Nick Young
2195313

Thomas Kuhn and *The Structure of Scientific Revolutions*

Thomas Kuhn's *The Structure of Scientific Revolutions*[1] was a very important book by all accounts[2]. This paper is to give a brief explanation of what it was about, and also to give some problems with it. To mangle the story into a exceedingly short form, science usually proceeds in a fashion given by the prevailing *paradigm*, or scientific theory (but there's more to it than that). This following of a paradigm is called by Kuhn 'Normal Science'. However, on occasion the paradigm will run into problems significant enough for practitioners to begin questioning it, and once these questioners establish their own paradigms, a revolution occurs, during which a new paradigm is selected. This paradigm then proceeds into its own period of normal science, and so on.

Normal Science

Kuhn defined 'Normal Science' as 'research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation of its further practice.'[3] Even in this definition it is obvious that some big changes in method talk were underway. The use of 'for a time' and 'some particular scientific community' indicate the transitory nature of the normal science period, and foreshadow the shocking (to those who were conditioned to expect Science (capital S) talk) revelations later revealed.

To continue, Kuhn's picture of normal science goes something like this:

Textbooks of science not only instruct prospective scientists in method etc. but also instruct them implicitly as to what sort of problems are considered appropriate. The reasons that this particular method-assumptions-problems-solutions complex were chosen over any other options was that, firstly, 'their achievement was sufficiently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity'[4], and secondly, 'it was sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve.'[5]

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[1] Kuhn, T.S. *The Structure of Scientific Revolutions*, 2nd. Ed., University of Chicago Press, Chicago, 1970

[2] That is, everything I can recall seeing about it acknowledged it as such.

[3] op. cit. 1, p 10

[4] ibid. p 10

[5] ibid. p 10

Sensibly, instead of calling what is followed in normal science a method-assumptions-problems-solutions complex, as I did, Kuhn gave it the much snappier name of *paradigm*. To clarify, Kuhn writes: 'I mean to suggest that some accepted examples of actual scientific practice – examples which include law, theory, application, and instrumentation together – provide models from which spring particular coherent traditions of scientific research.'[6]

Again, even this early on in the book, it is easy to see that some quite odd stuff is being said here. By grouping law, theory, application and experiment into the transient idea of normal science, Kuhn is laying the groundwork of the story of revolutions.

However, to return to the main point, in normal science, the aim for practitioners of science is to examine the problems of the paradigm, and come up with solutions that fit with the paradigm. Schuster[7] pointed out that these problems can be classified into two classes, problems of fit and problems of extension.[8] Problems of fit are concerned with improving the 'fit' of obtained data with theoretical predictions, while problems of extension are concerned with extending the paradigm to cover new areas of phenomena.

Between these two areas, there is plenty for practitioners of normal science to do. They can be improving instruments, devising more accurate ways of measuring, or they can be working on using the methods of the paradigm to solve problems in other domains. I think that the characterisation sometimes applied to normal science of a straitjacket is perhaps a bit unfair, because although the practitioners of normal science are limited in their choices, they also have the advantage of not having to justify deep assumptions, choices of methods and so on. This is all laid out in the paradigm.

Revolution!

The question raised by all of the thinking about normal science is 'what happens when the paradigm runs across something it cannot explain?' Kuhn calls problems that are unsolvable within a paradigm 'anomalies'[9], and it is a buildup of these that create a revolution. The buildup of anomalies creates what Kuhn refers to as 'crises'. This is an awareness of anomaly, and that the anomalies are intractable. Eventually, someone will feel that the anomalies justify a new paradigm, and will devise one which appears to explain both the anomalies and the data explained by the previous paradigm.[10]

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[6] ibid. p 10

[7] Schuster, J.A. *The Scientific Revolution: An Introduction to the History and Philosophy of Science*, Schuster, Sydney, 1995

[8] summarised from ibid. p 145

[9] op. cit. 1 p 52

[10] this paragraph is summarised from three chapters in Kuhn, chapters, 6, 7 and 8.

As Schuster says, 'this is where the community debate comes into play.'[11] The community debates the new contender, probably with much vehemence, with all kinds of implicit assumptions up for questioning, and so on. There may be other rival contenders emerge into the debate, but eventually, a new paradigm is accepted. However, exactly how this occurs is interesting, because it is difficult to explain.

The reason for this is because the new paradigm is, to some extent, what Kuhn called incommensurable[12] with the previous paradigm. Technically, this means that no common measure exists, but as Schuster pointed out, this cannot be totally the case[13], and Kuhn, in his 1969 postscript to *The Structure*, says the same.[14] However, some measure of incommensurability is important for Kuhn's theory, as this explains why the debates about paradigms are often circular and last a very long time.

Problems with Kuhn

One of the problems with the 'vanilla' version of Kuhn's theory is that it provides little to no explanation of the most interesting parts of the picture, that of the transition between normal science and revolutionary period, and of revolutionary period to normal science. Part of the reason for this is that Kuhn seems not to have allowed for the modification of a theory while in the normal science period. This means that, as soon as any modification is made to a theory, it is possible to say that the science is in a revolutionary period, and thus the whole idea of sciences being in 'revolutionary' and 'normal' periods becomes very unclear. That is, when it is difficult to establish what period you are in under Kuhn's model, then the model breaks down.

Another problem lies with the notion of progress, and related to it, is the special status of science as a mode of thought, and belief. For most, the idea of progress is very much related to the idea of gradual accumulation of knowledge over time. Kuhn's model destroys that notion by saying that there is no one Scientific Method, that what is the method in one science at one time is just that, nothing more.

[11] op. cit. 7, p 151

[12] op. cit. 1, p 148

[13] op. cit. 7, p 148

[14] op. cit. 1 p 198-199

Also, the special status of science as a mode of thought would appear to depend on Science having this Scientific Method that unifies it and makes it whole, no matter if you are studying particle physics or evolutionary biology, or whatever. If Kuhn's model is the case, then scientists are no longer special. They do not necessarily know more than their antecedents did. For many practitioners of science, this is understandably a difficult pill to swallow. According to Kuhn, any paradigm is valid as long as the community accepts it. Thus, it would seem, the infatuation with scientists and philosophers of science who like to think of themselves as logical, and workers in the tradition of Newton, eradicating the mysteries of the world with the blazing light of their science, have their batteries run out if they take Kuhn as true. So, obviously, they ignore Kuhn, and the descendants of Kuhn, the sociological histories of science and so on.