The Philosophy of Science

A book review of 'The Philosophy of Science' by Prof Samir Okasha

I recommend the Oxford University Press series *A Very Short Introduction*. These small books can easily be placed in a pocket to be read while waiting for a train, plane or whatever. While I am not endorsing all the contents, they are a feast for anyone wanting to explore a subject of interest and for any budding polymaths.

In this pamphlet I review the publication in the series called the *Philosophy of Science*. The author, Prof Samir Okasha, is professor of history and philosophy of science at Bristol University. His book *Evolution and the Levels of Selection* won the prestigious Lakatos Award for books in this field. While I am the kind of person the book is aimed at, I am cautious of things I am told and my review reflects this.

What is science?

What is science? Naturally the author begins with this question[1]. Whatever it is, it is distinguished from religion, astrology and history. It features observation, experimentation and the construction of ideas. I observe that *idea construction* seems to play a greater role and explains some of the odd things regularly appearing in our newspapers and scientific publications.

We are told that the neat ideas of Newton, developed by his standing on the shoulders of earlier intellectual giants, were shattered by relativity theory and quantum mechanics, which ideas seem to conflict with common sense[2] and remain incomprehensible to all bar a few.

We are told Darwin's theory of evolution in his book *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*[3] is the event that stands out in the development of biology. We are told that, so persuasive was the evidence Darwin adduced, it became scientific orthodoxy. Subsequent work, we are told, has provided striking confirmation of Darwin's theory which the author states forms the centrepiece of the modern biological worldview[4]. I comment that evolution cannot be proven experimentally or by observation. It is the outcome of idea construction. One asks if this idea has any sounder scientific basis than the ideas of the Greek astronomer Ptolemy whose explanation of astronomical movements took some 1,800 years to replace[5].

Philosophy of science supposedly questions scientists' assumptions.[6] Karl

Popper upset many when he concluded that a theory has to be falsifiable to have scientific credence. Popper had no time for a scientific idea if there was always an explanation to support the theory whatever evidence was found.[7] Our author criticises Popper on this, but his reasoning seems to miss the point. The fact that Adams and Leverrier were able to use Newton's gravitational theory to explain why Uranus did not conform to the theory does not in my humble opinion contradict Popper's rule.[8] The ideas of Newton, Adams and Leverrier were falsifiable. One is tempted to think the author feels impelled to argue against Popper on the issue of falsifiability of a theory as the author's expertise is in evolution theory which always has an answer whatever contrary evidence is produced.

Portrait of David Hume. Image in the public domain.

Scientific inference

We are told that *scientific inference* is used, amongst other things, to justify scientists' telling us that we are closely related to chimpanzees and the universe is expanding. Some inferences (deductive) have to follow a known, while other inferences (inductive) only do this on balance. Others (non-deductive or inference to the best explanation), we are told, seek to provide the best explanation. The author accepts that scientific hypotheses can rarely if ever be proved true by data.[9] The author has another go at Popper who we are told asserts that a scientific idea can be proved false but never wholly proved true by any amount of data.

We are treated to an analysis of the idea of the 18th century thinker David Hume who argued that arriving at a conclusion based on the evidence to date was wrong as it relied on the uniformity of nature, that things consistently happen that way. The possibility of randomness, even if imagined, has to be allowed for in this way of thinking. I observe that Hume and others do not allow for revelation knowledge; by revelation we are told that in Christ 'all things hold together'[10] which explains why things don't happen randomly.

What, it seems, we can conclude from all the philosophical arguments is that it is hard for us to draw wholly satisfactory inferences even if we compile lots of evidence. The author tellingly says that science relies on induction, but Hume's argument seems to show it cannot be justified on rational grounds,[11] a view with which many philosophers agree.[12]

The author explains the concept of inference to the best explanation (known by its acronym IBE) frequently used by scientists. They reason from their data to a theory or hypothesis which explains the data. The author cites Darwin's use of facts which are, supposedly, hard to explain. Darwin asserted that the similarity of horses and zebras' legs could be better explained if the animals were descended from a common ancestor rather than created separately. I observe that this can only be true if one rules out either the amazing variability within a species or special creation as causes. The author asserts that Darwin's idea could explain a diverse range of facts about the living world and has simplicity on its side. But even the author accepts that simplicity of an idea does not mean it is true.[13] I will add to the author's possible doubts that Darwin's idea explains too much.

A goal of science is to discover causes of natural phenomena. The idea is simple, but in practice science accepts it has limitations. Hume highlighted that, unless a cause is observed, it has to be drawn by inference. Scientists then apply causal principles. Do certain factors lead to an outcome? The fact that a factor correlates with an outcome does not define causation as there may be other unidentified factors which are the principle cause.[14] The controlled experiment is a mainstay of modern science, but it struggles with handling the variables. The randomized controlled trial (RCT), the gold standard of evidence-based medicine, seeks to override the variables by randomly choosing a wide selection of patients in the test of a new drug. The author observes the outcome does not strictly prove the drug being tested is cause of the outcome, but constitutes evidence.[15] If randomization has to be relied upon, I wonder why so much reliance can be placed on scientific knowledge.

The author accepts that inductive thinking, a main tool of science, leans on probability in two guises - objective (how often things happen) and subjective (a measure of a rational degree of belief). The latter allows us to say the probability of life on Mars is low. As evidence builds, one's credence in a hypothesis is increased, is updated, a process called *conditionalization*.[16] A 17th century cleric, Thomas Bayer, used it and from this has developed a branch of statistics. Successful predictions are its hallmark. The author argues that building a hypothesis from evidence did not apply to Copernicus or Newton or Darwin as their ideas were new. I comment that, the first two developed their ideas from evidence they had noted. Darwin's idea built on the thinking of others[17] and it was based on the strength of his idea, his imagination, and not the evidence. This contrasts with Copernicus and Newton.

The author acknowledges that some hypotheses are at the outset simply best guesses. I note this with amusement as it explains some of the entertaining ideas that flow from some scientific gatherings.

Explanation

Science seeks to explain what happens. Carl Hempel came up with the simple model of explanation (the *covering law* model):

- General laws)→ Phenomenon to
- Particular facts) be explained

For example, Newton applied the law of gravitation and some additional facts to explain that the orbits of planets are elliptical. Hempel said that explanations lead to predictions and vice versa.[18] The covering law has its limitations as the author explains. Hempel was an empiricist and this line of thinking emphasises experience to explain an event rather than a cause. Others look to causality even though both outlooks can be used for an explanation. The author refers to Newton's explanation of elliptical planetary motion from (i) the law of gravity and additional facts (the covering model) and (ii) from elliptical orbits being caused by gravitational attraction (causality model). But causality too has its limitation - as H_2O does not cause water to be water.

A refreshing admission is made that science cannot explain everything, such as life's origin. We are told that we know that about four billion years ago molecules which had the ability to make copies of themselves appeared in the primeval soup and life evolved from there.[19] I ask - how do we know? Which of the many principles elucidated in this helpful book allows us to express such knowledge. We are entertained with the notion that molecular biologists are working hard on explaining the origin of life but are faced with the problem that we do not know what the conditions were four billion years ago. I think this is irrational according to all the learned material the author has put into his book. How can we say we know anything so far away? There is the old trick of the defence barrister who argues that the prosecution witness was too far away in time and distance to establish the fact. But here we have scientists arguing in favour of a fact (which is both implausible and unproven in the present) that happened a long, long time ago in a far, far away place and thus beyond contradiction!

In the end, as something cannot explain itself, e.g. the laws of gravitation explains things other than itself, there will always be something that is unexplained.[20] (I wish that was remembered by some scientists.) The author bravely asserts this view is too negative and cites Daniel Dennett's view that even consciousness can be explained.

The puzzle is – a science which studies physical entities is not reducible to physics. If broken down to their fundamental particle level, the entities cannot be explained, such as why nerve cells outlive skin cells. Resort is made to a concept of multiple realization, which seems to be saying that phenomena can be explained by different sources of knowledge. This illustrates how science is, I comment, bending over backwards to secure its stronghold over knowledge while remaining critical of statements of Christian faith.

Scientific realism

We are introduced to scientific realism (that science aims to provide a true description of the world) and anti-realism or instrumentalism (science aims to find empirically adequate theories which accurately predict the outcomes of experiment and observation).[21] The contrast is shown when explaining the unobservable. Not that this is new as the writer to the Hebrews states: 'Through faith we understand that the worlds were framed by the word of God, so that things

which are seen were not made of things which do appear.'[22]

The anti-realist says that science creates convenient fictions to predict observable phenomena. The kinetic theory of gasses predicates molecules which is a model which conveniently and correctly predicts the behaviour of gasses. This is well suited to scientific theorising using mathematical models. But such models, we are told, rely on idealized assumptions to manage the model. The aim is empirical adequacy, not truth, say the anti-realists, but not the realists.

Realists say we can rely on the evidence to believe something is true, for example that all matter is made up of atoms. Hilary Putman, an American philosopher, originated the no miracles argument – if a theory accurately predicts an outcome, not to rely on it requires an extraordinary coincidence, even a miracle, to explain the outcome. Why do lasers work if atoms and electrons do not exist?

But then the history of science has many well supported theories which proved false – for example, that fire released phlogiston into the air. The realists should be more modest in their assertions in the light of history. (I comment on how little modesty is shown in practice when scientists confidently explain unobserved events in the long-distant past.) August Fresnel's mathematics supported the wave theory of light (moving in ether) as opposed to the particle theory supported by Newton. Fresnel's predictions were confirmed by optical experiments. However, modern physics has shown ether doesn't exist. So anti-realists say[23] that we should not assume modern scientific theories are even roughly on the right lines just because there is evidence to support them. The author sums it up to say that, as history shows, we should be cautious about assuming our current scientific theories are true, however well they fit our data.[24] It makes one think of the fantastical explanations for the creation of the world and the universe.

Would that scientists were more circumspect in some of the claims and so less deriding of others and of Biblical truth! Is the Big Bang such a better idea than God's command?[25]

Philosophers of science have argued over the limits of what science can say about the unobservable. Anti-realists say this is very little whereas realists are more pragmatic, e.g. a charged particle is unseen, but seen by its trail in a cloud chamber. Anti-realists argue that empirical data will leave open the explanation for the unobservable – the theories are underdetermined as there will always be competing theories to account for the data and scientists should be agnostic in their attitude towards prevailing theories. (I see little appetite in the scientific community to entertain contrary ideas to the prevailing view on evolution.)

Scientific change

The author gives us a real treat when he summarises the work of Thomas Kuhn and his book The Structure of Scientific Revolutions (1963). If you want a taster of the book under review, I suggest you read chapter 5. It should encourage you to study the rest of the reviewed book. Logical empiricism (science's superiority through its objectivity and rationality) was holding sway despite science's history of

non-rational discoveries (e.g. Kekule's dream leading to his discovery of benzene's hexagonal molecular structure).[26] Kuhn drew a picture of a paradigm in scientific thinking and how it can suddenly change[27]:

- There is a set of fundamental assumptions which are accepted;
- Those assumptions are used to resolve problems;
- It is a way of thinking which unites the scientific community;
- The standard scientist resolves problems which otherwise contradict the paradigm but do not test its veracity; so conflicting data is assumed to be wrong;
- Over time the conflicting data builds up until there is a crisis when the paradigm breaks down;
- At that stage other ideas are given space until a new paradigm is established.
- That adopting the new paradigm involves a certain act of faith, and in Kuhn's words, 'the transfer of allegiance from paradigm to paradigm is a conversion experience';
- Forceful advocates will give the new paradigm wider acceptance.
- The notion science develops to a higher state is inaccurate and philosophically naive.

Kuhn's ideas undermine the public's perception of the objectivity and rationality of science. We are told that most people think these ideas are of value, but I comment that it is strange the public hear little of them. It explains in part how evolution has been allowed to survive until now.

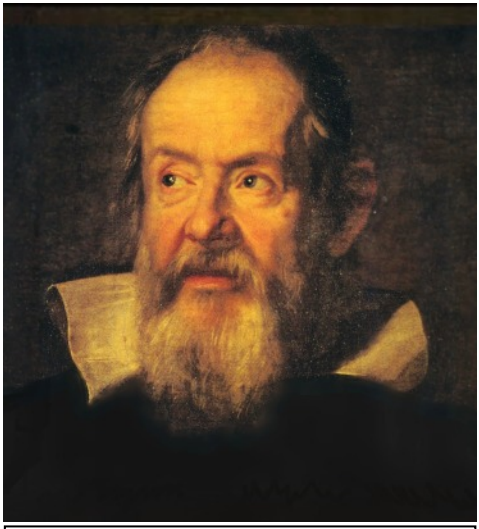
The author spends a good while on Kuhn's ideas as they have shaped a lot of scientific thinking. Kuhn argues that scientists with different paradigms cannot communicate effectively and collect data bent towards their own view. Kuhn says objectivity loses to the scientist's paradigm and even goes as far as saying that truth is relative (which is a self-defeating statement). We are told many philosophers agree that theory-neutrality is unattainable, and most reject the empiricists ideal of a class of data statements free of a commitment to a particular theory.

Kuhn said there is no algorithm to decide which theory is better and this thinking prevails at present. The author acknowledges that an element of subjectivity is required between two competing theories and concludes that Kuhn is not too radical to think that an act of faith is needed to adopt a new paradigm. Such a new paradigm may prevail by the sheer determination of its advocates.[28] The author accepts that the rationality employed in science needs to be more relaxed and pragmatic. This is an admission that science and faith are not so at odds in the way many in the science community portray them.

Particular philosophical questions

Chapter 6 gives us examples of how philosophical questions apply to particular sciences. We learn the debate about space continues today, having begun in the 17th century between Isaac Newton (who argued for absolute space into which God created all things and Gottfied Leibniz

(who argued that space is the totality of special relations between objects and came into existence when God created the universe). Contrary to popular belief, the issue of the different kinds set out in Genesis 1[29] continues – for what is called 'the species problem' of how to define the different kinds is unresolved. Darwin's assertion that there is no clear demarcation between species, sub-species and varieties sits badly with the thinking of biologists; we are told even evolutionary biologists are convinced there are natural groupings in nature.[30] The author himself, even though evolution is his specialist field, says the underlying problem concerning species is evolution itself.[31] It seems to me that contorted thinking is required to get around the problem.



Portrait of Galileo, who rejected Aristotle's thinking on the planets. Image in the public domain.

The final chapter

The book ends with a section on critics of science. It is admitted modern science and scientists are elevated to a very high place in society. If one is said to be unscientific, then he or she is irrational and worthy of contempt. Like a priesthood, scientists are the possessors of knowledge inaccessible to the ordinary person. The author expresses the view that something like science worship is a feature of the intellectual world and even goes on to say perhaps science deserves to be worshipped.[32] Some, like Bertrand Russell, argue that science is the only legitimate path to knowledge and, if it can't answer the question, the question isn't a genuine question.

The section on science and religion is weak. The author makes the error to say that the Catholic Church rejected Galileo's Copernican views because they contradicted scripture. They didn't. The problem was they contradicted Aristotle and Ptolemy whose views then held sway in society and were reflected by the Church (as we see today over evolution). Darwin's supposed triumph over the Genesis account of creation is given only a few lines. The writer supposes that there are no true scientists who reject evolution.

The author gives four pages to attack creationism and intelligent design. One argument he handles is the irreducible complexity of biological organism (that an organ works only if all its parts work together at once and not by adding bits now and then) - such as an eye. He seeks to rebut the argument by saying Darwin resolved the problem over the eye by ***imagining*** a sequence leading from a simple eye to a complex one by a gradual series of incremental improvements. The author asserts that recent scientific work has offered detailed insight into the

probable sequence. He concludes the science has successfully endorsed Darwin's natural selection process for the development of the eye.[33]

The author admits there is 'some' truth in the charge the fossil record is patchy and there are 'so few' transition fossils. The author dismisses this problem by saying fossils aren't the only or main evidence for evolution.[34] One finishes the book by thinking the author has not used the material in his excellent book on the philosophy of science to analyse his adherence to Darwin's ideas and the theory of evolution.

I commend this slim but meaty book for a general read to anyone who dares to look into scientific thought. It makes one realise that, firstly, science's foundations are not as firm as they are held to be in popular belief and, secondly, science requires exercises of imagination and even faith. Faith is thereby given a seemingly strange endorsement by the principles set out in this book. Some of these principles are employed by the writer of the letter to the Hebrews who gives an explained, realistic and experiential account of faith in the reality of the lordship of Christ. He observes that we need faith to please God and God rewards them who diligently seek Him.[35]

References

1. Page 1. **2**. Page 7. **3**. What a title! One can see how racism became further entrenched in the Western world with this evolutionary thinking. **4**. Page 8. **5**. As the author explains on page 3. **6**. Page 11. **7**. Page 11-15. **8**. Ibid. **9**. Page 19. **10**. Colossians 1 verse 17. **11**. Page 22. **12**. Page 23. **13**. Page 26. **14**. Pages 26 to 28. **15**. Pages 29 and 30. **16**. Pages 32 and 35. **17**. See Malcolm Bowden's *The Rise of the Evolution Fraud*. **18**. Pages 36 to 48. **19**. Page 48. **20**. Page 49; and contrast this with Proverbs 25: 2 It is the glory of God to conceal a thing: but the honour of kings is to search out a matter. **21**. Chapter 4. **22**. Letter to the Hebrews 11: 3. **23**. Page 62. **24**. Ibid. **25**. My comments. **26**. Pages 73 to 74. **27**. Pages 72 to 78. **28**. Page 85; see again *The Rise of the Evolution Fraud* by Malcolm Bowden. **29**. Verses 21 to 25. **30**. Page 99. **31**. Page 100. **32**. Page 114. **33**. 'Alice laughed: "There's no use trying," she said; "one can't believe impossible things." "I daresay you haven't had much practice," said the Queen. "When I was younger, I always did it for half an hour a day. Why, sometimes I've believed as many as six impossible things before breakfast."' Lewis Carroll, *Through the Looking Glass*. **34**. Page 122. **35**. In particular, read Hebrews 11.

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