

How this Book is Structured into Sections

Section 1: The History of Science and the Cult of 'Facts'

Chapters: 1 to 4

We will have two items on our agenda as we begin this Section: First, from analysing how historians construct their facts (rather than finding or discovering them) we are going to move toward suggesting that in science too, the facts are constructed, rather than found or discovered; and that facts are very much shaped and conditioned by the theories, aims and beliefs entertained by scientists. When we see what we mean by the construction of facts—in history and in science—we will be able to move away from the old stories of method, autonomy and progress which prevent us from doing anything but 'fairy tale' history of science. Secondly, we are going to see that there is a very special, and misguided, way of writing the history of science, a way of writing that depends upon old fashioned ideas about facts, method, autonomy and progress. This misleading form of history writing, we will learn, is called Whig history, and we must get rid of it as well, if we are to clear the ground for a critical history of science as a social institution and as a social product of our culture.

Section 2: Conflict and Revolution in Science--Copernicus vs. Aristotle

Chapters: 5 to 8

In the last Section, on theory-loading of perception and theory-loading of facts, we were warming up with a few ideas to assist us in doing history of science in a better way. Now we are going to have a Section of the subject which does some historical work: our first historical case study. We are going to look at the confrontation in the Scientific Revolution between the originally dominant, established world view, cosmology and astronomy, which was that of Aristotle, and the world view, cosmology and astronomy of the challengers, loosely called Copernican, following from Copernicus (died 1543). To do this, we are going to put to work some of our ideas about not being Whiggish, for example, not considering Aristotle as stupid and the Copernicans as obviously right. We shall follow these people as they make and break facts, and make and break theories. We shall show that the making and breaking of facts and the making and breaking of theories are not historical phenomena that depend on the 'good guys' making true contact with the nature of reality, and the 'bad guys' not making such contact. These phenomena instead depend on people's personal, social, political and institutional tactics, ways and means of making and breaking facts and theories—that is why it makes for interesting history, instead of mythical fairy tales of Whig history.

Section 3: The Myth of Scientific Method—Two Tales

Chapters: 9 to 11

In Section 2 we examined an interesting part of the history of science, with Copernicus challenging Ptolemy and Aristotle, and 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 philosophical breathing space. In this Section, we are going to dredge from the domain of philosophy, with its 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, based on our experience, why those stories of method do not tell us much that is useful 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 in later Sections.

Section 4: How Do Scientists Really Do Science?

Chapters: 12 to 14

We begin this Section by bringing out into the open something that was implicit in what we have done so far, but which now needs a philosophical discussion. It is the idea that theories have deep presuppositions built into them, which shape or condition them, the idea of what historians of science call 'metaphysics', or the metaphysical background to theories. We have already destabilised the old idea of given objective facts because we have seen that facts are actually theory-loaded. What we are going to see is that theories are presupposition-loaded; theories are shaped and conditioned by cultural presuppositions, beliefs, commitments, aims, that exist in a given society or culture; pre-suppositions that shape the origin and the use of the given theory. So, as theories are to facts, cultural presuppositions (or the metaphysical background to theories) are to theories.

We then turn in this section to the Copernican debate in the two generations following the death of Copernicus. We shall discuss aspects of the work of three key participants—Tycho Brahe, Kepler and Galileo—and we shall be applying to our historical analyses, the new critical concepts about facts, theories, pre-suppositions and the social shaping of knowledge that have begun to emerge thus far.

We are therefore concentrating on the reception, the interpretation, of a new theory when it is put forward—the process of professional negotiation and reinterpretation that finally accepts or rejects the new theory. This is one of the social phenomena of science that historians and sociologists of science find very important to study. After all, a theory is not just what its inventor says it is; a theory is what the other members of a profession say it is, as debate and negotiation unfold about the acceptability of the new claim. You cannot impose your will upon an entire profession. It's up to your colleagues to judge and interpret your theory.

While we study this process of negotiation and interpretation by later Copernicans and their opponents, we will also look at some general sociological/political aspects of science. We do this by looking at several individual's work in the Copernican debate and in each case isolating one general socio-political aspect that they illustrate: With Tycho it is the professional negotiation of theory claims; with Kepler it is the nature of scientific discovery as intellectual construction within a metaphysical context and web of research priorities, and with Galileo and the telescope we will look at the theory loading of instruments and the politics of the use of instruments in science.

Section 5: An Attempt to Revise Our Understanding of How Science Works

Chapters: 15 to 16

We have looked at two accounts of scientific method, Popper's and the older inductivist account. We have seen that they do not throw much light on what we know about the history of science. Scientific change, debate and work is more complicated, for social and political reasons, than those stories tell us. We have so far reached an artificially constructed point similar to the state of this discipline about forty-five years ago. At that point work in the field of history and philosophy of science was very much affected by the appearance of Thomas S. Kuhn's book *The Structure of Scientific Revolutions*.

Kuhn's work on the nature of scientific change has affected thinking in many areas, extending to wider fields of history, sociology, political science anthropology and even art history. Although an educated person today can afford to be ignorant of Popper, one cannot afford to be ignorant of Kuhn. He was definitely moving in the right direction, even if many of his followers do not agree with much of what he originally said. In this section we will examine his ideas in detail. This will provide a useful starting point for thinking about scientific change in a non-mythological manner.

Kuhn's theory of how science develops and of what scientists do was first published in 1962. It has become the most influential and widely read work in modern philosophy and history of science. There are few people who would accept literally everything Kuhn says, but most of the new ideas about science of the last forty years have been stimulated or molded in some degree by Kuhn's philosophy. His work is also widely read in other academic fields. If you make some effort to understand his thought you will be better off in this subject, and will also have added to your general education related to early 21st century culture in a significant way.

Section 6: Raising the Stakes: Society, Politics and Scientific Change

Chapters: 17 to 22

Here we return to our historical study, but with a changed conceptual, theoretical focus. It is time to consider the history of science from a stand-point that takes more account of broader social forces, institutional factors and social contexts.

First, we will examine the classic, and much misunderstood, issue of Galileo's unfortunate encounter with the Catholic Church, and we will go on to examine the larger social context of the Galileo affair. This will bring us to the heart of the matter because we shall come to the issue of the conflict of 'Philosophies of Nature' in the Scientific Revolution. This is important because it has to do with social context and social shaping. The big systematic explanations of nature, the Natural Philosophies, were very sensitive in social and institutional senses. They had to maintain proper relations to religion, to educational institutions, to the political climate, so they were social and cultural lightning rods. When we look at the Natural Philosophical changes in the Scientific Revolution we are actually looking directly at how larger social forces affected the development of the sciences.

We shall therefore have to deal with the reasons for the manufacture and acceptance of the Mechanical Philosophy. This has less to do with the attempt to falsify Aristotelianism, than with the attempt to destroy a dramatic new challenger, Neo-Platonism, especially in its magical manifestations. We shall learn be careful to avoid the Whiggish conclusion that Mechanism triumphed because it was 'right'.

Finally, we shall discuss Newton and Newtonian Natural Philosophy. Here, one must be careful to avoid two pitfalls: (1) that Newton 'got it right', that he was the first to 'really see' nature. And (2) that Newton represents the 'end' of the Scientific Revolution, the final set of truths to which everything before was naturally tending.

Section 7: What is at Stake in Understanding the History of Science?

Chapters:23 to 28

This final Section is about **historiography**, which means an analysis and discussion of the assumptions and theories which historians use in their work (descriptions, narratives, explanations). In other words, the assumptions about how the world works which are made in historical explanations. Thus, the historiography of science is the analysis of the assumptions that the historians of science make.

To begin with, we are going to deal with the two main traditions or schools of thought in the historiography of science which were popular in the last century. They are called Internalist History of Science, and Externalist History of Science. We shall see that neither the Internalist nor Externalist pictures can give a satisfactory picture of the 16th and 17th century astronomical community as a social, political, institutional, sub-culture. We will also look in detail at one of the most important versions of externalism, the work of the sociologist of science Robert Merton on the 'Protestant ethic and the rise of modern science'. Although his work has been questioned, it has also recently been developed in revised form by some leading historians of science. We will correct and improve both the original and newer 'Merton' explanations in the spirit of what we have been studying this session.

Finally, we will realise that the ideas we have seen throughout this subject take on new resonances against the Internalist/Externalist debate. Neither side in that debate developed the idea that the 'inside' of a science is a social site, a sub-culture where micro-politics and the construction, negotiation and destruction of fact-and-theory-claims is carried on. Given this insight, we then can work out the consequences of this 'post-Kuhnian' view and also factor in an understanding of 'Natural Philosophy' as a field of social and intellectual contention in the Scientific Revolution. This will, at long last, give us a sketch picture of the process of the Scientific Revolution as a whole; that is, a sketch of a new sort of narrative and explanation for this period in the history of science.