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Philosophy of Science 3

Scientific Thought: A Linear Progression?

Thus far we have looked at how science has progressed from what is considered to be its inception – the science of Ptolemy and that which followed it over 1,500 years later in the form of the Copernican revolution. We have examined what certain philosophers have had to say about the methods of science – Aristotle's method of induction which can lead us to deduce further statements about the world, for example. We also looked at the philosophy of Francis Bacon and his 'Four Idols' before taking a brief look at Karl Popper's falsification principle.

This week, I want to look at the philosophy of two well known philosophers of science – Thomas Kuhn and Paul Feyerabend. Both took radically different positions in relation to the belief that scientific progress can be understood as a cumulative and linear progression. But, if we are to understand that properly, we need an example of this supposed linear and cumulative progression. So here is a very short science lesson!

Isaac Newton's Theory of Gravity (very simplified!)

Newton developed a theory that was able to explain the movements of the moon and the planets and, as such, make a variety of predictions based upon it (tides, motions of the planets across the sky and so on). He discovered (inductively) that every planet accelerates toward the sun and that such acceleration is inversely proportional to the square of its distance from it. From this he deduced that every body attracts every other with a force directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

Newton's theory completely did away with the need for epicycles to explain the motions of the planets across the sky, for instance. Whilst Copernicus had postulated the heliocentric solar system, he still required epicycles to explain the retrograde motions of the planets. In this sense, Newton's theory could be said to explain much more than that of Copernicus – it covers more facts, so to speak. However, while it is the case that Newton's theory could explain more than Copernicus', it became apparent that it only fitted the facts in relation to the solar system and objects visible to the naked eye. A steady stream of anomalies began to be found outside of these limits.

Einstein's Theory of Relativity (even more simplified!)

The speed of light is constant (186,000 per second) and central for Einstein. This gave rise to his claim that there is an equivalence between mass and energy – he expressed this in his famous $E = mc^2$ (E is energy, m is mass and c is the speed of light).

Without delving too far into the implications of Einstein's theory, there are two aspects that are philosophically relevant (on their own terms, as well as specifically in relation to philosophy of science).

The first is that an event cannot occur at exactly the same time for any two observers – the time frame of any observer is relative to himself or herself. There is, as such, no absolute time. Think about it this way: on average reflected light from the surface of Mars takes 12.7 minutes to reach earth (it varies because the distance of Mars from Earth is not constant). Now, imagine that at 8pm by the clock in this room you are observing Mars from Earth and imagine that someone a Martian is observing Earth – you have exceptionally powerful telescopes which allow you to see the other waving. According to Einstein, since the light from Mars takes 12.7 minutes to reach Earth and since the same will be true (in reverse) for the Martian, both of you will be seeing each other waving 12.7 minutes before the time showing on your respective clocks. In other words, both of you are observing events that took place 12.7 minutes before your own time frame. There is no absolute position from which both events can be observed simultaneously – this is the possibility excluded by the theory of relativity.

The second is that although speed of light is constant, the number of wavelengths of light per second is varied by gravity. This means that time runs at different speeds throughout the universe depending on the proximity of objects with substantial gravity. It also means that gravity can bend light and this was first empirically demonstrated by Sir Arthur Eddington in 1919. It was known where the stars would be during the eclipse; those closest to the sun were observed. It transpired that they were not quite in their usual positions relative to other stars and, as such, confirmed that the light from those stars had been bent round the sun; consequently, where they looked to be in the sky from earth was not where they actually were. This phenomenon also helped explain anomalies in the observed orbit of Mercury that could not be understood using Newton's theory of gravity.

For our purposes, we can see that Einstein's position covered more facts than Newton's (was able to explain more) and that Newton's theory covered more than Copernicus' and so on. This is what is meant by the linear and cumulative progression of science and scientific thought.

However, after Popper' falsification principle, this idea was challenged in a fundamental way by both Thomas Kuhn and Paul Feyerabend. Kuhn drew a contrast between periods of what he called "normal science" which were generally sustained for substantial periods of time and "revolutionary science" in which everything was up for grabs.[1] During periods of normal science, scientists are generally engaged in puzzle solving in relation to fixed presuppositions – Ptolemy, you will recall, solved the puzzle of the retrograde motion of the planets through his theory of epicycles. However, during such periods, any research that does not take as true certain presuppositions or paradigms (such as the Earth being at the centre of the universe) is dismissed as crazy speculation. Kuhn argued that, generally speaking, there is a massive bias in favour of work that supports the current paradigm and that which may pose big problems for it is generally ignored. This, I think, is also true in philosophy.

Only when a paradigm is plagued by too many unsolvable puzzles (puzzles that also cannot be ignored) or when a new model possess obviously greater explanatory power than its predecessor will one encounter a paradigm shift – a period of revolutionary scientific thinking in which, for a short time, all is up for grabs until a new paradigm is established.

Another dimension of Kuhn's argument that follows from this is that of 'incommensurability' – a new paradigm cannot be measured by the same standards as the old one and he went on to suggest that those living under the governance of different paradigms actually lived in a psychologically different world. A parallel can, perhaps, be drawn here between Kuhn's claim about psychologically different lives and Wittgenstein's assertion in his *Tractatus Logico-Philosophicus*:

> *6.43 If good or bad willing changes the world, it can only change the limits of the world, not the facts; not the things that can be expressed in language.*
>
> *In brief, the world must thereby become quite another. It must so to speak wax or wane as a whole. The world of the happy man is quite another than that of the unhappy man.*

Similarly, after he had abandoned much of what he had written in the *Tractatus* he is recorded as having pointed out to the philosopher Elizabeth Anscombe that the heavens would have looked exactly the same to those who believed in an earth centred universe as it would to someone like Einstein.

Paul Feyerabend (1924-1994)

In his most famous work *Against Method* Feyerabend takes a more radical position than even Kuhn. Unlike Kuhn who suggested that there are long periods of normal science interspersed with shorter periods of revolutionary science, Feyerabend believed that science was always revolutionary insofar as there are always hypotheses that are incommensurable with one another (take the climate change debate, for example). It is a view he called 'theoretical pluralism'. The idea that a theory 'fits the facts' (as Kuhn believed) is mistaken; rather, there are no facts at all, since the idea of facts is, itself, theory laden. Indeed, he believed that facts can only be explained by reference to the practice that gives rise to the possibility of talking about facts at all – namely social practices such as language. As such, the concept of a fact only makes sense because its grammatical foundations are such social practices. In other words, the meaning of factual statements is answerable to what we might think of as social conventions. This is similar (although not identical to) Wittgenstein's later thoughts about meaning; that what is meaningful is interdependent with the kinds of significance that things have for us. Feyerabend believes there is no single method guaranteed to produce good results – it all depends on what count *as* good results.

An analogy might help here: often one hears people saying to the recently graduated (particularly those with humanities degrees) that they need to do something useful or practical with their degree. They might continue by saying that their degree is useful insofar as it develops transferable skills that are relevant to the jobs market but to dedicate one's life to history, music or philosophy, for instance, really just isn't practical. And so on.

But it should be observed that what is practical is determined by what matters – not the other way round. If I want to be a poet or a composer, for example, what is practical will be very different compared to if I wanted to be a stockbroker or mortgage adviser. What is practical is different in each case. Thus, if I wanted to be a poet but went about it by playing the financial markets, I probably wouldn't get very far; similarly, if wanted to enter the world of the financial markets and studied iambic pentameter in order to do so, it is unlikely that I would be successful. I understand what count as good results in relation to what matters to me (and what my aims are) and I devise certain practical methods to achieve them.

Similarly, Feyerabend is saying that any method one uses only produces good results if it is already understood what count as good results.

[1] Much of this work was done in his book *The Structure of Scientific Revolutions*.