

Paradigms in science (Paradigme în știință)

Professor Solomon Marcus wrote a very interesting and thoughtful book on so-called universal paradigms (Solomon Marcus, *The Universals Paradigms*, Parallel 45 Publishing House, 2007, Bucharest, Romania). He shows that every historical period has their dominant paradigms. Language, paradox, time, art, science, mathematics and game are paradigms. The paradigms are ideas with large coverage. When they cross the quasi-totality of the human knowledge or human behaviour, are called universal paradigms. Professor Marcus groups the paradigms in several categories. These are: paradigms of the behaviour and education: understanding, didactics, handbooks, intellectuals, criticism spirit, intellectual property, university; paradigms of the globalization: provincialism, modernity, teatrality, globalization; geographic paradigms: Europe, North-America, Japon, Brazil; paradigms of the information, communication and computers: paper, celerity, information, communication, computer; coupled paradigms: invention and discovery, nature and culture, identity and alterity, discrete and continuum, science and religion, order and chaos, energy and entropy, center and periphery; paradigms of thre imprecision and complexity: inaccuracy, approximation, deterministic chaos, fractal; semiotic paradigms: symbol, language, indicators; mathematically inspired paradigms: axiom, theorem, non-euclidian; diachronical paradigms: future, history; control paradigms: science monitoring, scientometry.

We shall keep an eye on the concept of paradigm, its history and development.

Since the late 1960s the word paradigm referred to thought pattern in any scientific discipline or other epistemological context. Initially, the word was specific to grammar: the 1900 *Merriam-Webster* dictionary defines its technical use only in the context of grammar or, in rhetoric, as a term for an illustrative parable or fable. In linguistics, Ferdinand de Saussure used *paradigm* to refer to a class of elements with similarities. The Merriam-Webster Online dictionary defines it as "a philosophical and theoretical framework of a scientific school or discipline within which theories, laws, and generalizations and the experiments performed in support of them are formulated; *broadly* : a philosophical or theoretical framework of any kind.

Historian of science Thomas Kuhn gave this word its contemporary meaning when he adopted it to refer to the set of practices that define a scientific discipline during a particular period of time. Kuhn himself came to prefer the terms exemplar and normal science, which have more exact philosophical meanings. However, in his book *The Structure of Scientific Revolutions* Kuhn defines a scientific paradigm as:

- *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
- *how* the results of scientific investigations should be interpreted

Alternatively, the *Oxford English Dictionary* defines paradigm as "a pattern or model, an exemplar." Thus an additional component of Kuhn's definition of paradigm is:

- *how* is an experiment to be conducted, and *what* equipment is available to conduct the experiment.

Thus, within normal science, the paradigm is the set of exemplary experiments that are likely to be copied or emulated. The prevailing paradigm often represents a more specific way of viewing reality, or limitations on acceptable *programs* for future research, than the much more general scientific method.

An example of a currently accepted paradigm would be the standard model of physics. The scientific method would allow for orthodox scientific investigations of many phenomena which might contradict or disprove the standard model; however grant funding would be more difficult to obtain for such experiments, in proportion to the amount of departure from accepted standard model theory which the experiment would test for. For example, an experiment to test for the mass of the neutrino or decay of the proton (small departures from the model) would be more likely to receive money than experiments to look for the violation of the conservation of momentum, or ways to engineer reverse time travel.

One important aspect of Kuhn's paradigms is that the paradigms are incommensurable, which means that two paradigms can not be compared to each other. A new paradigm which replaces an old paradigm is not necessarily better, because the criteria of judgement depend on the paradigm.

A more disparaging term groupthink, and the term mindset, have very similar meanings that apply to smaller and larger scale examples of disciplined thought. Michel Foucault used the terms episteme and discourse, mathesis and taxinomia, for aspects of a "paradigm" in Kuhn's original sense.

A simplified analogy for *paradigm* is a habit of reasoning or, the box in the commonly used phrase "thinking outside the box". Thinking inside the box is analogous with normal science. The box encompasses the thinking of normal science and thus the box is analogous with *paradigm*. "Thinking outside the box" would be what Kuhn calls revolutionary science. Revolutionary science is usually unsuccessful, and only rarely leads to new paradigms. When they are successful they lead to large scale changes in the scientific worldview.

Paradigm shifts 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, physics seemed to be a discipline filling in the last few details of a largely worked-out system. In 1900, Lord Kelvin famously stated, "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 very simple 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.

In *The Structure of Scientific Revolutions*, Kuhn wrote that "Successive transition from one paradigm to another via revolution is the usual developmental pattern of mature science." (p.12) Kuhn's idea was itself revolutionary in its time, as it caused a major change in the way that academics talk about science. Thus, it caused or was itself part of a "paradigm shift" in the history and sociology of science.

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.

Kuhn himself did not consider the concept of paradigm as appropriate for the social sciences. He explains in his preface to "The Structure of Scientific Revolutions" that he concocted the concept of paradigm precisely in order to distinguish the social from the natural sciences (p.x). He wrote this book at the Palo Alto Center for Scholars, surrounded by social scientists, when he observed that they were never in agreement on theories or concepts. He explains that he wrote this book precisely to show that there are no, nor can be, any paradigms in the social sciences. Mattei Dogan, a French sociologist, in his article "Paradigms in the Social Sciences," develops Kuhn's original thesis that there are no paradigms at all in the social sciences since the concepts are polysemic, the deliberate mutual ignorance between scholars and the proliferation of schools in these disciplines. Dogan provides many examples of the inexistence of paradigms in the social sciences in his essay, particularly in sociology, political science and political anthropology.

Perhaps the greatest barrier to a paradigm shift, in some cases, is the reality of paradigm paralysis, the inability to see beyond the current models of thinking.

Examples include Galileo's theory of a heliocentric universe, the discovery of electrostatic photography, xerography, and the quartz clock.

Another perspective to the concept of what a paradigm is, is that a Paradigm is the Gestalt (organized whole) of the three main branches of philosophy that forms a "Weltanschauung" (German for 'Worldview')

Uses of the concept *paradigm* in the understanding of Kuhn and others, are mostly unclear and ambiguous analogies — *ignotum per ignotius* (the unknown explained by means of the more unknown), or *obscurum per obscurius* (the unclear explained by means of the more unclear) — to other concepts like the model.

Kuhn defines a paradigm as: "an entire constellation of beliefs, values and techniques, and so on, shared by the members of a given community"(Kuhn). This definition by Kuhn appears in the 1969 postscript to his original book, because originally the use of the term paradigm was not clearly defined. Besides this definition Kuhn mentioned another sense of use he had: a Paradigm also "denotes one sort of element in that constellation, the concrete puzzle-solutions which, employed as models or examples, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science" [Ibid]. The term remains imprecise due to the different uses it is given.

Paradigms could be described from a structural perspective. Paradigms operate on different levels; the macro, meso and micro levels of the paradigm's structure. The levels address the fundamental structure of the paradigms, rather than its chronological-historical categorization or the etymological use, as used by most disciplines. The levels of paradigms are always present and not limited to these categories. They assist in an understanding of the functioning of a paradigm.

In the *macro* level, a cognizance of the basic assumption to the question: 'what can be understood' is required. The question is: "Can it in reality be assumed that the essences of ideal things could be known at all, as in Plato's and Aristotle's use of the theory of ideas? Besides the essentialistic approaches of these two philosophers, is it not possible that "the things themselves reveal themselves as they are", analysed in Heidegger's fundamental ontology? The assumption we make in answering these questions will predispose the perception that determines the way we ask the question about how we come to knowledge.

In the *meso* level, the question is how the macro level influences and forms the resulting theory of knowledge. "Is only deductive-delimited knowledge of human perception available to man, or is man open to an inductive-comprehensive understanding of the world?". If man is open to inductive knowledge, where does it originate? The assumption on the macro level is the basis for this assumption. All philosophical efforts since the pre-socratics are essentialistic. An ontological approach seeks to evade the essences of things, requiring the things themselves to reveal them as they are.

In the *micro* level, the consequent perception of the two preceding levels, answering the questions of what is in the world and how the world is understood, is used in a practical way of doing. Is the praxis built on multiple 'laws of conduct' (ethic), or is it a fundamental and constant encounter with the open world as a different way of perception? Such a different perception is an 'affective awareness'. Previous and current understanding of perception is limited to essentialistic categories of limitation. 'Affective awareness' is by nature open and unlimited, inductive and not limited to 'sense perception'.

Handa, M.L. (1986) introduced the idea of "social paradigm" in the context of social sciences. He identified the basic components of a social paradigm. Like Kuhn, Handa addressed the issue of changing paradigm; the process popularly known as "paradigm shift". In this respect, he focused on social circumstances that precipitate such a shift and the effects of the shift on the social institutions, including the institution of education. This broad shift in the social arena, in turn, changes the way the individual perceives reality.

Another use of the word *paradigm* is in the sense of Weltanschauung (German for world view). For example, in social science, the term is used to describe the set of experiences, beliefs and values that affect the way an individual perceives reality and responds to that perception. Social scientists have adopted the Kuhnian phrase "paradigm shift" to denote a change in how a given society goes about organizing and understanding reality. A "dominant paradigm" refers to the values, or system of thought, in a society that are most standard and widely held at a given time. Dominant paradigms are shaped both by the community's cultural background and by the

context of the historical moment. The following are conditions that facilitate a system of thought to become an accepted dominant paradigm:

- Professional organizations that give legitimacy to the paradigm
- Dynamic leaders who introduce and purport the paradigm
- Journals and editors who write about the system of thought. They both disseminate the information essential to the paradigm and give the paradigm legitimacy
- Government agencies who give credence to the paradigm
- Educators who propagate the paradigm's ideas by teaching it to students
- Conferences conducted that are devoted to discussing ideas central to the paradigm
- Media coverage
- Lay groups, or groups based around the concerns of lay persons, that embrace the beliefs central to the paradigm
- Sources of funding to further research on the paradigm

The word *paradigm* is also still used to indicate a pattern or model or an outstandingly clear or typical example or archetype. The term is frequently used in this sense in the design professions. Design Paradigms or archetypes, comprise functional precedents for design solutions.

This term *paradigm* is also used in cybernetics. Here it means (in a very wide sense) a (conceptual) protoprogramme for reducing the chaotic mass to some form of order. Note the similarities to the concept of entropy in chemistry and physics. A paradigm there would be a sort of prohibition to proceed with any action that would increase the total entropy of the system. In order to create a paradigm, a closed system which would accept any changes is required. Thus a paradigm can be only applied to a system that is not in its final stage.