The Structure of Scientific Revolutions

The Structure of Scientific Revolutions (SSR) was originally printed as an article in the International Encyclopedia of Unified Science, published by the logical positivists of the Vienna Circle. In this book, Kuhn argued that science does not progress via a linear accumulation of new knowledge, but undergoes periodic revolutions, also called "paradigm shifts" (although he did not coin the phrase, he did contribute to its increase in popularity), in which the nature of scientific inquiry within a particular field is abruptly transformed. In general, science is broken up into three distinct stages. Prescience, which lacks a central paradigm, comes first. This is followed by "normal science", when scientists attempt to enlarge the central paradigm by "puzzle-solving". Guided by the paradigm, normal science is extremely productive: "when the paradigm is successful, the profession will have solved problems that its members could scarcely have imagined and would never have undertaken without commitment to the paradigm".

In regard to experimentation and collection of data with a view toward solving problems through the commitment to a paradigm, Kuhn states: "The operations and measurements that a scientist undertakes in the laboratory are not 'the given' of experience but rather 'the collected with difficulty.' They are not what the scientist sees—at least not before his research is well advanced and his attention focused. Rather, they are concrete indices to the content of more elementary perceptions, and as such they are selected for the close scrutiny of normal research only because they promise opportunity for the fruitful elaboration of an accepted paradigm. Far more clearly than the immediate experience from which they in part derive, operations and measurements are paradigm-determined. Science does not deal in all possible laboratory manipulations. Instead, it selects those relevant to the juxtaposition of a paradigm with the immediate experience that that paradigm has partially determined. As a result, scientists with different paradigms engage in different concrete laboratory manipulations."

During the period of normal science, the failure of a result to conform to the paradigm is seen not as refuting the paradigm, but as the mistake of the researcher, contra Popper's falsifiability criterion. As anomalous results build up, science reaches a crisis, at which point a new paradigm, which subsumes the old results along with the anomalous results into one framework, is accepted. This is termed revolutionary science.

In SSR, Kuhn also argues that rival paradigms are incommensurable—that is, it is not possible to understand one paradigm through the conceptual framework and terminology of another rival paradigm. For many critics, for example David Stove (Popper and After, 1982), this thesis seemed to entail that theory choice is fundamentally irrational: if rival theories cannot be directly compared, then one cannot make a rational choice as to which one is better. Whether Kuhn's views had such relativistic consequences is the subject of much debate; Kuhn himself denied the accusation of relativism in the third edition of SSR, and sought to clarify his views to avoid further misinterpretation. Freeman Dyson has quoted Kuhn as saying "I am not a Kuhnian!", referring to the relativism that some philosophers have developed based on his work.

The Structure of Scientific Revolutions is the single most widely cited book in the social sciences. The enormous impact of Kuhn's work can be measured in the changes it brought about in the vocabulary of the philosophy of science: besides "paradigm shift", Kuhn popularized the word "paradigm" itself from a term used in certain forms of linguistics and the work of Georg Lichtenberg to its current broader meaning, coined the term "normal science" to refer to the relatively routine, day-to-day work of scientists working within a paradigm, and was largely responsible for the use of the term "scientific revolutions" in the plural, taking place at widely different periods of time and in different disciplines, as opposed to a single scientific revolution in the late Renaissance. The frequent use of the phrase "paradigm shift" has made scientists more aware of and in many cases more receptive to paradigm changes, so that Kuhn's analysis of the evolution of scientific views has by itself influenced that evolution.

Basic Terms of the Theory:

Paradigm: In science and philosophy, a **paradigm** is a distinct set of concepts or thought patterns, including theories, research methods, postulates, and standards for what constitutes legitimate contributions to a field.

The Oxford English Dictionary defines a paradigm as "a pattern or model, an exemplar; a typical instance of something, an example". The historian of science Thomas Kuhn gave it its contemporary meaning when he adopted the word to refer to the set of concepts and practices that define a scientific discipline at any particular period of time. In his book, The Structure of Scientific Revolutions (first published in 1962), Kuhn defines a scientific paradigm as: "universally recognized scientific achievements that, for a time, provide model problems and solutions for a community of practitioners, i.e., what is to be observed and scrutinized

- the kind of questions that are supposed to be asked and probed for answers in relation to this subject
- how these questions are to be structured
- what predictions made by the primary theory within the discipline
- how the results of scientific investigations should be interpreted
- how an experiment is to be conducted, and what equipment is available to conduct the experiment.

Paradigm shifts:

In The Structure of Scientific Revolutions, Kuhn wrote that "the successive transition from one paradigm to another via revolution is the usual developmental pattern of mature science" (p. 12).

Paradigm shifts tend to appear in response to the accumulation of critical anomalies as well as the proposal of a new theory with the power to encompass both older relevant data and explain relevant anomalies. New paradigms tend to be most dramatic in sciences that appear to be stable and mature, as in physics at the end of the 19th century. At that time, a statement generally attributed to physicist Lord Kelvin famously claimed, "There is nothing new to be discovered in physics now. All that remains is more and more precise measurement." Five years later, Albert Einstein published his paper on special relativity, which challenged the set of rules laid down by Newtonian mechanics, which had been used to describe force and motion for over two hundred years. In this case, the new paradigm reduces the old to a special case in the sense that Newtonian mechanics is still a good model for approximation for speeds that are slow compared to the speed of light. Many philosophers and historians of science, including Kuhn himself, ultimately accepted a modified version of Kuhn's model, which synthesizes his original view with the gradualist model that preceded it. Kuhn's original model is now generally seen as too limited.

Some examples of contemporary paradigm shifts include:

- In medicine, the transition from "clinical judgment" to evidence-based medicine
- In social psychology, the transition from p-hacking to replication
- In software engineering, the transition from the Rational Paradigm to the Empirical Paradigm.
- In Artificial Intelligence, the transition from classical AI to data-driven AI

Kuhn's idea was, itself, revolutionary in its time. It caused a major change in the way that academics talk about science; and, so, it may be that it caused (or was part of) a "paradigm shift" in the history and sociology of science. However, Kuhn would not recognize such a paradigm shift. Being in the social sciences, people can still use earlier ideas to discuss the history of science.