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THE HISTORY OF THE DEVELOPMENT OF SCIENTIFIC POPULARIZATION THROUGH THE PRISM OF THOMAS KUHN'S STRUCTURE OF SCIENTIFIC REVOLUTIONS

The scientific article considers the problem of formation of approaches to popularisation of science as part of the general scientific process. Accordingly, the features of conducting science popularization activities, compared with the traditional sphere of scientific activity itself, are investigated. It was determined that, unlike the universal approaches of traditional sciences, science popularization activities depend on socio-political and economic conditions not only in time, but also in space, that is, on the prevalent social realities in different countries. The process of developing science popularization was divided according to the structure of Thomas Kuhn's scientific revolutions. It was established that the initiative for popularizing science passed from professional scientists to journalists and educators, who acted as intermediaries, and, ultimately, to a wide range of Internet users, which include all previous categories and people completely unrelated to them. This makes the current paradigm diversified and decentralized. It was also found that the change of paradigms in the field of science popularization is interdependent on technological development and on the principles of organisation of social institutions. Ultimately, it was determined that today the popularization of science is in a crisis state of transition to a new paradigm.

Keywords: paradigm, popularization of science, scientists, journalists.

Introduction. The dissemination of information about current scientific discoveries, as well as about the general principles of the functioning of objective reality among the broad strata of society is an independent specific type of activity. At the same time, it is directly related to the scientific process of acquiring knowledge. The role of popularization of science for society and the scientific community and its place in the general structure of the process of studying the laws of the universe in various forms of their expression is a controversial issue, because it touches on the issues of preserving the reliability of scientific information, methods of disseminating this kind of data, the activities of individual specialists in popular science activities, their training and involvement in the broader scientific process, which as of today is still quite closed to the general public

Formulation of the problem. Popularization of science is an important part of the process of scientific progress, as it provides public support for scientific research, the interest of potential scientists in joining these efforts, as well as the introduction of scientific achievements into everyday life. Effective implementation of measures to popularize science should ensure the sustainability and effectiveness of the

system for forming a scientific worldview in society. As the goal of this system and of the corresponding worldview we should consider the ability of the people to make rational decisions in various areas of daily activity and, as a result, the harmonious functioning of society as a whole.

Relevance. In order to formulate the most effective approaches to the dissemination of scientific information and interest in science among society, it is necessary to understand the current state of this activity. This is possible only by tracing the process of its formation. Given that the popularization of science is dependent on social circumstances, it is advisable to perceive its development not so much as a linear, but, rather a revolutionary, cyclical process. Based on this, it is relevant to analyze the popularization of science through the prism of Thomas Kuhn's structure of scientific revolutions. This makes the study of the most appropriate methods of popularizing science an extremely important and relevant task.

The purpose of the article is to analyze the history of the development of science popularization through the prism of Thomas Kuhn's structure of scientific revolutions in order to form an understanding of the actual state of popular science media ecosystems.

To achieve this goal, it is necessary to perform the following tasks:

- to determine the features of science popularization activities compared to the traditional scientific process,
- to investigate the historical process of the development of science popularization,
- to investigate the structure of the formation of the current state of science popularization using the methodology of Thomas Kuhn.

The methodology of researching the chosen topic involves the use of socio-communication and axiological approaches. Among the main methods used in the process of conducting this scientific research were analysis, synthesis and generalization.

Analysis of recent research and publications. The question of the actual state and process of development of science popularization interests a number of scientists both in Ukraine and in the world. Thus, L. Massarani and I. Moreira study science popularization in a historical perspective, focusing on the key dilemmas that accompany this activity in the process of its constant reformatting [1]. P. Panayotova considers the diffusion model of science popularization, wishing to more accurately determine the role of science popularizers and trace the historical continuity and the very origins of scientific popularization activities [2]. The history of science popularization is also studied by J. R. Topham [3].

The most relevant method of science popularization today is the use of social media capabilities, and it is this problem that is being studied by N. Vrabec and L. Pieš [6] on the example of Slovakia, whose experience may be of interest to the Ukrainian audience. The role of social media as a tool for popularizing science is being studied by O. Zhyvaga, O. Vovchenko, and N. Petrenko [9]. In more detail, trends and features of popularization of science in Ukraine are being studied by M. Butyrina and M. Ivanytska. [7;8]. The interaction between higher education and science popularization as two interconnected but at the same time distinct types of activity is being studied by J. Geng and J. Yan [10].

Results. Popularization of science and the worldview formed by scientific approaches is a specific separate sphere of human activity, different from traditional science itself. To a large extent, it is more of a practical activity than a set of universal facts and principles that explain objective reality (as traditional sciences can be characterized). The point is that popularization of science, although it is the subject of study in the field of social communications and media studies, is still directly related to social reality in all its multiples of expression. According to that, views of the process of popularization of science as a unique phenomenon may differ depending on the social norms of each specific society. Given such a vastness of the issue, it is advisable and even necessary to define clear boundaries of the object that we are investigating in this article.

Thus, in this work we will primarily consider the popularization of science in the media at different stages of its development, depending on the prevailing socio-economic circumstances. The direct implementation of scientific activity may be associated with the popularization of science, but does not necessarily accompany it. That is, the publication of the results of scientific research in professional, highly

specialized magazines will not be considered their popularization. We also do not consider in detail the process of providing education, whether in state, private, or other types of public institutions. We do not examine the activities of various types of scientific exhibitions, festivals, and museums. We will focus our attention on the accessible presentation of scientific information for wide audiences in the media, in those forms that function through the use of communication technologies that prevail at a particular point in time (i.e., we consider both newspapers, radio and television, and blogs, depending on the moment in history when certain form of information transmission technology was/is the most widespread).

By popularization of science we mean the dissemination of information and facts, which were obtained using the scientific method, among the general public in order to encourage people to support and participate in scientific activity, as well as to conduct further independent research on specific popularized issues or other areas of activity using scientific approaches. Thus, we consider the primary task of popularization of science to be to encourage people who are not involved in a particular field of science (or in science in general) to become interested in it and study it independently.

Since in this article we analyze the process of development of popularization of science according to Thomas Kuhn's structure of scientific revolutions, let us proceed to consider the basic principles of this approach. According to Kuhn, scientific progress does not occur in a purely linear way of cumulative accumulation of knowledge, but takes the form of a periodic competition between paradigms. By paradigm, Kuhn understands a set of generally accepted principles, theories and methods on which scientists rely in carrying out their activities and within which they operate with facts. It is important that, according to Kuhn, several paradigms cannot coexist at the same time. This idea is logical given that traditional sciences (primarily natural sciences) explore fundamental principles of functioning of the universe at different levels. Therefore, approaches to their understanding should also be accordingly universally accepted.

Popularization of science, on the other hand, is somewhat different in this regard, because it, as a part of journalistic activity, depends on the socio-political system that exists in a society or state. Thus, the approaches to journalism in liberal democratic states and in authoritarian regimes are radically different. In societies that have built an effective legal system that protects human rights and freedom of speech, journalists usually act on their own initiative. In such a system they focus on the needs of consumers of information, while being in competition with other journalists or media organizations. In contrast, in authoritarian or totalitarian systems, the media function rather as channels of information for the masses, that is, a tool for conveying to the general public the information, norms and values that authorities or even individuals holding high positions wish to disseminate. The approach to popularization of science also depends on such conditions. In democratic societies where the circulation of information is free of censorship, popularization of science can be a private initiative and even have the goal of achieving a certain commercial success in competition with competitors. In contrast, authoritarian and totalitarian systems represent only one clearly defined point of view on various issues, including scientific ones.

A great example here is the strict state control and even the ban on certain biological sciences (such as genetics) in the USSR at certain stages of the development of this totalitarian state [12]. In liberal societies, such restrictions could not exist. Thus, we see that, according to the definition of the paradigm in the structure of scientific revolutions by Thomas Kuhn, approaches to the popularization of science in different socio-political systems also cannot be combined. That is, we see the presence of different mutually exclusive paradigms of the popularization of science in different states, but within the same state these different paradigms cannot exist at the same time.

Having established the specifics of popularization of science, let us proceed to a direct consideration of the stages of its development according to the structure of scientific revolutions. To do this, we will simultaneously trace the process of formation of modern science and journalism, at the intersection of which popularization of science exists. According to Thomas Kuhn, the first stage of scientific development is the so-called stage of normal science, during which scientists work within the framework of an established paradigm. We can assume that the first such paradigm in popularization of science arose during the formation of modern science in the 17th–18th centuries. At a time when science was not yet institutionalized, it was

rather based on the individual initiative of early scientists who needed public recognition of their activities in order to ensure the existence of science in the format that they proposed and represented [1]. Accordingly, they were the primary popularizers of scientific information. Under this paradigm, scientific popularization was carried out almost exclusively by scientists themselves, and the public was considered an important part of the legitimization of science as a social activity. At the same stage of historical development in the 18th–19th centuries, journalism in its modern sense began to emerge as a commercial activity for the dissemination of information among the broad masses of the population. These two processes: the development of science and journalism, were interconnected due to complex social and economic changes caused, not least, by the industrial revolution (which is certainly difficult to imagine without the scientific revolution) [11].

The more science began to bear practical results for societies and states, the more institutionalized it became. Gradually, scientific activity transformed from the rather public work of individuals to the work of entire teams concentrated in scientific institutions, which were rather closed. Reporting information about the results of research under such conditions took place primarily within the scientific community itself. It was being made with the help of various kinds of scientific periodicals written in a specific scientific style, to understand which you require some prior training. Accordingly, the direct connection between the scientist and the community was lost in most cases. Thus, it can be argued that the anomalies of Kuhn's structure accumulated, related to the fact that science was developing, but the direct involvement of the community in it was becoming less significant. Ultimately, the role of the scientist as a popularizer of science ceased to be a characteristic function of most figures in the scientific sphere, which can be interpreted as a crisis of this paradigm. Instead, among people not involved in scientific activity, knowledge was disseminated by specially trained professionals. In developed countries, where science was acquiring institutional forms, systems of general education were also being built, mandatory for all citizens, and journalism in its modern sense was also beginning to take shape. The new paradigm assumed that the popularization of science would be engaged not so much by scientists as by teachers and journalists (although both would refer to scientists). However, two clarifications should be made here. First, the situation varied in different countries. Second, education and popularization of science are related, but still different areas of activity. Given the topic of the study, we will focus on the second of them.

With the further development of communication technologies, the popularization of science took on new forms. Information about scientific innovations or interesting facts was first disseminated through printed newspapers, later on radio and television, and through books. The transition to each new technology can be considered as a separate cyclical process of crisis changes in the paradigm of how information was presented. It is obvious that a textual description of an experiment and its results in a printed publication is perceived by people in a fundamentally different way compared to its visual representation on television. The second option, of course, more easily captures the audience's attention and involves a completely different narrative structure.

Over time, special media outlets dedicated exclusively to science began to emerge. At the same time, the principles of popularizing science remained generally stable: the means of disseminating information, whether printing houses, radio stations, or television channels, were owned by large centralized players. Media representatives in this scenario acted (as can be understood from the definition of the word "media") as intermediaries between scientists and the audience.

New anomalies and, accordingly, crises have arisen with the introduction of the Internet. The fundamental difference here is that this technology allows virtually every user to independently produce, publish and distribute information content. Accordingly, the media have lost their monopoly on the dissemination of information, and at the same time, scientists have partially lost their monopoly on the production of data presented as scientific. The point is that a large number of publications have appeared on the Internet that present themselves as scientific, but are not based on scientific principles. An example would be information campaigns by people who oppose vaccination or even a community of people who claim that the Earth is flat. At the same time, scientists have also received the opportunity to independently publish

information in a way convenient for them. Of course, it cannot be said that journalists have been left out of this structure, because reporting information in an accessible way is a specific type of activity that requires certain training. Using their professional skills, journalists continue to do their work, simply using new technological capabilities.

But there is another key difference in this paradigm shift, namely interaction with the audience. Publishing materials on the Internet allows you to enter into a direct dialogue with readers, viewers or listeners. And this makes it possible to more deeply involve people in the discussed topic (in our case, science). Such a paradigm shift, of course, causes conflict. As in the situation when institutional science and media were formed, the formation of the online blogosphere requires new legislative regulation, the creation of which is accompanied by a large number of discussions. In addition, there is a certain rejection of the blogosphere as a phenomenon equal to journalism or as a part of journalism by some professional journalists. There are also disputes among scientists themselves as to whether the popularization of science should be considered part of the scientific process or whether it is something separate that scientists themselves should not engage in. The process of transition to a new paradigm has not yet been completed, so it can be argued that the popularization of science today is in the process of crisis changes. Again, we note that all these processes proceed differently in countries with different socio-political systems. For example, in the People's Republic of China there is strict censorship and state control over the dissemination of information, including scientific information, while in the countries of Northern Europe such a phenomenon is practically absent or minimized.

Conclusions. As a result of the study, an analysis of the development of popularization of science was carried out through the prism of Thomas Kuhn's structure of scientific revolutions. It was found that, unlike traditional natural sciences, the scientific popularization activity depends in its paradigms not only on the general processes of scientific progress, but also on the socio-economic conditions of the states in which it operates.

The first period of normal science in the sense of the existence of a single paradigm was the time of the formation of modern science in the 17th–18th centuries. At this time, the initiative for the popularization of science belonged to scientists themselves, who sought to demonstrate to the communities in which they lived the usefulness and importance of their field of activity. When they succeeded in this, science began to acquire more institutional forms, which gave rise to a number of anomalies. From an individual-oriented process, scientific research became a rather closed collective effort of scientific institutions, inaccessible to wide audiences. This caused a crisis and a transition to a new paradigm, in which the popularization of science was carried out by professional journalists and professional educators in cooperation with scientists. Scientific and technological progress led to changes in communication technologies, which led to new approaches to the popularization of science through printed periodicals, radio, television and books. In all these cases, the role of media intermediaries was of key importance.

Today we are in the process of transition to a new paradigm, which began with the spread of the Internet among the global community. It created a number of fundamentally new approaches to the popularization of science, namely: it allowed scientists to directly disseminate their information; it allowed people not related to science to do the same; it provided new ways for journalists to fulfill their professional duties, thus creating a highly competitive pluralistic environment. In addition, social networks allow for virtually instant direct interaction between the audience and scientists and science popularizers, which is also an expression of a new paradigm of decentralized science popularization.

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Дмитро Спорняк

ІСТОРІЯ РОЗВИТКУ ПОПУЛЯРИЗАЦІЇ НАУКИ ЧЕРЕЗ ПРИЗМУ СТРУКТУРИ НАУКОВИХ РЕВОЛЮЦІЙ ТОМАСА КУНА

Розглянуто проблему формування підходів до популяризації науки як частини наукового процесу. Відповідно до цього досліджено особливості провадження діяльності з популяризації науки, порівняно з традиційною сферою безпосередньо наукової діяльності. Визначено, що, на відміну від універсальних підходів традиційних наук, діяльність із популяризації науки залежить від соціально-політичних та економічних умов не лише у часі, а й в просторі, тобто від превалентних соціальних реальностей в різних державах. Здійснено розподіл процесу розвитку популяризації науки відповідно до структури наукових революцій Томаса Куна. Встановлено, що ініціатива щодо популяризації науки переходила від безпосередньо науковців до журналістів та освітян, які виступали як посередники і, зрештою, до широкого кола користувачів мережі "Інтернет", які включають у себе всі попередні категорії та людей, абсолютно не пов'язаних з ними, що робить нинішню парадигму диверсифікованою і децентралізованою. З'ясовано також, що зміна парадигм у сфері популяризації науки перебуває у взаємозалежності від технологічного розвитку та від принципів організації соціальних інституцій. Зрештою, визначено, що сьогодні популяризація науки перебуває в кризовому стані переходу до нової парадигми.

Ключові слова: парадигма, популяризація науки, науковці, журналісти.