Nick Young
2195313

In order to best explain Popper's falsificationism, I feel that it is necessary to quickly review what constituted the standard view of scientific method before Popper.

The standard view relies on two things:

- a natural world that is observable, and that creates objective facts when observed
- an unbiased observer.

Next the unbiased observer makes observations and then induces laws from regularities in the observations. The theory will be tested by testing its predictions against reality. If the predictions are correct, then the theory will last. As theories are confirmed, they are integrated into the world view, an eventually, when there are enough theories, theories of theories will be found. In this way, science progresses via the gradual accumulation of knowledge, like the building of a wall. Various low-level theories are built on by higher level theories, creating a structure which only gets higher and broader with time.[1]

Now, in Popper's time, everyone knew that there were problems with this. Among them were the problem of induction, or how laws are generalised from a limited set of experiences, and the problems of theory loading of observation. Hume[2] had thought about the problems this theory of theories raised. Popper's enterprise was firstly to demarcate science from non-science[3], and secondly to eliminate the problems with the received view, including the problem of induction.

To begin with, Popper said straight out that his story of method had nothing to do with discovery.[4] He felt that discovery was something a practitioner of science simply experienced, like a revelation, not by observing and noticing regularities. He called these initial hypotheses conjectures.

The core of Popper's story, however, lies in his ideas about how a theory was tested. Popper felt that searching for confirmatory cases was useless, for a number of reasons.[5]

Firstly, It's very easy to gather positive evidence. Apart from this being morally corrupt, Popper felt that a theory that could only collect positive evidence was unscientific. (This was part of his criterion of demarcation.)

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[1] Paraphrased from Schuster, J. *The Scientific Revolution: An Introduction to the History and Philosophy of Science*, Schuster, Sydney, 1995, Ch. 9
[2] Hume D, 'An Inquiry Concerning Human Understanding', *David Hume on Nature and the Understanding*, Collier-Macmillan Ltd., London, 1962, p 52-58
[3] see Popper, K.R. *Conjectures and Refutations*, 3rd ed., Routledge & Kegan Paul, London, 1969, p 33
[4] as noted in op. cit. 1, p. 78
[5] These three reasons from ibid. p 80. However, the modus tollens illustrations are my own.

Secondly, there was the logical problem of the modus tollens argument. This goes something like so:

If P then Q

Q

Therefore P

where P is a theory and Q is a prediction of the theory. When it is stated like this, it is clear that it is illogical to proceed from Q to P, because you can't be certain that more evidence won't come along later and explain Q.

Thirdly, Popper felt that looking for negative evidence teaches you more. This is related to the logical problem. If you only ever find confirmatory evidence, then can you really be said to be learning anything, since you cannot confirm your theory by finding confirmatory evidence? Thus, by looking for negative evidence, and finding it if you are lucky, you really learn something, namely that your theory was false, and that you need to devise a new one.

What Popper proposed was that scientists looking to test their hypotheses should be trying to falsify them. That is, they should be trying with all of their heart and soul to prove their theory wrong.[6]

This solves Popper's three problems with positive evidence. The logical problem is solved as follows:

If P then Q

Not Q

Therefore Not P

This is based on standard principles of logic available since Aristotle.

So Popper advocated the rigourous testing of theories by testing their risky predictions and attempting to prove the theory false. The 'risky' part was part of the criterion of demarcation. If you make theories that can possibly be false, then you are making risky predictions. Popper's criterion of demarcation says that your theory must be possibly falsifiable in order to be 'scientific'. Obviously the methodological talk depends on this, because if you aren't making falsifiable predictions, then you won't be able to attempt to falsify them.

Another issue that Popper was considering was the problem of scientific revolutions. The traditional picture of the scientific theory had no place for revolutions that caused the falsification

[6] see ibid. p 79

of laws previously established. In terms of the metaphor discussed before, revolutions involve the pulling down and remaking of a section of the wall. Popper wanted to allow for this by allowing for the falsification of theories, and thus their replacement by new theories.

However, Popper's position did have a number of problems.

Firstly, although Popper acknowledged the theory-dependence of observation, he did not completely apply this to his position, especially with respect to the actual testing being conducted. The problem here is that, because of the theory dependence of observation, no test can be considered conclusive. There is always some sort of normative correction that can be applied to the data to make it fit, or the theories underlying the observation can be questioned. In fact, it seems that this is what tends to happen most often, that tests are conducted, and then the results are either moulded to fit the expected framework or ignored.

As John pointed out, the methodology of science is more a weapon against opponents than a hard and fast set of rules with which to do science.

The major problem Popper's theory faced when discussing scientific revolutions was that all of the 'revolutionary' theories have faced apparently falsifying evidence at the time of their creation.

For example Copernican theory was faced with the crippling problem of not having a working physics if the Earth was moving, because Aristotelian physics depended on the Earth being stationary and in the centre of the universe. This meant that proponents of Aristotelian cosmology could simply point to the diagrams of the earth orbiting the sun and say that it was nonsense. The particular example usually given is that of falling objects. Aristotelian physics says that objects raised above their natural level will fall when the restraint is removed, in order to return to their natural position. If the Earth is spinning and moving through space, why do things fall straight down? They should be left behind! Within the context of their physics, this was a perfectly legitimate argument. It wasn't until Galileo came up with the notion of relative motion, and a concept of inertia, that this problem could be resolved. However, if the Copernicans had been strict Popperians, they would have had to throw away their theory the moment this falsifying evidence was presented to them.

From all of this, it appears that Popper's attempt to save scientific method has failed. The corrections applied by scientists in order to cling to the theories they have devoted years to do occur. Although Popper has applied some corrections to his theory in later years to allow for these tendencies, the problems remains, because, I think, Popper was always concerned with telling scientists what they *should* be doing. People fail to live up to this, but it is useful to scientists to be able to accuse rival theories of not being 'scientific' on methodological grounds.

I think that, even though Popper's story of the methodology of science is not considered correct, it is still important for a number of reasons.

As John pointed out in discussion, it is important because it is used as a tool for argument, and for attacking opponents. One need look no further than the Psych. department at this university to see this in action.

It is also important because it has been taught to, and understood by, those people who constitute the 'experts' in many scientific fields.

Thus Popperian logic has been used in statistics to justify the use of the null hypothesis, where you decide what you want to find out, then go out and test the negation of that. If the statistics support the negation of the null hypothesis, then you throw it out, as Popper would have you do, and accept a new theory, the one you wanted to prove! If not, you say 'the evidence does not support eliminating the null hypothesis' and go on to explain why you think your experiment did not do what you thought.

Popperian logic allows scientists who like to think of themselves as logical, 'hard' scientists, driven by external facts and so on, to create methodological arguments that allow for more sophistication than the logical positivist picture, while simultaneously preserving the 'special' status of science as being the **WAY**.