Thomas Kuhn

Thomas Samuel Kuhn was born on July 18, 1922, in Cincinnati, Ohio, United States. He received a Ph. D. in physics from Harvard University in 1949 and remained there as an assistant professor of general education and history of science. In 1956, Kuhn accepted a post at the University of California--Berkeley, where in 1961 he became a full professor of history of science. In 1964, he was named M. Taylor Pyne Professor of Philosophy and History of Science at Princeton University. In 1979 he returned to Boston, this time to the Massachusetts Institute of Technology as professor of philosophy and history of science. In 1983 he was named Laurence S. Rockefeller Professor of Philosophy at MIT.

Of the five books and countless articles he published, Kuhn's most renown work is *The Structure of Scientific Revolutions*, which he wrote while a graduate student in theoretical physics at Harvard. Initially published as a monograph in the International Encyclopedia of Unified Science, it was published in book form by the University of Chicago Press in 1962. It has sold some one million copies in 16 languages and is required reading in courses dealing with education, history, psychology, research, and, of course, history and philosophy of science. *Structure* has also generated a good deal of controversy, and many of Kuhn's ideas have been powerfully challenged (see Weinberg link below).

Throughout thirteen succinct but thought-provoking chapters, Kuhn argued that science is not a steady, cumulative acquisition of knowledge. Instead, science is "a series of peaceful interludes punctuated by intellectually violent revolutions" [Nicholas Wade, writing for *Science*], which he described as "the tradition-shattering complements to the tradition-bound activity of normal science." After such revolutions, "one conceptual world view is replaced by another" [Wade].

Although critics chided him for his imprecise use of the term, Kuhn was responsible for popularizing the term paradigm, which he described as essentially a collection of beliefs shared by scientists, a set of agreements about how problems are to be understood. According to Kuhn, paradigms are essential to scientific inquiry, for "no natural history can be interpreted in the absence of at least some implicit body of intertwined theoretical and methodological belief that permits selection, evaluation, and criticism." Indeed, a paradigm guides the research efforts of scientific communities, and it is this criterion that most clearly identifies a field as a science. A fundamental theme of Kuhn's argument is that the typical developmental pattern of a mature science is the successive transition from one paradigm to another through a process of revolution. When a paradigm shift takes place, "a scientist's world is qualitatively transformed [and] quantitatively enriched by fundamental novelties of either fact or theory."

Kuhn also maintained that, contrary to popular conception, typical scientists are not objective and independent thinkers. Rather, they are conservative individuals who accept what they have been taught and apply their knowledge to solving the problems that their theories dictate. Most are, in essence, puzzle-solvers who aim to discover what they already know in advance - "The man who is striving to solve a problem defined by existing knowledge and technique is not just looking around. He knows what he wants to achieve, and he designs his instruments and directs his thoughts accordingly."

During periods of normal science, the primary task of scientists is to bring the accepted theory and fact into closer agreement. As a consequence, scientists tend to ignore research findings that might threaten

the existing paradigm and trigger the development of a new and competing paradigm. For example, Ptolemy popularized the notion that the sun revolves around the earth, and this view was defended for centuries even in the face of conflicting evidence. In the pursuit of science, Kuhn observed, "novelty emerges only with difficulty, manifested by resistance, against a background provided by expectation."

And yet, young scientists who are not so deeply indoctrinated into accepted theories - a Newton, Lavoisier, or Einstein - can manage to sweep an old paradigm away. Such scientific revolutions come only after long periods of tradition-bound normal science, for "frameworks must be lived with and explored before they can be broken." However, crisis is always implicit in research because every problem that normal science sees as a puzzle can be seen, from another perspective, as a counterinstance and thus as a source of crisis. This is the "essential tension" in scientific research.

Crises are triggered when scientists acknowledge the discovered counterinstance as an anomaly in fit between the existing theory and nature. All crises are resolved in one of three ways. Normal science can prove capable of handing the crisis-provoking problem, in which case all returns to "normal." Alternatively, the problem resists and is labeled, but it is perceived as resulting from the field's failure to possess the necessary tools with which to solve it, and so scientists set it aside for a future generation with more developed tools. In a few cases, a new candidate for paradigm emerges, and a battle over its acceptance ensues - these are the paradigm wars.

Kuhn argued that a scientific revolution is a noncumulative developmental episode in which an older paradigm is replaced in whole or in part by an incompatible new one. But the new paradigm cannot build on the preceding one. Rather, it can only supplant it, for "the normal-scientific tradition that emerges from a scientific revolution is not only incompatible but actually incommensurable with that which has gone before." Revolutions close with total victory for one of the two opposing camps.

Kuhn also took issue with Karl Popper's view of theory-testing through falsification. According to Kuhn, it is the incompleteness and imperfection of the existing data-theory fit that define the puzzles that characterize normal science. If, as Popper suggested, failure to fit were grounds for theory rejection, all theories would be rejected at all times.

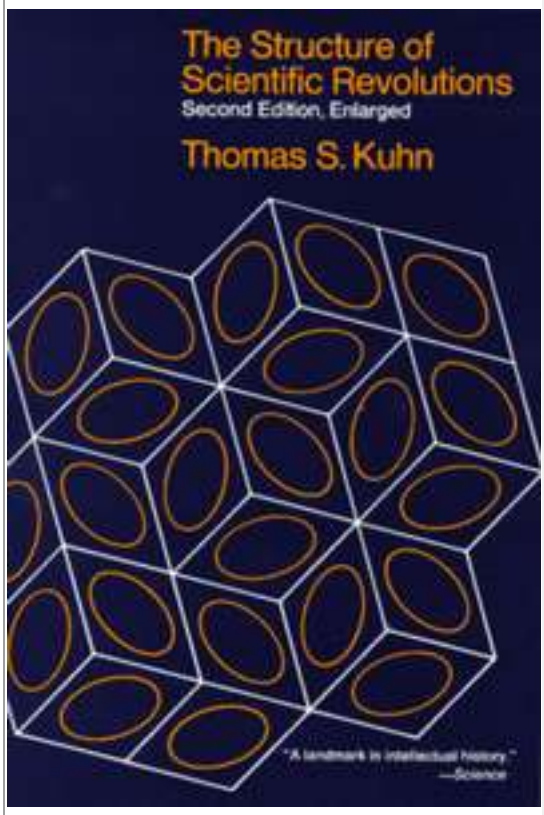
In the face of these arguments, how and why does science progress, and what is the nature of its progress? Kuhn argued that normal science progresses because members of a mature scientific community work from a single paradigm or from a closely related set and because different scientific communities seldom investigate the same problems. The result of successful creative work addressing the problems posed by the paradigm is progress. In fact, it is only during periods of normal science that progress seems both obvious and assured. Moreover, "the man who argues that philosophy has made no progress emphasizes that there are still Aristotelians, not that Aristotelianism has failed to progress."

As to whether progress consists in science discovering ultimate truths, Kuhn observed that "we may have to relinquish the notion, explicit or implicit, that changes of paradigm carry scientists and those who learn from them closer and closer to the truth." Instead, the developmental process of science is one of evolution from primitive beginnings through successive stages that are characterized by an increasingly detailed and refined understanding of nature. Kuhn argued that this is not a process of evolution toward anything, and he questioned whether it really helps to imagine that there is one, full,

objective, true account of nature. He likened his conception of the evolution of scientific ideas to Darwin's conception of the evolution of organisms.

The Kuhnian argument that a scientific community is defined by its allegiance to a single paradigm has especially resonated throughout the multiparadigmatic (or preparadigmatic) social sciences, whose community members are often accused of paradigmatic physics envy. Kuhn suggested that questions about whether a discipline is or is not a science can be answered only when members of a scholarly community who doubt their status achieve consensus about their past and present accomplishments.

Thomas Kuhn was named a Guggenheim Fellow in 1954 and was awarded the George Sarton Medal in the History of Science in 1982. He held honorary degrees from institutions that included Columbia University and the universities of Notre Dame, Chicago, Padua, and Athens. He suffered from cancer during the last years of his life. Thomas Kuhn died on Monday, June 17, 1996, at the age of 73 at his home in Cambridge, Massachusetts. He was survived by his wife and three children.



If you would like more, try the following.

- Outline of the *Structure of Scientific Revolutions*.
- Synopsis of the Outline [as it appeared in The Philosopher's Magazine].
- Special issue on Kuhn from the journal Configurations.
- The Nature and Necessity of Scientific Revolutions, from marxist.org.
- Three scholars speak on Thomas Kuhn and Scientific Revolutions. Requires Real Audio.
- Kuhn at Malaspina University's Science Ring.
- Shifting Science - Kuhn, with a nice embedded glossary.
- A fine summary of *Structure* by Andreas Ehrencrona.
- A review of *Structure* by Steven Hodas.
- Review of *Structure* by Daniel P. Moloney.
- Thomas Kuhn: Paradigms Die Hard, by Imran Javaid for the *Harvard Science Review*.
- A Tribute to Thomas Kuhn, from @brint.com. Numerous links. Highly recommended.

- Thomas Kuhn and The Structure of Scientific Revolutions, developed by Dr. Michael Austin. First-rate. Numerous links.
- The Revolution that Didn't Happen - great reading by Steven Weinberg. Mirror site.
- Has There Ever Been a Paradigm Shift?, by by Arthur M. Young.
- The Function of Dogma in Scientific Research, by Craig Squires.

- On Science, Scientific Method And Evolution Of Scientific Thought, by Dr. Yogesh Malhotra.
- The Nature and Necessity of Scientific Revolutions, by Craig Squires.
- Review of Thomas Kuhn: A Philosophical History for Our Times, by Steve Fuller, *Scientific American*.
- Thomas Kuhn's Irrationalism, by James Franklin.
- Informative slide show on Scientific Knowledge from the Department of Physics at the University of Illinois.
- A brief biography.
- Scientific Progress, Relativism, and Self-Refutation, by Tim McGrew.
- Obituary from the New York Times.