

Our Changing View of Reality

A Scientific Perspective

by

Tony Heyes

- This talk is all about science
- The extent to which science can tell us about reality

- We live in a world of solid objects and things
- But ask a scientist and she will give you a very different answer

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Wilfrid Sellars (1912 – 1989)



Wilfrid Sellars

- The Manifest World
- The Scientific World
- Incommensurate world views
- Can we live with incommensurate world views?

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Major General Albert N Stubblebine III



Philosophy of Science

- Epistemology - a branch of philosophy that investigates the origin, nature, methods, and limits of human knowledge.
- I am NOT a philosopher; I am a “hands on” scientist:
- I CAN change a light bulb
- I did invent something that most of you use every day of your life

Philosophy

As for philosophy; I am an

Ultracrepidarian

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The Common Sense view of Science

- For 300 hundred years from the time of Galileo Galilei (1564 - 1642) until that of Max Planck (1858 - 1947)
- No problem – there was no such subject as The Philosophy of Science

The Common Sense view of Science

- Experimental, progressive, building an understanding of the *external real world*.
- Reductionist - founded on Newtonian mechanics.

Sir Isaac Newton (1643 – 1727)



What I need to do is:

- Talk a little about early views as to the nature of science.
- Describe the Common Sense View and explain WHY we had to abandon it.
- Examine what has replaced this Common Sense View.

Pre-Science

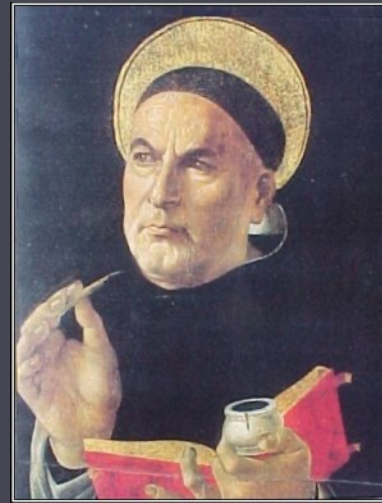
- Knowledge as dogma
- The Greeks: Aristotle (c. 384 - 322 B.C.). The Four Elements
- Fire is primarily hot and secondarily dry.
- Air is primarily wet and secondarily hot.
- Water is primarily cold and secondarily wet.
- Earth is primarily dry and secondarily cold.

Pre-Science

- But there WERE some experimentalists
- Aristarchus (c. 310-230 B.C.)
- Eratosthenes (c. 273 – 195 B.C.)
- Ptolemy (c. 100 - 170 A.D.)
- Europe entered the “Dark Ages”

Greek Learning comes to Europe

- 12th and 13th Century, Moors in Spain
- Thomas Aquinas (1225 - 1274)

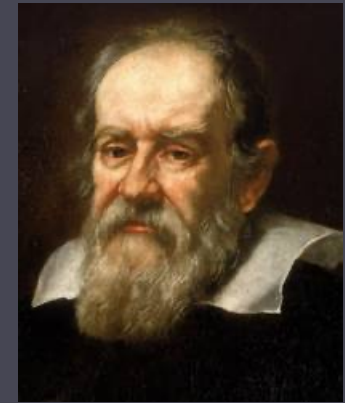


Shaking the Foundations

- Nicolaus Copernicus (1473 -1543)
- Johannes Kepler (1571 - 1630)
- Giordano Bruno (1548 – 1600)
- Galileo Galilei (1564 - 1642)

The Reformation

- Science flowered in Protestant Europe
- But what did Galileo do?
- and Newton
- Laplace - the mechanical world



How does science work?

- Francis Bacon (1561 - 1626)
The Scientific Method
- Collect facts and then *induce* the Laws of Nature
- singular and general statements
- Induction Deduction



Some Definitions

- Hypothesis: an idea, provided it is testable
- Theory: an interlocking and consistent system of empirical observations and testable hypotheses that has never failed scrutiny.

Some Definitions

- Laws of Nature
- Induction - a problem!

David Hume (1711 – 1776)



Philosophical Objections

- David Hume (1711-1776) Induction
 - 1.The principle of induction worked successfully on occasion 1
 - 2.The principle of induction worked successfully on occasion 2
 - 3.The principle of induction worked successfully on occasion 3
- Conclusion: The principle of induction always works.

Philosophical Objections

- Hume pointed out that the Principle of Induction was, itself, based on an Inductive Argument.
- ie. A circular argument

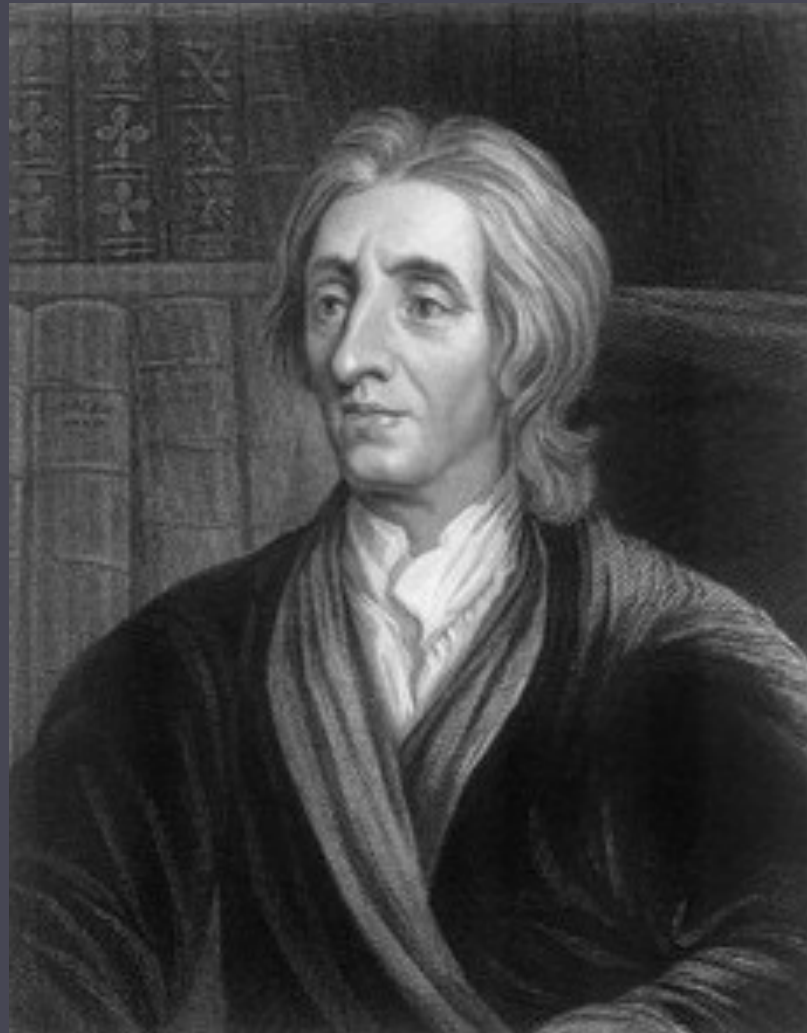
More Philosophy



- Bertrand Russell (1872 - 1970)
- The case of the inductive turkey

John Locke

(1632 – 1704)



John Locke

- Pointed out that there was no such thing as sound unless there was someone there to hear it
- Likewise colour was not an attribute of an object but a perception

Thought for the day

- If two people claim to see the exact same colour
- Is it a pigment of their imagination?

Molyneux's Question

William Molyneux (1656 –1698) asked Locke whether a man who has been born blind and who has learnt to distinguish and name a globe and a cube by touch, would be able to distinguish and name these objects simply by sight, once he had been enabled to see?

Mike May



Bishop George Berkeley

(1685 – 1753)



- Suggested that familiar objects like tables and chairs are only ideas in the minds of perceivers and, as a result, cannot exist without being perceived.

God in the Quad

Ronald Knox (1888-1957)

There was a young man who said "God
Must find it exceedingly odd
To think that the tree
Should continue to be
When there's no one about in the quad."

God in the Quad

Reply:

"Dear Sir: Your astonishment's odd;
I am *always* about in the quad.
And that's why the tree
Will continue to be
Since observed by,
Yours faithfully, God."

And a more modern version

- If a tree falls in a forest and no one is around to hear it, does it make a sound?
- If a man speaks his mind in a forest, and no woman is around to hear it: is he still wrong?

And yet

- It is fun to giggle at Bishop Berkeley
- But his ideas are not a million miles from what we now call
 - The Copenhagen Interpretation of the Quantum Theory

Copenhagen Interpretation of the Quantum Theory

- Has, in turn, been lampooned, viz:
 - Schrödinger's Cat



"About your cat, Mr. Schrödinger—I have good news and bad news."

One more Philosopher



- Immanuel Kant (1724 - 1804) pointed out that the only thing we have to go on is our sense experiences, anything we use to account for those experiences is a man made construction.

The Scientists' Response

Scientists ignored the Philosophers and got on with the job

- They did make one concession:
- *Theories may be, and usually are, conceived of, prior to the making of observations.*

The success of Newtonian science

- A reductionist approach giving a coherent picture embracing mechanics, optics, magnetism and electricity
- A theory is true – or has a high probability of being true – if it adequately describes the phenomena
- Better still, if it is useful in predicting novel phenomena.

And then the wheels fell off.....

- Max Planck (1858 – 1947)
- Albert Einstein (1879 - 1955)
- Wave/Particle duality – even atoms!
- Niels Bohr (1885 - 1962)
- The Quantum Theory

Copenhagen Interpretation of the Quantum Theory

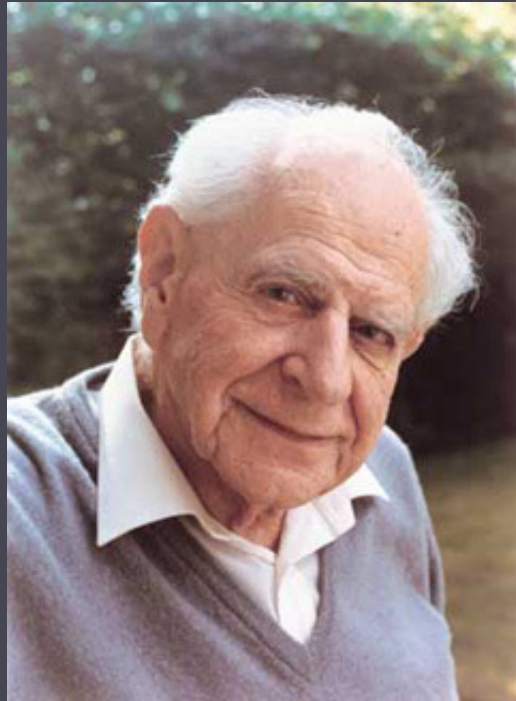
- The mathematics worked
- But the concepts were incompatible
- Waves or particles
- The role of the observer?

“Shut up and calculate”



Richard Feynman (1918 - 1988)

Scientists begin to take an interest in Philosophy



Karl Popper (1902 - 1994)

Induction

- Popper to the rescue

All swans are white

The repeated observation of white swans
can never prove this statement

The observation of just ONE non white
swan will falsify it

The statement is asymmetrical

The Hallmark of Science

Bold conjecture - followed by an attempt to falsify

Only those theories capable of falsification can be counted as scientific

Falsificationism

- Adlerian psychology
- Marxist Economics
- Darwin's Theory of Evolution by Natural Selection?
- J B S Haldane's reply

Theory Comparison

- Mars moves in an ellipse around the sun
- All planets move in ellipses around the sun

The second is better than the first; it has more *potential falsifiers*. This is tantamount to saying that if a theory claims more (and at the same time resists falsification) it is a better theory

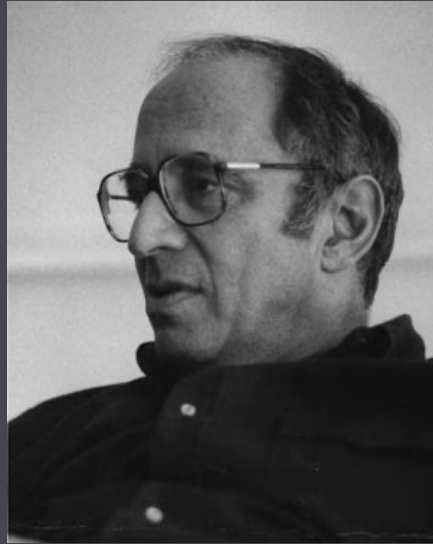
The problem with Falsificationism

- But Falsification is NOT the whole story.....
- Discovery of Neptune (1846); perturbations in the orbit of Uranus (1781)
- did NOT falsify Newton's Laws of Motion

Thomas Kuhn (1922 - 1996)

- *pre-science - normal science - crisis - revolution -*
- *new normal science - new crisis - revolution -*
- *new normal science - new crisis - revolution - etc. etc.*

Thomas Kuhn



Normal scientists articulate
the *paradigm*

So what of Reality and Truth

- The theories of science are *metaphors of reality*. It is “as-if” the world were like this, or like that.

Utilitarianism

- Science is a tool, it should be judged by its utility
- Sadly the term Utilitarianism already has a meaning in philosophy so we cannot use it!

Model Based Reality

- We can never know whether our theories are true, nor can we ever estimate as to how close they are to the truth.
- Theories are *adequate* or *inadequate*.
- But adequate at what?
 - Adequate at correlating our experience of the world
 - Better still, extending our experience

Stephen Hawking (1942 – 2018)



The quest for the TOE

- The so-called quest for the Theory of Everything is shear hubris.
- Even if we correlated the total of our experience we could never be certain that there was not some phenomena hiding around the corner.

Stephen Hawking (1942 – 2018)

- Stephen loved to be controversial but was never shy about changing his mind
- Philosophy is dead
- Model-dependent realism
(The Grand Design (2010))

Wilfrid Sellars

- The Manifest World view of everyday life
- Now joined by *SEVERAL* incommensurate scientific world views

The 'Take-home' Messages

- Be sceptical: every scientist worth his/her salt is a sceptic.
- Nullius in verba
- Be 'open minded' but not to dogma and unsubstantiated claims. Be open minded to new evidence.

The 'Take-home' Messages

- Evidence trumps dogma, every time
- John Maynard Keynes (1883 – 1946)
- “When the facts change, I change my mind. What do you do, sir?”

- Enjoy the fruits of science
- The fact that there is much we do not understand does NOT mean that anything goes.
- “Magic carpets and broomsticks do not fly, aeroplanes do”
 - (Richard Dawkins)
- Never fly in an aeroplane designed by a Post-Modernist.
 - (Tony Heyes)

Our Changed View of Science

