Paradigm

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The term "paradigm," from the Greek word *paradeigma*, is mostly associated with the work of the philosopher and historian of science Thomas S. Kuhn, who in his seminal book *The Structure of Scientific Revolutions* (1970) used it to speak of traditions in science which are shaped and developed by following particular exemplars of scientific work. Before Kuhn, the term "paradigm" had a standard use most commonly in the teaching of grammar where particular words, the paradigms, illustrate how verbs are to be conjugated or nouns declined. In philosophy we find it in the work of Georg Lichtenberg who compared exemplary scientific achievements to grammatical examples and in Ludwig Wittgenstein's later writings where paradigms are understood as models and objects of comparison. In this sense, paradigms were also used by the philosopher of science Stephen Toulmin (1961).

Despite the fact that "paradigm" has been criticized as having too many meanings in Kuhn's *Structure*, two major senses stand out: paradigms as concrete examples of scientific achievement which function as models for rigorous and systematic research; and paradigms as conceptual schemes, frameworks, or traditions which are shaped by this activity. For these two senses, Kuhn introduced two different terms in his 1969 "Postscript" which was published in the second edition of *Structure*: "exemplar" and "disciplinary matrix." "Disciplinary matrix," which captures the framework sense of the term, encompasses beliefs, models, symbolic generalizations, commitments, techniques, values, and, notably, exemplars, that is, shared examples and standards of scientific research (e.g., Newton's *Principia* or the inclined plane). Paradigms in the wide sense came to be seen by Kuhn as problematic but remain the dominant understanding of the term. Only recently has the significance of paradigms in the narrow sense – as exemplars – been highlighted since they are supposed to establish similarity relations among model applications and are taken to be important in case-based rather than rule-based reasoning and learning.

Kuhn used the concept of paradigm to account for the cohesion characterizing scientific communities. Normally, the consensus observed would be attributed to particular rules that scientists follow and which would comprise the alleged scientific method, but Kuhn could not find such rules. Scientific education does not involve abstract teaching of rules nor was there agreement as regards axioms or definitions which would appear in the axiomatization of theories. The concept of paradigm, in the sense of exemplar followed, allowed Kuhn to account for agreement and at the same time explain diversity in scientific fields and scientific practice which would not be possible if scientists were to follow universally applicable rules of scientific method. Kuhn talked of the priority (both temporal and logical) of paradigms over rules but this idea should not be taken to imply that the two notions, paradigms and rules, are to be contrasted. Emulating paradigms in education and research sets rules which, when followed, establish a practice that eventually forms a tradition and a framework.

Kuhn's focus on paradigms brings into relief the importance of convergent thinking

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as a condition of creativity, innovation, and even revolution in science in opposition to what most educators and psychologists usually endorse, namely divergent thinking which emphasizes imagination, freedom, and open-mindedness. Only by establishing what is normal can one recognize the anomalous and the abnormal to overcome it and be creative. Convergent thinking is achieved by dogmatic initiation and rigid education centered on repetitive exercises with concrete problem solutions, the paradigms. Kuhn (1977) spoke of the "essential tension" implicit in scientific research, that is, the effort to simultaneously conform and innovate.

Paradigms are intimately related to other concepts in Kuhn's model, namely, to normal science, anomaly, revolution, and incommensurability. In normal science scientists solve research problems (puzzles), which they model upon the paradigms used. Anomaly, literally deviance from normalcy, emerges when there are unexpected results and the means to eliminate it are not available. Revolution occurs when what was anomalous and problematic in the previous framework is assimilated and "normalized" in a different configuration, the new paradigm. The two successive or competing paradigms are between them incommensurable, that is, they lack any common measure as regards standards, concepts, ontology, or perceptions.

The transition from one network to the next, the famous *paradigm shift*, was compared by Kuhn to living in different worlds, to religious conversion, and to the gestalt switch in ambiguous figures, such as the duck-rabbit, in order to point to radical discontinuity in scientific development and to stress that the adoption of a new paradigm is not a matter of rigorous logical inference but rather of change of perspective. This gave rise to charges of irrationality in the development of science, as if endorsing a paradigm was a matter of taste, to charges of relativism given that the standards of correctness and empirical adequacy were made internal to each particular framework, and to charges of idealism since to a large extent ontology was also internal to paradigms. Thus, progress in science could not be explained nor could convergence to truth as to how the world is be made sense of. In response to such criticism Kuhn restricted global incommensurability to local while other scholars sought to rescue some common ground between successive frameworks.

The use of paradigms in relation to science helped draw attention to scientific communities and the practice of scientific research in opposition to linguistic articulation and logical treatment of scientific theories.

SEE ALSO: Kuhn, Thomas; Relativism; Wittgenstein, Ludwig

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