

Tendencies and Prospects for the Application of Natural Science Methodology in Social and Humanitarian Knowledge

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Abstract—The laws of the intensity of the application of natural science and mathematical methods in social and humanitarian knowledge are observed, depending on the specifics of the philosophical foundations of the latter, in particular, the doctrine of human being. The possibility of applying these methods within the framework of humanitarian knowledge is explained due to the presence of a unity of the qualitative diversity of social and humanitarian objects, despite the indisputable differences of individuals participating in social relations. It is noted that the possibility of applying scientific and mathematical methods in social and humanitarian knowledge is one of the sources for the appearance of such a new direction in the development of modern science as the interdisciplinary approaches and theories. The ecophilosophical approach is given as an example of modern knowledge, which combines the achievements of natural science knowledge and the initial philosophical humanitarian principles of consistency, integrity and personalism. The article considers the possibility of applying mathematical methods in historical cognition based on the postulate of objectivity and the regularity of the historical process.

Keywords—*scientific method; mathematical method; humanitarian knowledge; historical science; theory of science; ecophilosophy*

I. INTRODUCTION

It has been asserted for a long time that the use of natural science and mathematical methods in the human science is impossible, due to the specific nature of the object of humanitarian knowledge, namely, the man. Up to the XIX century, the existence of laws that could be described using mathematical language was practically denied in humanitarian knowledge, and the very concept of humanitarian science was not introduced into scientific locution. The humanism and anthropocentrism of the

Renaissance, a period that most modern specialists consider in the field of the history of science as a time in which scientific knowledge itself has not yet taken shape, was at the stage of “protoscience”, was replaced by an interest in natural science, technology, and subsequently the economy, inherent in the era of the Modern Age. At the same time, there was no place for a person as an individual or as a unique person among the subjects of scientists’ interest of that period. The philosophical paradigm of the Modern Age includes primarily the epistemological aspect of the study of a man.

In the Age of Enlightenment, a man comes to the fore as a rational subject, an indispensable attribute of which is mind. The role and importance of the mind in the life of both the individual and society is absolutized, a man for philosophers is primarily a rationally thinking subject. However, the natural science, the realm of objective laws remains the sphere of application of mathematics; and everything connected with man is attributed solely to the world of the subjective, and therefore, in principle, not amenable to mathematical analysis. Therefore, the human sciences that existed at that time are descriptive, speculative. The principle of tabula rasa (“clean board”) as an expression for the epistemological thesis about the congenital mental emptiness of a newborn person, is used in ancient Greece and finds itself in Aristotle’s work “On the Soul”. Directly in science, in particular, in pedagogy, this principle was formulated by John Locke, who proceeded from the primacy of the student’s consciousness, and the theory of innate ideas was criticized.

The ideas of the French philosopher Auguste Comte [1], who, primarily, set the task to systematize social processes, to find the common between what seemed to be different social events and facts and based on this, be able to conduct a comparative analysis, use a different methodology of the

special sciences in order to discover social regularities, the possibility of a scientific explanation and prediction of changes in social phenomena become a new milestone in the formation of ideas about the use of mathematics in humanitarian knowledge. As a result, a new social and humanitarian science — sociology appears.

II. PRECONDITIONS OF APPLICATION SCIENTIFIC METHODS IN THE HUMAN SCIENCES

In contrast to the concepts of ordinary language, mathematical concepts are a generalization of the objects of study from their quantitative characteristics, in which a careful study of these objects at a qualitative level leads to the selection of such a general content, which is subsequently investigated by mathematical methods [2]. It is also noteworthy, that the detected and recorded qualitative characteristics for identifying or distinguishing objects and objects of study with the necessity of that time and within the framework of established traditions led to the formalization of the signs themselves and their further mathematical (digital) numbering. Both formal mathematical methods and formal quantitative models, distracting directly from the content of reality, operate not with random, insignificant quantitative characteristics of objects, but with those repetitive quantitative characteristics that are significant for these objects and which changing leads to change, ultimately, of the qualitative content of the system, the elements of which these objects are.

Thus, the unity of the qualitative diversity of objects is one of the important prerequisites for the mathematization of scientific knowledge, and this fact largely explains the situation in science until the twentieth century, when the question of the mathematization of humanitarian knowledge was not posed in principle. Unlike natural elements, people, as elements of reality and elements of society, are not identical to each other, the consciousness of each person is unique, unique and special is its spiritual, intellectual world, as well as the genetic set of abilities. As a result, it is often said about the possibility of studying the trend of uniformity between people, recognizing the presence of a special methodology of humanitarian knowledge, aimed primarily at understanding and not at explaining the object. In the social sciences, despite the fact that individuals differ as personalities, the diversity of social situations, the hypothesis of similar images of the social behavior of participants in social relations is adopted, on the basis of which mathematical and statistical methods are actively used in sociology and economic sciences [3]. Statistical methods are actively used in management science, as well as the construction of mathematical models, game theory, combinatorial tasks.

During the twentieth century, new trends in the development of science emerged and settled: right up to the present, the dialectic process of the unity of differentiation and integration of scientific knowledge is going on [4]. The process of introducing scientific and mathematical methods into the human sciences itself reflects the fundamental connection between seemingly completely different disciplines and the complete failure of the strict

differentiation of the latter at the present stage of development of the scientific views system [5].

The urgency of the problem of possibility, its translation into a status of obligation and an understanding of the prospects for using the methods of the natural and mathematical sciences in humanitarian knowledge is determined by the modern state of development of holistic scientific knowledge as such. It is obvious that the development of interdisciplinary research, so demanded in the modern world, naturally leads to increased mutual influence and, as a result, to interpenetration and effective interaction of the natural and human sciences [6]. And this means that, on the one hand, there is a humanization of natural scientific knowledge, on the other hand, the productivity of the application of natural science methodology in humanitarian knowledge is revealed and increased.

The successful use of the radiocarbon method in such sciences as history and archeology may be cited as an example [7]. The radiocarbon method is based on several hypotheses: the concentration of radiocarbon in the atmosphere is constant and does not change throughout history; the share of radiocarbon in all living things is the same as in the atmosphere, regardless of their location; physicochemical conditions, such as temperature or humidity, do not affect the decay of radiocarbon; The examined samples are not contaminated; therefore, the ratio of carbon-14 to carbon-12 does not depend on external factors. These hypotheses were often criticized during the first use of this method when large errors occurred, mainly because the measurement methods were imperfect. In the early 80s of the XX century, mass spectroscopy techniques allowed to obtain accurate measurements with minimal error. The results obtained by this way are often verified using dendrochronology, the science of determining dates using the study of tree rings.

III. ECO-PHILOSOPHICAL APPROACH AS A SYNTHESIS OF NATURALLY SCIENTIFIC AND HUMANITARIAN COMPONENTS

In our opinion, the eco-philosophical approach, founded by A.Naess, a Norwegian philosopher who formulated the ecophilosophical principles in his speech in Bucharest at the 3rd World Future Research Conference, which took place in September 1972, can be considered as a modern philosophical approach, harmoniously combining the achievements of natural science knowledge and the initial philosophical principles of consistency, integrity and personalism, on the basis of which the use of natural scientific methods in humanitarian knowledge is promising. Under the term “ecophilosophy” Ness understood the philosophy of ecological harmony, or equilibrium, which treats classical ecological problems from the point of view of the systems approach, from the standpoint of the same value of nature and man in the surrounding world, with the requirement to combine the means of ecology and social philosophy to achieve this harmony [8]. He formulates the concept of a deep ecologist, which, unlike conventional ecology, focused on combating individual environmental pollution problems, elevates environmental protection

activities to a general cultural philosophical level without detracting from the meaning of natural science. According to Nass, the fight against environmental pollution and resource depletion should not be separated from the overall holistic system of the world, and should take into account the possible negative consequences of certain actions, such as an increase in the price of good living conditions and a deepening stratification of society.

The holistic approach to the problem of the man and nature interaction, proposed by Nass, transformed into a broader and more comprehensive approach in course of time that posed the question of the interaction between a man and the world as a whole, in the unity of its biological, social and spiritual factors [9]. An analysis of the universal relationship "a man - the world" based on the ecological-cultural imperative is carried out in modern ecophilosophy, and thus the ecophilosophical approach, stating the important place of human origin in the world, necessarily includes self-determination and self-identification of a modern man [10, 11].

The ecophilosophical approach makes it possible to identify the main reference points of mutual influence of humanitarian and natural science methodology and to determine the scope of scientific synthesis, application of natural science methods and research methods new to humanitarian knowledge, as well as the tools tested in natural sciences, since the subject of ecophilosophy is "the study of the universal forms of the human world in its organic relationships with the cosmos, nature, culture, and society [12]. On the basis of the anthropic principle, which asserts the incompleteness of the picture of the world outside of human parameters, ecophilosophy restores the idea of man as a microcosm, a part of the world as a totality" [13].

IV. THE APPLICATION OF MATHEMATICAL METHODS IN HISTORICAL SCIENCE

Nowadays, the application of mathematical methods in the development of the theory of the humanitarian sciences is becoming increasingly popular. The iterative process of introducing mathematical methods into the human sciences itself is a reflection of some fundamental connection between seemingly different at first glance disciplines and complete failure of the strict differentiation of the latter at the modern stage of development of the scientific views system [14]. An inevitable reality is an interdisciplinary environment, generating new knowledge that goes beyond the old conservative theories. This leads to further expansion and complication of the world in all its diversity (in all its "dimensions").

Moreover, the noted pattern of interpenetration of various branches of scientific knowledge is observed from the lowest level, the foundation of these disciplines as such [15]. So, speaking of the mathematization of humanitarian knowledge and the promotion of the development of mathematics by the human sciences, one should not forget about the inevitable oncoming process of rethinking of the natural and mathematical sciences in the framework of humanitarian sections, causing a powerful synergistic effect due to the

exchange of ideas between such different sciences, which are able to describe the real world with all its laws (mostly natural) and problems (mainly socio-economic) as fully as possible.

The problem of using mathematical methods in humanitarian knowledge occupies an important place in scientific research, starting from the second half of the twentieth century [16]. It would be likely to reveal this thesis by the example of history, the very science, which representatives quite recently accepted the postulate on the objectivity and regularity of the historical process [17].

Russian scientists play a prominent role here. Since the early sixties of the twentieth century, they have raised the question of the possibility of using quantitative methods in their research. The results of their work were such works and collections as "Mathematical methods in Historical Research" M., 1972, "Mathematical methods in research on social and economic history" M., 1975, "Mathematical methods in historical-economic and historical-cultural studies "M., 1977," Mathematical methods in socio-economic and archaeological research "M., 1981, and many others. The championship in these studies belongs to the scientific school of Academician of the Academy of Sciences of the USSR I.D. Kovalchenko.

According to I.D. Kovalchenko, in the process of mathematization of historical knowledge it is necessary to distinguish the actual mathematical methods and quantitative methods. From the point of view of formal logic, such a classification is not quite correct, since, strictly speaking, the concept of "quantitative methods" is in relation of dependency to the concept of "mathematical methods", therefore it is necessary to answer the question of how I.D. Kovalchenko determines the content of these concepts.

The quantitative methods, as is determined by the academician, are the analysis of processes and phenomena based on a system of quantitative indicators that reveal the main characteristics of these objects of analysis, and the application of these methods uses a mathematical apparatus. On the other hand, the mathematical methods make it possible to achieve a new level of development of historical research, since they are used to build mathematical models of processes and phenomena based on a quantitative data system [18].

I.D. Kovalchenko pays special attention to the fact that with all the possibilities that a quantitative method provides to a historian, these methods cannot be absolutized, the importance of qualitatively meaningful methods cannot be underestimated. Disclosing the inner essence of the studied processes and phenomena, meaningful analysis with necessity plays a leading role in historical science, in its turn, disclosing the essence, content of a phenomenon or process is unthinkable without describing them and taking their quantitative characteristics into account. Thus, the qualitative and quantitative types of history analysis in combination with descriptive methods complement and enrich each other. Defining the specifics of using quantitative methods in historical science, I. D. Kovalchenko notes that "quantitative analysis allows to establish the absolute and relative measure

of the features and properties of considered objects and phenomena and to reveal the intensity of their demonstration”, which is impossible while using in historical research only descriptive methods [19].

Studying the question of the application of mathematical methods in history, I. D. Kovalchenko draws the following conclusions. First, the application of these methods is necessary to identify the quantitative measure and the boundaries of the objects characteristics under study when conducting their classification and the classification of their constituent elements, for example, certain layers, groups. Secondly, the formalization of the results of historical knowledge is an integral part of the development of already existing historical theories and the creation of new ones. Thus, the dynamics of the historical development of an object, upon condition of sufficient information, can be expressed in a mathematically defined functional relationship. Thirdly, the use of quantitative and mathematical methods is mandatory in the construction of multidimensional typological classifications, without which modern historical science is inconceivable. Finally, quantitative and mathematical methods are effective in checking the truth of information sources, as well as in the processing of this information, which are both quantitative and descriptive; in the formation of a representative system of facts, when the means of mathematical statistics are used to determine a representative sample, etc.

V. CONCLUSION

It is necessary to distinguish clearly the use of natural science and mathematical methods in the social sciences and humanities to solve their own problems, develop their theoretical foundations, and use the methods of mathematics to solve applied problems. Thus, the statement that jurisprudence used mathematics in full from the very beginning, according to the level of development of mathematical knowledge, for example, a fraction to distribute the inheritance, or the area of figures to resolve land disputes, refers to the second case. The distribution of inheritance or division of land by area is not a development of jurisprudence as a science, but is the subject that serves as the application of jurisprudential knowledge.

The application of natural science and mathematical methods in the social and human sciences provides new opportunities not only for introducing diversity into the established system of methodology of humanitarian knowledge, but first and foremost, it provides an opportunity to explore new aspects of social and humanitarian objects and get new information about them, which, in principle, could not be obtained using traditional established methods. It is also important that the application of natural science and mathematical methods necessarily requires a deeper approach to the object of social and humanitarian knowledge, for example, the hermeneutic individualized approach, which does not lose its value, develops the principle of detecting unity in the qualitative diversity of social and humanitarian objects [20].

However, it is important to bear in mind that, despite the presence of positive results in the present process with thegnoseological prerequisites of a variety of philosophical foundations that coexist on equal terms in the conditions of modern postmodern society, there is a threat of an unsafe bank towards reductionism and the physicalization of the humanitarian sphere, human and natural sciences knowledge as an integral part of the world-historical process of the epistemological ascent of humanity.

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