9 The Commonly Accepted Myth of Scientific Method

In Section 2, Chapters 5 to 8, we talked about an interesting case in the history of science, with Copernicus challenging Ptolemy and Aristotle. We have seen many of the issues that we discussed at the start of this subject, about theory loading of facts and Whig history of science, come into play. Because we have seen so much that is new in just this one confrontation, we now have a Section that gives us some philosophical breathing space. In this Section, we look mainly at the story of scientific method, both the old story invented by Aristotle, and also one of the most recent stories, the Popperian story of method. We are going to see why those stories of method do not tell us anything about the dynamics of science, except that scientists like to use those stories as part of their rhetoric. Liberated from any further need to think that science actually is practiced according to a unitary method, we shall be able to resume our historical case study.

At the beginning of this book it was suggested that science is hidden from our view; that the actual historical, political, social processes of science were hidden from our view by the Cult of Facts. This was the basis of three other things that helped to hide the real nature of science. These were: (1) the idea that there is a simple scientific method which can generate and validate scientific knowledge; (2) the idea that the method is best used in isolation, meaning that science and scientists must be free of social and political and ideological restraints and influences; and (3) the related idea was that science makes an unambiguous, easily discerned kind of progress. We are going to concentrate on the 'method' part of this (fig. 1).

Let's review a little bit about facts and theories. The historical case of Copernicus illustrates a number of points. First, facts are not little mirrors of reality located in our minds. Second, facts are verbal or symbolic reports shaped by cultural grids, (ideas, aims, values) and external input (which are not facts). Facts are created by this process. Third: Theories are not simply summaries of facts, regardless of how you think about facts; whether you think of them in the simple mirror analogy or whether you think about them as culturally loaded reports. Why? As we saw in the cases of Aristotle, Ptolemy, and Copernicus, theories also involve wider cultural assumptions or what in Chapter 11 we shall call 'metaphysical backgrounds'. Fourthly, theories are not selected on the basis of their agreement with facts -- at least not on the basis of their agreement with given objective facts, because we do not have access to such things. Theories are selected on the basis of judgement and argument in the light of criteria, and different people have different criteria or different versions of the same criteria or different weightings for the same criteria.

Let us come to method and see whether we can be liberated from this oppressive cultural myth. Method is a great story which has a wonderful history of at least 2500 years back to Aristotle, who invented the commonly accepted method story. In the 17th century we have people like Francis Bacon, Galileo, Newton who updated and approved that story. The story of method has a real function in science which unfortunately is not to tell us how science is done. In fact, its job is to mislead us as to how science is done . Method operates like a cultural myth, protecting science and scientists because it allows them to say to non-scientists why they (scientists) are special and why they should be left alone. The myth states that there is a way of doing things in science which people outside of science do not know or cannot properly use.

This method is unique and single (for if there were several scientific methods what good would they be). It is effective, for it really works, and, if you are smart, it is transferable. You start with physics and astronomy then you move on to chemistry, then move onto physiology and psychology (which became 'scientific' in the 20th century). Perhaps this leads on to economics as it becomes 'scientific'. Maybe even history will become scientific one day! Of course this all serves a related function of empowering scientists over and against other people who are not scientists, because (if you believe the story) it turns scientists into the sole experts on scientific issues.

What is the story of scientific method, how does it work? We start with two fundamental things: Nature or the universe, which is a system of 'objective facts' is one of these, and the other thing you need in this story (for all stories need a sufficient number of characters to work structurally) is the unbiased observer. (fig. 2) So, you have as it were, the subject, the unbiased observer; and the object, which is nature, a system of objective facts. It is a happy upbeat story. The unbiased observer is by definition 'unbiased', not drunk, stressed, insane, ill, not culturally biased, not committed to, or conditioned by, any biographical, social, political, ideological, discursive, linguistic, anthropological or other matter, whatsoever. This subject (unbiased observer) gets in touch with the facts, which dance into his or her mind as little mirrors of reality (which is the naive story of perception as in Chapter 4). Now, once the unbiased observer is in contact with the facts, the method story states that he/she forms generalisations about relationships among the facts, this is called Induction. A generalisation formed by unbiasedly observing the facts is a tentative generalisation, it's a potential candidate to become a law of nature, a scientific law, its a draft law if you like; or what Aristotle would have called an Hypothesis (a tentative idea of a law). Since the hero of this story is extremely objective and rational, he will not jump to conclusions, but will put his tentative conclusions to the test. (fig. 3)

What is a Test? A test is not a test of bias or prejudice (pre-judgement). No, a test has to be objective and the only objective test is to test your hypothesis against nature itself. Strictly speaking, you do not always test your hypothesis against nature, but against the prediction that has come from your hypothesis, or the explanation that is drawn on the basis of your hypothesis. You test that explanation of that prediction against the relevant facts. Only two things can happen for the honest unbiased observer of the test: either your prediction or explanation is supported by the facts or it isn't supported by the facts. This is not a matter of opinion, but a matter of objective testing. If your prediction or explanation, based on your hypothesis, is supported by the facts, then if you go through a few tests, you can say that your hypothesis is promoted to the status of a law. If your hypothesis fails you would not be biased and hang on to it, would you? You would get rid of the hypothesis and start again.

What is a Law? A law is a little hard brick of congealed fact. But remember where we got the law from: it is a generalisation about facts, tested and accepted; and therefore a law is crystalised facts. That is all it is -- there is nothing else in there.

Several conclusions about the nature of science and the nature of the history of science follow from this story--they are supposed to follow from this story, for they are one of the prime purposes of this story:

First of all the history of science must consist in the heroic discovery and extension of the scientific method, by heroic figures, starting with Aristotle and going on the Bacon, Galileo, and Newton. The scientific method has been perfected and then applied widely and more widely to more and more different kinds of facts. For example, Aristotle for

his own reasons did not stress the role of experiment in scientific method, or the role of mathematics in experimental method; but, in the 17th century the heroic scientific figures of the day, corrected that oversight on the part of Aristotle. Bacon stressed experiment; Galileo and Newton stressed experiment and mathematization. So by the time of Newton the scientific method is largely in place.

Given the discovery of the method, the history of science then consists of the slow, but steady, accumulation of systematic facts. The slow steady growth and progress of science is like the slow construction of a brick wall (fig 4). The wall grows longer, higher and firmer as time goes on and brick is laid upon brick--except in this case the bricks are little units of confirmed fact and theory. Using method over time we get a collection (a growing accumulation) of established facts in the form of laws, laws which are really little packages of summarised fact. And, every once in a while, whilst this collection is growing, somebody comes along and discovers how to generalise about the facts in Law 1, Law 2, Law 3, to produce a Law 1 Prime, which is on an upper level, another higher theory so to speak. But since these laws and theories are nothing but summarised facts, it is perfectly feasible that someone will come and generalise about these facts, producing yet a higher law. This is exactly what the great scientists do; they are the ones who add crucial bricks to this wall of facts so that the wall of facts grows throughout time progressively. It grows in length, width and height. As time goes on we discover more and more truths and our knowledge collected in the brick wall comes to mirror, in a slightly different organisation, the system of objectives facts from whence it was all drawn, that is, it comes to mirror nature.

The third conclusion, then, from this is that science makes progress slowly and surely from ignorance to truth, because with the piling up of the bricks is a collection of systematized knowledge of facts. The bigger, wider and higher the wall, the more truth we know and the less ignorant we are. The fourth point is that this, of course, is another version of the Whig history of science. Whig history says we progress towards the truth, that we are closer to the truth than the people in the past. Therefore, we can judge their scientific behaviour on the basis of the truth that we know. Perhaps they misused the method; perhaps they misjudged facts; perhaps they did not see certain facts because they were biased. We know more than they do; we should judge them on that basis. This is pure Whig History!

The story we have just been talking about is one that we cannot buy into any more. Our analysis of facts and our analysis of just one or two episodes in the history of science undermines the basis of this story. Point 1: the states of mind, inside your heads, called perceptions are theory-loaded. Point 2: perceptions inside your head theory-loaded as they are, are not reports that can be circulated to your friends and colleagues. 'Facts' are reports that are circulated to your friends and colleagues. 'Reports' circulated to your friends and colleges are even more theory-belief-value and goal-loaded than your private perceptions.

These findings about the theory-loading of facts are very corrosive of the traditional story of method. Clearly, it remains true of humans that they observe things and generalise about them. But, now we can see that everything tends to depend upon the grids or theories or categories that humans take to the observing situation. You will observe, report and generalise about types of things and events which are allowed for and exist in your theoretical grid. In other words, certainly humans observe and generalise, as the method story states, but that is only half the story, because the facts you generalise about are, to a very large extent prefabricated by your beliefs, aims and

theories. This means that two contending parties backing different theories, can both say that they are obeying 'scientific method' because each will tend to observe and generalise about the sorts of facts shaped by their own theory.

An example: Heavy bodies fall down, as Aristotle and children affirm. This can be confirmed a trillion times by dropping different types of heavy bodies from a height and they will fall downwards. Therefore, I would be very justified to generalise that 'all heavy bodies fall down'. A student in this subject would dispute this saying: "That isn't modern physics, bodies do not possess weight, but mass -- weight is the force on the body in a gravitational field -- and there is no absolute 'down' in the universe." But I would say "That's just the point, I perceive, report and generalise about the kinds of facts that my grid allows." And the story of method doesn't allow for that, for it does not allow that two groups of people could have different theories (grids) and hence happily go on for ever observing and generalizing about two rather different sets of facts. This story we have just heard about method cannot deal with this, because it pretends that one *and only one* set of facts is real and available to be objectively and correctly known. According to the method story, any other set of facts is the result of bias or error. But in our example, both parties have been 'generalising correctly from (theory-loaded) facts'. At the research coal-face, where science is made or broken, nobody has access to that privileged set of real facts, they only claim to know by hurling arguments based on scientific method at each other, as they go about the business of dealing with inevitably human, theory-loaded facts.

Similarly, the idea of theory-loading of facts is corrosive of the other side of the traditional method story--the point at which we test predictions against the facts revealed in experiments or controlled observations. Again, nobody is denying that humans perform tests and experiments and that they compare the results with their predictions. To that simple extent the traditional method story is correct. But it is only half the story, because if observations are theory-laden, then of course the observations that humans make of the results of tests and experiments will be also. Again, people with differing theories or prior beliefs will tend to observe different facts in a test situation or experiment. This undermines the idea that the facts are simply given to us from nature, and that objective method-obeying humans can simply compare THE FACTS to their predictions.

For example, let's go back again to the Chapter on Aristotelian natural philosophy, and imagine that we want to test that claim of Aristotle: 'All heavy bodies fall down'. In order to be rational and follow method I have to perform a test: **Here is a Heavy Body: I Predict It Will Fall Straight Down when I drop it.** Voila! it fell down!, confirmation of my theory that all heavy bodies fall down. Now you may think the experiment was trivial, but all theories work that way. The facts are constructions, they are not given, the generalisations are shaped by the grid of categories of facts that is available within a certain framework, and the tests are designed and observed within a theoretical framework. There is no stepping outside a theoretical framework into some wonderful objective, unbiased situation in order to observe the outcome of the test. If I believe in a theory and I go out to test it, then I am going to observe the test in the light of that theory (or at least some theory). There is no un-theory-loaded observation of the result of a test. Tests are not definitive in the sense told by the traditional method story!

Let us look at Copernicus in this light. According to this story Copernicus must be a man who has new facts and new generalisations. I will admit that he has new generalisations, but I do not believe that his generalisations are produced by first

discovering some new objective facts and then generalising about them. What makes Copernicus' theory different? He has not opened up some new view of objective facts. He has just got a different theory which shapes somewhat different facts. Why does he have a different theory?, because it is shaped by a somewhat different set of (Platonist) presuppositions, and a different criterion for judging whether a theory is good or not. The criterion and the presuppositions shape the theory and the theory shapes his evaluation of the facts.

What about testing? There was not much in the way of testing because there were not many tests that could be conjured up -- and notice they were thought up in the framework of Aristotelian physics. For example, it was argued as a 'thought experiment' that if the earth spins then everything must fly off it. Since things do not fly off the earth it must not be spinning! True, in this 'test' there was an assumption that Aristotelian physics is true. You perform tests of Copernicanism in that framework and it does not perform well, surprise, surprise. So, in the 16th century, Copernican theory did not look healthy. Nothing in the form of new objective facts was evident in Copernican theory. Copernicus had a different theory which gave him somewhat different facts, not vice versa.

We now come to an important nub of the matter. Copernicus on his side and the followers of Aristotle and Ptolemy on their side are each perfectly entitled to say that they have correctly followed the scientific method.

We have seen what Aristotle says according to the methodological story: observe the facts, generalise, test. Aristotle invented the story of scientific method, and used it to present and legitimate his theories.

Then Copernicus comes along wanting to tell a different story (as do Galileo and Newton later). A Copernican method story is:

> Aristotle does not understand scientific method. What doesn't Aristotle understand? That scientific method must be mathematical, which Aristotle's method most assuredly is not, therefore, he will never be able to see the right facts and therefore generalise from those facts. Now, what facts is Aristotle missing because he does not understand the role of mathematics in science? The facts of the cosmic harmonies, of course!

Or, Copernicus could argue this in a different way by saying:

> I know certain facts that we all agree on, such as, Venus is never far from the Sun. You people (Ptolemy and Aristotelian) explain it and I can explain it also, but my explanation is more mathematically elegant than yours. Since mathematics is the key to science and to method, my theory and my method are better.

So, Copernicus can package his work in a methodological story, as can Aristotle. That does not mean that Aristotle on the one side and Copernicus on the other actually reached their viewpoints by using method, that is, that Aristotle unbiasedly observed facts and tested and Copernicus also unbiasedly observed facts and tested, because then we would have to condemn one person as being wrong for some as yet unascertained reason of bias or error--they both can't be right. Believing in method produces Whig history! It does not work that way, for each side *constructed* its theory within a

background of beliefs, values and aims; each side *tested* its theory within a background of beliefs, values and aims and each side could *explain their theory by using a method story*. Which shows rather that the Method Story is just that, a story. It is not what they really do but what they say they do as part of their attempt at winning the 'theory' debate. My theory is better than yours. My facts are better than yours. My criteria are better than yours. My method is better than yours. It is all the same argument. Buy my theory not his.

Historical cases put the commonly accepted myth of scientific method to rest. But do not misunderstand me. I have not said that science is non-existent; I have not said science is nonsense. What I have said is that we do not know much about the actual workings of science and its history as long as it is protected by the story of method. We have seen how that story can be used on both sides of an argument; how it is used as a rhetorical weapon in scientific fights. The method does not really produce scientific knowledge, or validate scientific knowledge. The 'method' is just a way of telling persuasive stories. The real question is: What *really* goes on in science? We shall learn more about that when we return to the history of the Copernican debate after Chapter 11, in Section 4

However, not everyone is convinced that method is dead as an account of scientific practice. Anthropologists who study myths know that myths are elusive, fertile, flexible creatures. Myths transmute and change, they alter. You can study their transmutation and their altering across both society and time. The story of scientific method is a myth and it alters and mutates. People do not give it up when faced with negative evidence, they simply say: "We have not understood scientific method properly yet, here is another version which is an accurate, workable version."

And so, in this century, even though this story has been criticised, there are philosophers and other people who still want to tell us that the scientific method exists. They believe a different version of the scientific method can be designed that is viable, one that at long last is the correct version. In other words people like me are proved wrong if a good version of method becomes finally available. In the 20th century, a new 20th century method story has emerged. Its author, Sir Karl Popper, the most important philosopher of science of this century, meant to elude and reject everything we have just talked about. Many educated people believe that he succeeded, and that a Popperian version of method works and has actually been the real method of science in all times and places. We shall now see what that new method story involves, what are its undoubted strengths, and why in the end, we probably must conclude that it, like all previous method tales, from Aristotle to Newton, functions only as myth and rhetorical packaging.

Figure 1
ENQUIRY BLOCKED BY STORY

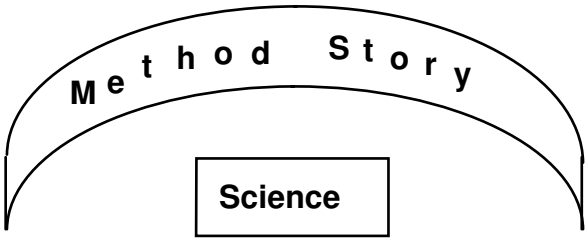


Figure 2

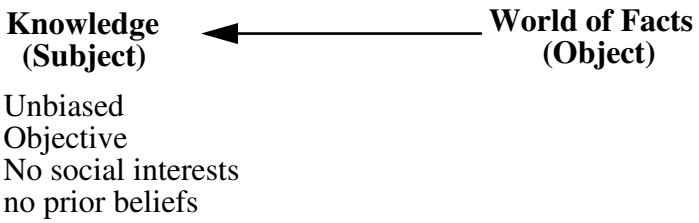


Figure 3
THE METHOD STORY

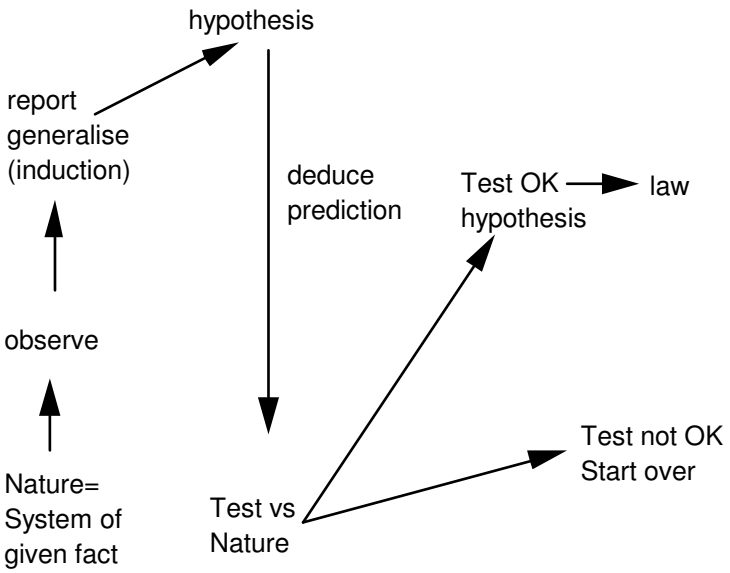
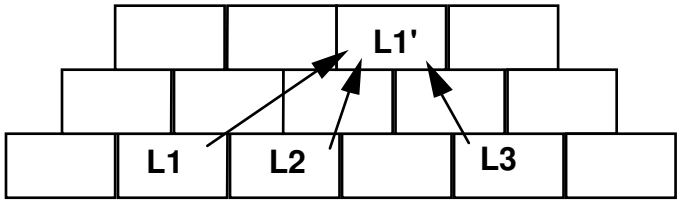


Figure 4 Brick Wall Metaphor of Progress



Bricks of facts and law grow Wider and Higher over time