

# **HISTORICAL DEVELOPMENT OF CONTEMPORARY SCIENCE**

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## **Abstract**

Ancient Greece has been considered as the cradle of scientific thinking by distinguishing between mythology and objective reality. The development of critical thinking has occurred very slowly. Aristotle made important step forward by dividing philosophy in two parts. The first deals with the existence as such and with events which are beyond the sensual perception as its subject is transcendental, the second incorporated all other disciplines and its knowledge is based on objective reality. He did not divide these two parts very clearly but we can see this division in all his writings. He elaborated the logic and moral philosophy and was looking more for the purpose than for the explanation of events. His knowledge of objective reality was a product of his time and we see the development of contemporary science in the confrontation with his writings. We can distinguish ontological, teleological and normological approaches in the process of cognition. A few further names are mentioned which contributed to the development of science as Francis Bacon, Immanuel Kant and August Comte.

**Key words:** philosophy, history of science, Aristotle, ontology

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## **Introduction**

This contribution aims to discuss the differences between methodological (formal) disciplines and disciplines studying parts of reality, which could be objective or virtual. Formal disciplines such as mathematics, logic, and statistics can be applied in any non-formal ones, their use is universal. Non-formal disciplines reflect a part of existing reality in our cognizance (they deal with objective reality) or they are results of our thinking (they deal with virtual reality). Sometimes we cannot distinguish between them, they are often interconnected. We have to accept the existence of two truths. Aristotle was the first who tried to solve this problem by creating the first and second philosophy. The truth in the science is

rather difficult question and many authors have expressed their meaning in this context (e.g. T.G. Masaryk). The formal disciplines create also mental paradigms, but they are not confronted with the truth; their truth is based on formal correspondence with advance accepted axioms. Limits of such knowledge stressed e.g. Albert Einstein.

The process of quantification as a basis for mathematics started when a notion of number was invented many thousands of years ago. The invention of measures later on was a second important step. The use of quantification helps significantly in the development of knowledge in all non-formal disciplines. The theology as dealing with the virtual reality was a continuation of Aristotle's first philosophy organizationally safeguarded by emerging Judaic and Christian churches. It plays the leading role among all disciplines and was supported by the emperor (e.g. our last emperor governed out of God's mercy) The new findings which emerge from other disciplines (as a continuation of the second philosophy) were occasionally not in agreement with the Scripture and so exposed to suppression. The writings of Greek philosophers were also banned up to the middle of second millennium and the scholastic based on deductive reasoning was the main content of then science. Francis Bacon refused scholastic and with his empirical approach to reality was the representative of changes in the 16<sup>th</sup> century. The founder of demography John Graunt acknowledges Bacon's natural philosophy and used his inductive method in the study of mass phenomena (e.g. numbers of deaths). Thus along with William Petty he was also a co-founder of statistics as one of the quantitative methods. Statistical regularities were found everywhere and they were explained in very different ways. They initiated also special branches of mathematics as mathematical statistics and theory of probability.

Only 200 years later in the middle of 19<sup>th</sup> century Adolf Quetelet tried to explain statistical structures as those existing in reality and gave them not only methodological but also ontological meaning; they reflect the differentiation of reality. However, he overvalued the symmetrical statistical distribution and especially the average, which had for him similar importance as ideas for Plato. One hundred years later Jaromír Korčák had completed this approach and showed that two equally important extreme statistical distributions exist in reality: the symmetrical and extremely asymmetrical one. His disciple Martin Hampl developed this idea further and tried to find on its basis the integrated order of reality.

## **1 The origin of critical thinking**

Ancient Greece has been considered as a cradle of scientific thinking. Its cultural rise started during the first millennium BC. There are many different explanations, why at that time and why in Greece. I would like to refer to one, which is not usually mentioned. It is the geomorphologic situation of the territory. Greece is not a country where large civilizations based on agriculture with millions of people could have been developed, such as in the valleys of Tigris and Euphrates, the Yangtze and the Nile. As a result many independent states emerged on the contemporary Greek territory and Greek population achieved an unprecedented high level of individual, cultural and societal development. At that time also first features of democracy emerged, although with the unequal status of slaves and women. Gods and myth were still everywhere, but philosophers started looking for reasonable explanation of events around them; they were not satisfied with myths and magic and they assumed that gods behave also according to certain logic and regularities.

The development of critical thinking was rather very slow. Important step forward made Aristotle (384-322) and his school by dividing philosophy into two: first and second one (O'Connor 1964, p.38). The first philosophy deals with the existence as such and events, e.g. with the metaphysics, which is beyond the sensual perception (its subject is transcendental) and the second one incorporates all other disciplines. Aristotle did not distinguish between these two philosophies clearly and such a situation exists up to now; the question is how we can evaluate the good, justice or the demands of social policy in the ontological order of thinking.

The elaboration of logic and moral philosophy (ethics) have been considered as the main contribution of Aristotle which influence the scientific thinking up to now; his results in other disciplines were insufficient or even wrong from the point of view of contemporary science (O'Connor 1964, p. 60). He was looking more for the purpose than for explanation of events. It is difficult to understand his posture towards myths, because he did not deal with them. His attitude towards God was similar; he was not for him the creator and God's providence. Aristotle's world did not need the creator and his God was not preoccupied with human affairs. It is not easy to understand how the God functions, because he was immaterial and living out of time and space.

Besides logic and moral philosophy Aristotle gave important attention also to mathematics, which is in principle close to logic. In the process of cognition mathematics was based on numbers and thereby the process of quantification was developed. However, many Greek

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scientists were known especially as mathematicians' relatively long time before Aristotle (e.g. Pythagoras living almost two centuries before Aristotle considered the number as a basis of everything; at the same time he also believed in reincarnation). The notion of quantity as such is also a quality: something is too much or too little, the distance (territorially, socially) could be large or small. The quality as such cannot be compared with another one because of its unique character. There are not exactly two identical qualities in the reality. This can clearly be seen especially in complex notions as culture, democracy or individual's IQ. It is not possible to say that e.g. one culture is superior to the other one. We have to find an operational system to formulate different features, which can be quantified. The quantification has two possibilities: calculation or measuring. The calculation is based on the numbers and measuring on measures. Both are mental paradigms which do not exist in reality, but they can be separated from the quality and so compared. Nobody can see number 2 (only as a written symbol, but not in reality) or meter. In fact any abstract notion (in comparison with a concrete one, e.g. Mr. Smith) cannot be seen in reality as such, e.g. a tree. However, all trees can be defined on the basis of common features which exist in reality, i.e. in the way of abstraction. The situation concerning numbers is different.

Any quality has an infinite number of features which cannot be separated because they form its internal substance. The selected features for quantification should express aspects of our interest, but they never cover the whole quality. The quantification is always an enormous simplification. The population size of Belgium, Belorussia, Czechia, Guinea, Hungary, Portuguese and Tunisia is very similar (around 10 mil inhabitants). This is quite important information, but unless we know more about these countries from other sources, this is really a very simple knowledge.

The mathematics is a product of human thought which is independent of experience and reality. In spite of this fact it is very important for all scientific disciplines. The measurement of time existed in ancient civilizations in astronomy and astrology. The numbers play also great roles in the human mythology, some of them were related to different myths, today we would say to prejudices. The number 7 was important in ancient Greek and Roma as well as in Judaism and Christianity. Plato (427-347 B.C.) wrote about the favorable number of 5040 (Novotný 1948, II, p.284; 1949, III, p.111). As we can see, it is factorial of 7. The number 4 is unfavorable in the Japanese culture. Some people do not like number 13; the 13 floor is omitted in certain towns and the line 13 does not exist in the network of street lines in some cities (e.g. in Prague).

The mathematics is developing on the basis of axiomatic. It is a formal discipline which creates limits to its contribution in the process of cognition. Albert Einstein (1879-1955) formulated this fact clearly: “How can it be that mathematics, being after all a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality? Is human reason, then, without experience, merely by taking thought, able to fathom the properties of real things? ...the answer ... is, briefly, this: as far as the propositions refer to reality, they are not certain; and as far as they are certain they do not refer to reality.” (Einstein, 1954, p. 233).

## **2 Two orders of thought**

Without going too deeply into philosophical thoughts, it is possible to distinguish in the process of cognition two approaches to objective reality. We can get to know what exists without trying to understand what is the purpose, role, function or use of certain thing or behavior as a part of reality. The answer of the question “why does this exist” is the aim of this approach and we call it ontological or also casual-ontological (Engliš 1947, p. 41). This approach is also called positive in economy (Sojka, Konečný 2004, p. 13). It is also possible to study the items of reality as desired or unwanted, useful or pernicious, etc. Thus here we are trying to understand why it is useful or what we should do to reach desiderative purpose. We call these approach teleological and corresponding findings or statements belong to virtual reality. Following this approach we have to create criteria, which do not exist in the reality but they are results of our thinking, assessments or desires. They reflect our interests which arose from our education, personal character, social and family posture, etc. In economy this approach is called normative (Sojka, Konečný 2004, p. 14). In the process of noesis Karel Engliš (1880-1962) defines also normological approach. “If we look in ontology at the reality as simply existing, if we look in teleology at the reality as desired, we look in normology at something what (for somebody) has to be” (Engliš 1947, p. 47). Although this explanation of normological order seems to be logical, its teleological background is evident. The access of obedient subject towards norms (moral, juridical or orders of parents) cannot hide their original purpose, even though this aim need not be evident. The obedient subject is usually interested mainly in the legacy, force and validity of the norms and not in their purpose.

### **3 The existence of two truths**

The theology has the same origin as Aristotle's first philosophy. It uses all accessible pieces of knowledge of the second philosophy and uses also scientific methodology. It incorporated all this knowledge into scriptures (e.g. Talmud, Bible and Koran) and fixated them as revealed truths, the dogmatically unchangeable truth. The theology became an important discipline in ancient and medieval science. It was always the first faculty in then universities since their gradual foundation starting in 12<sup>th</sup> century in Europe, with important influence on other faculties.

Simultaneously with the development of theology various churches originated, among Christians the oldest and dominant in Western world is the catholic one. Its constitution lasted several centuries and completion of this process is assigned to Aurelius Augustus (354-430). His looking for truth is based on the inquiry of the man himself. According to him the knowledge is the ability of human soul to recognize and evaluate surrounding world, the ability given by God and mediated by Apostles. The Catholic Church became an influential organization in the 8<sup>th</sup> century with the large support of population. The emperor Charles the Great (742-814) recognized this situation and concluded the concordat with the Catholic Church with the advantage on both sides. The Church assumed the responsibility for some public functions in the field of education, health, social and charitable services. The emperor protected the Church instead of its persecution in previous centuries. On the other side the church sanctified the emperor's government as the rule from mercy of God.

Achievements of the Church were indisputable and the scholastic doctrine connected with Dominican priest Thomas Aquinas (doctor angelicus, 1225-1274) dominated then science. Theologians supported other formal disciplines as mathematics and logic, but they were suspicious to other disciplines which originated from the Aristotle's second philosophy. When the new knowledge was not in agreement with the dogmatically revealed truth, it was branded as heresy and believers of this knowledge were persecuted very hard. Giordano Bruno was one of the last victims; he was burn to death on February 17, 1600.

The contemporary of Giordano Bruno was Lord Chancellor and Viscount St. Albans Francis Bacon (1551-1620), who at that time lived in England. He opposed then predominant scholastic, introduced the inductive method in the cognizance of objective reality and clearly distinguished natural philosophy from theology. He was against premature generalization, but at the same time against random experiments. He stressed the pragmatically oriented and purpose-built cognizance of the nature, which could bring along the knowledge of natural

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laws. He was aware that man limiting himself to empirical cognizance could be affected by idols; he recognized four of them: they originated in misunderstanding of objective reality, from contacts with people, from various dogmas and myths and from generally accepted prejudices (Hesse 1964, p. 141-152).

The influence of scholastic was diminishing but the Church did not give up. The truth can be found in the ontological order of thinking only, we are coming to it gradually and we should never be sure about it; it is subjugated to changes and the process of cognition is endless similarly as the discussion about it; we should never believe in it. The theologians do not distinguish between the ontological and teleological orders of thinking. Propositions found in these two orders are similarly truthful, irrespective of the fact, where they were found, in the nature or in our thoughts. All originate in the will of God, they are always indisputable and it depends on us if we believe in them or not.

The well-known Czech writer Karel Čapek (1890-1938) wrote a book based on discussions with the president of the then Czechoslovakia: Talks with Tomáš Garrigue Masaryk (1850-1937); Čapek asked Masaryk what was the truth and he answered: “Please, what are, those birds over there in the park? The magpies, Mister President. You have better eyes, said Masaryk. Are they not pigeons? No there are magpies. Are you certain? Yes, I was studying them closely for a while. The pigeons fly differently. So you see you expressed yourself the features of truth: that you know it certainly because you were looking attentively and I verified my knowledge according to you. If you insist on defining the truth, I would say: The truth is what we securely know, what is the conscious reality” (Čapek 1937, p.351).

In the teleological order of thinking we are looking for the origin of various propositions (e.g. ethical norms), or we can take them as communicated by somebody, as unchangeable revealed truth. Immanuel Kant (1724-1804) influenced very much philosophical thinking and in his famous saying we can see the acceptance of two truths. He had to abolish the knowledge to make place for the belief. “Kant himself insists that the moral law is autonomous, self-sufficient and in particular independent of religious belief...he seeks to derive it not from God, as legislator and judge, but from a man himself as a rational being... he is attempting to expound a Christian view of morality while explicitly repudiating its religious foundations. He is attempting to set forth the idea of God’s law without reference to God” (Warnock 1964, p. 308).

Many other authors distinguish the ontological and teleological order of thinking and consequently two truths. The well-known sociologist Max Weber (1864-1920) was one of them. He “stressed the necessity of careful dissection of the knowledge and evaluation.

Surely not because he would like to evade the expression of his own ethical, political, economic or social persuasion. Just on the contrary, he considered himself a university teacher ... who stressed factual study of some social conflict and who was not trying to bring about to students certain solution, but who wanted every student to know what is going on in individual situations ... as ethically more worthwhile” than lectures of professors, “who presented political speeches from university chairs” (Musil 1966, p. 577).

Another example is T. G. Masaryk, who wrote: “Usually one speaks about the antagonism between the science and the religion and the antagonism is seen in both of them. I do not see any necessary conflict between the science and religion. That is when the piousness – religion in the subjective sense – is declared as an emotion, which follows up every world view, and when the theology is considered to be the world view, ... then it is evident that the issue is whether we want to arrange our life according to theological or philosophical point of view..... As far as the theology considers the revelation as the main source of the knowledge, the science has confidence in experience and in reasonable explanation. The theology has therefore mysteries, the science riddles and problems; the theology is infallible, the science accepts only to a very small extent evident propositions and their contents with more or less probable precepts” (Masaryk 2001, p. 204); and he continues onwards: “The theological verdicts head towards practical style of life, whereas the scientific ones lead first of all to theoretical interpretation of life. Therefore, the first more than the second ones contributed in time to existing organization of society” (ibid., p. 205).

Many authors in the history of science accepted explicitly the existence of two truths, or this conclusion can be derived from their writings. I would like to mention only two examples as representatives from different scientific disciplines. Adam Smith (1723-1790) was interested not only in economy but also in ethical laws, especially in his first writings. He was the coeval of Immanuel Kant (born the same year and died fourteen years sooner). They probably did not know each other, but their approach to this problem was similar. Two generations younger August Comte (1797-1857) is considered as a founder of sociology. At first he completely rejected religion. In his three stadia mankind’s history: theological or fictive, metaphysical or abstract and positive or scientific; there was no place for religion in the third one. He refused to deal with metaphysics in his writings *Lectures from positive philosophy* (1830-1842), but in reality he dealt with it. He realized in the second phase of his life that something is lacking in the society (especially for its stability) and he created the Positivistic Association and later the Positivistic Church (1849) as a religion of humanity with relevant rituals, priests, holidays and saints. He himself made pertinent proposals, designed the complicated liturgy, composed

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prayers and put together church calendar. Instead of God the object of the cult should be the Great Being; he named himself the Hierarch (Guru) of this church (Diderot 2000, III, pp. 251-2; Neff 1948, pp. 64-66).

From the Aristotle's first philosophy originated the theology and the scientific philosophy. Every discipline has its own philosophy, i.e. problems, which are trying to explain but in the process of cognizance are limited only to formulating hypotheses. We accept any hypothesis as truthful unless we find something that is not in agreement with it. In this case we formulate new one or it is not the shame to confess that we do not know the answer. "The science is the power of man, but it also convinced him about his impotence; because there is a little what we know, much more that we know incompletely, we are mistaking in many cases and there are very many things we do not know completely" (Masaryk 2001, p. 25).

## Conclusions

The contribution started rather broadly trying to find the germs of critical thinking. It was considered as the introduction to the discussion of problems of quantification. The first stage of quantification was connected with mythology and invention of numbers were used for various prejudices, e.g. the number of 7 in Western culture or number of 4 in some Asian cultures (Japan). This process of primitive quantification was followed by invention of measures derived first from the different parts of human body (cubit, ell, inch, foot and finally decimal system). The quantification helps to the development of abstract thinking. The distinction between the objective and virtual reality is not clear; the abstract idea has sometimes much higher importance than a concrete name. And here Aristotle is coming with the distinction of the first and second philosophy. However the mythology through the theology had a decisive influence on the cognition of objective reality. The further step was done by natural philosophy of Francis Bacon and by acceptance of two truths by Immanuel Kant. The relation between the science and religion (faith) exists since and it is differently touched by philosophers (e.g. T.G. Masaryk); it is also a permanent question for every thinking human being.

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