Paradigm Shift

A paradigm shift, suggested by Thomas Kuhn [1], is not just a small change in science, or the modification of a theory. It is a scientific revolution and completely changes the way in which science looks at the world. It often dictates how the public looks at the world.

For example, Darwin’s theories [2] were intensely debated by scientists and theologians. This debate spilled over into the public consciousness, and newspapers became filled with cartoons and caricatures.

A paradigm shift [3] is often the result of scientists working at the fringe [4] of the paradigm, performing research [5] that most other researchers feel is a little misguided, or a dead end.

In most instances, this view is correct but, every so often, a scientist has a revelation. More often than not, they feel the weight of scientific and public opinion, and become ridiculed.

However, slowly but surely, other scientists try out the research, and a few lost voices in the wilderness increase into a new way of thinking.

For example, Feigenbaum's explorations of chaos theory took a long time to take root, and his ideas were marginalized, because they lay outside the established classical paradigm of physics. Early Chaos Theorists found difficulties in receiving funding [6], finding supervisors, and finding journals willing to publish their research.

Kuhn’s paradigm definition [7] is a little more than a theory, although the terms are often used interchangeably. It is a complete and overall view of a phenomenon, often relying upon some basic principles.

This process continues for a long time, until some experiments begin uncovering errors. A certain amount of error [8] is accepted, and it can be absorbed by slight changes in the paradigm.

However, eventually, the basic and fundamental principles may be shown to have error and there is a paradigm shift, a way of looking at the same information in a completely different way.

Probably the best way to look at a paradigm shift is through example, using example of Ptolemy, whose fixation upon a paradigm created problems. Ptolemy, in common with most Ancient Greek philosophers, believed that the earth was at the center of the universe, and that the sun and other planets revolved around it.
Unfortunately, the empirical observations [9] did not entirely fit this view. Some planets, when their positions were measured, appeared to move backwards relative to others, a retrograde motion.

This fits Kuhn’s idea of a paradigm dictating the very nature of a research paradigm, before the inevitable paradigm shift.

The answer, postulated by Ptolemy, working within the paradigm, was that the planets moved in epicycles, or circles within greater circles.

The problem with that view came when Ptolemy, and later observers, made more accurate observations. More epicycles had to be added, making circles within circles.

It was not until Copernicus that this view was challenged. He postulated that the sun was at the center of the solar system, which was regarded as the center of the universe at that time.

This was an example of fringe science [4] beginning to build up evidence against a paradigm. He did not completely find the answer, because his model still needed epicycles; he had no inkling that orbits were elliptical, and not the perfect circles that convention dictated.

However, his mathematics and theory was cleaner, and Occam’s razor [10] dictated the simplest course. With Galileo [11], and the invention of the telescope, the model fell into place, and the first fairly accurate model of the universe appeared.

The paradigm shifted, and it was only the resistance of the church that prevented immediate adoption. After this came Newton’s ideas and physics worked within a new paradigm.

Poor Ptolemy is often used as a metaphor for bad science and irrationality, but this is very unfair, and is an example of a fallacy, an argument from superiority. Using the equipment he had available, with no telescopes and limited mathematics, there was little wrong with his theory or methods.

His measurements were supremely accurate and were used for measuring the motion of the planets until the time of Copernicus. His rigorous and meticulous approach was faultless, and he was a good empirical scientist. Copernicus, Galileo and Newton had a lot of respect for him, so the modern world must be careful not to judge Ptolemy harshly.

Unfortunately, this is one of the downsides of paradigm shifts, where scientists who performed good work within the confines of the paradigm become ridiculed. Much of the problem is that they cling to their theories, becoming more stubborn, and showing signs of confirmation bias [12]. This opens them up to ridicule by history, and they are judged by this, rather than by their other achievements.

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