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"Positivism" On Trial

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Abstract

Unlike logical positivists, Alexander Koyré was concerned with the conceptual analysis of science and its intellectual, philosophical and metaphysical roots. He was deeply convinced of the mathematization of nature as the key to early modern science, the nature of which was announced by Koyré as revolutionary. He argues that theory determines the structure of observation and experiment; in other words, theory precedes experiment; and, therefore, science is a theoretical activity. Facts-gathering and doing experiments come after the theory; because the theory determines the structure of the observation and the experiment. Hence, in this paper, it is aimed at setting forth Koyré's crucial ideas regarding "nature of science".

Key words: Science, nature of science, conceptual analysis of science, logical positivists.

Özet

Alexander Koyré, mantıkçı positivistlerden farklı olarak, bilimin kavramsal çözümlemesiyle ilgilenmiş ve bilimin entelektüel, felsefî ve metafizik kökleri hakkında çalışmalar yapmıştır. Devrimci bir nitelik taşıyan çağcıl bilime açılan kapının doğaya matematik kavram ve formülasyonlarla yaklaşılması olduğunu hararetle savunan Koyré'ye göre, gözlem ve deneyin yapısını belirleyen kuramdır. Başka deyişle, kuram deneyden önce gelir; dolayısıyla bilim kuramsal bir etkinliktir. Olgu toplama ve deney yapma işi kuramdan sonradır. Bu bağlamda, eldeki çalışmanın amacı, "bilimin doğası"na ilişkin Koyré'nin öne sürdüğü can alıcı fikirlerin gözler önüne serilmesidir.

Anahtar sözcükler: Bilim, bilimin doğası, bilimin kavramsal çözümlemesi, mantıkçı pozitivistler.

Introduction

The philosophers who argued that scientific explanations are provided by applications of laws are called positivists. It should be stated, without further ado, positivism started as a reform movement in both philosophy and science. A figure particularly connected with the origins of positivism is the French mathematician and social scientist Auguste Comte, who had started his serious thinking in an age and at a place characterized by intellectual confusion and social disorder. Comte's major philosophical contribution centered around his idea of the positive sciences and the positivistic theory of knowledge. Positivism is to be defined as a general atti-

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tude of mind, a spirit of inquiry, an approach to the facts of human existence. Since it refuses the assumption that nature has some ultimate aim or purpose, in the first place, its central specificity is negative. In the second place, positivism gives up any labor to discover either the essence or the internal causes of things. The spirit of positivism is sounded off on the endeavor to scrutinize facts by observing the constant relations betwen the things and formulating the laws of science simply as the laws of constant relations between various phenomena. In other words, we have no knowledge of anything, but phenomena and our knowledge of phenomena is relative, not absolute. We know only the facts and their relations to other facts in the way of succession or of similitude. These relations are constant; i.e., always the same in the same circumstances. The constant resemblances linking phenomena together, and the constant sequences uniting them as antecedent and consequent, are termed their laws. For Comte, the history of ideas points out that there has been a clear movement of thought through three stages, each of which stands for a different way of discovering truth. These stages are the theological in which phenomena are accounted for as being caused by divine powers; the metaphysical in which anthropocentric concepts of divinity are substituted for impersonal and abstract forces; and the positivistic or scientific in which only the constant relations between phenomena are regarded and all endeavors to explain things by references to beings beyond our experience are abondoned (Kabadayı 2004: 1-3). In a nut shell, positivism contained an attack focused on the metaphysical inclinations in science. For positivists, laws satisfied the most important goal of science, namely, its utilitarian promise to provide prevision, prediction of the future course of events. Adding logic to positivism is with the Vienna Circle. An axiomatic system for symbolic logic, the logic of quantifiers and predicates with identity, made a language to clarify obscurities and ambiguities in the propositions of science. Hence, the positivists became the logical positivists or logical empiricists.

The men forming the Vienna Circle were attracted to the methods of science and mathematics. They were inclined to reject metaphysics, as had the earlier positivists regarding metaphysics, as Comte did, as outdated by science (Gross 1971: 107-109). To separate themselves from the earlier Comtean positivists and to stress that they would combine the rigorous techniques of the new logic with the empirical character, which is why they are called logical positivists or logical empiricists. If the charge against metaphysics was that its language was meaningless, such a charge required the use of some criterion by which to test which sentences did and which did not express a genuine proposition about a matter of fact. Hence the logical positivists formulated the verification principle as the basic criterion for the meaningfullness of a proposition. If a proposition fulfilled the requirements of this criterion, it was regarded meaningful, and if a proposition failed to do so, it was held meaningless (Feigl 1969: 5). To repeat, they have proposed a criterion of meaningfulness which has come to be called the verification principle of meaning, according to which, a meaningful statement must be verifiable either *in fact* or *in principle*. Leaders of the Vienna Circle were quick to advance that most statements of traditional philosophy were nonsensical or meaningless, that, apart from the sentences of logic, scientific statements were the only true statements or propositions. That is to say, all statements must be capable of verification, and should be clarified; it will then be found to be useful. Consequently, true science free of metaphysical and nonsensical elements is in progress by the accumulation of the facts based on sense experience and observation with the application of the inductive methods and reasoning (Kabadayı 2004: 3-5). The verification principle consisted in the notion that the meaning of a statement is the method of its verification. The assumption behind this principle was that verification must always depend on empirical observation, i.e., in sense experience. Accordingly, any proposition that is not able to be verified by the method of observation would be said to have no meaning. By this idea of science, logical positivists put forward the claim that only can observation provide to build sientific theories regarding the nature of empirical world (Kabadayı 2004: 15).

Standing against this conception of science, Koyré argues that true science is possible by getting rid of positivist posture and approach, because there have always been metaphysical things and elements in science and scientific revolutions to be taken place. Koyré (1892-1964) was an astronomer much interested in the history of science, particularly the contributions of Galileo. The term “the scientific revolution” was framed in more or less its current meaning mostly by the works of Koyré. He was born in Russia, studied in Germany and spent several years in the Middle East. Koyré, throughout his writings, went on distinguishing a number of revolutions, one of which was the revolution of Galileo. Thus, Koyré believed in revolutions in science; for him, as a historian of science, one’s duty was to shed light to what a given great scientist from the past owed to certain predecessors; to reconstruct as faithfully as one can that scientist’s own thought in the context of the preavaling spirit of the time as well as overcoming the positivist approach to history. Hence, the birth of early modern science was not just the emergence of lots of new statements regarding nature; not even, for example such fundamental propositions as the principle of inertia. The discovery and subsequent adoption of these statements could only be figured out in the framework of a larger transition described by Koyré as a fundamentally new overall conception of motion. And this transition could only cause to happen in the wider framework of a new conception of the universe at large. Thus, it is high time to get down the business of spelling out Koyré's ideas regarding true science, which, in his view, becomes possible only by overcoming the positivist posture. To do so, we will especially take advantage of Koyre's analyses akin to particularly contributions of Galileo.

Koyré argued for the dominating role of ideas over experience in the Galileo's scientific thought (Koyré 1992: VII). For Koyré, experiment is a question put to nature and before in so doing a scientist or better a natural philosopher should decide the language which nature understands (Koyré 1992: VII).

In his paper, "Galileo and Scientific Revolution of the Seventeenth Century", Koyré begins by a very well-known metaphor, namely, "Modern Science did not spring perfect and complete, as Athena from the head of Zeus, from the minds of Galileo and Descartes's" (Koyré 1992: 1). Koyré states that modern physics is born with the works of Galileo and looks on the law of inertial motion as its fundamental law. And modern science aims at explaining everything by number, figure and motion (Koyré 1992: 2). In order to illustrate his ideas, Koyré goes on arguing that the principle of inertial motion is very simple, which states that a body, left to itself, remains in its state of rest or of motion so long as it is not interfered with by some external force. In other words, "a body at rest will remain eternally at rest unless it is put in motion. Moreover, a body in motion will continue to move and to persist in its rectilinear uniform motion so long as nothing prevents it from doing so" (Koyré 1992: 2). Hence, the principle of inertial motion appears to us perfectly clear and self- evident (Koyré 1992: 3).

Koyré continues by spelling out that,

> all this clear and simple notions which form the basis of modern science are not clear and simple *per se et in se*, but only as a part of a certain set of concepts and axioms, apart from which they are not simple at all. This, in turn, enables us to understand why the discovery of such simple and easy things as, for instance, the fundamental laws of motion, which today are taught to, and understood by, children, has needed such a tremendous effort …. by some of deepest and mightiest minds ever produced by mankind: They had not to "discover" or to "establish" these simple and evident laws, but to work out and to build up the very framework which made those discoveries possible. They had to reshape and to reform our intellect itself; to give to it a series of new concepts, to evolve a new approach to Being, a new concept of nature, a new concept of science, in other words, a new philosophy (Koyré 1992: 3).

In addition this, Koyré holds that we are so well used to the concepts and principles forming the basis of modern science that it is almost out of the question for us to realize worth either the hindrances that had to be surmounted for their establishment, or the obstacles that they hint and contain. The Galilean idea of motion strikes us so normal that we think that we have had it from observation and experience (Koyré 1992: 3). In Koyré's point of view, on the other hand, we are similarly used to the mathematical approach to nature so well that we are not conscious of the daring assertion of Galileo that the book of nature is written in mathematical (geometrical) characters.

Koyré keeps going by stating that,

> Aristotle and Ptolemy were against the possibility that the earth moves, the arguments of Aristotle and Ptolemy can be boiled down to the statement that, if the earth were moving, this movement would affect the phenomena occurring on its surface in two perfectly definite ways: (1) the tremendous velocity of this (rotational) movement would develop a centrifugal force of such a magnitude that all the bodies *not connected* with the earth would fly away, and (2) this same movement would cause all bodies not connected, or temporarily disconnected with it, to lag behind. Therefore, a stone falling from the summit of a tower would never land at its foot, and, *a fortori*, a stone (or a bullet) thrown (or shot) perpendicularly into the air would never fall back to the place from which it departed, because, during the time of its fall or flight, this place would be "quickly removed from below it and rapidly moved away" (Koyré 1992: 7).

One must not make fun of this argument, says Koyré. "From the point of view of the Aristotelian physics, it is perfectly sound. So sound that, on the basis of this physics, it is utterly irrefutable. In order to destroy it, we must change the system as a whole and evolve a new concept of movement: the concept of movement of Galileo" (Koyré 1992: 6-7)

Hence, Koyré points out that

> the position taken by Kepler is of a quite particular interest and importance. It shows us, better than any other, the ultimate *philosophical* roots of the Galilean revolution. From a purely scientific point of view, Kepler –to whom we owe, … the very term *inertia* – is, undoubtedly, one of the foremost-… genius of his time: it is needless to insist upon his outstanding mathematical gifts, equaled only by the intrepidity of his thought. … and yet, philosophically, he is much nearer to Aristotle and the Middle Ages than to Galileo and Descartes. … the term *inertia* means for him the resistance that bodies oppose, not the change of state, as for Newton , but only and solely to movement; therefore, just like Aristotle and the physicists of the Middle Ages, he needs a cause or a force to explain motion, and does not need one to explain rest; just like them, he believes that, separated from the mover, or deprived from the influence of the moving virtue or power, bodies in motion will not continue their movement, but on the contrary, will immediately stop (Koyré 1992: 11)

Koyré moves on arguing that we realize that Kepler, the founder of modern astronomy, was failure to set up the basis of modern physical science for only one reason: he still maintained the belief that motion is, ontologically, on a higher level of being than rest. Galileo was well conscious of the hardness of Kepler's job in that he knows very well that he has to copy with the worst enemies, namely, authority, tradition, and common sense (Koyré 1992: 12)

At this point, Koyré asserts that,

> Galileo is perfectly clear about it. Thus, discussing the famous example of the ball falling from the top of a mast of a moving ship, Galileo, explains at length the principle of the physical relativity of motion, the difference between the motion of the body is relative to the earth, and as relative to the ship, and then, *without making any appeal to experience,* concludes that the motion of the ball, *in relation to the ship*, does not change with the motion of the latter. Moreover, when his empirically minded Aristotelian opponent asks him, "Did you make an experiment?" Galileo proudly declares: "no, and I do not need it, as without any experience I can affirm that it is so, because it cannot be otherwise (Koyré 1992: 13).

Thus, Koyré holds that the theory precedes or comes before the fact. Experience is no use because before any experience we already have the knowledge of fundamental laws of motion we are after. We find and discover it not in nature, but in ourselves, as Plato sounded off about long ago (Koyré 1992: 13).[1]

According to Koyré, scholars have insisted on the Galilean fight against authority, especially against that of Aristotle: against the scientific and philosophical tradition, approved by the Church and tutored in the universities. They have emphasized the role of observation and experience in the new science of nature. It is true that observation and experimentation build one of the most characteristic features of modern science. It is certain that in the works of Galileo we ascertain a number of appeals to observation and to experience, and bitter ridicule toward men who didn't believe their eyes because what they saw was against the indoctrination of the authorities, or even worse, who did not want to have a look with Galileo's telescope for the dread of seeing something which would conflict with their traditional theories and beliefs. It is perfectly clear that it was just by building a telescope and by looking through it, by alert observation of the moon and the planets, by his discovery of the satellites of Jupiter, that Galileo challenged the cosmology and the astronomy of his times (Koyré 1992: 18).

1 Cf. also the paper written by Alexander Koyré "Galileo ve Piza Deneyi" translated into Turkish by Kurtuluş Dinçer, in Yeniçağ Biliminin Doğuşu, Ankara: Gündoğan Yayınları, 1994.

As we have seen, Koyré argues that, one must remember that “observation and experience in the sense of brute common-sense experience did not play a major role; or, if it did, it was a negative one, in the foundation of modern science” (Koyré 1992: 18).

Koyré goes on setting forth that experimentation is the methodical questioning of nature, a questioning which assumes a language in which to devise the questions, and a dictionary which makes us read and decipher or interpret the answers. For instance, Galileo was of the opinion, as we know in advance, it was in mathematical or in geometrical language that we are supposed to talk to *Nature* and get her answers (Koyré 1992: 18-19).

For the time being, it must indeed be stated that Koyré seems to be the followers of Pierre Duhem and Émile Meyerson regarding the theory-ladenness of observation and experiment; and it seems that Thomas S. Kuhn kept these ideas alive after Koyré. For Duhem, the scientific theories are verified or unverified as a whole. Hence the framework of a theory is just as open to revision as the content of the theory, that is, Duhem thesis is about the underdetermination of hypothesis by experiment, i.e., scientists do not submit single hypothesis, but groups of hypotheses, to the control of experiment, and, thus, experiment alone cannot conclusively falsify hypotheses. In Duhem’s point of view, “a physical theory is not an explanation; it is a system of mathematical propositions, the purpose of which is to represent as simply, as completely and as exactly as possible a whole group of experimental laws. In other words, physical theory would be merely a method of classification of physical phenomena keeping us from drowning in the extreme complexity of these phenomena” (Duhem 1954: ix).

In Duhem’s view, “any experiment in physics consists in two parts, the first part is composed of the observation of certain facts; thus in order to make this observation it suffices for one to be attentive and alert enough with his or her senses. The second part involves the interpretation of the observed facts; hence to make this, it is not enough to have an alert attention and practiced senses. That is to say, it is vital to know both the accepted theories and how to apply them. To repeat, then, an experiment in physics is not simply the observation of a phenomenon; it is, besides, the theoretical interpretation of this phenomenon” (Duhem 1954: 145).

As a matter of fact, for Duhem, the physicist or scientist can never subject an isolated hypothesis to experimental test, but only a whole set of hypotheses; when the experiment is not in agreement with his or her predictions, what he or she finds out is that at least one of the hypotheses constituting this group is not acceptable and ought to be adjusted. But the experiment does not point out which one should be modified. In other words, physical science is a system which must be taken as a whole. In short, an experiment in physics can never condemn an isolated hypothesis, but only a whole theoretical group (Duhem 1954: 187). As has been seen, for Duhem, no isolated hypothesis and no group of hypotheses separated from the rest of physics is capable of an absolutely autonomous experimental verification. In sum, to Duhem, a physical theory is not an explanation, but a method classification of physical phenomena keeping us from getting lost and drowning in the extreme complexity of these phenomena. In other words, a phsical theory is a system of mathematical propositions, the aim of which is to stand for as simply, as completely and as much as possible a whole group of experimental laws. Above all, an experiment in physics is not simply the observation of a phenomenon; it is the theoretical interpretation of this phenomenon as well. Since the aim of all physical theory is the representation of experimental laws, the terms such as “truth” and “certainty” have only one signification with respect to such a theory. Accordingly, any experiment in physics involves two parts. On the one hand, it is composed of the observation of certain facts; on the other hand, it consists of the interpretation of the observed facts. And in order to make this interpretation, it is necessary to know the accepted theories. I am of the opinion that this sounds off on the theory-ladenness of the observation and the experiment.

When we get to the ideas of É. Meyerson[2] regarding the true nature of science, we see that like, Koyré, he also criticizes the positivistic interpretation of science especially in his well-known work, namely, *Identity & Reality* and he provides an important rejection and refutation of positivistic epistemology by arguing that it must be recalled that research is always dominated by preconceived ideas, that is, by hypotheses and theories, which are indispensable in guiding our advance. Thus, Meyerson believes that we are never entirely free from them. He also argues that the experimenter, whenever he thinks, is psychologically predisposed in advance of experimentation to posit ontology come what may. Hence, Meyerson works on the theories produced by scientific thought to disclose and to uncover the psychological principles accompanying all scientific investigations (Meyerson 1930: 5,120,121).

For Kuhn, as in the case of Koyré, a scientific community cannot practice its trade without some set of received beliefs. Kuhn’s central concept is the paradigm meaning mainly concrete model and set of fundamental theoretical assumptions.

2 Meyerson was leading philosopher of science of France as well as being one of the most dominant historians of science in the Western world, whose idea of science deserves to be elaborated much more detailed study than it is spelled out and illustrated here. That’s why, I am working on a paper akin to his understanding of science so as to unconceal the nature of science.

First of all, Kuhn’s conceptions of paradigm, normal science and extra-ordinary science are supposed to be defined shortly so as to understand his idea of science. In Kuhn’s point of view, a paradigm is a theoretical structure providing a model for scientists in doing researches in a certain time period (Kuhn 1970: viii). Normal science, the activity in which most scientists inevitably spend almost all their time, is predicated on the assumption that the scientific community knows what the world is like. Normal science is also a puzzle-solving activity, in which the paradigms are not questioned, but the puzzles are ironed out in the context of the paradigm (Kuhn 1970: 5). However some unsolved problems, unexplained facts and anomalies can be seen in normal science period. But all those are not enough for giving up a paradigm. In order to abandon the paradigm, it should not be fixed or mended. This is how extra-ordinary science begins, namely, the existing paradigm leads to crisis being a prerequisite to a scientific revolution (Kuhn 1970: 81-82). The new paradigm irons out some problems and difficulties that the old paradigm could not deal with or handle. The world changes as well when the revolution takes place in that everything has changed with the advent of the new paradigm. Facts and fields of experience have also changed, that is, a change caused to happen in knowledge claims.

Thus, in Kuhn’s account, no theory can be tested or falsified by just depending on obsevations or sense experiences. And Kuhn brings up the claim that the observation is laden with theory and that paradigms are self-verifying and self-supporting. As has been set forth, a paradigm is essential to scientific inquiry in that paradigms help the scientific communities to bound their discipline since they help the scientist to create avenues of inquiry, to formulate questions, to select methods with which to examine questions and to define areas of elevance. Men whose investigation is founded on shared paradigms are committed to the same rules and standards for scientific practice. Furthermore, a paradigm guides and informs the fact-gathering and researchers focus on facts which can be compared directly with predictions from the paradigmatic theory; a paradigm, says Kuhn, sets the problems to be solved, too.

Having spelled out the similar ideas of these philosophers of science especially regarding the priority of the theory over observation and experiment. Now it is time we got back to Koyré’s ideas again so as to grasp the essence of his ideas on science along with views set forth above. Koyré argues that what the originators of modern science, including Galileo, had to do was not to detract and to battle certain defective and wrong theories, and to improve or to substitute them for better ones. They had to do something quite different. They had to overthrow one world and to substitute it for another. They had to reform the skeleton of our mind itself, to reaffirm and to reshape its concepts to develop a new approach to Being, a new idea of knowledge, a new idea of science (Koyré 1992: 20-21).

As an example of this, Koyré refers to Galileo by stating that a new and original concept of motion had to be formed and developed. It is this new concept that we owe to Galileo. To be repeated, as it is pointed out, Koyré asserts that in Galilean science, which is experimental and not experiential, theory precedes and guides experiment, which justifies, or invalidates, the theory, and provides secure facts akin to the matter under examination. Hence, theory constitutes science (Koyré 1973: 469-470).

Koyré stresses the same issue in his book *Newtonian Studies* by stating that

> as for experience and experiment– two things which we must not only distinguish but even oppose to each other– I am convinced that the rise and growth of experimental science is not the source but, on the contrary, the result of the new *theoretical*, that is, the new *metaphysical* approach to nature that forms the content of the scientific revolution of the seventeenth century, a content which we have to understand before we can attempt an explanation … of its historical occurrence (Koyré 1965: 6).

According to Koyré, Newtonian science seems to be in history as relied on a dynamic view of physical causality and as connected together with theistic or deistic metaphysics. This metaphysical system does not show itself up as a constitutive part of the Newtonian science; it does not penetrate into its formal structure. Yet, it is by no means an accident that not only for Newton himself, but also for all the Newtonians this science implied a reasonable belief in God. Once more the book of nature appeared to reveal God, an engineering God this time, who not only had made the world clock, but who continuingly had to supervise and tend it in order to fix its mechanism when needed (Koyré 1965: 20-21).

Koyré also pays his attention to the most important problems dealt with by scientific methodology regarding the relation of theories to facts; its aim is composed of the establishment of the conditions which a theory must meet to be accepted and of the ways and means which make us decide if a given theory is valid (Koyré 1970: 116). He continues as follows:

> … *too much* methodology is dangerous, and as often as not, or more often than not – we have examples enough in our own times – results in sterility. I would go even farther: in my opinion, the place of methodology is not at the beginning of scientific development, but we might say, in the middle of it. No science has ever started with a *tractatus de methodo* and progressed by the application of such an abstractly devised method, *Descartes on Method* not withstanding, which, as we well know, was written not *before* but *after* the scientific "essays" to which it forms a preface. Indeed, it codifies the rules of Cartesian algebric geometry (Koyré 1970: 118).

That is to say, the theory determines the observation and experiment; in other words, theory precedes experiment; and science is a theoretical activity. Gathering facts and doing experiments come after the theory; because the theory establishes the structure of the observation and the experiment.

In conclusion, Koyré thinks that "science" is baseless, because without taking into consideration the history of science, figuring science out is out of the question. For him, scientific ideas are to be comprehended with their historical frames and contexts, because the place of forms of thought spelled out by philosophy in the development of scientific thought is indispensable. In addition, he thinks that true science is possible by getting rid of positivist posture and approach, because there have always been metaphysical things in science and scientific revolutions to be taken place. Men of science and scholars, among them Galileo and Newton have employed metaphysical and religious elements in their ideas of science. Accordingly, Koyré handles the scientific discoveries of the past with the understanding and conceptual frame that on the basis of these discoveries are irrational non-logical, magical, mysterious, mythical and philosophical elements and things. Hence, positivism is a child of failure. Above all, he also argues that observation and experiment have hardly played important roles in the emergence and development of modern science. Regarding scientific revolution, i.e., substituting the old theory for the new one. Koyré asserts that it is not that a new theory takes a stand by refuting and rejecting the old one with observation and experiment, but a radical change on philosophical look. In the final analysis, Koyré is convinced that science is founded on an ontology or conception of universe, that is to say, science is nothing but the idea of nature.

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