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BASIC PHILOSOPHICAL AND METHODOLOGICAL IDEAS IN THE EVOLUTION OF PHYSICAL SCIENCES

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A R T I C L E I N F O.

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Abstract

The purpose of this study is to share my research and experiences with science students on the topic of "Methods of Philosophy and Physical Sciences", which is one of the main topics of the "Philosophy of Science" course, which I am interested in as a hobby. For a quarter of a century, I have been giving it to physics students from time to time as an elective course, and I have been sharing it with science students in the process of the development of physics. To introduce the philosophical and methodological ideas that play an active role and enlighten those who want to do research on this topic.

Akut Gence, translation editor of The Five Biggest Ideas in Science, in his introductory article; Unfortunately, the level of scientific literacy in our country is quite low... Of course, there are circles that especially want it to happen. That is why, according to the survey, which covered 34 countries and the results of which were published in Science magazine, one of the most prestigious science journals in the world, it ranked last in terms of coverage of science and evolution. Most of our people prefer nonsense to scientific explanation, dogmatic opinion to scientific opinion. People, especially if they are not scientifically educated, easily confuse science with pseudoscience and prefer pseudoscience to real science. . Because pseudoscience is easier than real science, it doesn't require much thought, and it doesn't provide explanations that contradict people's common thought patterns for hundreds of years. But true science can shake up our millennia-old thoughts and beliefs with new explanations that must be tested through constant questioning, experimentation, and observation. In science, no explanation is the final explanation. When research on one question is completed, new questions emerge to be explored. The scientific method always raises new questions. This is where science differs from dogma. Dogma cannot be doubted. Nothing in dogma can be the subject of research and therefore cannot be tested by the

scientific method. Scientific explanations are constantly changing based on new findings. There is always a better, more consistent explanation for a natural phenomenon. We love this in the development of physics. The real problem here is how to convey the new developments in science to the masses without distorting them, and in this way the people will get rid of lies and dogmatic thoughts. This problem is especially important from the point of view of physical sciences.

The problem of conveying the developments in this regard to the mass of readers who are not familiar with the method and philosophy of physical sciences is of great importance today, and it became clear that this task requires a very deep study. We say that the public must fully understand the greatness of the achievements in the physical sciences, their intellectual value, and the great influence they can have on the future of nations and the evolution of civilization. On the other hand, it requires a very detailed study, we said. Because scientific knowledge is increasing and becoming more complex day by day. As a result, it would be very difficult to present this information to other interested readers, especially science students and scientists, without spoiling it. Then a conflict arises between the sincere desire to convey to the reader the findings of science in general, and physical sciences in particular, and the duty imposed on the conscience of every scientist . forward without distorting the truth beyond what is scientifically determined. Therefore, real scientists who understand their place in modern society should not remain indifferent to their efforts to convey the progress of science to the general public. Because only such research can teach these layers the intellectual superiority of scientific achievements and the extremely important results that can arise from them in the practical field.

There are many valuable scientists who have successfully presented science to the general public through public lectures and works. Among them, the famous British experimental physicist Faraday, the American physicist Richard Feynman, the winner of the Nobel Prize in Physics, the famous British scientist Roger Penrose, who is one of the most knowledgeable and creative mathematical physicists in the world. There are not enough interesting studies today. on the philosophy and methods of the physical sciences. However, many revolutionary discoveries have emerged from the philosophical thinking mechanism of the physical sciences. This is undoubtedly a very interesting and broad topic that should be studied in detail by famous scientists such as philosophers, naturalists or philosophers of science. New theses may need to be conducted on these topics in order for him to do this properly. For example, you can think of a major historical aspect; It is about how the philosophy and methods of physical sciences have developed in the last century, and how they have influenced the development of science. Moreover, one might think that a philosopher, scientist, philosopher of science, or philosopher of physics can study the subject of the method and philosophy of physical science from his own point of view and study it from a completely different perspective. There may be another question that needs to be answered in this regard; This is about what kind of research can be done in the philosophy and methods of physical sciences in our country today. Philosophers-physicists and philosophers of science are expected to be interested in this issue.

As a theoretical physicist, I gained knowledge from my lectures and national research presented at conferences, seminars, physics congresses on the subject of "Physical Science Method and Philosophy", which is one of the subjects of the "Philosophy of Science" course. I have been interested in it as a hobby for almost a quarter of a century and have been teaching it occasionally as an elective course. The fact that this topic is not well known by the public, has not received enough attention and research among philosophers of science and physical philosophers. The purpose of my research is to present to the public my very interesting research and experiments on this topic. to share with students of valuable science and

introduce the research methods and philosophical ideas that play an active role in the development of physical science and enlighten those who want to conduct research in this regard. After this introduction, I discuss topics such as philosophy, science, and classification before presenting a synthesis of various views and opinions presented in the literature on the topic of "the main philosophical and methodological ideas that played a role in the evolution of physical sciences." Science, philosophy of science, physical science, philosophy, science and physics, is of the opinion that identifying key scientific concepts closely related to the topic will be useful for a better understanding of the topic. In this regard, based on the unique philosophy and methods of classical physical sciences, which are an integral part of philosophy and science, different opposing philosophical views were evaluated in the course of the development of classical physical sciences from the 17th century. Philosophical interpretations of quantum theory are given. Finally, during the development of modern physics in the 20th century, research methods used by theoretical scientists working in physics, how a scientist should work to understand the laws of nature, success through method, Einstein's method, the impact of theory. The theory of relativity, opposing views and views in the development of modern physics. .

Definitions of some basic scientific concepts

What is philosophy?

In Meydan Larousse, philosophy is defined as follows: the sum of views about the principles of being and objects, the place of man in the universe, God, history and, in general, all the main problems of metaphysics. A system of thinking aimed at revealing the basic principles of science (Philosophy of Science, Philosophy of History, etc.). The philosopher's doctrine and system, school, era (Aristotle's philosophy, German philosophy, ancient philosophy, existential philosophy, etc.). According to some, philosophy is a tool for seeing, understanding and interpreting the world and life, guiding and supporting behavior, based on the concept that "everyone has his own philosophy".

What is science?

Science is a concept that has been used in different senses throughout its historical evolution. In general, the ancients called recipe theory "science". Nowadays, we see that the concept of science has changed significantly. For example, philosophers of science have developed criteria for what is and is not within the scope of science. Prof. According to Feigl, these criteria should be:

(i) they must be examined subjectively against each other;

(ii) must be reliable;

(iii) It must be clear and distinct,

(iv) must be systematic in nature,

(v) it must be comprehensive,

Based on these criteria, how can science be defined?

According to the definition given in the encyclopedic dictionary, science is "a coherent body of knowledge about a certain category of facts, subjects, or phenomena, confirmed by legitimate and experimental methods." According to mathematical philosopher Henri Poincaré, science is "like a building whose building blocks are facts; this building has many rooms, each of which represents a field of science. A. Einstein once said; Science is not just a catalog of unrelated facts, a set of laws. Science is the greatest work created by the human mind with its free ideas and concepts. Physical concepts try to reveal reality and widely perceived impressions and it establishes a relation between facts. The validity

of our logical structure depends only on how and in what way our theories realize this relation." According to many philosophers of science, their favorite definition of science is; Science is arriving at truth by deriving logical meanings from experimental observations. However, there are those who say that science cannot be fully defined. According to them, every definition riff can reveal only one aspect of science. Philosophers of science do not yet seem to agree on a complete definition of science. There is no consensus among them on the classification of science.

Classification of subjects:

Philosophers of science generally divide science into two classes: applied and experimental sciences. Applied sciences; These are the disciplines that produce and use technology. For example; such as engineering, medicine, agriculture, aviation and marine sciences. Experimental sciences; It is divided into two: formal sciences (mathematics-logic) and real sciences based on phenomena. Real sciences based on events are also divided; social sciences (sociology, economics, history, language, etc.) and natural sciences (theoretical sciences) that discover reality are called rule sciences. It divides natural sciences into two subgroups: physical sciences (physics and chemistry) and life and behavioral sciences (biology and psychology). The main purpose of applied sciences is to use the discoveries of both experimental and applied sciences to develop tools and machines needed by people and put them into service. In short, technology is production. The main purpose of experimental sciences is psychological. It is the observation, search and research of data to arrive at facts. It is a sense of psychological satisfaction given to us by the extraordinary abilities of our mind to predict and explain reality. This is to satisfy the artistic feelings of scientists, such as increasing mutual competition, increasing their country and their prestige, and receiving awards. The second goal is logical. It can be explained by three concepts; describe, explain and predict.

Description; is to form with the help of mathematics.

Explanation; This is to show under what conditions our observations are valid. to guess; is to predict the event. A good theory is a theory that can make preconceived ideas and confirm these ideas through experiments. It is known how important a role physics plays in the development of philosophy, especially physics, which is a theoretical science among experimental sciences. , technology and many other subjects. One of these is his contribution to the philosophy of science.

What is philosophy of science?

This is a philosophical current that appeared in the 19th century. In this century, the progress in the physical sciences opened up very wide horizons for philosophers. A lot of technical inventions are accompanied by a lot of logical analysis. A new philosophy is built on the basis of a new science. This new philosophy began as a by-product of scientific research and developed along with positivism. This philosophy aims to make thought more coherent, bring it closer to material or concrete reality, and at the same time open an inclusive perspective to it. In short, the main goal of the philosophy of science or positivist philosophy is to process the data obtained from various fields of natural phenomena into a coherent doctrine.

What is Physics, which plays an important role in the development of modern science, philosophy, technology and many other fields of science?

Physics, the most basic science of nature, is the study, study and research of the basic principles, properties, how the universe works, inanimate objects, interactions between them and phenomena that are naturally encountered and perceived by humans. consists of fields of science. through laboratory, experiment and theory. It is a whole. Physics is a broad field that encompasses everything from the most

fundamental particles that make up the structure of matter, such as electrons and quarks, to the behavior of stars and galaxies in the universe. However, physics is limited to the most general and basic representations of things and phenomena. Physics, like mathematics, plays not only a descriptive but also an integrative role between theory and experiment. We can divide physics into two periods: classical physics and quantum physics. The period from the beginning of the 17th century to the beginning of the 20th century is called the period of classical physics. Five major revolutions in physics took place during this period.

These revolutions in turn; The revolution of classical mechanics (Newton, Galieo, Kepler, Copernicus) was the first revolution that allowed us to move from the chaos of Earth-centered Ptolemaic astronomy to a heliocentric planetary system, which began with the Copernican revolution and continued with Galileo and Galilei. Kepler and largely completed by Newton. The revolution in classical mechanics rescued mechanics from the impasse it had been in since Aristotle and brought its fundamental laws, principles, and concept of universal gravitation. The thermodynamic revolution (Carnot, Mayer, Joule, Helmholtz, Thomson, Clausius, Gibbs, Nerns) is the second revolution, founded by Carnot and continued by Mayer, Joule, Helmholtz, Thomson, Clausius, Gibbs and other scientists. Nerns. This revolution was the driving force of industrialization. "The electromagnetic revolution (Maxwell, Faraday, Coulomb, Ampere, Oersted,..) started with William Gilbert in the 1600s and Charles Francois Du Fay, Benjamin Franklin, CA de Coulomb, A. Volta, L. Galvani, HC Oersted, Jean Baptiste Biot , F. Savart, AM Ampere and Faraday, based on the work of many physicists and mainly synthesized by Maxwell, the electromagnetic theory constitutes the third great revolution. The most important aspect of this revolution is that it shows that all interactions are through a field and that light is an electromagnetic wave. This revolution gave people greater technological power than people could ever imagine.

The statistical mechanics revolution (Boltzmann, Maxwell, Clausius, Gibbs) was the fourth revolution, and the works of Clausius, Maxwell, Boltzmann and Gibbs opened the door to atomic and molecular physics and provided a better understanding of gas dynamics. The fifth and sixth revolutions left their mark on the century as the most important scientific revolutions of the beginning of the 20th century. These are the special and general relativity theories developed by A. Einstein and the quantum theory, which is the work of a group of famous physicists. These are real revolutions in science, because one of them solved the internal contradictions of classical physics and very high-speed movements of particles on the order of the speed of light, and the other completely solved all the problems associated with atoms. It has been discussed for 2400 years. At the same time, these revolutions not only made it possible to look at nature with new eyes, but also brought new theories and principles. New research methods and philosophical views played an important role in the realization of these revolutions. These revolutions also gave rise to new technologies. Under their influence, all fields of science, in particular social, science and engineering, philosophy and logic, have made great progress. This section examines research methods and philosophical ideas that play an active role in the development of physics and physical sciences in general. The relationship between philosophy, science and physics. The classical period of philosophy begins at the end of the 16th century. According to the famous philosopher and mathematician Descartes (1566-1650), who left his mark in this period, philosophy is like a tree whose root is metaphysics, its stem is physics, and its branches are medicine, mechanics, and ethics.

Descartes argues that ethics is the highest science because it requires knowledge of other knowledge. He considers philosophy to be the most perfect expression of metaphysics and physics, says that "God determines all physical foundations", and in his opinion, knowledge of God is a necessary

condition for all other knowledge. Descartes, who was methodical and said, "I think, therefore I am" and preferred mathematics because of the precision and clarity of his proofs, wants to restore metaphysics and prove the clarity of the reasoning "God exists." arguments 2+2=4. Leibniz (1646-1716) is the author of many misconceptions. Contrary to Descartes's principle of clarity, which he saw as his source, he proposed the principle of causality and called it " nothing" expressed negatively. exists without a cause" and positive such as "everything has a cause". He dreamed of a general science and a universal nature.

Inseparable parts of philosophy and science; Methods and philosophy of classical physical sciences: Methods of classical physical sciences; It is mainly derived from "practice" as well as philosophical views. Some philosophical views are very general, and some are related to nature. The philosophies and methods of the physical sciences do not offer a single solution from the outset, but instead offer diverse and often contradictory but increasingly complementary forms. For a long time, a priori and theoretical attitudes prevailed over empirical knowledge. In Ancient Greece and the Middle Ages, when Aristotle's views prevailed, physics was thought to be sufficient to have a few directly perceptible data in order to be unified into a metaphysically inspired system. This theoretical dominance can be seen in Descartes at the beginning of the 17th century, as well as in G. Galileo, who is considered one of the first founders of experimental physics. But these physicists developed a new understanding of physics based on mathematics that contradicted Aristotle's qualitative physics. On the other hand, during the same period, the experimental physics movement started by the English scientist Francis Bacon (1561-1626). Bacon gave knowledge a practical purpose. It is necessary not only to know nature, but also to influence it. His distrust of reason (reasoning) suggested the use of experience and observation of phenomena as the criterion of truth, and the method of induction as a method of elimination. Because behind various "idols" (wrong ideas, idols) were hidden facts, they had to be hidden.

Philosophy and methods of reception in modern physics:

In this section, I will try to detail how a scientist works and what strategies he should use to try to better understand the laws of nature using the methods and philosophy of physical science. How does a scientist work to better understand the laws of nature? To answer this question, it is enough to focus on what methods of work they followed in the past to bring the science to its current level. We can learn a lot from the working methods of these great scientists. We can use their experience. Because there are many common points between the problems that interested scientists in the past and the problems that we are trying to solve today.

The methods used by theoretical scientists working in physics can be divided into two:

1st experimental method,

2-Mathematical method,

Theoretical scientists using the experimental method use experimental data in their research. That is why they are in constant contact with experimenters and constantly monitor the obtained results. They are drawn to comprehensive analysis and satisfactory evaluation of the results they are interested in. A scientist who conducts theoretical work using mathematics first examines and criticizes existing theories. He tries to reveal his flaws and shortcomings. It tries to expand the scope of theories by clearing them of their shortcomings or examines the possibilities of development. The important point here is that care must be taken to correct the theory without destroying its great achievements. It is difficult for scientists to clearly distinguish between these theories. two available methods. While there are those who use these

methods separately, there are those who use both and benefit from these methods in their work. In other words, it is possible to make a ranking of other methods between these two methods. The method adopted is closely related to the subject being studied. In a subject about which little is known, it is appropriate to use an empirical method to find a way out. The first thing anyone who wants to work on a new topic should do is to collect and classify all the data published by experimental physicists on the topic. For example, consider how our knowledge of the periodic table in chemistry has evolved over the past century. First, the experimental data were collected and organized. As the system was gradually installed, confidence in it grew more and more. Finally, when the periodic table was more or less complete, the gaps between them were used to discover other elements that were previously unknown. All the elements whose existence was predicted in this way were later found in nature one after another. Recently , a similar situation was encountered in high energy physics. A periodic table-like systematics of all observed elementary particles was constructed. All the properties that a particle should have in the spaces between them were predicted and then checked to see if they exist in nature. Over time, it became possible to observe many of them in laboratory conditions.

A scientist working in a little-known field of science should pay attention to the results of experimental studies, if he does not want to speculate too much, even if it can be wrong. But that doesn't mean there shouldn't be any speculation. Sometimes, even if the result of speculation on a topic is wrong, it can be indirectly useful and interesting. Such views are considered extreme ideas among scientists. In fact, we should keep our minds open to new and interesting ideas. In conclusion, we shouldn't be totally against speculation, but we shouldn't overemphasize it either. Another area of research that has a lot of speculation is cosmology. Although there are too few facts to go on, theorists have tried to build various models for the universe based on some assumptions. One of the main elements on which these models are based is that the laws of nature have always been the same since the beginning of the universe. This is a guess, we have no evidence. Therefore, these models may be wrong. How do we know that the laws of nature, especially the fundamental constants of nature, do not change over cosmological time? The idea that such a change could happen is undoubtedly very disturbing to modelers.

Strategies adopted in the study of physical sciences:

A basic scientist must have a certain strategy in studying a physical system. However, this can vary from subject to subject and from scientist to scientist. If we look at the works of scientists who made great discoveries and made great contributions to the basic sciences in the past, we can summarize the main research strategies they adopted and which we generally use as a guide today:

1. Theoretical scientists should pay serious attention to the results of experimental studies. They should be closely interested not only in one group of experiments on the subject they are studying, but also in the development of all other experiments. Only then will it be possible to develop theories that are consistent, more comprehensive, consistent with experimental data, and even make new predictions. A really good theory developed in this way can offer new and interesting experiments to confirm its predictions. Theorists should pay close attention to the results of experimental studies.

2. A scientist may be somewhat skeptical of the work of others, but should be completely disinterested in research in the same field.

3. Scientists should be open to new ideas. Conservatism in science is not a good thing. This prevents the progress of science.

4. When analyzing a system in physics, we can always use the properties of simple systems. When

investigating a system, the researcher wants to consider each factor that affects its behavior separately. Each of these factors is related to the actual system in some way. However, only a few of them have a vital impact on the behavior of the system. More simply, the properties of these systems must be investigated using the properties of ordinary systems before they are fully understood. We can say that this is a way of studying the model of a physical system.

Summary: All these characteristic features of strategies and research methods used in the study of physical systems are among the most powerful inventions of the human mind. Its fruits have completely changed the way of life, thinking, habits, philosophy, perception of the world and views of science. For a long time, the use of methods and strategies of physical sciences has spread to all fields of science. Indeed. , some fields such as psychology, economics, and sociology are described as "scientific" because they use a scientific strategy to some extent. Despite everything, the strategy is most successfully used in physics. This is particularly appropriate because it is the relatively simple systems that physics is really interested in. In conclusion, we can say that physics is the simplest science because it deals with the simplest systems. Therefore, physics forms the basis of all other natural and engineering sciences. Physics teaches us what we know about the world and the universe, how people know what they know today, and how they move toward new discoveries. Thanks to physics, we have the power to deal with it, understand it and predict it. We make new discoveries with what we have learned in physics. Every new invention means the birth of new technologies. It gives people the pleasure of studying and understanding nature from a physical point of view. Teaches laws of natural phenomena. It empowers people to understand the world they live in. Because in today's world, physics lies behind the important innovations, the tools that create new jobs, and the everyday problems that people face. That is why today physics is not only a field of interest for physicists, but also a field of science that interests everyone with its subjects. Briefly, we can say that physics is a systematic study of the main properties of the universe. Each of these fundamental properties is closely related to the behavior of matter in the universe and the fundamental interactions between them. Physics is the greatest work created by the human mind, developed by reason, observation, experience, scientific skepticism and theory-based scientific methods, free thought and concepts. Without a doubt, we can say that "the queen of science is the science of physics", "the queen of the science of physics is physics."

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