

Beyond Internalism and Externalism Sociology of Scientific Knowledge & Contextualist History of Science

We are now going to discover how in the History of Science we got out of the dilemma of the Internalist/Externalist debate. So far, you have been taught implicitly from outside that bind, but it is necessary to make the alternative assumptions explicit. We will work mainly on re-conceptualising the inside of science now. Let's return to our key diagram (fig. 1).

We know what an Internalist is: a person who attributes simple conceptual, intellectual, cognitive essence to Science, who assumes the history of science is the history of the inner intellectual logic of whatever is put inside. The outside--society, economy, political institutions, religious, ideological atmospheres--are not important in shaping the content and in driving the process. In many Internalist explanations you also get the idea that there are 'nasty' external factors that can get in the way and inhibit the proper development of science -- that is how social factors enter the Internalist argument, as negative factors.

For Externalists the membrane between the inside and outside of science is highly porous. Indeed there is an inside to Science, and the inside consists of intellectual, conceptual and cognitive content, but what is there and the direction which it evolves is always the product of a shaping or causation of whatever large social factors are most favoured by that Externalist explanation. In the classic Marxist ones, the form of explanation is by the changing economic and social structure. This whole debate between the Internalists and Externalists continued because both sides assumed the things that we reject today in the discipline of history of science: a large monolithic thing called capital S 'Science', and an 'inside' to Science which consists only in ideas, theories or methods. In our discipline today we believe there are sciences which have variously intertwined histories and to understand the history of the sciences one must not over-simplify from the beginning and just talk about Science, capital S.

Beyond the Internalist and Externalist view lies something more profound. First, instead of saying 'inside Science' let us say 'inside a/or any, science'. Second, both the Externalists and Internalists made an assumption about what is 'inside' science. They thought that only intellectual materials existed there: the ideas, the concepts, the theories, the methods of Science. As I began to suggest in previous Chapters this is not the way we have thought about the **'insides' of sciences** in this subject. Inside a science we do not find concepts or ideas or theories rattling around in a void. We find a social institution: People in social and institutional relations--the people being professional practitioners of that science.

What does this mean? Inside any science is a smaller sub-society or sub-culture of the larger society, and as a sub-culture that science has a definite social complexion/structure. There is, for example a hierarchy of power and resources in this sub-culture: there are people with power and those with less power; people who control the resources and people subject relatively to that control; people who specialise in certain skills within that social structure and others who specialise in other skills. Just as in the astronomy sub-culture in the period that we studied. A man such as Galileo had almost no skills in mathematical astronomy; but Kepler had that to spare; Galileo was investing himself in telescopic skills which was part of the social set-up of

astronomy. The point of looking at the 'inside' that way is that it dissolves the old terms of reference for the debate.

To put it in a nutshell: If the inside of any science is a sub-culture, a small social institution, what goes on there? There the relevant experts are struggling to construct/shape claims about what are the facts, and what are viable theories. People manufacture claims, they package and publish them; they see them accepted, rejected, re-negotiated or modified. The game is to get most of your facts and theories accepted for the time being.

This means that the Externalists and Internalists were both wrong about what is 'inside' science, but they were also wrong, respectively, on what is outside science. Think of any sub-culture, any institution in society: the University is a good example, for we have many sciences institutionalised in each university. Each University is collectively a sub-culture in society. It is ridiculous to argue that Universities evolved out of their own inner logic; it is patently absurd. So, if each science is a small social system (and this is my point) there is no reason to deny the external influences on the content or direction of a science.

But what happens to the Externalists view: their view also becomes implausible because the science as a sub-culture is not an hostage from moment to moment of the immediate gross social imprinting of the larger society--otherwise there is no sub-culture! Think again about universities: just as it is ridiculous to believe that they are independent of society it is also ridiculous to think that everything that happens in those institutions from day to day, month to month, year to year, is simply and always the direct imprint of what the economy or state or government and the society of the day want to do or get out of the universities. Universities in Australia are under social pressure for they are, completely, the funding 'footballs' of government, but even that does not make them clay in the hands of these external forces, for as institutions (sub-cultures) they have a certain degree of institutional momentum and resources and power which they can mobilise against external forces which they do not want to allow in.

So, it would be ridiculous to view universities as ivory towers never affected by society at all, but, it would be equally ridiculous to think that what we are doing in the 1990s in the Universities is simply the result of what the Minister for Education, Training and DEET had planned and demanded a few years ago.

The same point holds for the fields of science, for they are never simply the result of what society is pushing at that moment, because otherwise the sciences would not be sub-cultures in any meaningful senses of the term.

One may ask which external factors are important. The answer is that that is a matter of detailed research. For example, it could be that in the 17th century the main external influence on science was from religion and the institutions of religion and education, not directly from the economy or the capitalist class. But, in the 19th century the emerging industrial capitalist system did affect science and scientists, and that may be the most important external factor at that stage. In the late 20th century it could be the State that is the most external factor on the direction of science. So you see it is a matter of empirical historical research and judgment. It could be that Hessen and Bernal were way off beam, but that if they had paid attention to the religious and theological concerns of the leaders of the day, they would have seen a lot of shaping of the inner workings of science by such religious and ideological forces. For instance, the mechanical philosophy was probably shaped more by religious and ideological concerns

than directly by the rising middle-class. It is still a question of an external shaping force but it is located in a slightly different place.

All this means we have a new 'inside' which is a social and political micro-culture, and the new 'outside' is whatever you find in the larger society which affects the inside. The boundary is now porous and empirical research will indicate how porous or non-porous in each given situation. There are some new names for the types of scholars who work with such reconceptualisations of the 'inside' and the 'outside'. 'Sociologists of Scientific Knowledge' are interested in the social construction of scientific knowledge within these sub-cultures. Another related and partially overlapping group of scholars mainly with historical training have concentrated more on this issue of what are the external shaping factors in any given case and the close study of the making and breaking of facts in any particular case are called 'Contextualist Historians of Science'. Both of these groups are all working in this new framework (fig. 2).

I want to reinforce our new understanding of the 'inside' by going back to Kuhn to show where he came up just short of being a modern Sociologist of Scientific Knowledge or a Contextualist Historian of Science. According to Kuhn, we recall that in the history of any given field of science there are two styles of scientific practice. In periods of normal science, puzzle solving science under one paradigm; then there are periods of dramatic overthrow of paradigm and adoption of a different one: hence, Normal and Revolutionary Science (fig. 3).

Let us dramatise this. In a normal period all of the members of the sub-culture are wearing the identical copies of the same paradigm strait-jacket. This strait-jacket is called the paradigm which gives them their concepts, their tools, their standards and really gives them their puzzles, the resources for solving their puzzles and for seeing whether the solutions are acceptable or not. The other kind of moment is when the strait-jackets have loosened, maybe they are off, and another strait-jacket is on offer and some people have already put it on and other people are considering putting it on. If a sufficient number of people put on the new strait-jacket then a revolution has occurred and there is a new paradigm (or strait-jacket) for the members of the community.

Now, this assumes that there is a big difference between normal work and a revolutionary period. Moreover, according to Kuhn if you are looking at the history of a given science, you will only find external factors during revolutionary turmoil. Kuhn does not believe that external factors can play much of a role during the normal period of the history of a science. I therefore think we can begin to see that Kuhn is by and large a modified hesitant internalist. If we look at his normal science it is self-enclosed and it goes according to its own inner-logic: the paradigm works, it has anomalies, you have a crisis, then maybe you get some external factors that may work on the internal workings. Kuhn did tell us that science is practiced by communities and that these communities are sub-cultures, but his model of science does not parallel these views for everyone in a particular science is wearing the same strait-jacket. Kuhn told us it was a social order but he really has no notion of the sociology of what the scientific field is like.

What we have actually observed in the historical cases in this book point goes strongly against Kuhn in very important ways, and they must now be brought out into the open. The way we should now look at the paradigm of a 'normal' science would be the following. The normal scientist is not running around in a strait-jacket, solving the problems within the strait-jacket of the paradigm. We now would say, that a paradigm is always being slightly reshaped and renegotiated in the community that owns it. Why?

Because, any significant success in establishing a claim about fact or theory (a puzzle solution) is reintegrated back into the paradigm for subsequent people to work with, to use as the basis of their own work -- so there is a feedback effect which affects how the paradigm is seen and used the next time. And, so on, and so on. Thus, paradigms are not static. Paradigms are in a renegotiable flux. If normal science is puzzle-solving the puzzle, the pieces, the rules of assembly are constantly being renegotiated. The very aim of the science is to on-goingly modify the paradigm by reintegrating results that have been produced within it. This is always the result of politics, negotiation and jockeying for position among the players.

On this view Kuhn does not look Kuhn anymore, for we see that *Normal Science* and *Revolutionary Science* are not two contrasting things but are labels for parts of a spectrum. **In other words, the concepts, theories and standards within a science are always being argued over and renegotiated and the revolutionary period is a label for a rather extreme changes that may occur within the science. What Kuhn calls 'normal science' is a period of relatively less significant alterations and renegotiations.**

So the following would be the literal Kuhnian picture of a Copernican Revolution--taking paradigms as fixed straight-jackets: Once upon a time there was a paradigm (or strait-jacket) called Aristotle and Ptolemy, which people used to solve puzzles but there were anomalies and then a crisis and man named Copernicus made the first leap to resolve the crisis by putting forward a different paradigm (strait-jacket) called the Copernican Paradigm. For a while there was competition and debate and in the end for some reason the Copernican strait-jacket won. But the point is you either practiced puzzle solving in one or the other paradigm--with the two block paradigms competing. (fig. 4)

Now let us ask ourselves something: according to Kuhn, surely the followers of Copernicus practiced in the Copernicus Paradigm in the above stright-jacket sense. Two of the most important followers of Copernicus were Kepler and Galileo. But, given our close study this session, do we really think that Kepler and Galileo simply accepted the strait-jacket offered by Copernicus in 1543 and simply solved the problems using Copernican's theory? You can see that Kuhn's paradigms are an over-simplification. Galileo did not even practice mathematical astronomy; he used the telescope and physics to argue why the Earth could possibly be moving. Galileo's version of Copernicanism is by no stretch of the imagination a repeat of Copernicus' theory, it is Galileo's own version of the theory. Do we really think that Kepler was shoulder to shoulder with Galileo as a strait-jacketed follower of Copernicus? No, Kepler does not have circles in his cosmos; he has ellipses and planet moving forces, searching for harmonies; physics of the heavens. Kepler has his own version of Copernicanism. His version of Copernicus does not parallel Galileo's version--in fact both their versions are in competition. These men are creative players and negotiators, following in a general line, but trying to get the best advantage for themselves with their own claims about the facts and theories, and so they have consequentially different versions of 'Copernicanism'. They are struggling in the sub-culture with non-Copernicans and with each other! (fig. 5)

Let's now go a bit further in deconstructing the idea of a straight-jacket Copernican paradigm, given once and for all by Copernicus. We studied Tycho Brahe in the way I am now arguing. I never suggested that Tycho was simply another Aristotle-Ptolemy clone. I asked you not to look at him that way. He is not a pure Ptolemaist and he is not a Copernican, but he is a good professional astronomer, a clever professional

negotiator saying: We want the basic Aristotelian system but we have to do something about the Copernican bid--especially the dangerous part of his bid where he has the harmonies, because I think he has something there. We have to get the harmonies back into the Aristotelian system. So, Tycho manufactures his theory to those specifications, as in figure 6.

Let's go even further. We also know that Kepler goes out on a limb for ellipses for he has data from Tycho; therefore, Tycho is part of the story, for he is Kepler's resource base; Tycho is a reference point for his own work. Kepler is in interaction with Tycho - borrowing from Tycho and moving out in his own direction. And, given that don't we also need a line between Aristotle, Ptolemy and Copernicus: isn't Copernicus in a way in part a Ptolemaic astronomer--just as Tycho in turn is in part a Copernican astronomer.

So, if I draw the required line (fig. 7) then the Kuhnian idea of 'living in different worlds' and 'different paradigms' and 'revolutionary overthrow' of paradigm begins to look a different way. If you read the story Kuhn's way it is a revolution: a sudden invention and imposition of a radically different world of scientific thought and perception. If you understand what is really going on, as we have studied it, then there is no way that Copernicus can function unless he is actually at least more than one foot in the Ptolemy and Aristotle professional and conceptual background. Almost everything that Copernicus does is in that tradition, except for the re-ordering of the planets. Copernicus can be seen as a person in the Greek and Medieval tradition who is making a rather radical bid, of which not too many people take very much notice. It is important that Copernicus is borrowing and re-negotiating and reformulating and making a bid.

Now, given figure 7, we can ask, 'Where did the supposed Kuhn revolution of paradigm occur? I submit no substitution of straight jackets occurred--only an historical process of negotiation, revision and alteration in one tradition and universe of discourse. The only important thing to understand is the process of bidding, counter-bidding, negotiating and renegotiating and trying to establish the longevity of ones own claims.

To call any person or moment in this process the 'real revolution' is just to add a rhetorical gloss--the kind of gloss that some players sometimes hurl at each other, as a tool and tactic in the negotiations-- 'revolution' is not a 'thing' opposed to 'normal science'--it is a social label sometimes applied by players (or commentators) to moments in a continuous process.

So in figure 8, my two schools of figure 4 have disappeared. We have an inner sub-culture of people arguing and negotiating all the time and any external factors that you, as an historian, can argue are important at any point in the story is on the outside. Questions about the churches and religion are important at one point; perhaps Humanism and the Renaissance are important at other stage; etc. etc. We can work external factors into the story now that we have a revised inside with which to work. So now in the case of Astronomy, Kuhn's diagram has changed into mine . This is what we have been doing all along in this book: post-Kuhnian Sociology of Scientific Knowledge and Contextualist History of Science . You can now ask again with new confidence what are the external forces that shaped this process of subcultural evolution and negotiation in astronomy?

Figure 1 Traditional Externalism / Internalism

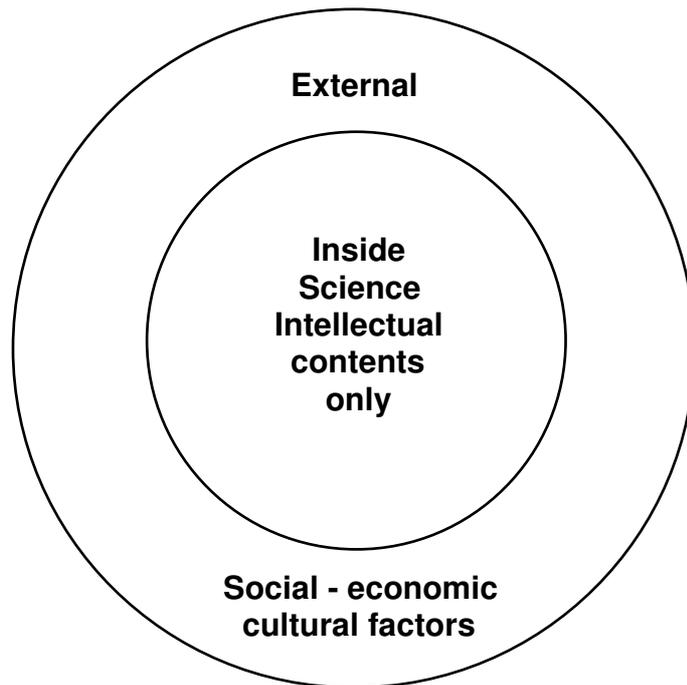
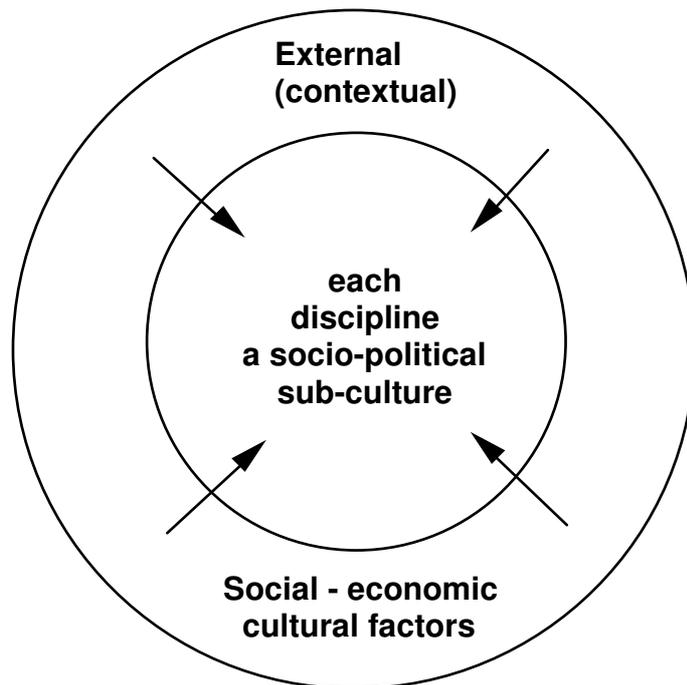


Figure 2



Sophisticated view via new sociology of scientific knowledge and contextualist history of science

Figure 3

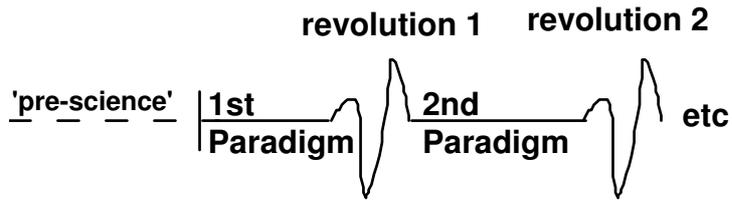
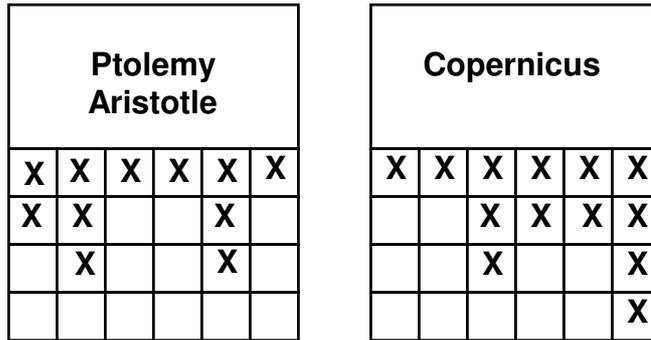


Figure 4 Block paradigms compete to solve problems



X = "solved" puzzle

Figure 5

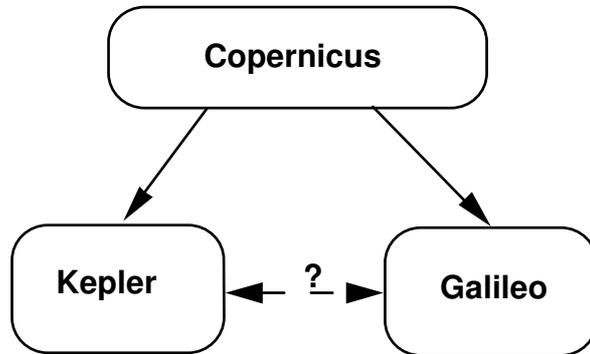


Figure 6

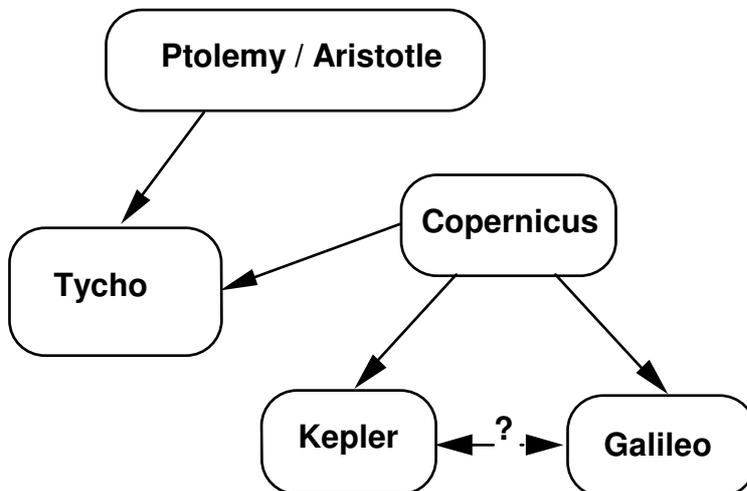
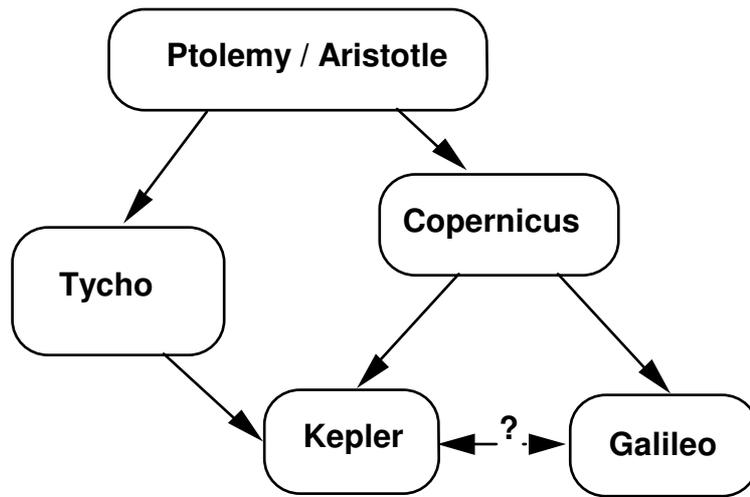
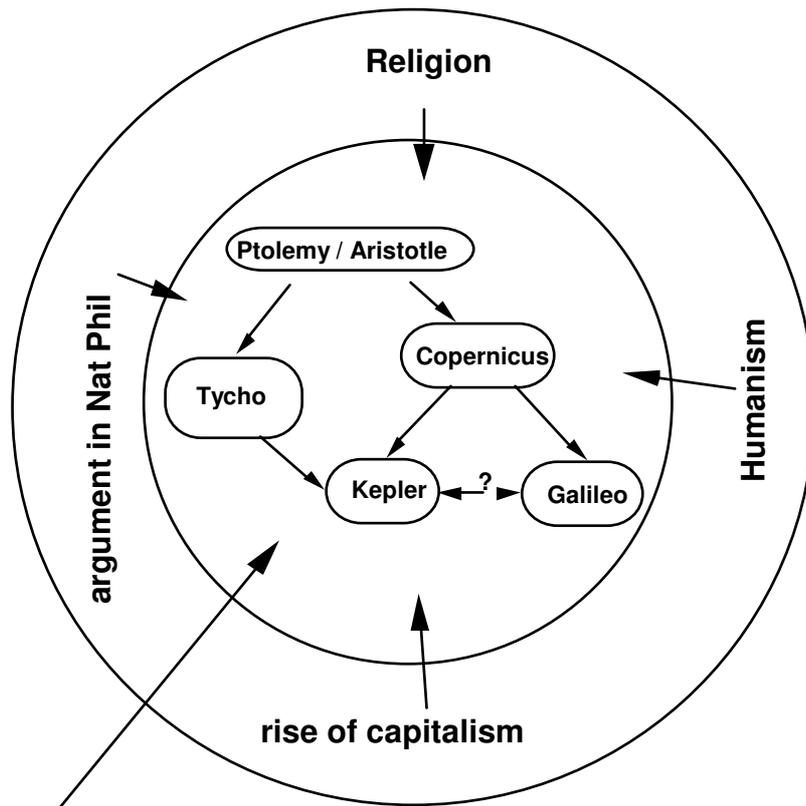


Figure 7



Astronomy community negotiates claims about theory and fact

Figure 8



evolving negotiation of claims in astronomy subculture