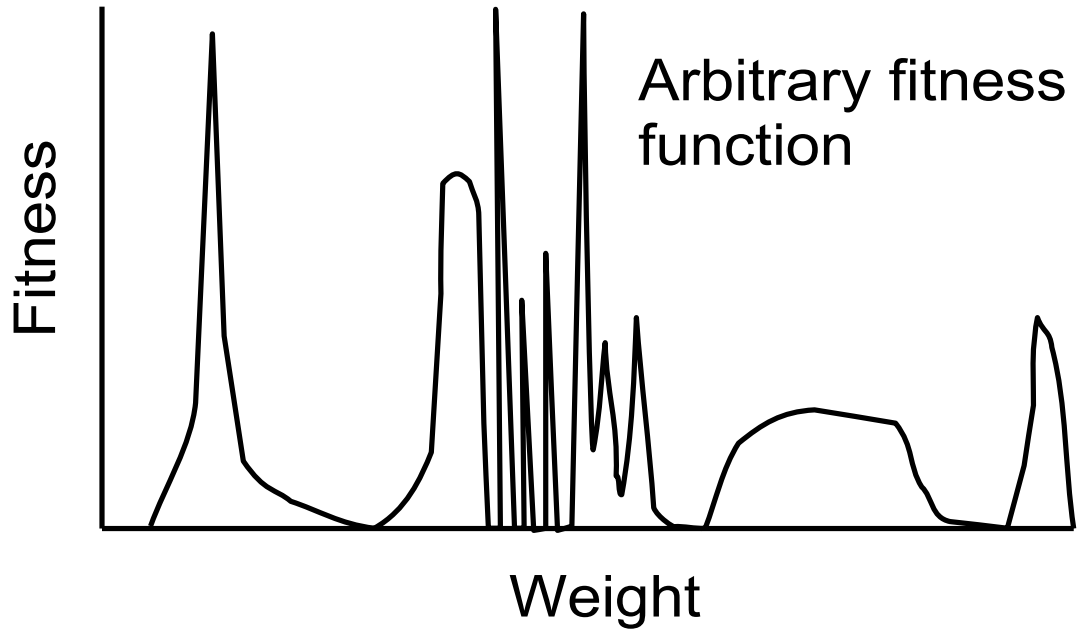
We see continuous range of sizes

Not all have same genome, yet survive, reproduce



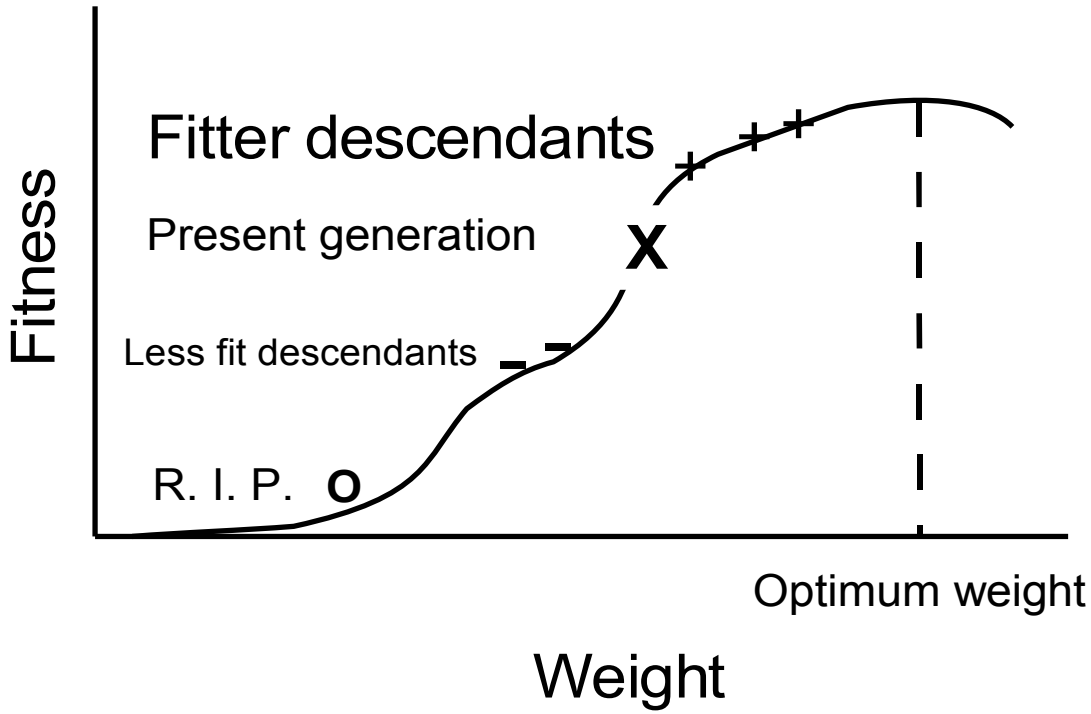
Fitness function cannot be arbitrary (random)

Or we'd see giant shrews, itty-bitty elephants



Hill climbing

More of fitter descendants survive, reproduce; population increases in average fitness



No Free Lunch theorems do not disprove evolution

Dembski: No strategy for finding a peak is better than a random search (wrong)

Perakh: No strategy for finding a peak is better than a random search *when averaged over all possible fitness landscapes* (right)

Most fitness landscapes not smooth, not realistic

Realistic fitness landscapes smooth

Evolutionary algorithms work better than random search on realistic fitness functions

Aside on theology

Intelligent-design creationism undermines theology:

Undercuts faith

(To me, a virtue)

Looks bad when caught

Theists should oppose intelligent-design creationism as much as naturalists

Should it be taught in schools?

No

Not mainstream science

No reputable supporters

Not even wrong

Interest in intelligent design is political not scientific

Not obsolete theory like

Heritability of acquired characteristics

Opportunity for abuse

Introduction of religion into science class

Conclusions

Intelligent-design creationism is

- Pseudoscience
- Based on
  - False analogy (Behe and Dembski's versions)
  - Incorrect understanding of entropy, probability
    - (Dembski's version)
- Scientifically uninteresting
- Religiously motivated
  - God-of-the-gaps argument
- Bad for science
- Bad for theology