

Let me start by giving you a somewhat personal overview of this subject and of the field of History and Philosophy of Science. First of all, we do not teach you science. If you want to become a skilled practitioner of science, you had better join a science department. HPS is not a natural science discipline -- we are a *social science* or *humanities* discipline and we do exactly what other people in the social sciences or humanities do. Everyone in the social sciences and humanities studies some sort of human activity or human institution -- it could be politics, art, the economy, the military, literature; or, it could be science and technology -- to see where it comes from, how it works, how it shapes history and how it affects society.

In the field of HPS, we study the human institutions of science and technology; they are our objects of study. We do not study nature. We study scientists studying nature. We do not make or sell technologies -- we study the people who make and sell technology and who try to influence people thereby. This may sound merely 'academic', in the same way that all of the social sciences and humanities can be labelled as not being relevant, or of not being capable of producing worthwhile knowledge. But we know things about science and technology as social institutions that have been shaped by society and in turn have affected society that the average practitioner -- the average scientist, engineer or technologist -- doesn't know about and these are real issues in our society, perhaps the key issues in fact. For example, issues about understanding the impact of technological and scientific change on society are highly relevant and timely. A glance at the newspapers will show that they are filled with medical, scientific, technological and environmental controversies, all with economic, political, moral and personal dimensions. It is the job of HPS to study these social dimensions of scientific and technological change and to help educate people about the issues and how to analyse them. This raises the question of where the history of science fits into this endeavour.

History and Philosophy of Science is not one discipline; it's a cluster, a constellation of disciplines. There are some Universities with HPS programmes or departments that teach history of science subjects and other Universities with HPS programmes which don't teach this type of subject. Some Universities don't have any HPS Department, but they do have a Department of Science & Technology Studies (STS), or a Department of Sociology of Science; or a Science and Technology Policy Unit. So, HPS is an umbrella term for a number of disciplines. There are certain disciplines that focus on the study of science: History of Science, Philosophy of Science, and increasingly Sociology of Science and Science Policy. On the technology side we have the Politics and Sociology of Technology, History of Technology, even Philosophy of Technology, as well as the very important Technology Policy area. In short, HPS is a vast canvas of overlapping and increasingly intersecting, very rich and quickly changing disciplines. Being a student in HPSC 1100 or HPST 2100 means you've located yourself in the midst of a subject which deals with large slices of the history of science as well as certain bits of the philosophy of science, and the newer, exciting sociology of science. As for my own location, I am an historian of science; trained in the history of science and the relevant context of European social and economic history. I also have training in philosophy of science and enormous amounts of professional retraining in the sociology of science.

I thought I'd give you a little personal view of why I got interested in some of these issues. Everybody's got his or her own biography and there are lots of good

biographical trajectories that could lead someone into these questions about the nature of science. I thought I might share some of mine with you, just to acquaint you with where I'm coming from. By my accent you will know where I come from - New York in particular - and by my age you may also guess that I was very much shaped by the scientific and technological panic that gripped the ruling circles in the United States in the late 50s and early 60s after the USSR launched the first man-made satellite, Sputnik, in 1957. The claim was that the Soviets were going to over-run us with scientific, technological and engineering advancements.

History unfolds in strange ways. In 1957 I was in primary school and by the time I went onto high school in 1962 the country had 'geared up' and everybody who tested at an IQ of over 120 or so was pushed into science and mathematics, in the hope that they would go into science, or mathematics, or engineering in University. Money was poured into the curricula. High school teachers were sent off to Harvard and Yale to learn advanced subject matter. In those days physics was still the main subject, for this was the time before the revolution in biology and before biotechnology had spun off from molecular biology. Watson and Crick only published in '52. So, in those days, physics was the great heroic subject; Einstein had died in '55 and he was the Great Man; the great physicist; the great humanitarian.

Despite the fact that I was demonstrably better in History and English subjects, than I was in Physics and Mathematics, I was pushed into a Physics major at University. I went to Columbia University in New York, which is one of the major historic Universities in the States, with a Physics department that had produced a dozen Nobel Laureates. I was stuck for two and a half years doing physics and there were personal problems, career problems, political and philosophical problems about my doing physics.

First of all, I discovered that the training you get in physics is actually aimed at teaching you how to solve little problems in physics, and set up experiments. The training isn't how to be a great man in physics for doing physics isn't like reading books about Einstein and Newton. I also discovered that a lot of physicists didn't work in ivy league Universities, they worked for the Defence Department as defence contractors, and perhaps in another time or place, that wouldn't have been so bad, but this was '66, '67, '68 in the middle of the Vietnam War - and we were not happy about that - even the war seemed a product of science. That is ultimately too simple, but the American attitude to it was technological, forgetting the political and historical complexities of the situation. We decided to enter this war and our technology will carry us through. If you transfer that attitude into academic type questions, those questions are obviously career and personal questions and intellectual questions such as: "How does science really work?" "How does it actually get done?" "Why is 'doing' science, so much different from its public benign image?" (I don't mean to imply that science in itself is something sinister or dirty or nasty). In the '60s science had a very benign image, and yet it was tied into social and political policy. So the question is "What is the image, and what is the reality?" "Was science always tied so closely to the State and to the industrial complex?", "Was it always like that?", "Did it have to be like that?"

Now these are historical, political and philosophical questions about science, and I switched into this discipline as was available at Columbia - a programme in history and philosophy of science as well as European history and then went on to do postgraduate work in that area. This is a fairly typical trajectory for colleagues of mine, about my age, and I suppose there are similar sorts of questions that sometimes lead students into our department. In second and third year, we get students who are troubled by their

scientific education, troubled by the impact of technology, the political questions, environmental issues and that sort of thing. These are real problems. Science and technology are real social and political phenomena in our culture -- we have a right to raise social, political and historical questions about them.

All this leads me back to the matter of this subject, because the one important starting point for us is the problem that, in a sense, I had as an undergraduate. It was the question of why there is a gap between the public image -- the public face of science -- the public story of science -- and whatever social and political complexities actually exist in its real practice. Why does it have a kind of mask? That's an important question for us, because before we can do any serious history of science, (say, the scientific revolution and serious work on Galileo, Kepler or Newton), we're going to have to think about this public face of science. By the public face of science, I mean the following: A set of interlocking stories, interlocking myths, that have been around since the seventeenth century and they are intended to say that everything in Science is all right.

The first story is the story of scientific method. According to it, science is based on the fact that scientists have discovered and perfected the method of doing science. The method is a simple set of rules and procedures for finding facts, and generating and testing theories. The method is unique -- there is only one method variously applied to all the sciences; and it is transferable -- where the method is used correctly, good, scientific knowledge results. The next story says that this wonderful method has to be used in isolation from *nasty* social influences, in isolation from bias, and ideology and religion for example. The method works best if you leave the scientists alone; if they are independent and autonomous, so it is the story of the autonomy of science from social influences. The final story is the story of progress -- that an increasing pile of knowledge spews out of laboratories and institutes through application of the scientific method. The pile of resulting knowledge gets bigger and bigger, like a pile of sausages from a sausage machine, where the sausage machine is the *method* working away, churning out *facts*. As the pile gets bigger and bigger, that is called *progress*.

So we have the linked stories of *progress, method and autonomy*. It would be so nice if these stories were true, because then we would have such an easy time in the history of science. For we could then say the good guys came along in the seventeenth century, invented the method, and caused progress to happen. Actually, there are books in the library that tell the story like that. Unfortunately each of these stories is a bit misleading, hiding the actual social and historical reality of how science is done and how it has evolved in history. One of our main aims in this subject is to analyse and deconstruct these stories so that we can get a glimpse, a taste of what the actual historical dynamics of scientific change are about; so that, in addition we can see how and why social forces shape the content and direction of scientific change (fig 1).

Our strategy in doing this is going to be determined by another important point: underneath the three stories of method, autonomy and progress there is something deeper, a myth that makes them all possible, which I shall call the *cult of facts*. This is the idea that the facts are just out there, waiting for the sausage machine to be set up, in social isolation, to make progress through the discovery and testing of these facts.

Now, in the next Chapter we are going to try to persuade you that facts are curious things and are much more elusive and flexible perhaps than ordinary, everyday thinking presupposes. Facts are much more historical products and much more historically variable. They are far more socially and politically shaped, than we usually give them credit for, especially in science. The fundamental thing I think we're going to find out

about facts is that they are very much a product of scientists' viewpoints, scientists' theories and scientists' choice of techniques; and that we need all kinds of social, political and historical analysis to explain scientists' choices of theory (and hence choices of the facts those theories entrain). Once you see that facts are shaped by theories and viewpoints, then all of a sudden science has an interesting history, because instead of looking at the good guys picking up facts, you start looking at people struggling to construct, make out and sell certain facts over and against opponents, who want to make out and sell different facts. That's exactly the kind of struggle we're going to see in the Scientific Revolution of the 17th century.

We will hear much more about facts in the next few Chapters. In Chapter 2 I want to show you that I'm fair dinkum, so I'm not going to start with scientific facts, but rather with history and historical facts because all of you have the bias whereby you would say scientists' facts are *real facts* but historians' facts are slippery, conditional, constructed, historically variable and the product of historians' viewpoints and interests. You all want to say that, and you're absolutely right, except at the end of this subject I want you to see that you also have to say the same thing about scientists -- their facts are slippery, conditional, constructed, historically variable and the product of their theories and viewpoints.

I will have two items on my agenda as we proceed over the next three Chapters. First, in Chapter 2 in analysing how historians construct their facts (rather than finding or discovering them) I am going to move toward suggesting that in science too, the facts are constructed, rather than found or discovered. When we see what we mean by the construction of facts -- in history and in science -- we will be able to move away from those old stories of method, autonomy and progress which prevent us from doing anything but 'fairy tale' history of science. These matters will be taken further in Chapter 4, dealing with the shaping of human perception and facts by prior theories, beliefs and aims. Secondly, in Chapter 3, I am going to show 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.

Figure 1 Interlocking Stories

