

Thomas S. Kuhn: The Structure of Scientific Revolutions

DÉRER BEATRICE

PHD student at the University of Debrecen – Faculty of Law

Legal Adviser at Bihor County Council

(derer_beatrice@yahoo.com)

ABSTRACT

Thomas Samuel Kuhn (1922-1996) is a famous philosopher and historian of science. His name inextricably binds the cognitive revolution of philosophy of science. The thesis of his masterpiece, 'The Structure of Scientific Revolutions' has deeply stirred up and triggered intense reactions within the world of science, prompting to criticism, almost, all the imagined amount of interpretation. By sensing the wave of criticism, Kuhn, constantly fine-tuned the sense of his theory, sometimes, seeming radically, but still remaining faithful to its spirit.

'The structure of scientific revolutions' is considered to be, on many aspects, the revolution of the philosophy of science. Prior to this, formulating the rules, has been considered to be the task of the philosophical reflection on scientific thinking, namely: first the discovery and then, the conclusion. Starting with the 20th century, mainly from the thirties, the theories had to be bound with the certificates, the hypothesis of the rational choice. Kuhn, as being the representative of the principle, underlined that the philosophy of science is not supposed to be prescriptive, but the basis of the actual process, namely, its transcriber.

WHAT IS THE PARADIGM?

Through '*The Structure of Scientific Revolutions*' in 1962, Thomas Kuhn introduces a new concept - the paradigm. According to Thomas S. Kuhn 'the paradigm is the phenomenon that the scientific community accepts, and vice versa, the scientific community is made up of those who accept a certain paradigm.'

The paradigm is a generally accepted view of science (concept – term) of a particular era in time. It is a systematic description of all the inflection of shapes (e.g. the table of conjugations). It

is the method of replacing parts of a sentence by using a class or a collection of terms (not being equivalents, or having the same meaning – synonyms – but words being used in the same way). The paradigms are somehow equivalent to each other therefore they are a series of interchangeable components. The paradigm is the result of different attitudes, values and methods of a given society, or a narrower one being adopted by the scientific community. The importance of the paradigm is dictated by the fact that people sometimes have crisis, conflicts with the existing view, attitude, belief, thought, knowledge, etc and the inconsistency, that is usually comprehensive (paradigm sized) can only be resolved by changing the paradigm. The size of the social changing of the paradigm is used in order to achieve a disproportionately large component of energy for free in the Community, by thinking and changing the attitude that requires relatively little mental energy input.

The development of science is linked to the changing of paradigm, while at a given it can coexist mutually exclusively a multi-paradigm that is applicable in the same area, such as the medicine and healing, the economic and politics, computer science and programming, etc (Wikipedia).

In the introduction of the *'The Structure of Scientific Revolutions'* the author explains the way he got into contact with the history of science, while being a student in theoretical physics. In the first chapter of the study – *'Introduction: A Role for History'* Kuhn presents the history of science as being a collection of facts of science, a bunch of theoretical and methodological phenomena, meanwhile the scientists - successfully or unsuccessfully – are trying to help. According to Thomas Kuhn, the main focus of his work should be the one of getting a clearer picture of the new science, adding that the examination of the history of science could be helpful. The scientific paradigm is made up of theories and assumptions that are accepted by the vast majority of the scientific community. The introduction of the paradigm is the result of a rotary reasoning (vicious circle): 'We believe in these assumptions, because we think they are so.'

The scientific community is always looking for answers to the fundamental entities of the universe. What are their interactions with each other and which is the effect? Due to the response, the scientist is trying to infiltrate within the researched subjects, showing the arbitrary, personal and historical aspects of the research.

THE NORMAL SCIENCE

In the second chapter – *The Route to Normal Science* - the writer presents the meaning of the normal research as being 'based ... on results, that have a certain scientific basis and to which the community looks up for further activities.' He continues the research by speaking about the works of the classics, that summarize some sciences, and that have been decisive to a number of practicing scientists, particularly Aristotle' Physics or Newton's Principia or his Opticks etc. Then he talks about calling paradigms the similar symptoms within his work that implicitly links to the normal science. In this section, Kuhn also mentions a number of disciplines that during the early stage in the history of science has collected data by chance, while the later is the usual path, and the scientific research gives results.

A changing of paradigm occurs when a part of the scientific community has not accepted or has not fully accepted the old paradigm, and the redefinition of the basic concepts used in the meantime becomes a necessity. A changing of paradigm shows the modifications caused by the scientific, economical and social factor resulted in the change of different things, as well as the relationship within the processes, or the changes in the known environment, therefore, the concept has been partially modified in various fields, each concept being able to disappear, while new ones are about to be formed. Thomas Kuhn also draws the attention that within the course of science there have

been events, difficult to be brought to awareness, while for many, still remaining unclear. He also highlights the possibility given to researchers to have a better chance to prove their studies, then the predecessors. He illustrates by using a few branches of science referring to a 'pre-paradigm' period, showing that in the ancient times - in the field of mathematics and astronomy, the results of the research reports have not been always understandable by the general public. Or in the case of 'the dynamics at the end of the Middle Ages the research has become esoteric, and only for a short time it was understandable: at the beginning of the 17th century, when a new paradigm belonging to the medieval science has replaced the old command (Thomas Kuhn, 2000).

The third chapter is named '*The Nature of Normal Science*'. Kuhn describes the paradigm as being a well established use of an approved model or sample. Further on, he explains the use of this term, mainly due to a lack of a better word. Later, he talks about the possibility that these two concepts do not always draw the same meanings of the paradigm. The statements are supported by examples, according to which the scientists are interested in a meticulous research 'they constitute what is called - the normal science (...). The research made within the standard framework, links the paradigm to associated theories and phenomena' (Thomas Kuhn, 2000).

The 4th chapter named '*Normal Science as Puzzle – Solving*' brings examples of achievements in the research of paradigms that do not meet the terms, do not meet the expectations. As an example, it is presented the case of Coulomb and his team, their managing to develop a device that is 'the paradigm is well incorporated into the results and expression' (Thomas Kuhn, 2000). He continues by wondering: if scientists fell in advance that the scheduled result is not achievable, then why do they experiment? The answer may not come as a surprise: 'The standard work in the area of science – at least for scientists – is important, because it increases the range and accuracy of the applicability of the paradigm' (Thomas Kuhn, 2000).

Moreover, the author talks about the problems encountered within a normal research, the capacity to solve a task in premiere, a non solvable task before. He compares the scientist to puzzles solvers.

NOT HAVING THE SAME MEANING...

'In case of a thorough examination of a specialized field or stage of development according to its historical background one can see that the conceptual and instrumental application of various theories leads to a certain reiterative and almost standard form.' According to Kuhn 'these paradigms are present within the tasks of the scientific community, the manuals, the presentations and the laboratory' (Thomas Kuhn, 2000). The author continues by stating that a community is able to acquire its profession only through everyday practice, therefore it is important to understand what one wants to learn. Certainly, historians explore areas that, yet, do not show a full picture of a phenomenon. Further on, he draws the attention on how different might be the meaning of the paradigm for each of us. For instance, two scientists, a physicist and a chemist while studying the same phenomenon formulate different conclusions. Their experiences towards the phenomenon have been similar, still the conclusions are different.

It is important that when studying a certain phenomenon, to avoid to study according to the definitions contained in books, but to observe and to be involved in the application of concepts. In order to illustrate this concept, he uses as an example the evolution of a doctoral student's research from the first grade of the dissertation based on professional training, then continuing, with presenting the tasks that become more and more complex; the previously studied cases are not always reliable, therefore, he must deal on his own with all the unknowns and find a way out – the hypotheses. Naturally, in order to set up the own hypotheses, hard work and research is required.

According to the author 'the direct modeling of the paradigms can also direct the research, not only be interrupted by abstract rules' (Thomas Kuhn, 2000). The illustrations of the paradigm showed above are part of the 5th chapter '*The Priority of paradigms*'.

THE CHANGING PARADIGM

The sixth chapter has been named '*The anomaly and the emergence of scientific discoveries*'. In this chapter, Thomas Kuhn, among other things, speaks about the way 'science often reveals new phenomena, that has not even been suspected before, and scientists often find radically new theories. (...) If science is compatible with the specificity of what has been said so far, the paradigm has driven the research in a useful way of changing paradigms' (Thomas Kuhn, 2000). According to his point of view, such changes can be detectable only if the findings, the three-dimensional innovations, then, the studies, the theoretical innovations are taken into consideration. The discovery begins with the disclosure of the anomaly of ignorance. Further on, it expands the idea that, nature does not meet the expectations of the paradigm, expectation that creates and drives the regular science. In order to be studied, the author explores and uses as an example the discovery of the oxygen. At least three scientists can boast about the discovery of the oxygen, demanding the glory for it. Being developed during a long historical time of events, Kuhn mentions the scientists by dates and names that can call themselves the discoverer of oxygen. According to the author, the discovery is linked to more than one person's name, even though usually, a discovery is linked only to a certain name or date. In the cases listed above, a new phenomenon takes place, namely the changing of the paradigm, even though, generally speaking, there is no clear answer. Then, by using as examples very important discoveries in science, Kuhn demonstrates that generally, the first-established paradigm of science is thought to reflect the scientists' respect for the truth. In order to continue the experiments, at a higher level, usually it is needed a major equipment, a professional preparation, that could lead to new knowledge and eventually to trigger the changing of the paradigm. Thomas Kuhn believes that, the anomaly becomes visible only in the background of the paradigm. The more accurate the paradigm is, the wider its range of validity is, the most sensitive indicator of anomaly, and therefore, the favorable opportunity to change the paradigm (Thomas Kuhn, 2000). However, the mere fact, that significant scientific results are often resulted in the same time, in different laboratories, indicates both the highly traditional nature of normal science, as well as, the preparation of the self-changed finiteness of the traditional activities.

One of the most important statements of Kuhn's study is the one about the successive characteristic of the paradigm, the incompatibility of the adverse paradigms; there are no neutral criteria upon which one could rationally and clearly decide about which is better: a paradigm – or two different ones or the viability of successive or conflicting parts of a paradigm. This incompatibility is not only a theory, but an empirical research exposed in the natural context, as being a phenomenon. According to Kuhn the paradigm is fundamentally determined by the prevailing vision of observation and experimentation, the empirical 'data', claiming it is already a theory – while through the theory the paradigm changes: the scientists belonging to various paradigms see other things, even though they look at 'the same' thing. Therefore, in fact, the opposing paradigms of empirical theories are not a common base or a field of reference – i.e. the empirically disjoint (Székely László, 2000).

Thomas Kuhn, in his book '*The Structure of Scientific Revolutions*' discourses throughout many pages and exposes as examples the incredible increase of the amount of knowledge. He describes all those symptoms, the proven facts that science gets a new appearance and a new thesis that leads to the emergence of new paradigms. Another studied issue is the phenomenon that leads

to new paradigms. 'If the detection of the anomaly plays a new role in indicating events, nobody is surprised that the theory is acceptable to all as being a prerequisite of such a change, just like a deeper recognition' (Thomas Kuhn, 2000). Kuhn talks about the high-valued different findings, ones that have contributed greatly to the appearance of the hitherto accepted phenomenon that is characterized by 'the scandalous situation of Ptolemaic astronomy, before the announcement of Copernicus. Galileo's contribution to the development of kinematics has been directly related to the difficulties discovered by the scholastic critics in the theory of Aristotle', and the examples continue with the results of Newton's research, that according to his believes, that have been proven by science itself, no paradigm theory has been able to explain some physical phenomena. These results, moreover, are developed in extensor in the 7th chapter – '*Crisis and the emergence of scientific theories*'.

The alternation of Kuhn's paradigms represents the development of science or as he calls it – the revolution. Due to this belief the history of science is abrupt, having sequenced periods around the traditional (normal), rather than cumulative, but discreet. Knowledge is a discontinuity (Szirbik Gabriella) The definition of the paradigm offers a new vision of the paradigm by defining the experience and the fact that constitutes the data. 'Even though the world does not change, due to the changes of the paradigm the scientist starts working in another world.' It logically follows, that the different paradigms, the paradigms before and after the revolution have to be incomparable. Kuhn's definition does not allow the transition to other principles' frameworks, not allowing the scientist to determine: to look to other things, and look at them differently. For Kuhn, science is a puzzle racking, but these puzzles and their solutions depend on the paradigm, and since the paradigms are incomparable, it is within the thinking of a paradigm that leads only to the dilatation of the anomalies, but it can not be exceeded. The incomparability also shows that there is no empirical fixed basis, no matter of the paradigm. Kuhn's definition of the changing paradigm shows the development of science, or - as indicated by his work – its revolution.

The 8th chapter named '*The Response to Crisis*' contains an interesting phenomenon: 'by accepting that prerequisites of appearance of new theories of crises, the question is how can scientists respond to the existence of a crisis.' Further on, he expands the idea that, in many cases, scientists are the consciousness about the need of a change, of a new paradigm. All these should be taken into consideration without giving up 'the paradigm that takes them to a crisis' (Thomas Kuhn, 2000). The creating of new paradigms is a necessity to science, as presented in the examples listed above, showing that the changes in time over the humanity from the past decades, it has been required for further discoveries; it is what the society demanded from the scholars. In this section, as throughout the entire study, Kuhn gives specific examples of evidence. Then, he also ensures that a 'normal science aims the deciphering of puzzles, that already assumes the existence of the paradigms' (Thomas Kuhn, 2000). There are cases when a paradigm falls into crisis. The transition from one crisis to a new paradigm, that can extend to a new scientific phenomenon can not be used by the modifying the old paradigm. This should be based on new foundations, while, of course, many things changes around it, during the transitional period of the 'old and new paradigm that can solve most of the problems, but never the same ones' (Thomas Kuhn, 2000). In the conclusion of the chapter Thomas Kuhn explains that the transition to a new paradigm is in fact a matter of scientific revolution.

In 9th chapter called '*The Nature and Necessity of Scientific Revolutions*', the author draws the attention on the study of the scientific revolution in the development of the science, presenting it as not being the cumulative of events, that involves a paradigm in whole or in part, becoming a new paradigm (Thomas Kuhn, 2000). Throughout this chapter, the author deals with the political revolutions that changed the political institutions – achievable if renouncing to a number of existing institutions, in order to adopt new ones instead. In most cases, this turns out to be a slow process, due to the preventing of the existing institutions. All these contribute to the society, as its members,

the people, at any given moment estrange from the political life, beginning to want and need new political institutions. As described by Kuhn, the citizens of Romania, during the past ten years, personally experienced how difficult it is to convert an existing, long-accepted paradigm to a new one or ones that in other Western European countries have been a reality for a long time. 'The scientists perceive the difference between the rejected old and the new theories' (Thomas Kuhn, 2000). Further on, he talks about what scientists can do in order to lose the validity of the new theory as being considered a special case; the old theory must be developed. Then, he returns to Newton's work, when in the 17th century, the scientists have adopted the corpuscular-mechanical explanation of the phenomena, due to which a range of science has become more effective; in order to illustrate he mentions the discovery of the planet Uranus. This chapter can be seen as a compilation of other examples that support the allegations, that the changing paradigm has been the one contributing to the evolution and development of science.

THE LEGAL JUSTIFICATION OF NURNBERG: NAZIS ON TRIAL

After ending the 2nd World War, the victorious Allies had to solve the problem of being legally liable to prosecute for acts of war the captured high-ranking people? Does one have to ignore these acts or to punish them with blood? Is there any law under which can be brought a thought and fair judgment?

The tribunals, according to the indictment preparers, regulate not only the actions of ordinary people, but as the supreme judge John Cook has told King John, even the rulers have to be submitted to "Gods and laws". The United States has come to the conclusion that the law established the basis for the trial to be conducted in such a way that leaves no doubt in order to punish only those who are supposed to be punished according to the facts. The United States' representatives have drawn and presented in San Francisco a draft of an international convention to the United Kingdom, the Soviet Union and the Provisional Government of France – the Minister of Foreign Affairs. After a number of amendments the proposal became the Statute of the Tribunal.

This Convention has laid down the legal system, under which the defendants were supposed to be condemned, reflects the views of more than the signatory, but also of other nations, that have stated their acceptance, even if having a different and highly respectable system of justice. These countries are: Belgium, the Netherlands, Denmark, Norway, Czechoslovakia, Luxembourg, Poland, Greece, Yugoslavia, Abyssinia, Australia, Haiti, Honduras, Panama, New Zealand, Venezuela and India. The Statute, according to which the Tribunal existed, has embodied certain legal concepts that were the basis of the later decisions. The legal rules have been permanently set in the Statute. This new law has not been formally published, at the time when the accused had committed the acts, yet, this law classified them as being crimes. The promulgation of the law came as a surprise. Until then, no one thought about the Nazis as being criminals, much less that there is going to be a prosecution condemning their acts, due to the lack of similar cases in the course of history after the war. However, the Nazis had committed crimes against humanity that could not be left unpunished. This statement has been sustained several occasions on various meetings by the representatives of the Allies - the United States, Great Britain, the Soviet Union and France. The legislator had the task to create laws that were according to the laws of their countries, so the guilty was to be prosecuted. As a consequence, a new paradigm has been established, namely, transforming the previously existing criminal laws into a legal system that holds war criminals answerable to their sins.

The Decisions of the Nuremberg trials have served as legal principles that largely contributed to the founding of the international criminal tribunal, ultimately, more than fifty years after the adoption of the International Criminal Court. The Nuremberg trials have served the basis in order to develop the following documents: the 1948's Convention on Genocide, the 1948's Universal Declaration of Human Rights; the 1968's Convention on the Non-Applicability of Statutory Limitations to War Crimes and Crimes Against Humanity; the 1949's International Humanitarian Law – the First Geneva Convention on laws and customs of war, with its 1977's supplementary protocols (Wikipedia).

BIBLIOGRAPHY

1. Thomas Kuhn: 'A tudományos forradalmak szerkezete' (*The Structure of Scientific Revolutions*), Osiris Kiadó, Budapest 2000, p. 33, 41, 47, 49, 51, 59, 63, 75, 77, 87, 89, 93, 101, 111
2. Székely László.: Empirikus és teoretikus paradigmák (*Empirical and Theoretical Paradigms*), Magyar Filozófiai Szemle, 2000 – 4/ 6 (The Hungarian Philosophical Review), <http://epa.oszk.hu/00100/00186/00007/szeke0046.html>
3. Szirbik Gabriella: A tudásfüggő társadalom tudása (*Knowledge of a Knowledge dependent Society*), http://www.kodolanyi.hu/szabadpart/32/32_tarstud_szirbik.htm
4. Wikipedia