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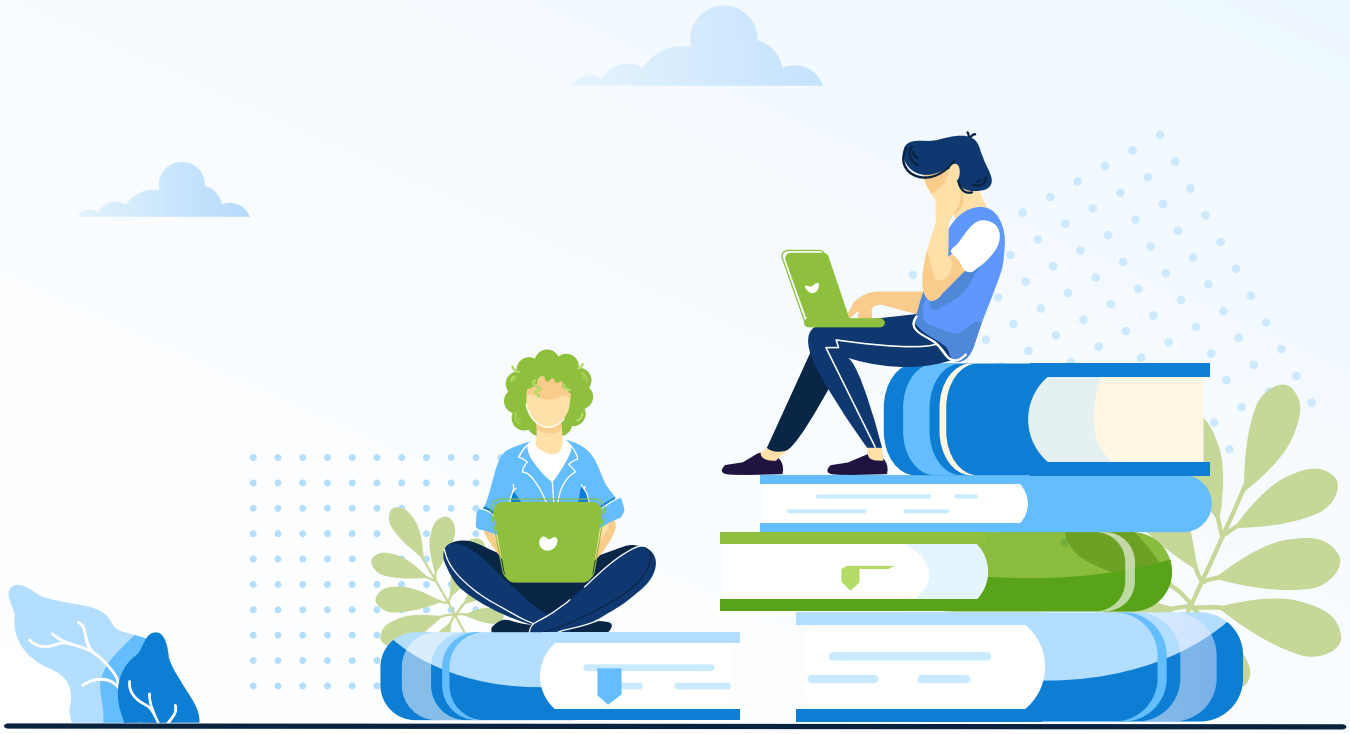

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INTRODUCTION

By the beginning of the 17th century, there had already been created the background for the rapid development of science. This was primarily connected with the fact of teaching physics in universities. Lecturers were often unable to explain the new phenomena discovered through technical and geographical discoveries. Appeal to the heritage of the ancient science corrected a number of misconceptions, but it was not enough to move forward.

It was impossible to go on without breaking the blind belief in Aristotle's point of view that reigned in the universities for a long period of time. Copernicus, Bruno, and Galileo were against the Aristotelian tradition. Their contemporaries and successors continued that fight.

BODY

New methodology and a new organization of science were introduced by Bacon and Descartes. One of Galileo's contemporaries who clearly recognized contradiction of old and new science discoveries was an English statesman and philosopher Francis Bacon (1561-1626). He understood that it was needed to develop and support the new methodology.

Government affairs did not prevent Bacon from making scientific progress. He decided to write an extensive essay entitled *The Great Recovery*. However, he managed to write only one part entitled "Novum Organum," (1620). In this work Bacon points out the condition of "normal", university, and science, and stated that it was not developed. It is seen how deep Bacon was right in saying that technical progress of his time did not go to any comparison with the modern technological progress. Bacon was able to see in this a tendency of continuous and infinite perfection of technique. He set and emphasized the disparity of practice and theory. Bacon emphasized that access to the ancient heritage can not eliminate this discrepancy (Bacon, 1967).

In his writings, Bacon reveals the reason of the state of science. In his opinion, the most important is the wrong aim and the wrong method of science. The latter is attributed to anti-scientific progress, rendered theology, and scholasticism.

Bacon added that the stubborn and prickly philosophy of Aristotle was mixed with religion more than it should have to. Bacon believed that the aim of science was to empower human life "with new discoveries and benefits", but its essence was not in useless speculations of scholastics. Bacon believes that scholastics and scholastic teaching impede the scientific progress. He is responsive to the fact that "at once and suddenly it can hit". Moreover, Bacon asserts that the person "rather believes in the truth which he/she prefers." Knowledge of the truth interferes with the imperfection of the senses, by which "subtle movement of particles in solids remains hidden" (Bacon, 1967).

Bacon divides scholars of his time into two classes: the empiricists and dogmatists. Empiricists are compared to ants dragging various facts and dogmas into their ant-hill. They are just like spiders weaving the cloth from their own bodies. According to Bacon, in science, it is necessary to work like a bee. You should remove the material from the outer world and efficiently process it.

Bacon's method is based on his experience. He believes that the science should be based on experience and practice-building of findings. "The causes and axioms" are the methods of induction (guidance). They are moving from particular facts to generalizations. These generalizations are scanned against experience and practice. "Our path and our method is the following: we do not derive from the practice of the practice and experience of the experience (empiricism), and the causes and axioms of practice and experience. And then from the causes and axioms we do again practice and experience as faithful interpreters of nature." The scientific truths are checked, so the experience and practice, in their turn, are derived from them.

The inductive method has played a great role in the development of science. For a long time the natural sciences of physics, chemistry, and astronomy were called the inductive sciences, in contrast to the humanities and pure science that was called mathematics. Bacon said that induction is incomplete and imperfect without a theoretical analysis, in other words without the use of mathematics: "It is just a natural advancing research, when the physical is completed in math." He took to atomic theory, arguing that "every natural act is done by means of very

small particles." It is the excellent performance of the method and philosophy of Bacon (Bacon, 1967).

Marx said: "The real founder of English materialism and all modern science is the experimenting Bacon Science. In his eyes, it is a true science. Physics is based on sensory experience. It is an essential part of science. Science is an experimental science, and it involves the application of a rational method towards the sense data. Induction analysis, comparison, observation, experiment are the principal terms of the rational method "(Bacon, 1967).

Essentially, Bacon understood the need to fund the science and academia. In his unfinished work of fiction, "The New Atlantis" he describes an institution as "House of Solomon" and its great importance for the rational construction of society.

Indeed, the need for scientific development gave rise to the new organization in the form of scientific societies and academies. The first academy, the Florentine Academy, was founded in 1657 in Florence, by students and followers of Galileo.

Scientific societies and academies of science were the new centers that emerged in opposition to the old universities. They were still in captivity of scholasticism. However, changes were made and universities were gradually drawn into a scientific movement. Suffice to say that from 1669 to 1695 Isaac Newton was a professor at the University of Cambridge.

The development of science required the development of scientific information. Conventional form of such information was the personal contact and correspondence. Thus, Bacon confirmed the development of scientific ideas. The experimental science has become a fact of social consciousness and the premise for creation of new forms of organization of science. This, of course, did not mean that science was made by Bacon. Bacon was the leading man of his time. He realized the importance of science for social progress, as well as its role in the technological development. He understood the reasons of failures of scholastic university science and correctly pointed out the role of experience in the development and practice of science. In the 17th century science has become a recognized public force. It assisted in the development of social production. Even more, science became an independent form of social consciousness.

Thus, we can talk about what happened in the 17th century. The scientific revolution arose as a result of classical physics development (and not just as a result of physics). It was done in a manner and with the methods of cognition as we know it today. Speaking of the knowledge method, it should be recalled that along with an inductive science the deductive method became widely used. A small number of general principles were derived and could be traced in private investigations. Thus, classical mechanics got developed from Newton's laws or the principles of dynamics and macroscopic electrodynamics. After Bacon, the method of deduction was justified by French philosopher Rene Descartes (1596-1650) in his book *Discourse on Method*, which was published in 1637.

Importantly, it would be an oversimplification to assume that the founder of the deductive method was Descartes and of the inductive - Bacon. Both methods originated in ancient Greece, while Bacon and Descartes only developed them in relation to science. In this case, neither Bacon denied the value of deduction, nor Descartes denied the experience and the value of induction. The overall scientific method is based on the dialectical combination of induction and deduction, and both great philosophers understood that. But Bacon emphasized the leading role of experience and induction. Descartes emphasized the logical analysis and correct conclusions. He believed that the basis of these conclusions could be found within clear and simple principles and strict logical sequence of inferences. In the method of Descartes, the mathematics is paramount.

Thus, according to Descartes, using the method of geometry in the study of the nature, great success can be achieved. For this method, there are not any inaccessible truths. This belief in the strength of the mathematical method is the characteristic of Descartes. In particular, Descartes appreciates the contribution by Galileo because he "tries to explore issues through mathematical reasoning" (Descartes, 1985).

But the basic problem of physics in the 17th century was the laws of motion. How to apply mathematics to the motion? Here, Descartes makes a crucial discovery: he introduces into mathematics the variables, as well as the correspondence between geometric figures and algebraic equations. Descartes lays the foundation of analytic geometry guided by understanding that in the sciences only mathematicians find some evidence and some accurate and obvious reasons.

The result of this was the beginning of the geometry. Descartes attached to his *Discourse on Method* two more works: *Dioptrics* and *Meteora*.

An idea or discovery occurred simultaneously. It was the idea of a variable. Galileo in his mechanical studies understood the need of operating variables. The idea of instantaneous velocity, which is changing from moment to moment, was mastered in its entirety. The "dialogue" describes how falling body freely goes through all stages of speed starting with zero. The parties did not immediately open the idea.

In 1644, Descartes published an extensive essay entitled *Principles of Philosophy* It included the writings of Descartes on the world (cosmos), which he intended to publish as early as 1633. He heard the condemnation of Galileo and postponed the publication of his work. And only eleven years later, he unveiled an expanded and revised version of this essay (Descartes, 1985).

In his writings, Descartes outlined an ambitious program. He created a theory of nature, guided by its methodological rule. It was based on simple and clear provisions.

In *Discourse on Method* by Descartes, he analyzed a variety of various assumptions and questions. However, in the act of thinking, there cannot be found any questions because our questions have already been the act of thinking. So here is the idea of the famous Descartes' proposition "I think, therefore I exist". To protect his doctrine from the attacks of the clergy, Descartes said that the existence of God and the external world

was created by God. But this could not deceive the clergy. They recognized the materialistic nature of Descartes. And till the end of his life the scientist had to seek refuge in Sweden, where he died faithful to his method.

Descartes seeks in a material substratum the most basic and simple things. Descartes belief is the idea that there is a pure extension, a kind of material space that fills the entire immense length, width and depth of the universe. Everything is in the constant motion, interacting with each other. The interaction of material particles obeys the basic laws or regulations (Descartes, 1985).

The first rule is that every particle of matter is individual and remains in the same state as long as it does collide with the other particles. This forces it to change this state.

The second rule was the following: if the next body collides with another, it can not loose during this collision nor take away from it.

In the third rule, although the movement of the body is often presented in the form of a curve and it is impossible to make any movement which would not be in a circular form, each of the particles of the body always strives to continue in a straight line.

These "rules" are usually perceived as the law of inertia and the law of conservation. Unlike Galileo, Descartes distracted from the action of gravity. By the way, he also spoke about reduced movement and

interaction of the particles, and referred to the direction of inertial motion in a straight line. However, the wording of Descartes was different from that of Newton. He was not talking about the state of uniform rectilinear motion, but explained the content of his term in general.

From the entire contents of the "Elements" it could be seen that the state of parts of matter is characterized by their size ("quantity of matter"), shape, speed, and ability to change the rate by external particles. This can identify the capacity with inertia.

According to Descartes, there are three types of particles (three items) of earth, air (sky), and fire. The largest particle is a particle of the earth. They are immersed in the environment of the particles of the sky, which are also interspersed in the fire particles that form the sun. Circular vortex motion of "heaven" particles is reflected in the movement of the planet that consists of the elements of the earth. The entire universe is divided into these vortex regionsthat can be regarded as precursors of modern galaxies. This is the cosmological hypothesis of Descartes. All phenomena are reduced to the movement and interaction of the particles. In the history of science, Descartes' physical view was called Cartesian. It is from the Latin pronunciation of the name Decarie. Cartesian view has played a huge role in the evolution of physics. All attempts to construct a unified field theory of matter repeatedly returnto the basis of Descartes' attempts to build a physical picture of the world with the continuous matter and the persistent mechanical movement (Descartes, 1985).

CONCLUSION

In summary, it is important to note that even though the methods of Descartes and Bacon were different, their exemplars synthesized into one marked the beginning of the modern scientific method. (Descartes, 1985).

Descartes significantly developed the method of deduction while Bacon developed the method of induction. Both, however, recognized the necessity of the two methods as complementary. Thanks to the efforts of both scientists the understanding of the scientific method as a dialectical combination of induction and deduction became widespread. The difference between the constituents of this scientific method was Bacon underlined the leading role of experience and induction, while Descartes prioritized the logical analysis and correct conclusions. He asserted that these conclusions grounded on clearly articulated and simple principles combined with inferences that came in strict logical sequence. In the method of Descartes, the role of mathematics is paramount. At the same time, findings of Descartes took into consideration Bacon's experience. In particular, Bacon's belief that the science should be based on experience and practice-building of findings was helpful in the development of Descartes' deductive method.

Descartes was the father of the modern scientific method in a way. His mind/ matter dualism had the effect of enabling one to focus on matter (res extensa) as the appropriate substance for scientific research. Res cogitans (the mind) is, on the contrary, the instrument for ascertaining truths in relation to the material world, i.e. it is responsible for segregating fact from fancy. This eliminated a large number of dubious human

occupations from the scientific scene, e.g. the clutter of superstitions, astrology, alchemy etc. Thereby Descartes placed epistemology, reductive and mathematical methodology on the map, and these have been utilized in science ever since, leading to the triumphal march of science down to the development of computers (Lawrenz, 2011).