

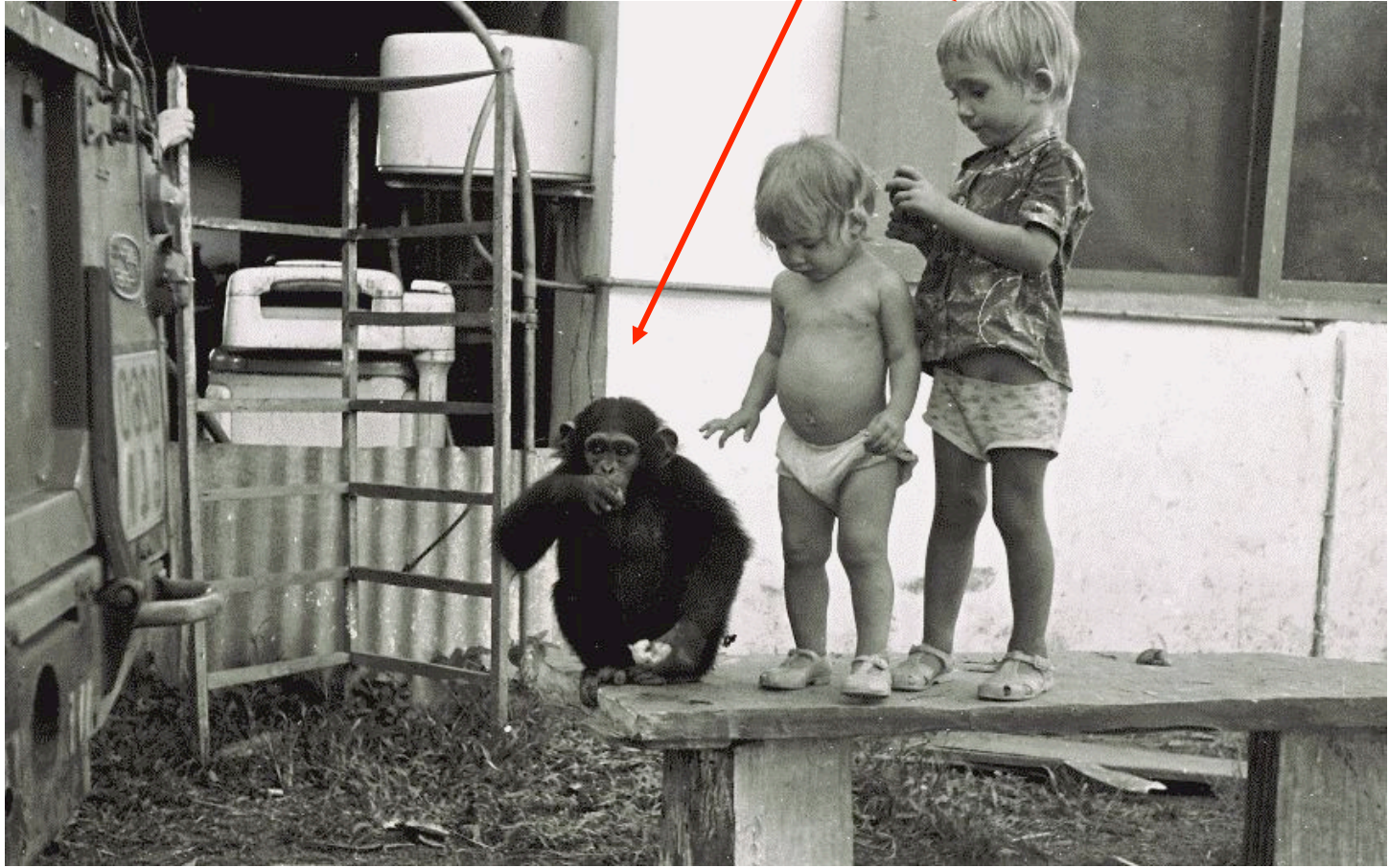
The limits of science and the reasons for God

Dr. Ard Louis
Department of Physics
University of Oxford

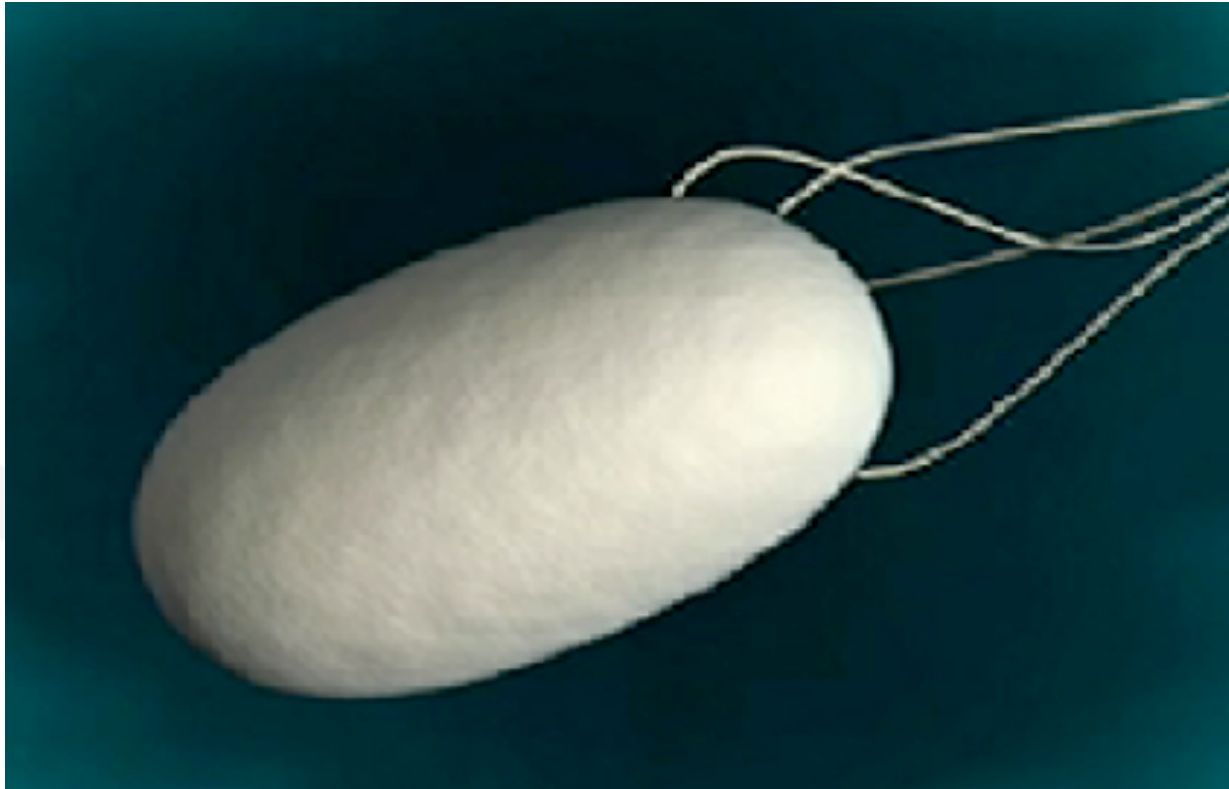


We share 15% of our genes with E. coli
" " 25% " " " yeast
" " 50% " " " flies
" " 70% " " " frogs
" " 98% " " " chimps

what makes us different?



Biological self-assembly

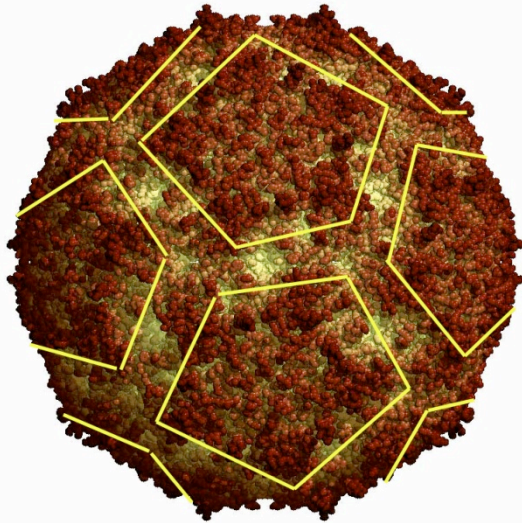


<http://www.npn.jst.go.jp/> Keiichi Namba, Osaka

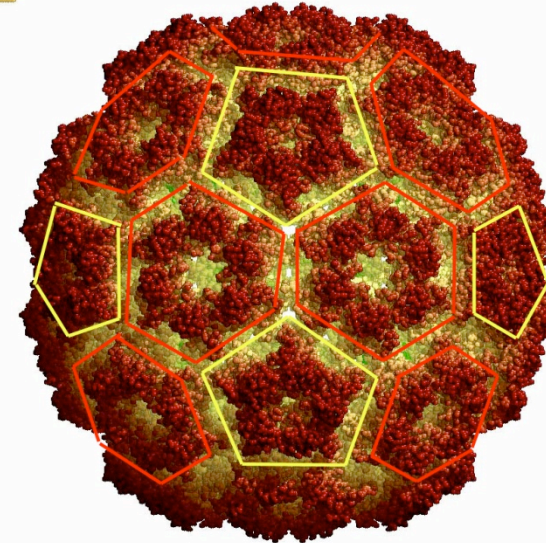
- Biological systems **self-assemble** (they make themselves)
- Can we understand?
- Can we emulate? (Nanotechnology)

Virus self-assembly

20Å Galleria mellonella densovirus PDB_ID: 1DNV



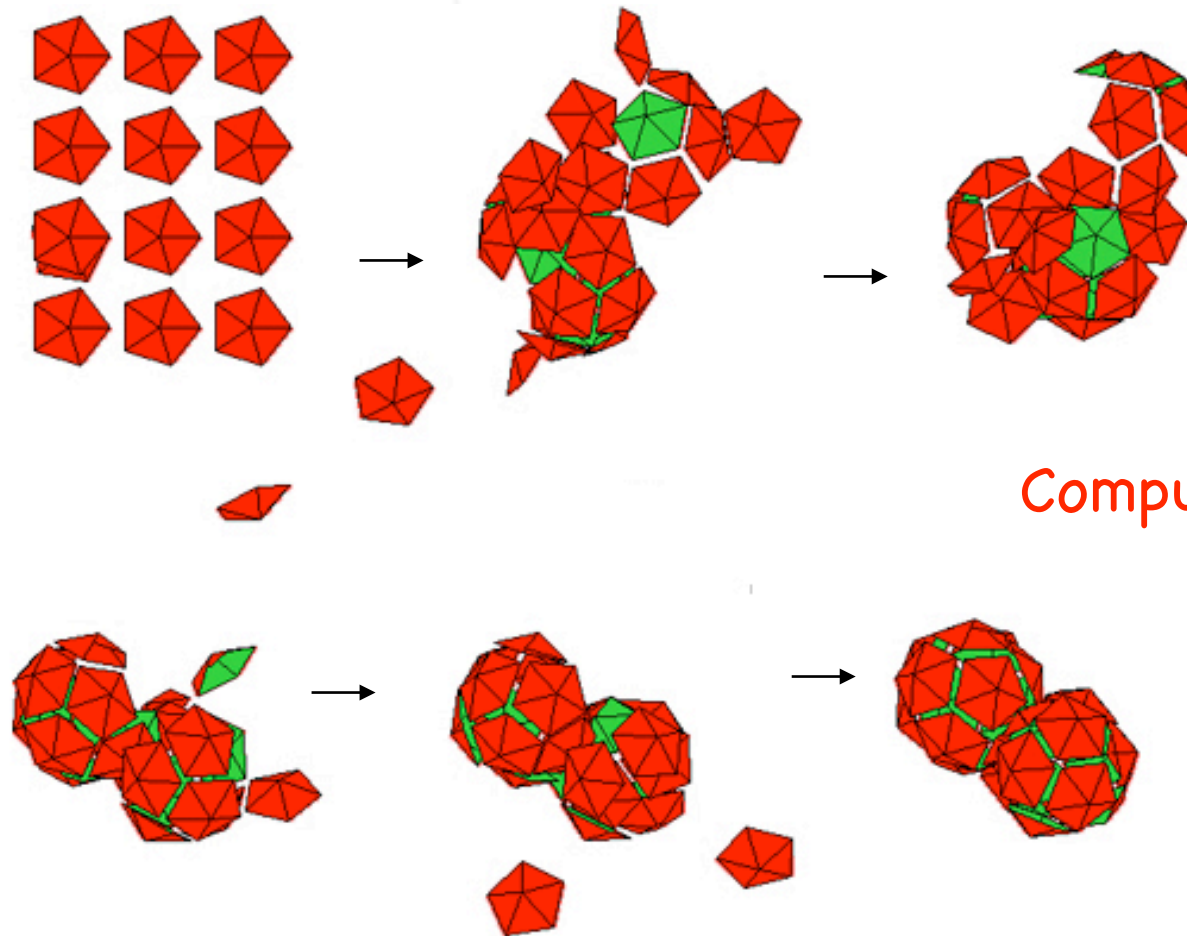
20Å Cucumber mosaic virus PDB_ID: 1F15



viruses

- Self-assembled from identical subunits (capsomers).

"computer virus" self-assembly

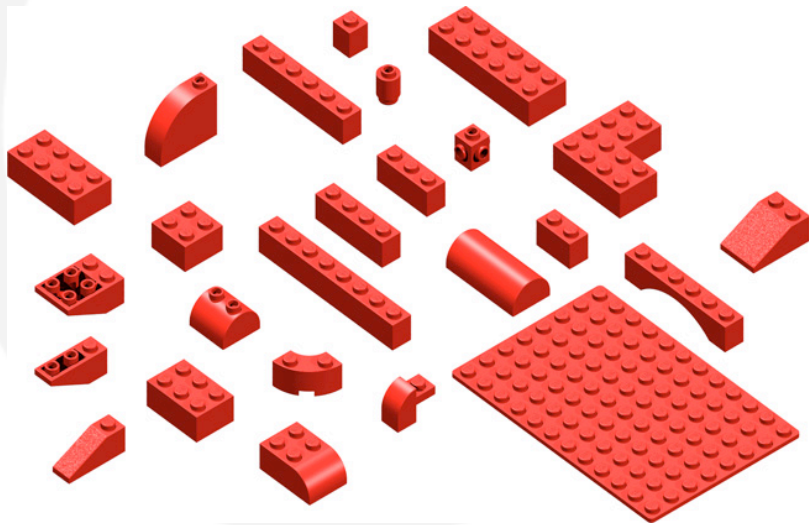


Computer viruses?

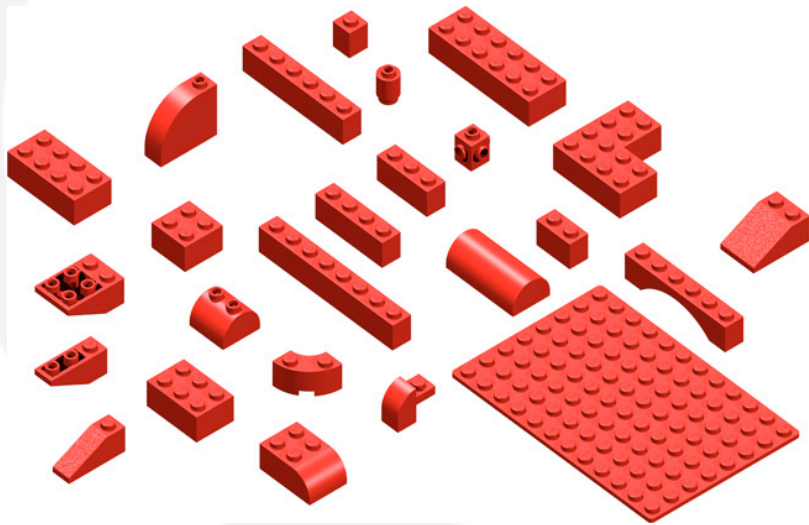
Monte-Carlo simulations: [stochastic optimisation](#)

<http://www-thphys.physics.ox.ac.uk/user/IainJohnson/>

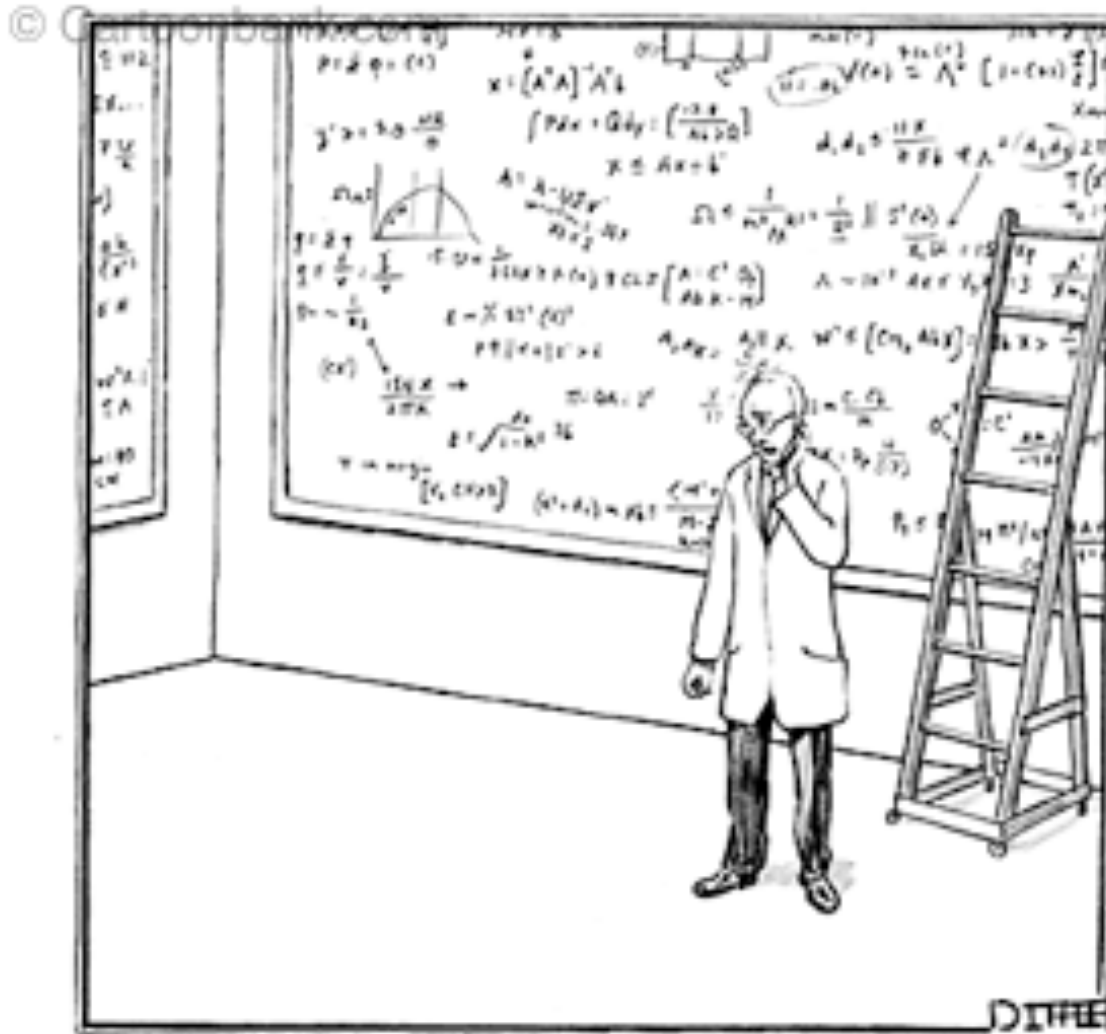
Self-assembly with legos?



Science is fun!



Science is fun!



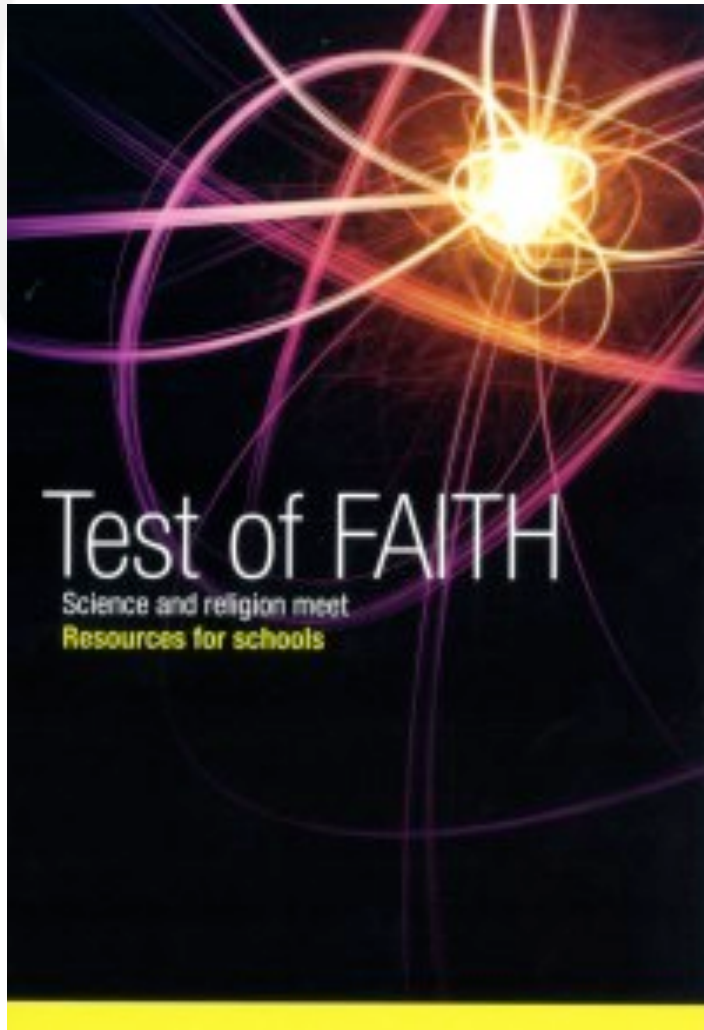
"I just figured out why we've never had girlfriends."

Will science explain everything?

Will we one day understand how the flagellum assembles or evolves? - yes -

Will science explain everything? - lets see -

www.testoffaith.com/



Book including

[Dr Francis Collins,](#)
[Prof. Alister McGrath,](#)
[Dr Ard Louis,](#)
[Dr Jennifer Wiseman,](#)
[Prof. Bill Newsome,](#)
[Rev. Dr. John Polkinghorne,](#)
[Rev Dr Alasdair Coles,](#)
[Dr Deborah B. Haarsma,](#)
[Prof. Rosalind Picard,](#)
[Prof. John Bryant](#)

--Study guide

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DVD

Outline

•Does science have limits?

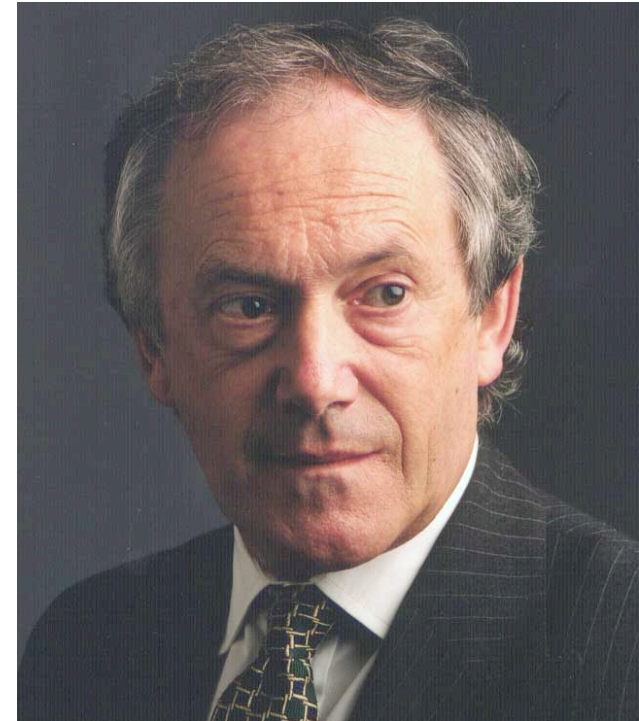
•Scientific method and tapestry arguments

•Questions beyond science?

•The bigger picture

Science without limits?

Scientists, with their implicit trust in reductionism, are privileged to be at the summit of knowledge, and to see further into truth than any of their contemporaries... there is no reason to expect that science cannot deal with any aspect of existence... Science, in contrast to religion, opens up the great questions of being to rational discussion ... reductionist science is omniscient ... science has never encountered a barrier that it has not surmounted or that we can at least reasonably suppose it has the power to surmount.... I do not consider that there is any corner of the real universe or the mental universe that is shielded from [science's] glare"

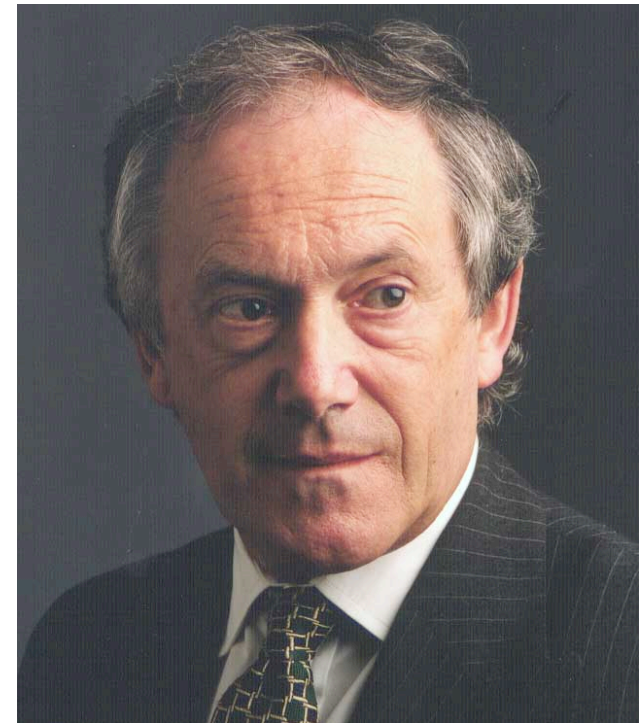


Prof. Peter Atkins
Oxford U

Science without limits?

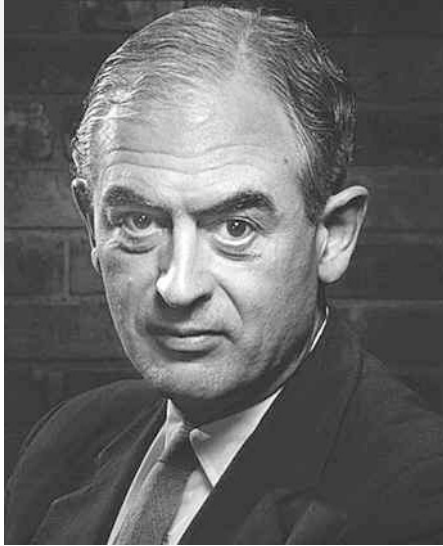
"...although poets may aspire to understanding, their talents are more akin to entertaining self-deception. Philosophers too, I am afraid, have contributed to the understanding of the universe little more than poets ... I long for immortality, but I know that my only hope of achieving it is through science and medicine, not through sentiment and its subsets, art and theology"

--The Frontiers of Scientific Vision, Ed. J Cornwell.
Oxford University Press, Oxford, 1995



Prof. Peter Atkins
Oxford U

Limits of Science?



Sir Peter Medawar
1915-1987

" That there is indeed a limit upon science is made very likely by the existence of questions that science cannot answer and that no conceivable advance of science would empower it to answer. These are the questions that children ask – the "ultimate questions" of Karl Popper. I have in such questions as:

How did everything begin?

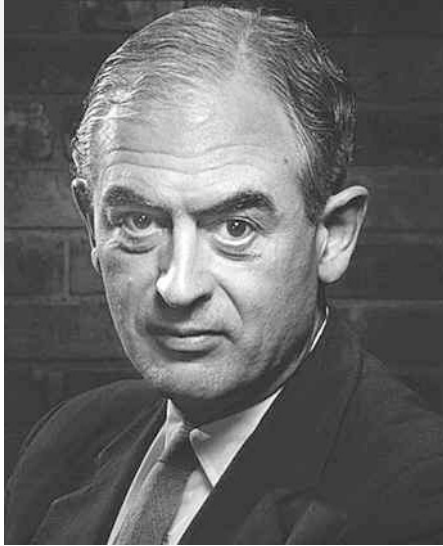
What are we all here for?

What is the point of living?"

" It is not to science, therefore but to metaphysics, imaginative literature or religion that we must turn for answers to questions having to do with first and last things."

-- Sir Peter Medawar, The Limits of Science, (Oxford University Press, Oxford (1987))

Limits of Science?

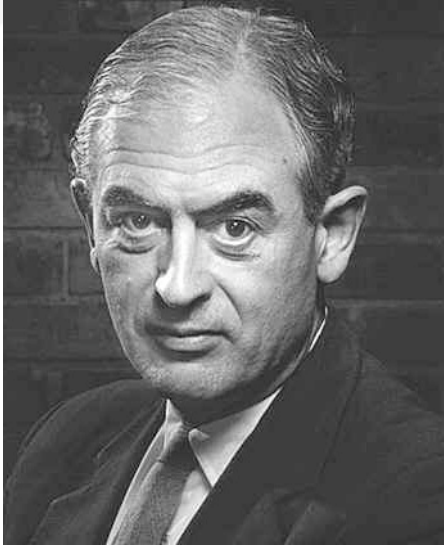


Sir Peter Medawar
1915-1987

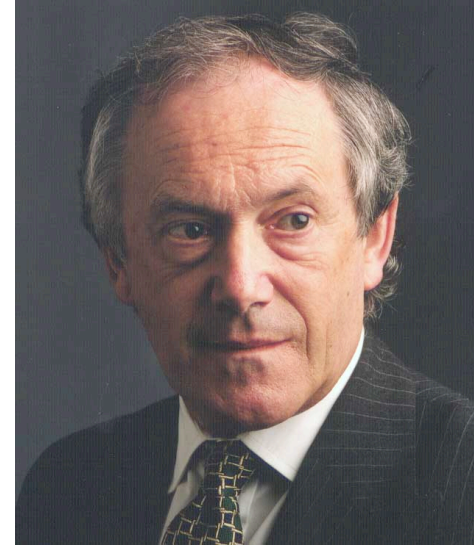
- *Science is a great and glorious enterprise - the most successful, I argue, that human beings have ever engaged in. To reproach it for its inability to answer all the questions we should like to put to it is no more sensible than to reproach a railway locomotive for not flying or, in general, not performing any other operation for which it was not designed.*

-- Sir Peter Medawar, The Limits of Science, (Oxford University Press, Oxford (1987))

Limits are not a sign of weakness



v.s.



Oxford men disagree on: *How do I obtain reliable knowledge about the world?*

Outline

- Does science have limits?

- Scientific method and tapestry arguments

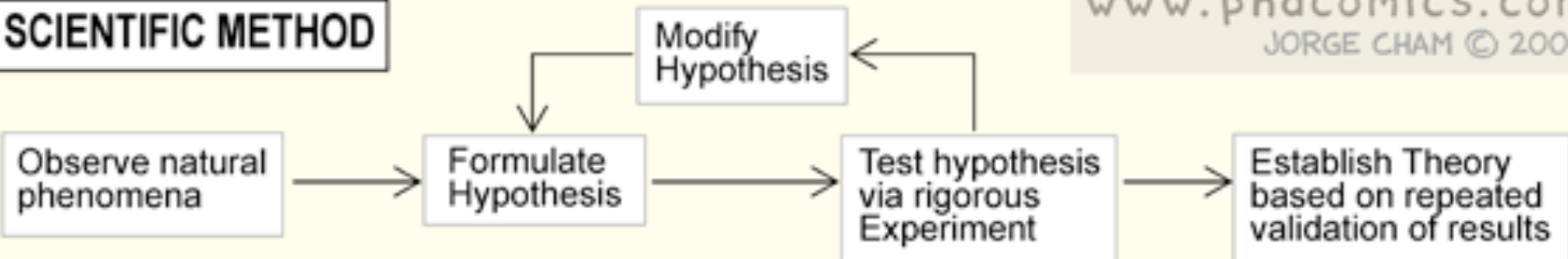
- Questions beyond science?

- The bigger picture

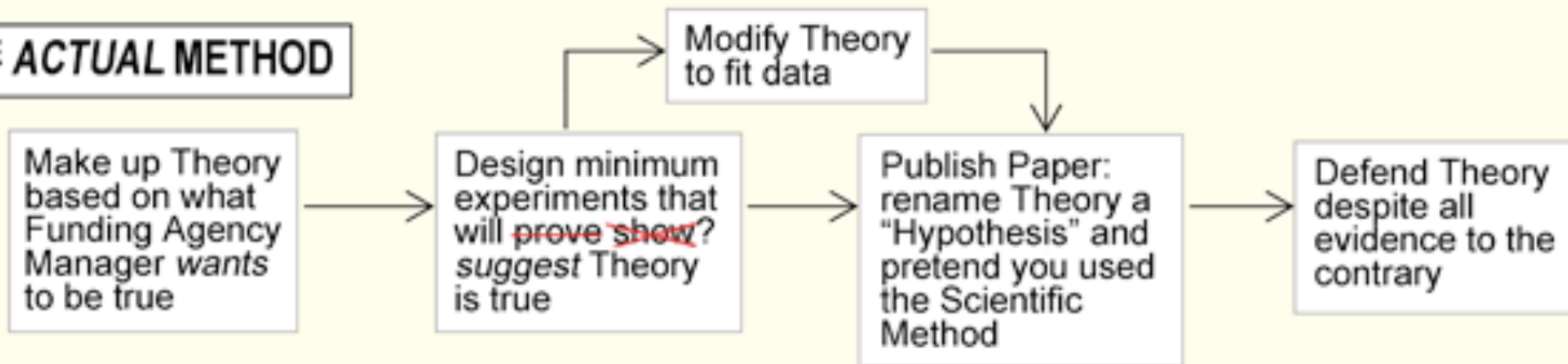
The scientific method ...

www.phdcomics.com
JORGE CHAM © 2006

THE SCIENTIFIC METHOD



THE ACTUAL METHOD





Paul Dirac
1902-1984

Unreasonable effectiveness of mathematics

Quantum Mechanics + Relativity = antimatter

$$H\psi(\mathbf{x}, t) = i\hbar \frac{\partial \psi}{\partial t}(\mathbf{x}, t)$$

Schrödinger equation (Quantum Mechanics)

+

$$E = \sqrt{(mc^2)^2 + \sum_{j=1}^3 (p_j c)^2}$$

Energy-Momentum (Special Relativity)

$$= \left(\alpha_0 mc^2 + \sum_{j=1}^3 \alpha_j p_j c \right) \psi(\mathbf{x}, t) = i\hbar \frac{\partial \psi}{\partial t}(\mathbf{x}, t)$$

Dirac Equation (1928)

$$\psi(\mathbf{x}, t) \equiv \begin{bmatrix} \psi_1(\mathbf{x}, t) \\ \psi_2(\mathbf{x}, t) \\ \psi_3(\mathbf{x}, t) \\ \psi_4(\mathbf{x}, t) \end{bmatrix}$$

Electrons

Positrons (antimatter) discovered 1932

Unreasonable effectiveness of mathematics, a wonderful gift which we neither understand nor deserve, E. Wigner (1960)

See also: "The applicability of mathematics as a philosophical problem", Mark Steiner HUP (1998);

Unreasonable effectiveness of mathematics



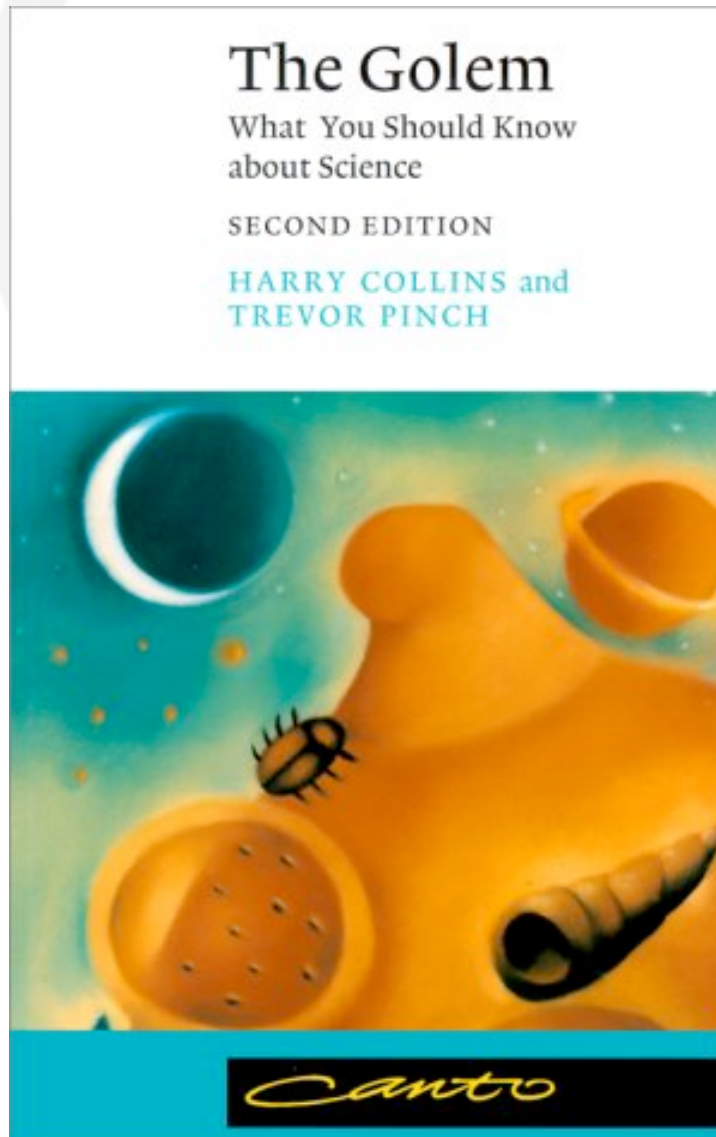
E. Wigner
1902-1995

"The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve"

--Eugene Wigner, *"The Unreasonable Effectiveness of Mathematics"* Communications in Pure and Applied Mathematics, vol. 13, No. I (February 1960).

See also: "The applicability of mathematics as a philosophical problem", Mark Steiner HUP (1998)

Golemizations



- 1887 Michaelson Moreley experiment: no aether wind
- 1905 Einstein explains this with special relativity
- 1933 Dayton Miller and others redo experiment and do measure aether wind – but physicists still believe in relativity

The meaning of an experimental result does not, then, depend on the care with which it is designed and carried out, it depends upon what people are ready to believe.

■ *The Golem: what you should know about science*
Harry Collins and Trevor Pinch (CUP 1993)

Tapestry arguments



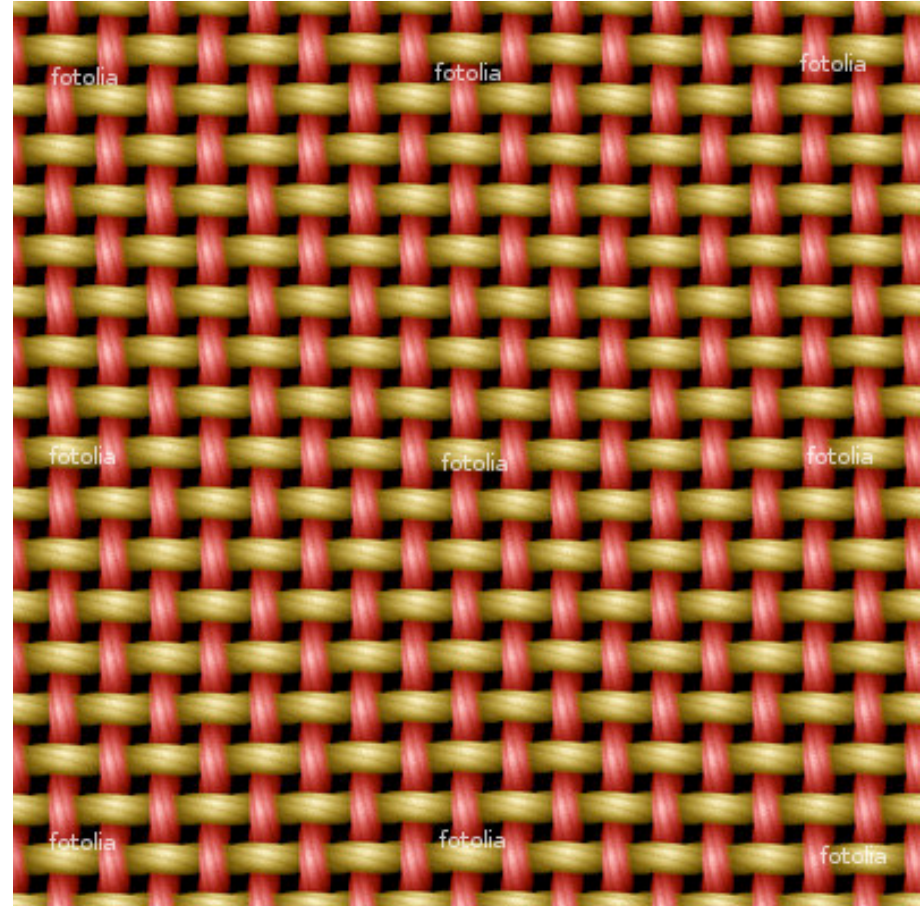
N. David Mermin
Cornell U

Science is a tapestry

-- you can pick at a few strings, but
that doesn't break the whole cloth

In this case: antimatter, hyperfine splitting, etc...

The Golemization of Relativity, David
Mermin, *Physics Today* 49, p11 April 1996



Science and Beauty



Henri Poincaré 1854 – 1912

A Scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing, life would not be worth living.

Dirac: the laws of nature should be expressed in beautiful equations.

Mathematical arguments in biology



E. Fox Keller
MIT

“To them [Biologists], experimental evidence, fallible as it might be, provided a far surer avenue to truth than did mathematical reasoning. Their implicit assumption seemed to be: How could one know one’s assumptions were correct? **Where, in a purely deductive argument, was there room for the surprises that nature might offer**, for mechanisms that might depart altogether from those imagined in our initial assumptions? Indeed for some biologists, the gap between empirical and logical necessity loomed so large as to make the latter seem effectively irrelevant.

• Evelyn Fox Keller, in “Making Sense of Life: Explaining Biological Development with Models, Metaphors, and Machines, HUP, (2002)

“A Clash of Two Cultures”, Nature **445**, 603 (2007)

You can’t ask those kinds of questions!!!!

(Biologist to AAL at “Protein-Protein Interaction Conf”, June 2004)

“Where are the equations” -- a physicist might ask

Tapestry arguments

- Basic scientific principles are shared across fields
- But what is considered “necessary” or “sufficient” for a (self-organised) tapestry varies from field to field (often unwritten)
 - E.g. the status of mathematical arguments in physics and biology
 - Cultural iceberg, above and below waterline
 - evidence: grant or paper review
 - demarkation problems
- mathematics->physics-> chemistry->biology->medicine-> psychology -> sociology -> anthropology
- Different cultures -- different levels of description
- Accuracy sometimes at the cost of imposing limits

Outline

- Does science have limits?
- Scientific method and tapestry arguments

• Questions beyond science?

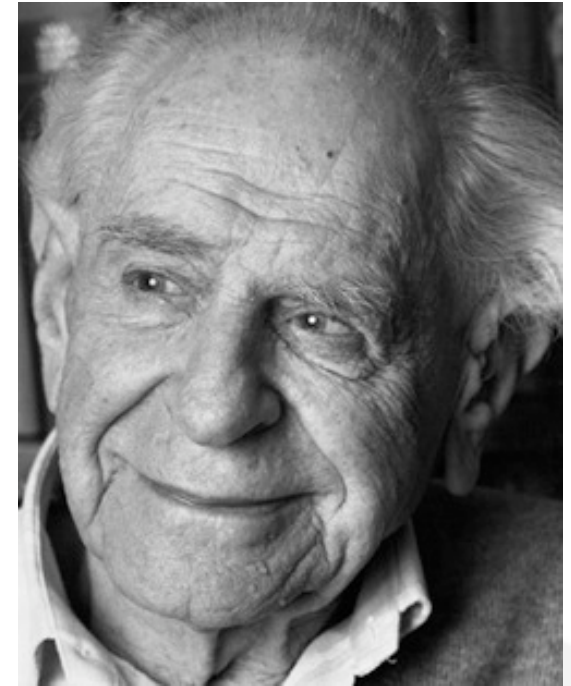
- Popper's ultimate questions:
 - *How did everything begin?*
 - *What are we all here for?*
 - *What is the point of living?*

- The bigger picture

Popper's ultimate questions

It is important to realize that science does not make assertions about ultimate questions – about the riddles of existence, or about man's task in the world The fact that science cannot make any pronouncements about ethical principles has been misinterpreted as indicating that there are no such principles while in fact the search for truth presupposes ethics.

-- Karl Popper, *Dialectica* 32:342 (1978)



Karl Popper
1902-1994

Key Metaphysical assumptions for science

- Uniformity
- Rationality
- Intelligibility
 - Applicability of mathematics

- Science has deeply Christian roots, e.g.
A. North Whitehead, Stanley Jaki; R. Hooykaas;

Only alternative to science is irrationality?



Bill Newsome
Stanford U.



Monument to irrationality?

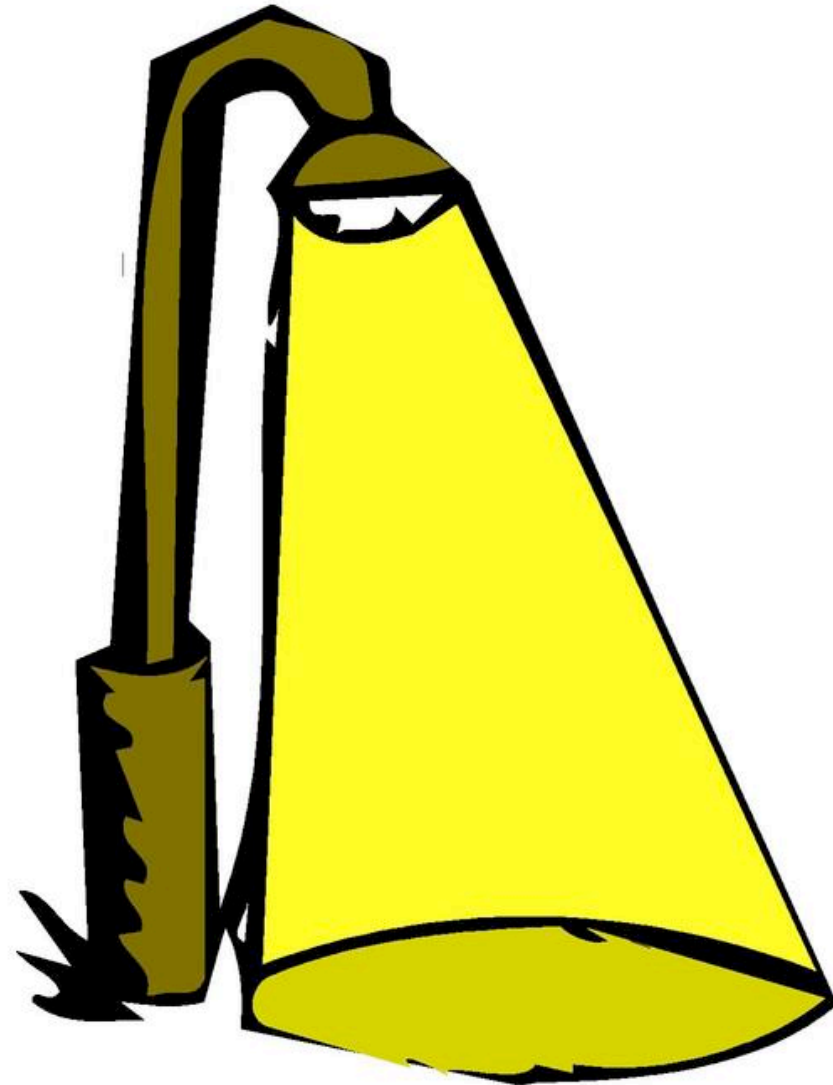
“The most important questions in life are not susceptible to solution by the scientific method”

Aside – Bill is the first religious believer quoted in this talk

Looking under a lamppost



Alvin Plantinga
Notre Dame U

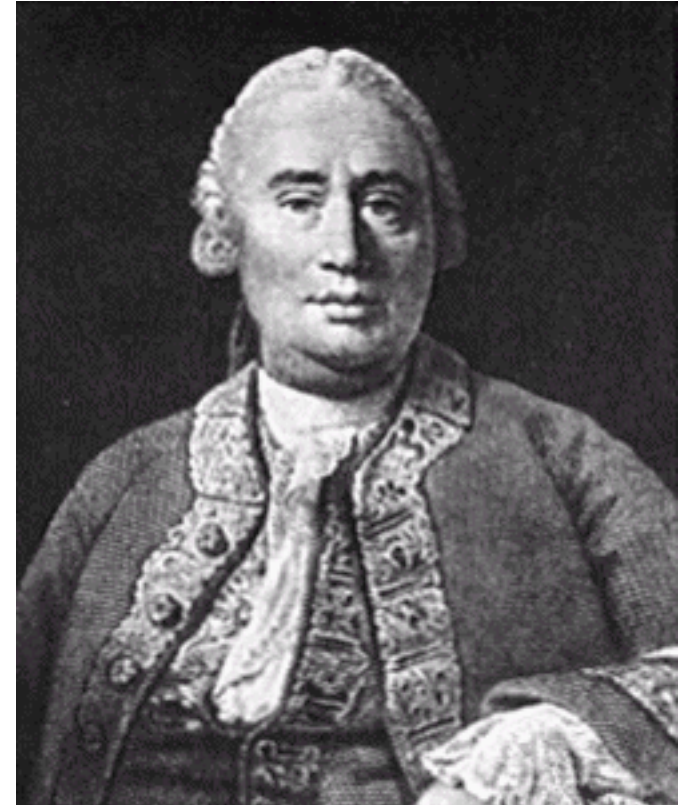


Questions of value

- What is the value of a human life?
 - chemist – value of the elements?
 - physiologist – size of your brain
 - psychologist – how smart you are
 - anthropologist – how the community values you
 - economist – how much economic value you produce

Deriving an ought from an is

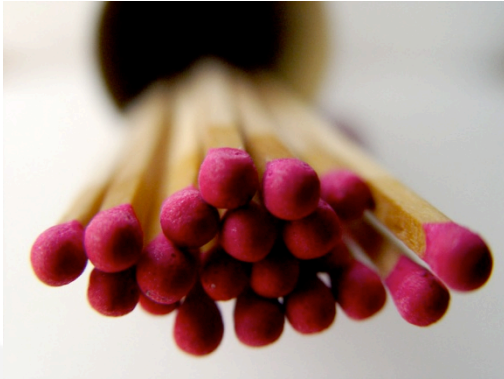
- when all of a sudden I am surpriz'd to find, that instead of the usual copulations of propositions, **is**, and **is not**, I meet with no proposition that is not connected with an **ought**, or an **ought not**.
- D. Hume in "A Treatise of Human Nature"



David Hume
(1711-1776)

Nothing Buttery

humans are collections of chemicals:



enough P for 2000 matches



enough Fe for 1 nail



enough Cl to disinfect
a swimming pool



enough fat to make
10 bars of soap

Nothing Buttery

humans are collections of chemicals:



enough P for 2000 matches



enough Fe for 1 nail



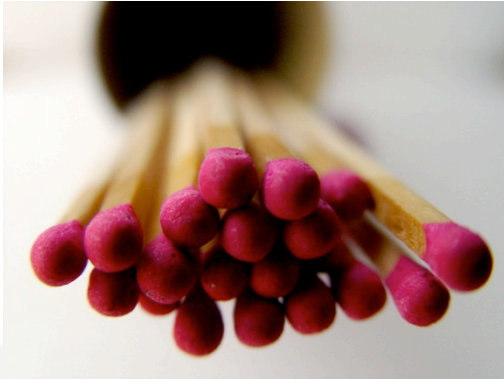
enough Cl to disinfect
a swimming pool



enough fat to make
~~10~~ bars of soap

Nothing Buttery

humans are collections of chemicals:



enough P for 2000 matches



enough Fe for 1 nail



enough Cl to disinfect
a swimming pool



enough fat to make
0.1 bars of soap

Dawkins on being human

- "The individual organism ... is not fundamental to life, but something that emerges when genes, which at the beginning of evolution were separate, warring entities, gang together in co-operative groups as 'selfish co-operators'. **The individual organism is not exactly an illusion. It is too concrete for that. But it is a secondary, derived phenomenon, cobbled together as a consequence of the actions of fundamentally separate, even warring agents.**"
- - Richard Dawkins, *Unweaving the Rainbow*, (Penguin, London, 1998) p 308.



Prof. Richard
Dawkins (Oxford)

Gene language

[Genes] swarm in huge colonies, safe inside gigantic lumbering robots, sealed off from the outside world, communicating with it by tortuous indirect routes, manipulating it by remote control. They are in you and me; they created us, body and mind; and **their preservation is the ultimate rationale for our existence.**

v.s.

[Genes] are trapped in huge colonies, locked inside highly intelligent beings, moulded by the outside world, communicating with it by complex processes, through which, blindly, as if by magic, function emerges. They are in you and me; we are the system that allows their code to be read; and their preservation is totally dependent on the joy that we experience in reproducing ourselves. **We are the ultimate rationale for their existence.**



Richard Dawkins --
The Selfish Gene (1976)

Denis Noble --
*The Music of Life:
Biology Beyond the
Genome* (OUP 2006)



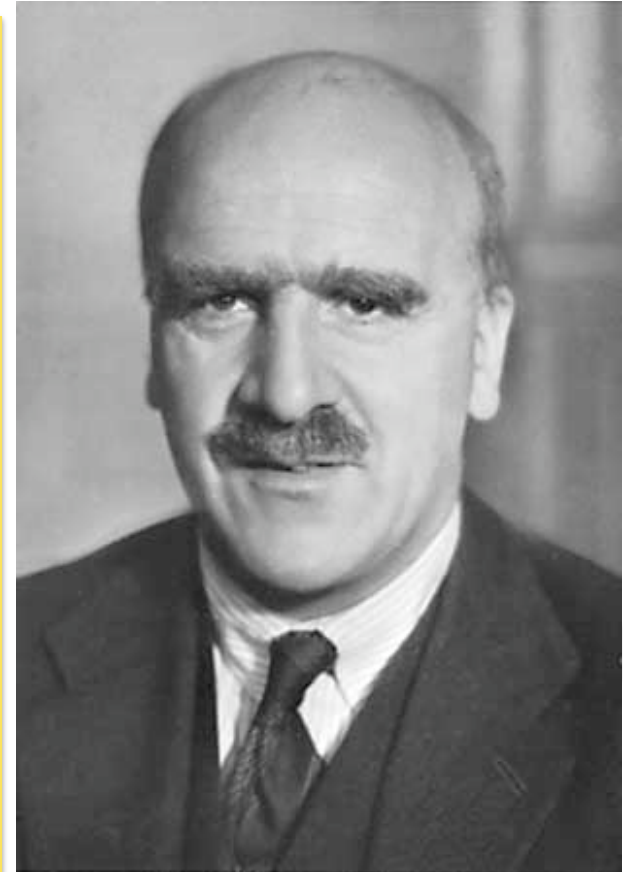
Mechanism v.s. Meaning (type errors)



why is the water boiling?

Materialism is not self-consistent

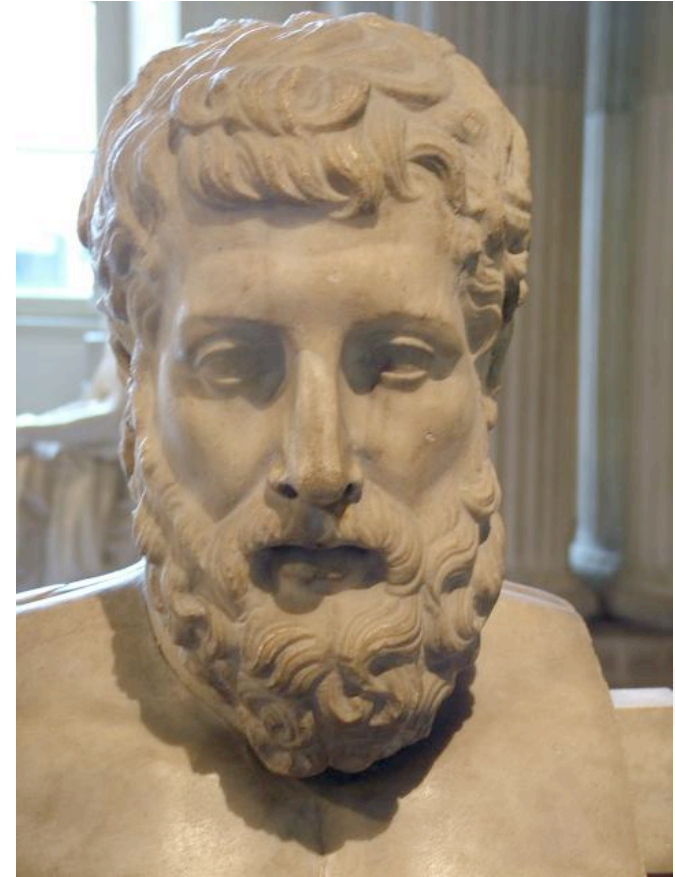
- For if my mental processes are determined wholly by the motions of atoms in my brain I have no reason to suppose that my beliefs are true... And hence I have no reason for supposing my brain to be composed of atoms.
-
- -J.B.S. Haldane, "When I am Dead "



J.B.S. Haldane
1882-1964

Materialism is not self-consistent

- Epicurus: “He who says that all things happen of necessity cannot criticize another who says that not all things happen of necessity. For he has to admit that the assertion also happens of necessity.
- (here it is an argument against determinism, but is linked to the argument against materialism)



Epicurus 341 – 270 BC

Karl Popper (the self and its brain) I do not claim that I have refuted materialism. But I think that I have shown that materialism has no right to claim that it can be supported by rational argument – argument that is rational by logical principles. Materialism may be true, but it is incompatible with rationalism

Science on values, meaning purpose

- In matters of values, meaning, and purpose, science has all the answers, except the interesting ones.
- F. Ayala in Darwin's Gift to Science and Religion. (2007)



Francisco J. Ayala
UC Irvine

Outline

- Does science have limits?
- Scientific method and tapestry arguments
- Questions beyond science?

• The bigger picture

Leap of Faith?



Richard Dawkins
Oxford U

"Faith is the great cop-out, the great excuse to evade the need to think and evaluate evidence. Faith is belief in spite of, even perhaps because of, the lack of evidence."

<http://richarddawkins.net/articles/89>

Tapestry arguments and inference to the best explanation

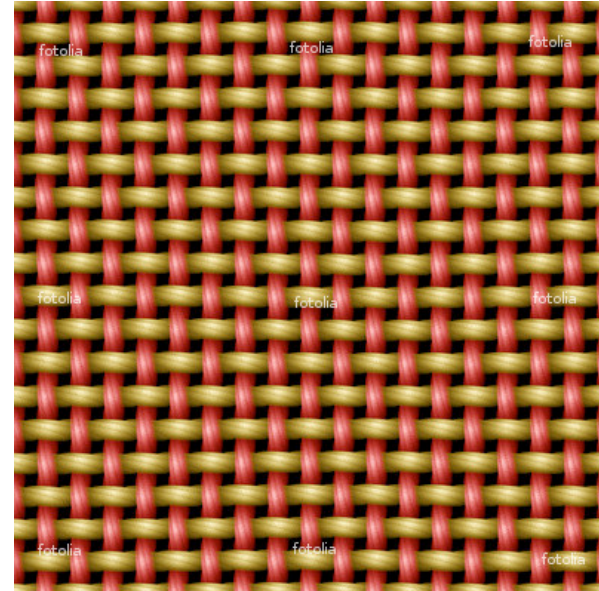
Science is a tapestry

-- you can pick at a few strings, but that doesn't break the whole cloth

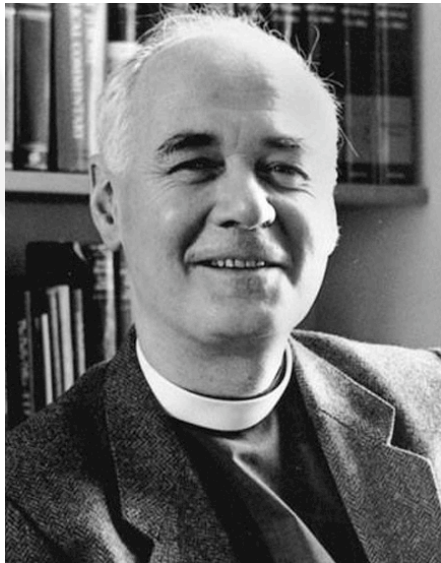
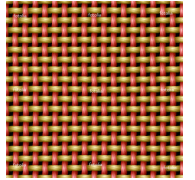
-- Apply this metaphor/methodology to other aspects of life?

-- complex questions, but very important!

-- whether you like it or not, you are all philosophers and theologians



Brute facts

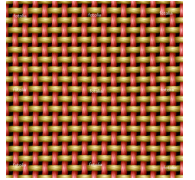


John Polkinghorne
Cambridge U

*If we are to understand the nature of reality, we have only two possible starting points: either the **brute fact of the physical world** or the **brute fact of a divine will and purpose behind that physical world***

John Polkinghorne, Serious Talk: Science and Religion in Dialogue, (1995).

Brute facts



Brute fact of physical world or a divine will and purpose behind it?

- Beauty
- Morality
- Rationality, Uniformity, bases for modern science
- Intelligibility (unreasonable effectiveness of mathematics)
- Fine tuning

Fine Tuning of physical constants: Goldilocks Enigma ... why just right?

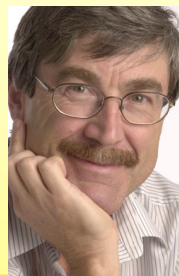
If the [fine structure constant] were changed by 1%, the sun would immediately explode
-- Prof. Max Tegmark, MIT



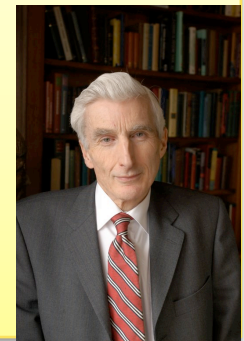
"The universe is the way it is, because we are here" –
Prof. Stephen Hawking,
Cambridge U



The Goldilocks Enigma: Why Is the Universe Just Right for Life ...
Paul Davies (2006)



Just Six Numbers
Sir Martin Rees
(2000)

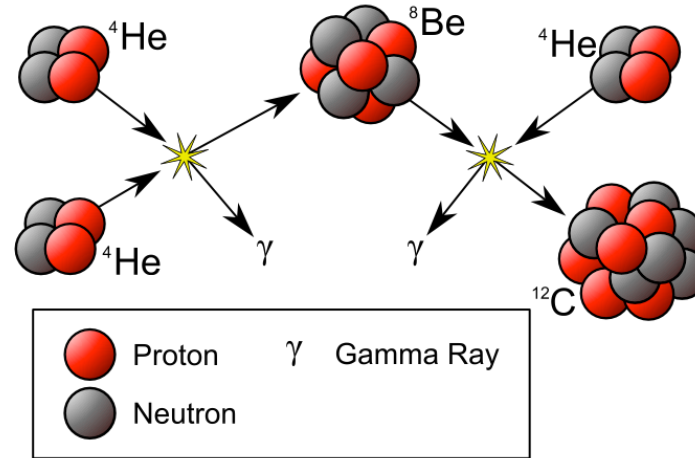


We are made of stardust

He  C through a resonance

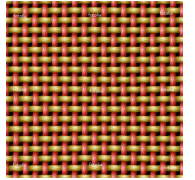


Sir Fred Hoyle,
Cambridge U



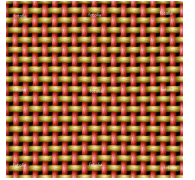
- “A common sense interpretation of the facts suggests that a superintellect has monkeyed with physics .. and biology”
- His atheism was “deeply shaken”

Tapestry arguments and faith



- Bible
- Resurrection
- Life and teachings of Jesus Christ
 - Just a great teacher?

Tapestry arguments for Bible



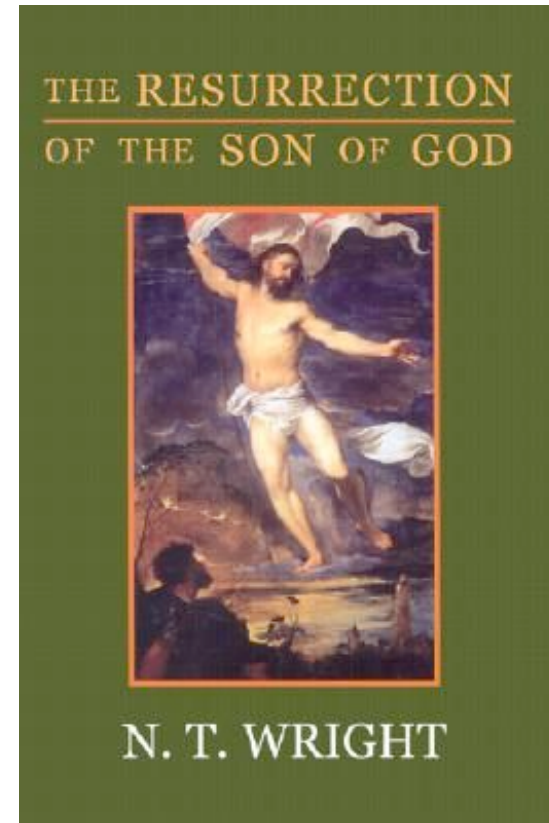
C.S. Lewis
1898-1963

I have been reading poems, romances, vision literature, legends and myths all my life. I know what they are like. I know none of them are like this. Of his [gospel] text there are only two possible views. Either this is reportage .. or else, some unknown [ancient] writer .. without known predecessors or successors, suddenly anticipated the whole technique of modern novelistic, realistic narrative.

Resurrection



N.T. Wright

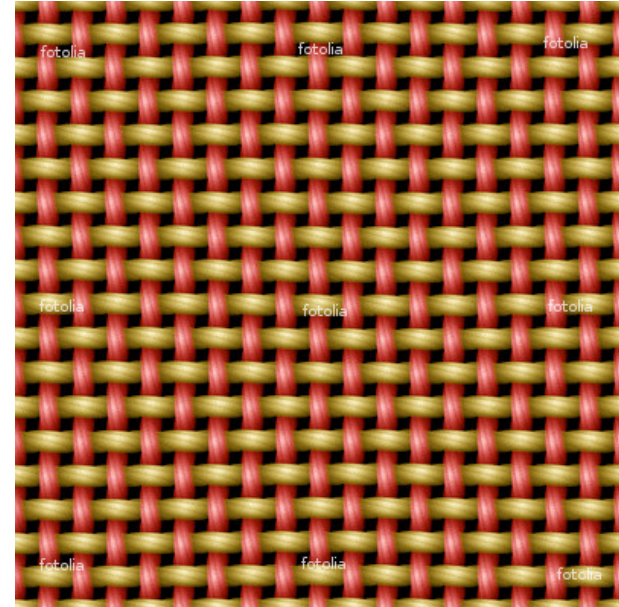


Tapestry arguments and inference to the best explanation

Why do I believe in Jesus Christ?

tapestry arguments:

- Bible
- Resurrection
- Life and teachings of Jesus Christ
- Just a great teacher?
- Experience of God in myself and friends



*I believe in Christianity as I believe that the Sun has risen—
not only because I see it, but because by it, I see everything else.*

C.S. Lewis, *The Weight of Glory*, (1942).

Here are a few popular books I recommend :

Francis Collins, "*The Language of God*"

An honest and easy to read account of how Francis Collins, formerly head of the human genome project and currently director of the National Institutes of Health, came to believe in God, and how he squares his science with his faith.

Alister McGrath, "*Dawkins' God: Genes, Memes and the Meaning of Life*"

http://en.wikipedia.org/wiki/Dawkin%27s_God

McGrath, a prolific theologian with a PhD in biophysics, gives a thoughtful response to Richard Dawkins' arguments against the existence of God.

John Polkinghorne, "*Quarks, Chaos and Christianity*"

A classic introduction to questions on the interface between science and faith by Sir John Polkinghorne, a former professor of theoretical physics at Cambridge. Also a good starting point to Polkinhorne's work.

- Ernest Lucas - "Can we believe Genesis today"

-

Tim Keller, "*The Reason for God*"

Whereas the other books on this list focus more on science/faith dialogue, here Tim Keller gives a good introduction to a broader set of arguments for the existence of God and the rationality of Christian faith.

Websites I recommend:

www.faraday-institute.org -- The Cambridge University based Faraday Institute for Science and Religion has a treasure trove of excellent online material

www.biologos.org -- An organisation set up by Francis Collins to help counter the shrill public discourse on science and faith with a more thoughtful and reasoned dialogue.

- www.testoffaith.com -- a website with loads of resources for churches, linked to a documentary that Bill Newsome (Stanford) and I participated in.

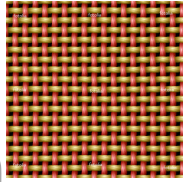


Freeman Dyson
Princeton

As human beings, we are groping for knowledge and understanding of the strange universe into which we are born. We have many ways of understanding, of which science is only one ... Science is a particular bunch of tools that have been conspicuously successful for understanding and manipulating the material universe. Religion is another bunch of tools, giving us hints of a mental or spiritual universe that transcends the material universe.

F. Dyson "religion from the outside, the new york review june 22, 2006 4-8

Tapestry arguments for Christian faith

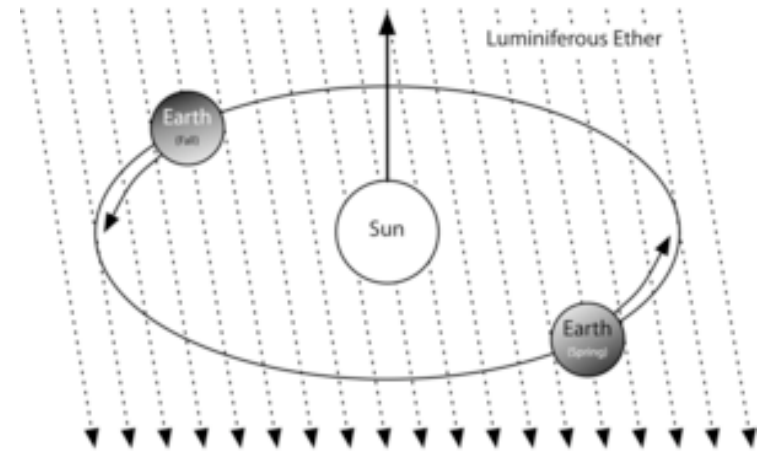
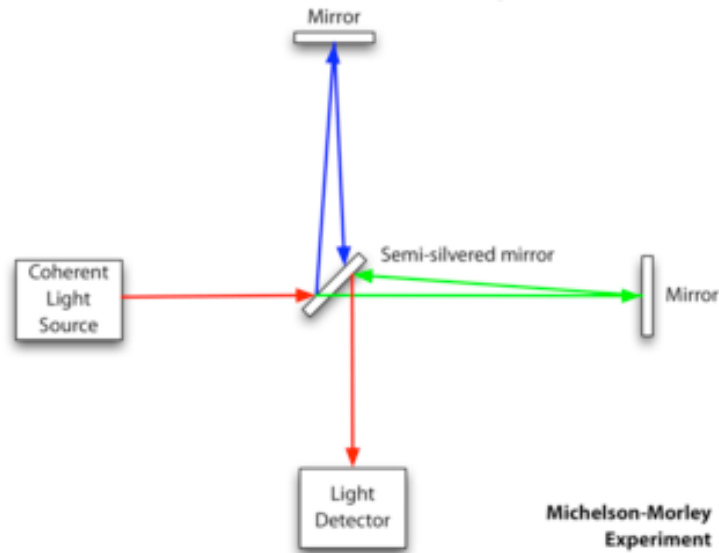


C.S. Lewis
1898-1963

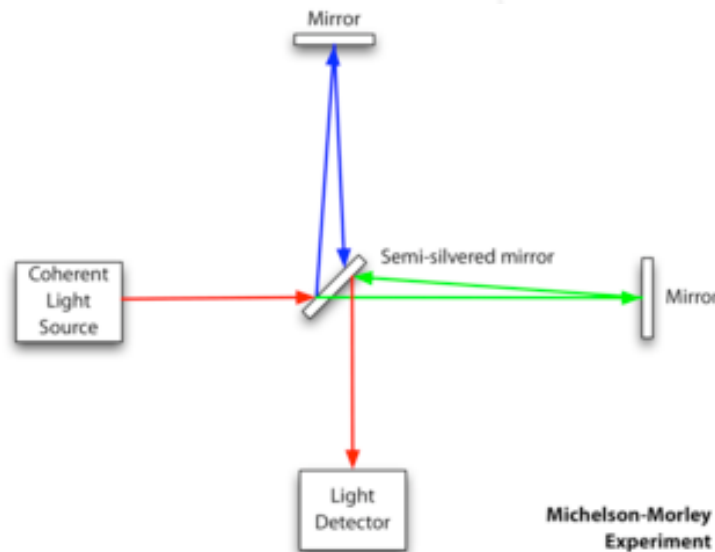
I believe in Christianity as I believe that the Sun has risen—not only because I see it, but because by it, I see everything else.

C.S. Lewis, *The Weight of Glory*, (1942).

Michaelson-Morley and Aether



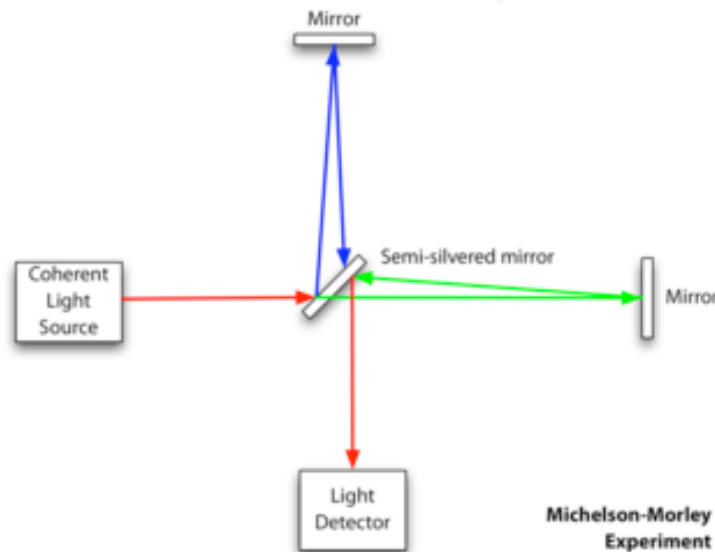
Michelson-Morley and Aether



- published 1887
- Einstein 1905
- Dayton Miller and others did measure aether wind see 1933 review

why did the community largely ignore Miller?

Michelson-Morley and Aether



- published 1887
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The meaning of an experimental result does not, then, depend on the care with which it is designed and carried out, it depends upon what people are ready to believe.

■ ***The Golem: what you should know about science***

Harry Collins and Trevor Pinch (CUP 1993)