Richard Feynman's Philosophy of Science

Ben Trubody finds that philosophy-phobic physicist Feynman is an unacknowledged philosopher of science.

https://philosophynow.org/issues/114/Richard_Feynmans_Philosophy_of_Science#:~:text=Feynman%20says%20we%20learn%20from,of%20Finding%20Things%20Out%2C%20p.

Richard Feynman (1918-88) was one of the greatest physicists of the twentieth century, contributing, among other things, to Quantum Electro Dynamics (QED), for which he won a Nobel Prize. His popular portrayal is of a buffooning genius with a preference for no-nonsense thinking – the sort that by his reckoning seemed in short supply within philosophy. He is noted, and quoted, for his dislike of philosophy, and in particular of the philosophy of science. Any quick trawl of the Internet will bring up quotes attributed to him on the absurdities of philosophy, no doubt informed by his brief flirtation with it at Princeton. Feynman would parody what he saw as 'dopey' exercises in linguistic sophistry. As he remarks in a famous lecture series, "We can't define anything precisely. If we attempt to, we get into that paralysis of thought that comes to philosophers… one saying to the other: you don't know what you are talking about! The second one says: what do you mean by 'talking'? What do you mean by 'you'? What do you mean by 'know'?" (*The Feynman Lectures on Physics*, Vol.1, 1963).

Indeed, similar sentiments were also expressed by the philosopher of science Sir Karl Popper concerning the openness to either intractability (constantly adding new terms to define the old ones) or tautologies (statements true by definition) if one has to define all terms precisely before starting scientific investigation. The point I'm making is that Feynman, for all his perceived dislike of philosophy, is in fact an overlooked philosopher of science himself.

The Philosophy of Doing Science

One of the most famous quotes attributed to Feynman, often requoted with relish by the British science presenter Brian Cox, is that "The philosophy of science is as useful to scientists as ornithology is to birds." But although this has become a standard put-down by some scientists to those philosophers brave enough to opine on science, maybe this phrase can be lit under a different light? Firstly, whilst Feynman did nay-say philosophy quite a bit, it's not clear that he actually said those words. And the saying itself points to something quite prescient within the philosophy and sociology of science – that there's a fundamental difference between speaking or writing about a subject, and living or doing the subject.

The standard portrayal of science in textbooks, documentaries and traditional philosophy of science is that science is its *methodology*: science is a method for discerning (approximately) true and false statements about the world. Specifically, scientists make hypotheses they then test with observation or experiment. Hypotheses which are disproved by observation are then discarded. This is sometimes called *the hypothetico-deductive model*. However, this is a way of talking *about* science, as ornithology is a way of talking about birds. Neither is actual science or the bird itself. Science itself is simply what scientists do. Putting this another way, all the description

and formalizing in the world will not tell you what it is like to be a bird, or more to the point, just what it is to do science.

In 1966, Feynman addressed America's National Science Teachers Association with a talk entitled 'What is Science?' At the opening of this address, Feynman states that in textbooks on science, "There is some kind of distorted distillation and watered-down and mixed-up words of Francis Bacon" (*The Pleasure of Finding Things Out*, 2001, pp.172-3). The Baconian method was to build up universal laws from single observations via inductive reasoning – a typical example being 'This swan is white; that swan is white; and so on – from which we can draw the conclusion that all swans are white'. Feynman rebukes the Baconian concept of science, saying one cannot merely observe nature – a judgement is involved about what to pay attention to.

Here Feynman comes across as making a distinction between explicitly *knowing* things (a bit of data, say) and seeking *understanding* (a deeper and more intuitive appreciation of how nature works). As he disliked philosophical exposition, he does not use these terms, but he makes it clear that the practice of science is dependent upon more than just explicitly knowing things, applying principles, or copying a format or method. He takes the Baconian approach to be an example of where philosophers have sought a methodological description of science and failed. But he says this failure equally applies to deductive models utilizing Popper's 'principle of falsification'. From all this Feynman says: "And so what science is, is not what the philosophers have said it is, and certainly not what the teacher editions [science textbooks] say it is." (*Ibid*.)

Feynman also states that learning the meaning of scientific concepts is not science. That is, the learning of what words and concepts mean is part of *teaching* science, but not of *doing* science. It is a necessary but not a sufficient condition of science. Concepts and words are the tools of science, but not science itself, since learning the meaning of words and concepts will only teach you about the limits of people's imaginations when naming or trying to describe things, and nothing about nature itself. To illustrate, he states that the scientific idea of energy is so difficult to get right that any everyday use of the term will derive incorrect inferences or deductions. We may for instance say that energy is 'in' a moving object. If we wind up a clockwork toy we may say that the energy in the spring makes it move, for example; yet it would be more accurate to say that it is the spring that makes the toy move. Feynman quips that you may as well say "God makes it move" as to say 'energy' makes it move (pp.178-79). The problem, he says, is that we use synonyms of 'energy' to describe what energy is. Feynman suggests that if you cannot re-describe the concept of energy without using the word 'energy', you are only learning definitions and have gained zero scientific knowledge. (He himself hints that science tells us about the relationships where energy is found, but not what energy is.)

Doing versus Receiving

'Understanding', for Feynman, is a much deeper relationship with the world than knowing what gets taught as 'facts' – I can understand something even when the evidence is pointing in the opposite direction. Feynman says that to be slavish to a received view or even to a method for discovering the facts means that we can never advance scientifically, for the old 'facts' may need to be overhauled in order to discover new ones, and how that may be done is, well, up for grabs. This flexible view breaks with the traditional view of science as a set procedure, methodology, or fact-checking system, and places Feynman alongside many contemporary historians of science.

To get at the spirit of what he's saying about science, Feynman quotes a children's poem about a toad asking a centipede how he runs. In trying to work out how he runs, the centipede falls over confused. Feynman likens the question 'What is science?' to this, in that any explication of what science is simply confuses the issue, for science is a lived activity and it has an inexpressible aspect. I can write down what it is for me to ride a bike – describe it terms of bio-mechanics or highway code rules – but none of this is how I do it, nor will it teach you how to do it. Science may well be a lot like this.

Feynman then offers up a theory of his own, going back to a hypothetical point to explain how science got started. His story is that our efficiency with language meant humans got to a stage where worldviews could be passed on without losing too much information. Mistaken ideas can be passed on too. So for Feynman the purpose of science is "to find out *ab initio*, again from experience, what the situation is, rather than trusting the experience of the past in the form in which it was passed down" (p.185).

This idea is more profound than it may seem. It not only echoes phenomenology in starting from experience as a first principle, it was also the driving idea behind some crucial developments in the philosophy of science. Thomas Kuhn's motivation for writing *The Structure of Scientific Revolutions* (1962) was that his experience from the archives of historical science clashed with the received view of science being taught in textbooks. Similarily, in his published lectures about Quantum Electro Dynamics, Feynman points out the disparity between what science is taught to be and how it is: "What I have just outlined is what I call a 'physicist's history of physics', which is never correct… a sort of conventionalized myth-story that the physicist tell to their students, and those students tell to their students, and it is not necessarily related to actual historical development, which I do not really know!" (*QED: The Strange Theory of Light and Matter*, 1990, p.6).

Science As Constructive Scepticism

Towards the end of his talk to the National Science Teachers Association, Feynman noted from his own experience that science is neither its content nor form. To just copy or imitate the method of the past is indeed to not be doing science. Feynman says we learn from science that you must doubt the experts: "Science is the belief in the ignorance of experts. When someone says 'science teaches such and such', he is using the word incorrectly. Science doesn't teach it; experience teaches it" (*The Pleasure of Finding Things Out*, p.187).

Again this simple idea is more profound than it seems. As I mentioned, a view widely received today is that science is its method: scientists check predictions against the evidence from observation. But Feynman is suggesting that our very experience of nature is molded by the collective scientific knowledge of the past, and that the way we view the world is handed down to us, so that evidence and observations are both historically loaded. For example, Aristotelians experienced the world as geocentric (earth-centred) in a void; Newtonians saw the world as heliocentric (sun-centred) in an infinite space-time; Einsteinians see the world as centreless in a finite space-time geometry. Feynman reasons that established descriptions of reality are hijacked as science in the name of trusted experience. In response, Feynman calls for a "philosophy of ignorance." This is more than just healthy scepticism; it requires professional judgement. Scepticism by itself – merely being distrustful of evidence or experience – is useless in science,

as it does not itself tell us what we should be looking for or doing. Feynman describes judgement in science as the skill to “pass on the accumulated wisdom, plus the wisdom that it might not be wisdom… to teach both to accept and reject the past with a kind of balance that takes considerable skill. Science alone of all the subjects contains within itself the lesson of the danger of belief in the infallibility of the greatest teachers of the preceding generation” (*Ibid*, p.188).

What Feynman calls ‘wisdom’ I would call ‘tacit understanding’. Under a conservative view it’s hard to accept that science is not its methodology or the knowledge it generates. These are certainly the by-products of doing science, but for Feynman they are not science itself. Science is not merely its form, method, past exemplars, or the beliefs and knowledge it generates, for these change when great discoveries are made.

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