Ministry of education and science of Ukraine
National University Odesa Polytechnic
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Philosophy and methodology of scientific research
(textbook for graduate students)

Odessa 2023

Prof. Afanasiev O.I., prof. Zharkykh V.Y., technical editor Panova K.I. Philosophy and methodology of scientific research (textbook for graduate students). – Odessa, 2023

Recommended for publication by the Academic Council of National University Odesa Polytechnic
(protocol №9 from April 26, 2023)

The textbook corresponds to the program of the course for graduate students of the ONPU. It presents philosophical-methodological problems of structure and dynamics of scientific researches, features of natural-scientific, technical and humanitarian knowledge, external and internal factors of evolution of science. The book is intended for graduate students of all specialties, can be used by students, masters, teachers and all who are interested in modern vision of science and its philosophical-methodological features.

Content

The introduction

The main provisions of the course "Philosophy and methodology of scientific research" are defined first of all by a sufficiently developed discipline - "philosophy of science", as well as other disciplines which study science in general and the process of scientific research, in particular. Among them it is possible to mention the methodology of science, psychology of science, sociology of science, history of science, scientific studies, etc. Since the science began to realize itself, the self-awareness of science has appeared, there has been a need in the named disciplines, the importance of which is constantly growing during the evolution of science. Therefore, this course is of particular importance for post-graduate students who somehow relate their activity to science, and soon become participants, organizers and leaders of various scientific projects.

The textbook considers both traditional problems of philosophy and methodology of science and modern topics, actively discussed in modern scientific and philosophical-methodological literature. They are paid a little more attention. In the presented topics the philosophical-methodological peculiarities of not only general scientific, natural-scientific or technical knowledge, but also humanitarian ones are considered. The fact is that humanitarian sciences are developing ahead of the pace. They are connected with great hopes for overcoming global problems in general, and in particular, effective humanitarian expertise, which is needed practically for all scientific and technical projects. Therefore, philosophical and methodological peculiarities of humanitarian disciplines have not so much special scientific significance for humanitarian subjects, but general scientific, which makes them useful representative of any specialty.

All scientific research suggests a certain combination of methods and mental procedures, some obvious and implicit preconditions, clear sequence of actions, various organizational structures, and many connections with social and cultural phenomena. In all components of scientific activity, especially in the pre-conditional knowledge necessarily present philosophical-methodological aspects, although often in the implicit form. The ability to make them sound and effectively use is a powerful reserve of scientific success. The philosophical and methodological knowledge also includes a significant intellectual and educational potential of mankind, attraction to which is a significant factor of scientific growth.

1. Subject of philosophy and methodology of science.

1.1.Balance of philosophy and science. Disciplines that study science.

Philosophy and science. Philosophy studies not only subjective and objective worlds, but also created by man phenomena. Among them is science. Philosophy was interested in science and when it was only some scientific knowledge, many of which were included in philosophy itself, and when science became an independent sphere of activity and divided into many independent sciences. Having divided on many independent fields of knowledge and activity, science has not ceased to be the only whole, and in this quality it is different from other ways of mastering the world by a person: From art, religion, philosophy. Philosophy is similar to them, and differs from them. For example, philosophy does not feel the image of the world and beauty as art, includes belief as religion, but also substantiates and proves its position as science, while having strict categorical apparatus, theoretical principles, methods and other signs of science. However, unlike science, philosophy does not use the experiment and has an indirect practical significance. Science, in turn, can also study religion, such as religious studies, art as art criticism, and also philosophy. There is no special term for this purpose. But since philosophy is represented in texts, they can be subject to study of different philological disciplines, for example, textology. Since some philosophical teaching was created in certain historical and cultural conditions, it can become a subject of study of history and cultural studies. But since philosophy has always assumed a high level of reflexia, it usually studies itself, using data of other sciences: history, cultural studies, linguistics, psychology, etc. When studying objects of external or internal world philosophy uses the achievements of other sciences: natural, social, humanitarian, technical.

When science began to realize itself as a special phenomenon, it became the subject of research of many disciplines. So there were philosophy of science, methodology of science, sociology of science, history of science, psychology of science, logic of science, science of science, scientometrics and other.

The sociology of science explores science as a social institute, its links with the structure of society, scientific groups as social groups, types of scientists and typology of their behavior, interaction of formal and informal communities of scientists, dynamics of their group and intragroup interactions. The sociology of science was in the 30s of the XX century, beginning with the work of the prominent American sociologist Robert Merton, and then his criticism Michael Malkei.

Science of science mainly studies the interaction of science with those social spheres, on which the effectiveness of science depends, and makes recommendations for the organization of state or sponsor scientific policy. Science of science took place in the 60-th years of the XX century, when the ideas about science of science studies were formed, and there were scientific teams working on relevant problems. Science of science used studies on history, sociology, economics, psychology, logic, philosophy of science, scientometrics, presents an integral picture of science in its internal and external relationships, because of which it is called complex discipline. It is mainly descriptive and does not reveal problems such as, for example, the sociology of science and does not produce a theory and models as philosophy of science. But you can still distinguish there the analytical direction – study of science as a social institute and a special form of activity, and normative – elaboration of recommendations on practical use: on enhancement of efficiency of scientific activity, principles of organization, planning and management of scientific research, on participation in various economic and technical programs, on improvement of processes of functioning of scientific knowledge, structure of scientific potential and so on.

Recently, the importance of **scientometrics.** This is the area of statistical study of science as an information array, streams of scientific information. Scientometrics began with the works of the British-American historian of science Derek Price and is the application of methods of mathematical statistics to analysis of stream of scientific publications, dispatch apparatus, growth of scientific personnel, financial expenses.

The history of science is a discipline that studies not only the history of scientific discoveries, the emergence of theories and circumstances that have influenced it, but also carries out the designing of some model, schemes, theory, especially those that interpret facts from the history of science with the purpose of creating a single picture, internal logic of science development. The main difficulty here is to contain contradictory facts within the framework of one concept without their distortion. One of the central problems is what should be guided in the selection of facts from the history of science: Is there enough philosophical-methodological position? It is connected with no less important problems: Can we rationally present the history of science? Is science purely rational? A lot of attention was paid to these problems by T. Kun, I. Lakatos, P. Feyerabend, S. Tulmin, for whom, in particular, historical models of science are models of philosophy and methodology of science.

It is impossible to specify the beginning and the first authors of the history of science, because in any scientific works necessarily mentioned predecessors even in those periods, which call a pre-science. One of the first more or less complete ideas about the history of science can be found in the Encyclopedia of Deni Didro. The construction of models of science development began with Thomas Kuna in the second half of the XX century.

Also distinguish **psychology of science** as study of psychological peculiarities of production of new knowledge, **logic of science** as search of regularities of scientific discovery, philosophy of science, as study of specific philosophical problems arising in science.

The philosophy of science arose in the XIX century as a direction in philosophy. It exists now, and includes various philosophical concepts, offered by prominent philosophers – experts of science, in which the original models of development of science and scientific knowledge are described.

At first philosophy of science was represented by philosophical directions: positivism, empriocriticism, neo-positivism, and since the middle of XX century, when the problem of philosophy of science began to include not only purely epistemological and methodological, but also sociocultural aspects of scientific and cognitive activity, this list of directions has been supplemented by neoceratsionalism, critical rationalism, the historical school of philosophy of science and so on. Many philosophical directions and schools included in their researches and philosophical-methodological problems of science (neokantianstvo, phenomenology, etc.). But starting since the second half of the XX century philosophy of science has become an independent discipline, having outlined the subject philosophical-methodological problems of science, although, it is clear, uses those achievements made in the framework of separate philosophical directions, as in the framework of theoretical science and disciplines studying science. If you sum up all those philosophical-methodological problems of science, which were discussed in the science itself and in different philosophical concepts, then you can reconstruct the image of philosophy of science as a system of philosophical-methodological knowledge, developing since XVII century. Although this is historically not entirely legitimate, but sometimes it makes sense, for example, to emphasize the importance of philosophical and methodological knowledge, the logic of its evolution, and so on.

Some authors bring together the philosophy of science or science of science, or to the sociology of science, or to the methodology of science. There are also attempts to present it as a harmful speculation on science (Paul Feyerabend). But more often philosophy of science is considered as a sphere of knowledge, which has an independent problem: It reveals preconditions of scientific thinking and activity, clarifes concepts and theories of science, determines specificity of scientific thinking, conditions of science, ideas and norms of science and so on. Unlike the methodology of science, which, however, is often considered in unity, the philosophy of science emphasizes the attention on the epistemological, philosophical-world, philosophical-methodological, rather than scientific-methodological and logical-methodological aspects of science.

In the course of the development of philosophy of science (and as philosophical doctrines, and as independent discipline), its problems changed somewhat. At the turn of XIX-XX centuries. the focus was: the task of building a complete scientific picture of the world, the correlation of structural characteristics of science, methods, theories, facts, the problem of demarcation (demarcation) of science and non-sciences, the difference of types of knowledge. Later, in the second third of the XX century the possibilities of empirical substantiation of science, theoretical loading of experience, methods of knowledge checks (verification, falsification) were investigated, models of explanation were built. Since 60 XX century the ideas of science, implicit knowledge, being introduced and studiedhistorical models of science, problem field is being expanded due to introduction of socio-cultural problems: How the methodological program and history of science are related, how the world-view and socio-cultural phenomena participate in scientific activity. At the turn of XX-XXI centuries. They are gaining special relevance problems of humanitarianization and humanization of science, changes of criteria of rationality, place and role of non-scientific knowledge, status and role of methods of humanitarian knowledge, in particular methods of germeneutics, places of narrativov, and also in linguistics structures in science, etc.

Modern research in the field of philosophy of science is under considerable influence of post-modern tendencies in culture and philosophy. As a result, within the disciplines studying science, especially in philosophy and methodology of science, attempts are made to understand the new situation, both in science and in philosophy and culture. In particular, they pay attention, on the one hand, to the "blurring" border between scientific disciplines, between science and non-science, professionalism and amateur, on antireductionism, increase of role and significance of interdisciplinary and transdisciplinary researches, on dependence of science on cultural influences or philosophical considerations, and on the other - on crisis of trust, to the rational tradition, to the science, on new priorities of antiscientism and so on.

Almost all of the problems became the subject of research in the discipline, which developed was already in XX century and also began to be called "Philosophy of science". It exists together with ontology, logic, methodology, epistemological, history philosophy, philosophy of man and others, and investigates various philosophical problems, which relate to science. Often in the philosophy of science as a discipline include those achievements made in models of philosophy of science of separate philosophies. For example, recognition of conventions as an important element of scientific research, and proposed this idea by Henry Poincare the founder of conventionalism. Criticism of the impersonal scientific knowledge came from the concept of personal knowledge of Michael Polani. The concept of paradigm has come into the philosophy of science on the concept of normal science Thomas Kuna.

The philosophy of science investigates scientific knowledge regardless of what scientific field it is received: in natural sciences, in social, humanitarian or technical sciences. If the philosoph of science studies the texts of physics, it does not solve physical problems. He is interested in the scientific search itself, its initial installations, the structure of scientific discovery, intrascientific and non-scientific, rational and non-rational factors that influenced it, dynamics, organization and structure of scientific knowledge, methods of research activity. Philosophy of science is reflection on science. For a clearer definition of the visible and problem field of science philosophy should be taken into account the specific philosophical problems of science as such problems that one science cannot solve.

The philosophy of science sometimes discuss the question: What is the main problem of science philosophy? This question is produced by the original position of the author, who offers this or that model of science. As the main problem is sometimes called the problem of transition from simple everyday statements to theoretical principles or the main problem of substantiation of these principles is considered. Although it seems that these approaches are similar, there are two different models of science philosophy. In the first case, philosophical-outlook and ontological ideas come to the fore, such as, for example, in Pylyp Frank or Alfred Whitehead and then will prevail generalization of scientific knowledge, construction of a single scientific picture of the world. In the second case, the philosophical-methodological and epistemological concepts will come to the fore and will prevail research of scientific procedures: Explanations, forecasts, falsification of theories, idealization, etc. This is how the concepts of outstanding philosophers of science were built: Karl Popper, Karl Gempel and others.

Methodology of science - discipline, which studies the regulations of scientific activity, first of all scientific methods and procedures. Unlike the method that proposes a description of specific actions and procedures, the methodology suggests the detection of the regularities of regulatory mental activity in the field of science. In general, the science methodology tends to be associated with the philosophy of science, often seen as part of it, and some of them seem to be extended and appear to be synonymous with science philosophy. Sometimes, however, it is assumed that the science methodology is engaged in its own problems: studies the concepts and methods of science, their sphere of application, substantiation of scientific results, regularities of development of scientific knowledge, analyzes stages of scientific research, language of science, research principles, scientific procedures and so on. For example, verification will be investigated within the framework of the methodology of science as a procedure of testing of scientific knowledge. When verification is considered as a criterion for the difference between scientific and non-scientific knowledge, that is, it is given general importance, it is investigated within the framework of philosophy of science.

Methodological problems in one or another degree touched already in the XVII century in the works of Francis Bacon and René Descartes. But as an independent discipline, the methodology of science consists of the second half of the XIX century, when the works of Augusta Conta form a new methodological ideal – a positive science, which carries out a true research knowledge, in contrast to theoretical speculative science. At present many methodological problems have independent scientific significance, both theoretical and applied. Subclasses of scientific and separate scientific methodological problems of science, which are relatively independent from philosophy, play a great role. In general terms, they talk about the general methodology of science. In a narrow sense, in relation to a specific scientific discipline speak about the methodology of physics, the methodology of mathematics and so on. However, the connection with philosophy is still felt. Since the substantiation of methodological considerations often requires philosophical considerations, and even the creation of special philosophical studies, as was the case in Bacon, Descartes or Cont, the literature on this discipline often give the united name – philosophy and methodology of science.

Scientism and anti-scientism in philosophy of science. Depending on the assessment of the status of science, the scientism and antiscientism orientation of philosophy of science differ. The Scientism version of science philosophy highly assesses the role of science, proves the unalternatives of scientific and technical progress, denies the shortcomings of science or justifies them. Solving all human problems and saving mankind from the modern civilization crisis rests on science. Scientism carries out demarcation of science and metaphysics, science and non-science, carries out reduction (construction) of qualitatively different theoretical structures to a single empirical basis, tries to purify science from philosophical and other non-scientific installations and inclusions. The Scientism philosophy of science is represented by names of all positivist oriented thinkers.

The Anti-scientism philosophy of science is represented mainly by anti-positivists, in particular Kurt Hubner, Theodore Roszak and others. Some post-positives, such as Paul Feyerabend, and many representatives of post-modern philosophy support this position. This position demands equality of science and non-scientific the way of vision of the world, criticizes the scientific rationalistic outlook, condemn science for the alleged source of dogmatism and totalitarianism that it is responsible for global problems and crisis of civilization.

It should be borne in mind that scientism and anti-scientism in philosophy of science are two extremes. In fact, both positions are partly correct. Indeed, science is responsible for the crisis of civilization. But, first of all, it is not only responsible for this, and secondly, to overcome the crisis, to solve global problems, threatening the very existence of mankind, can only be on the way of the development of science. Without science it is impossible.

1.2. Philosophical-methodological problems of science: outlook, ontological, epistemological, cognitive, axiologic, sociocultural, methodological.

The main problems of philosophy and methodology of science will be considered in detail in the relevant topics. Now it is necessary to show how they go to the general philosophical level. Among **various philosophical and methodological** problems of science one can distinguish such, which besides own methodological load carry other according to its name: outlook, ontological, epistemological, cognitive, axiologic, sociocultural. Actually, methodological problems, which are sometimes called scientific-methodological ones, can be divided into **general methodological** problems when the preconditions of scientific thinking and activity are investigated, the specificity of scientific thinking, conditions of scientific knowledge, ideas and norms of science and others are determined, and **separately methodological** ones, when scientific concepts and theories are explained, the nature of methods, conditions of their adequacy, and scientific procedures are explained. In case of all substantiation of the above mentioned names, it is necessary to bear in mind the relative condition of their clear separation, as in pure form they are almost not found. In any scientific research they are present in the complex, except that some can prevail. It is also important that they have a philosophical meaning and often meet not only in science, but also outside it. All of them are referred to methodological in that sense and when on them depends on the solution of specific methodological problems of science: choice of the initial position of the researcher, choice of method or theory, production of hypotheses, setting of goals, method of substantiation of scientific provisions and much more.

World-view problems of science are usually called those, depending on the answers to which the idea of the world, about a person, its place in the world and so on. Both questions and answers are formed in many respects by science, although they can be related to religion, art, philosophy, everyday experience. In turn, the attitude to science also depends on them. Among them, in particular, are the issue of the emergence and structure of the universe, the origin of life, the emergence of a person, its possibilities. They determine the attitude of the scientist to his activity, his position on the role of science, importance of scientific discoveries or inventions. If, for example, the scientist represents a person with the highest achievement of evolution, the center of the universe, the owner of the world, which is all allowed, and science is represented by the highest degree of intellect, the role of science is seen in constant transformation of the world, society, the person itself, and any scientific achievement should be realized in practice as a certificate of endless progress. If a person is only part of the world, and perhaps not the best, and science is one of the ways of mastering the world, and perhaps not the best, then the attitude to scientific results and their embodiment will be at least more careful.

World-view problems come together with **ontological problems.** Among ontological problems there are ideas about the system, structure of the world. They are a world-view-ontological background of scientific reasoning, and often a direct methodological precondition. For example, the idea of whether the world has a corpuscular or field (wave) nature lay of the discussion between Newton and Gouk about the nature of sound. Newton thought that sound is carried by particles, and Guk represented it as a wave process. Newton won the discussion, although later it turned out that he was wrong. Maxwell's conviction that the world is a solid continuum, not a combination of particles, has helped him to create an electromagnetic theory. It is obvious that any scientific activity is determined by initial settings, in which together with theoretical principles present and outlook-ontological components, which in some cases play a positive, and in other negative role. Discard them or not to take into account in the work is impossible, because it is a part of mind, intelligence. The only way out is to realize them. Then, it is possible to trace their influence on the scientific result, so that they can be used successfully, or, on the contrary, eliminate. The trouble is that in the past to analyze these initial settings and preconditions in full volume was not possibility because of the undeveloped philosophy of science. Now such an opportunity is, although the scrupulous philosophical-methodological analysis of the scientific process of the task is not easy.

The epistemological problems of science are connected with some or other understanding of scientific knowledge in the plan understending of its relation to object and in terms of its structure, functioning, development, and sometimes in the correlation of to subject, although the latter relate to the epispemological problem in the case when the epistemology and gnoseology differ, that, far from always makes sense to do. One can cite such an example of an epistemological problem: Scientific knowledge can be understood as a reflection of reality, and can be understood as a result of agreement, convention, between scientists. The latter is an investigation of the philosophical concept of conventionalism. If such a point of view is initial, so to speak, working, it will directly affect scientific activity. For example, the famous French mathematician Henry Poincaré stood at the opening of a special theory of relative, in any case knew all those provisions which then form the essence of this theory. But he did not make a decisive step, because his conventionalism did not admit either scientific ambitions or other theoretical ideas of known facts. Albert Einstein, on the contrary, came from the opposite epistemological prerequisites, in which knowledge was considered as an reflection of reality, so, the more true this reflection in theory, the better for science. He made a decisive step, and the theory of relative right bears his name, although there were attempts to attribute the primacy of Poincaré. However, in another respect, Einstein's epistemological position prevented him from understanding the essence of statistical quantum mechanics. He was convinced by the end of his days that this theory is temporary and will be replaced by unambiguous, rather than statistical forecasts of behavior of microparticles. "God does not play in the dice! – he told the creators of quantum mechanics. But their point of view about the fundamental nature of statistical phenomena of the microworld has won.

Cognitive problems in the methodology of science are related to the notion of knowledge not in terms of its correlation to object or subject as in gnoseology or epistemology, but in terms of its acquisition, storage, representation, transformation, reproduction. Of course, the gnoceologi and epistemological concepts in the cognitology are used. But here the theory of knowledge necessarily includes concepts of artificial intelligence, theory of decision-making, theory of information. In modern science the cogenic approach and complex of cognitive science were formed, among which besides theory of knowledge, theory of artificial intelligence, theory of information separate sections of psychology, linguistics, microbiology play an important role. The cognitive approach was largely inspired by the ideas of Popper's "Third World", Polani's "Personal Knowledge", Kuna's "paradigms" and other ideas of the representatives of philosophy and science methodology.

Some authors attach special importance to the cognitive sociology of science, which fixes the dependence of appearance and recognition of scientific theories on deep psychological factors, which affect social determinants of scientific theories: For example, scientific observations are quite dependent on emotions. They believe in the spirit of post-modernism that, as a result of a large number of different concepts of science philosophy, the latter will cease its existence, falling into separate unrequired points of view. Then, after the death of the traditional philosophy of science, it will be replaced by the cognitive sociology of science. It will begin by deciding on consensus — agreement between scientists on what theory to call true, which method is correct, which observations are adequate, and so on However, representatives of the existing (standard) concept of science are sure that, say, observation without any consensus is just adequate reality and excludes emotion, and one can elimination the prejudices and intellectual prejudice of scientists for the sake of objectivity of observations. But, on the other hand, it is against the simplest truths of psychology, according to which the observation can not be broken from the observer and its emotional state and cannot be passive. There is no definite solution to the given problem. The example shows how unexpected, difficult, with far-reaching consequences, problems may arise. what would seem to arise in the simplest scientific situations.

Axiological problems in the methodology of science began to be investigated relatively recently, when it became clear that in addition to knowledge in science values function, and often they have an non-rational nature. It is also important that, together with purely scientific values, which are usually well-understood: truth, scientific professionalism, objectivity, substantiation of scientific results, etc., in science work and a non-scientific, but important values, for example, ethical, esthetic, and political, and then narrow group. Many values are of a methodological nature, as they often directly or indirectly regulate scientific activity. The importance of accounting for such values is growing, as a result of the significantly increased influence of science in society, risk and potential danger of many scientific projects.Some of them should be solved to evaluate the scientific project: What values are put in its basis. Methodological training of the scientist suggests the ability to distinguish the axiologic problems from other methodological problems.

Socio-cultural problems in science arise when it is necessary to analyze and take into account the social and cultural environment of science, which directly or indirectly enters the tissue of scientific research or, at least, influences it. It is almost always done in hindsight when subsequent generations of scientists and methodologists explain the mistakes or shortcomings of their predecessors "conditions of that time", for example, the inperfection of devices or mathematical apparatus, or ideological, political and other socio-cultural factors. It is easy to explain the lag of genetics or linguistics in Soviet times by the corresponding ideology and totalitarian political system. Any scientific texts bear the imprint of social and cultural conditions of the time, and some require considerable effort to determine what exactly was meant by this or that autor. Accounting of socio-cultural insets and socio-cultural context of science allows not only to understand the predecessors better, but also to reveal the rational grain of their works, which can be used. For example, it is unlikely that any of the modern experts in classical mechanics could easily understand the fundamental work of Isaac Newton "Mathematical starts of Natural Philosophy", where the fundamentals of classical mechanics are laid out due to a huge number of philosophical, theological and other considerations, without which Newton's contemporaries would not accept the author's ideas. However, at the end of the XIX century, Ernst Mach taught the Newtonian mechanics as a deductive system, excluding everything that was not close to it directly, adding to this branch of physics a modern look.To do this he has helped philosophical teaching of empiocriticism, or mechanism, according to which the role of philosophy is precisely to clarify scientific concepts and to exclude from science non-scientific provisions. The difficulty here is that it is easier to do with the back number than with respect to modern knowledge. Therefore, the efforts of the methodologies are directed to develop ways of distinction and separation of scientific and non-scientific, in particular socio-cultural, outlook-ontological, axiologic and other components of science.

1.3.Philosophy and methodology of science in light of philosophical doctrines.

Scientific and methodological problems in one or another degree have touched already in XVII century, when the formation of classical science has gone. This is evidenced by the methodological ideas of the English philosopher Francis **Bacon,** as well as the rules for the management of the mind of the French thinker René **Descartes.**

At this time, a specific empirical material was accumulated, it had to be somehow sorted on the basis of some methodological principles and rules, which were proposed by Bacon and Dekart. Their methodological settings were the opposite, which was connected with different areas of natural science in which they worked. The Bacon methodology is called empico-inductive, and Descartes' methodology is rationalistic-diductive. They generally understood the purposes of the methodology equally: to improve the methods of knowledge, so that people increasingly know about nature.

Bacon justified the iduction as a method of generalization of the research knowledge. This method offered a transition from generalization of the research data to the creation of the theory, and also meant a transition from the theory and its output to the before setting up new experiments. In addition, the Bacon examined the obstacles and obstacles that the researcher is warning in the process of learning. He called them idols. A family idol, for example, is an example of an anthropomorphic vision of nature, when a researcher attributes human properties to objects, such as goals. This provided an opportunity for the Bacon to criticize the Arstotelian teleology and use the principle of causal explanation. The idol of the area or the market – age-old superstitions are connected, in particular, with the spoken language. The idol of the theater is a non-critical faith in authority. The idol of the cave is errors that arise from the peculiarities of the organs of sensuality and incorrect life impressions of a single person.It forces the individual to see nature, like from the individual cocoon, in which a person was formed, educated, got an education, and not as nature actually is. Objects of nature, on the Bacon, should be presented as they are in fact, and not as they show us the idols. Thus bacon has substantiated the most important methodological principles, which are still key for scientific research, for example, the principle of scientific objectivity, criticality, nature of explanations.

Dekart, focusing on the constructive possibilities of mathematical knowledge, formulated rules of the method. In these rules expressed the rationalistic confidence of Descartes that the mind (potentially or real) has general, absolutely reliable axioms of knowledge, which are accessible only intuative, that is clear, expressive perception. Hence, the methodological absolutization of the possibilities of deducion as a way of obtaining new knowledge was understood. By Dekart, the valid deduction, unlike logical, from sylogism, acquires an invaluable value in getting new truths. That is why such deducation is seen as an heuristic method

Bacon understood that the “through simple enumeration” of certain cases does not give reliable, credible knowledge. His merit is that for the improvement of the induction he proposed to pay attention not so much to the maximum complete enumeration, but to the accounting and understanding of the very essence of negative cases.

However, as soon became clear, an empyriko-Inductive method of knowledge underestimated the heuristic role of mind, witty hypotheses. In turn, the rationalistic-deductive method has disclaimed the cognitive opinion from experience, undervalued the role of sensations in the knowledge.

Meanwhile, the successes of science and their growing isolation from classical philosophy provoked ideas about the possibility of full independence of science from philosophy. In 30-60 the XIX century made up **positivism** as a philosophical-methodological direction, which was oriented on the so-called "positive" knowledge, that is, knowledge obtained in specific sciences. Studying the ways of obtaining such knowledge and the appropriate methodology will get supposedly get rid of the metaphysical prerequisites of science. That is how positivism I tried to overcome the classical philosophical tradition, while preserving the norms of rationalism and trust in the empirical data of science. His representatives were French philosopher Auguste Kont, who sought to create sociology as a strict science, philosophy, economist and sociologist John-Stuart Mille and others.The influence of a positivist philosophical-methodological position in one or another degree felt in the further science and remained until now, although it can not be called dominant.

Sometimes the so-called **second generation of positivism**, represented, for example, by Ernest Mach. These positivism researchers analyzed the changes in science that took place in the second half of the XIX and early XX century and tried to identify the substantial grounds of science. In philosophical grounds of science of this time tried to understand also the greatest scientists of that time: Henry Poincaré, Albert Einstein, Nils Bohr, Max Born and others.

In the non-classical philosophy of the end of XIX - the beginning of XX century there is a cardinal revolution in approach to problems of methodology. This is connected first of all with the review of the fundamental role of rationalism in scientific knowledge and, accordingly, with the revision of methodological bases of scientific knowledge. Radical criticism of rationalism was carried out by Friedrich Nietzsche, the founder of the **"philosophy of life"**, giving primacy to non-rational means of knowledge: instinct and intuition, directed by will to life. It was an attempt to depart from the traditional for the classical philosophy of the division of the subject and object of knowledge, abstract vision of the subject, an attempt to make the process of knowledge adequate to the spontaneity and variability of the vital beginning.Thanks to this, such authors of the first half of the XX century as Henry Bergson (1859-1941), Henrikh Rickert (1863-1936) began to investigate the cognitive possibilities of intuition in comparison with the intellect and to create the appropriate methodology. The result of such researches was the division of the sciences about nature and sciences about values (natural sciences and humanities). Bergson is called the founder of the philosophy of **intuitionism**, and Rikkerta together with other famous philosophy Wilhelm Vindelband is called **neokantiants.** The further development of the methodology was influenced by the division of Vindelband all sciences into nomotetic, which formulates scientific laws, and ideographic, such, which describe individual, unique phenomena. From Neokontians is popular and now, though controversial, the point of view that natural science studies the laws of nature, and humanitarian sciences study unique phenomena of human spirit and culture.

Another attempt to review the priorities of the classical philosophy was the Edmund Gusserl **phenomenology** (1859-1938). Its purpose was to justify the rationalism of a new appearance, which will allow to build a real "science education", to make philosophy "strict science". Phenomenology is a science about the way of intuitive and contemplative "consideration of the essence" due to phenomena, that is, a special form of consciousness. Through them demonstrates themselves and or another point of view reality, one or another semantic content. Appeal to "phenomenon" as an element of the stream of experiences required its purification from abstract, pre-given knowledge and understanding, for which a special procedure of phenomenological reduction was assigned. Development of a phenomenological method meant restoration of trust in intuitive and contemplative processes of consciousness.The main goal set before Gusserl and his numerous students - a reversal in the principles and methods of scientific knowledge was not achieved, but his ideas were very productive for the formation of new directions of research activity of consciousness, possibilities of understanding of reality, problems of meaning creation and language. There was an interesting phenomenon of hermeneutics, which before and after, developed independently.

Hermeneutics emerged as an ancient art of interpretation of sacred texts. She acquired a new sense in German romantics Friedrich Schlegel and Friedrich Schleyermacher at the turn of the XVIII and XIX centuries, and thought them as an art of understanding others' individuality. Schleyermacher, for example, thought that thanks to germeneutics the text can be understood better than the author himself understood. The methodology of germeneutics was developed in Wilhelm Dillthea (1833-1911), which defined germeneutics as an art of understanding written fixed life manifestations. One of Husserl's pupils, Martin Gaidegger (1889-1976) gives a new understanding of the phenomenological method, defining it as a phenomenology of hermeneutics. Gaidegger has tused the reality of the "living world" mainly as a language reality, hence the beginning of his "observation" as an listening, that is, watching what is heard in the word, in the language.The real language is considered by Gaidogger as an undismembered preconceived entity that coincides with life itself, therefore revival of the real language and ability to hear it is considered by Gaidogger as a world-historical task.

Further development of philosophical hermeneutics was carried out by Hans-Georg Gadamer (1900-2002), a student of Gaidegger, for which the significance of the experience of hermeneutics is in the interpretation of what the text reveals, carrying out its game. In methodological terms, interesting reflections of Gadamera about the prerequisite knowledge, which he calls precognitive, in the sense of what prejudges, for reason. Prejudgment (as a kind of boon) leads the researcher to understand any text. The important task of the methodology of hermeneutics is that the scientist does not become a slave of prejudgment. In the second half of the XX century, problems of hermeneutics were considered by Paul Riker and others.

To the problem of language, meaning and sense came in the end and thinkers, who represented absolutely different direction in philosophy of the XX century - **neo-positivism.** Neo-positivism was formed as a historical form of positivism in the early 20-ies of the XX century and one of its first directions is **logical positivism**, presented by Max Schlyk (1882-1936), Rudolf Carnap (1891-1970). For logical positivism, as well as for positivism of XIX century, the tendency to eliminate metaphysics from scientific knowledge, and scientific philosophy is considered by it only as logical analysis of the language of science with the purpose of revealing "directly-given", that is, the content of scientific concepts, which is tested by logical concepts.Such orientation of logical positivism is connected with real methodological problems of science of XX century. At this time, the role of sign and symbolic values is increasingly understood, the tendency of mathematics and formalization of knowledge is increasing, the dependence of methods of considering the reality on the type of language is revealed. Close to logical positivism there is an analytical philosophy, represented by such thinkers of neo-positivistic attitude, as Bertrand Russell (1872-1970), Gotlob Frege (1848-1925), George Moore (1873-1958), Ludwig Witgenstein (1889-1951).

The next stage of the development of neo-positivism was **post-positivism.** His prominent representatives: Karl Popper (1902-1994), Imre Lakatos (1922-1974), Paul Feyerabend (1924-1994), Thomas Kun (1922-1999). In general, post-positivism is a departure from very rigid formulas concerning the exclusion of philosophical clauses from scientific knowledge and the priority of independent scientific theory. It records the change of scientific paradigms and the role in this process of philosophical theories, recognizes the role of postanavic factors in non-scientific knowledge, expands methodological principles. Popper, in particular, supplements the principle of verification by the principle of falsification of scientific theories.

Alternative postpositivism as a methodological concept is a **cultural-historical approach** (Michel Fuko, etc.), in which development was also attended by Soviet philosophers (Boris Hessen, Vladimir Bibler, Piama Gaydenko, etc.). Supporters of this approach emphasize the study of historical dynamics of science as an organic part of culture in general and its separate types (historical and national cultures). The main problems of this direction are: analysis of cultural and historical preconditions of the origin and formation of science, peculiarities of basic cultural and historical types of science, dependence of science on peculiarities of national cultures.

The general conclusion of cultural and historical approach in research of science can be formed in the following way: Appearance, content, features and dynamics of science depends not only on the type of objects and methods studied, but also on the type of culture, part of which this science is. As science development steadily grows its informational and methodological power, the weight of its internal factors, which determinate the content and dynamics of science. However, science always remains an immanent part of culture and cannot fail to test its influence in different forms. The concept "socio-cultural background of science" is sometimes used to summarize the role of social factors in the development of science.

Recently the philosophy of science is influenced by the **post-modern** philosophy. The term "postmodernism" is used for the characteristic of the postnon-classical type of philosophy as a part of modern culture, the state of which is defined as postmodern. For the post-modernizm characteristic not only interest in language and mind-forming structures, but also to virtual forms of confusion, representing simulated models of thinking, - simulators, as well as interest in structures of everyday life, forming human consciousness and influencing science.

Post-modern or post-modernizm literally means that after "modern". Under the modern one is understood a combination of ideas, which defined the modern epoch, but which formed in the new time and especially in the Age of Enlightenment: faith in progress, reason, science, truth, freedom. The term "postmodern" began to be applied in the beginning of XX century and was widely spread in the sixties, recording innovations in architecture, literature, art, and in the eighties began to be applied in philosophy due to the French philosophy Jean-Francois Liotaru (1924-1998). Post-modernism means understanding of the crisis of classical philosophy and generally rational type of culture in which modern humanity lives. Therefore, the idea of impossibility of philosophy as a theoretical unity is spread, because the world is not subject to attempts to process it and does not fit into any theoretical schemes.Moreover, the world is based on human action, revenge for the attempts to change it into intelligent, as it seems to the person, foundations, collapse of all the transforming, in particular, scientific, projects. That is why philosophy of post-modernism refuses from ontology, i.e. description of the world such as it is, from logical system of texts, from theorization.

One of the foundations of post-modernization is **post-structuralism.** He arose in 70 years of the XX century. as one of the directions of linguistic philosophy. The leaders of post-structuralism were Jacques Derrida, Jacques Lakan, Roland Bart, Julia Kristeva and others. If earlier it was considered that the truth and sense are inside the text, then from the poststructuralism positions they are outside the text and belong to the author or the interpreter (the reader of the text). Truth and sense are always generated in the course of interaction of one subject (reader) with another (author). Therefore, any truth is always not only relative, but also subjective and personal. The idea of a purely objective and absolute truth is, in the opinion of post-structuralists, an ideological breed of totalitarian consciousness, the most important element of the technology of power and the lever of its realization in the traditional class society.

Post-modern is also associated with fundamental changes in the forms of thinking and research problems. For example, the classics of philosophy, science, methodology did not focus attention on absurdity, madness, sex, and the state has oppressed these processes. From the point of view of post-modernists, the mind has already led mankind into the hopeless of global problems and put it on the verge of death, so mind, science, logic can not be trusted. A person must live emotions, intuition, game. Emotions, for example, are more important in the language, they convey more precisely the anguish, the ecstasy, the train, the irony and generally the attitude of the person to the given situation, which constantly changes. For post-modern the main freedom in everything: In creativity, in culture, freedom, transitory into chaos. However, one can assume that chaos will be settled sooner or later in the system of the new level.There are all grounds to expect that the future of philosophy and methodology of science will be determined by its ability to generalize and understand the accumulated scientific and cultural experience.

Post-modernism (Jean-François Liotar, Julia Kristeva) made decisive conclusions for understanding the whole modern culture: culture is a text, because it is often almost impossible to distinguish the text as a representation of cultural phenomena from the culture itself. The fundamental characteristics of each sphere of human activity (everyday knowledge, philosophy, poetry, art literature, science) are called the storytelling and the plot (narrative), since any text, in particular scientific articles and monographs, always is a story in one or another degree. This means, first, a teleological way of organizing any text, and not an objective-descriptive one. Secondly, it means that any scientific text in its own structure always suggests communicability, appeal to another subject, as a necessary singer of a recognizable act.Thus, from the point of view of the post-modernists, the main direction of knowledge is not a description of the object subject, but an endless interpretation of the text by different subjects.

Any text, and therefore scientific, always relies on a large array of unknown text adopted by the author of implicit knowledge (intuitive information), being part of a larger whole – some context, the limits of which can no longer be defined completely and unequivocally. In this respect, the science does not differ qualitatively from mythology, art literature, philosophy. Everywhere – fundamental multimeaning, invisibility, openness for new interpretation. The nature of language, based on it human culture and all its manifestations, including science, such that a person is forced to live in the created by it pluralist and always not until the end of a certain world. Perhaps this is an exaggeration of the post-modernizm.But the marked uncertainty of the world is a necessary condition of human creativity as natural for a person and at the same time a specific form of its existence, which distinguishes a person from all other living and non-living objects. The condition and simultaneously consequence of creative activity of a person is constant support in society of the necessary level of diversity and pluralism. At the same time, it requires people to observe such norms and values as tolerance, humanism, consensusality, responsibility.

Soviet philosophy of science was built on philosophical principles of Marxism, overcoming ideological and dogmatic resistance, which was expressed either in the defeat of scientific collectives, in the noisy critical campaigns, or in control over publications. In the Soviet version of philosophy of science could exist only as criticism of foreign philosophy of science. Fortunately, in this sphere of activity there were creative, critically thinking philosophers, who were wary of philosophical dogmatism, inherent in Marxism-Leninism, so their critical works often looked like propaganda of interesting foreign ideas. After 1985, a productive dialog with Western methodology, logic and philosophy of science began.Now on the post-Soviet space philosophy of science basically does not separate itself from the world philosophical-methodological opinion. The famous contribution to philosophy of science was made to Soviet and post-Soviet period: V. S. Stepin, V.N. Porus, L.A.Mikeshina, V. S. Shvirev, E.A.Mamchur, A.A.Pechenkin, A.l. Nikiforov, V.G. Gorokhov, M.A. Rozov, V.P. Filatov, well-known philosophy and methodologists of science, working in Soviet and then in independent Ukraine: M.Popov, A.I. Uymov, S.B. Crimean and others.

In particular, Soviet researchers began to distinguish between the levels of methodological knowledge for the first time. Although basically this idea was given by the counter-ideological considerations: To go from the dogmatic thesis about material dialectics as the only scientific method, – nevertheless, the objective basis for the allocation of methodological levels is.

The first level is philosophical, where the initial philosophical position of the researcher, its valuable settings, the meaning of scientific activity, the general picture of the world, pre-term knowledge and so on is fixed. This level is investigated by philosophical means.

The second level is a general scientific. It includes: general scientific concepts, style of thinking in the science of this epoch, ideas and norms of this scientific school, etc. The general scientific level is studied by both philosophical and scientific means.

The third level is the level of specialized scientific methodological knowledge: Examples of solution of specific scientific problems, limits of their application, criteria of selection of theories for engineering implementation, limits of simplification of mathematical and other models, peculiarities of special scientific and technical creativity. This often includes methodological aspects of special scientific, applied and technical knowledge, although sometimes the scientific and technical methodological level is allocated separately. This level can be studied both by philosophical and general scientific, but more often by special methodological means.

In the American and Western European methodological tradition it is not accepted to distinguish such levels. There in any scientific research it is necessary to identify the philosophical-methodological component, in particular, as a sign of methodological information of the researcher. In the post-soviet space, this approach is also introduced, but is not common, perhaps until it spreads. Philosophical-methodological research are more often given over to the philosopher and methodologists of science, and what makes a spesific scientific, worc by itself seems to be free form this. However, it is unlikely that this situation can be considered as a professional division of labor, rather – a sign of methodological inawareness of the scientist.

Modern science methodology, although presented by different schools with ambiguous approaches and philosophical reasons, however, has a very clear general range of problems and often general understanding of them. Thus, a new image of science was formed, which is not limited to the ready knowledge, its anatomy and the identification of separate methods and procedures, but takes into account the deep grounds of formation and development of science, style of thinking of epoch, sociocultural context of science, its history, interpenetration of various scientific methods. There was a sort of turn from the internal methodology of science to the analysis of external determinants, and the limits of its subject became less rigid.

At the same time, the assessment of the non-scientific methodological regulations of science (internal scientific) is ambiguous. For example, there are exsternalist and internationalist orientations.

Ecsternalism is a current in philosophy and methodology of science, which appeared in England in 30-s of XX century. From the point of view of exsternalism, the main task of the methodology of science is reconstruction of socio-cultural regulativs of scientific activity, which is precisely what determines the dynamics of science, and the structure of the obtained knowledge and intrascientific methodological regulations. Representative – John Bernard (1901–1971). Some influence on the formation of ecsternalism was Marxism, for which science is not self-sufficient system and depends on socio-economic factors. The typical representative of exsternalism is a historical school in the methodology of science

Internationalism is a course in philosophy and methodology of science, opposite to ecsternalism. The chief representative Alexander Koire (1892-1964), born in the imperial Russia, lived and worked in the West. From the point of view of internationalism the main driving force of science is internal factors: Logic of scientific knowledge movement, evolution of problems and their solutions, intellectual traditions. Thus, individuals, cultural and social factors can only exert an external slowing or accelerating influence. The latter case differs from the neo-positive approach, which in fact ignored the socio-cultural background of science.

Importance of science philosophy. With general agreement on the importance of science philosophy, its role is seen in different ways. Some consider it to be a special worldview, others to be a scientific concept, the third to be a methascientific methodology, and the fourth to be a model for the development of science. There is a point of view, according to which philosophy of science is a description of those situations which occur in scientific research. Then any researcher can "develop" the philosophy of science, describing his specific case. The opposite position shows that the philosophy of science is a theory with its own regularities, and as in each theory it can be seen only by a specialist, so that it is not accessible to all scientists. It is obvious that these are extreme positions. After all, there are specialists-mathematicians, but at the same time it is obvious that mathematics in one or another degree is necessary for all.This applies to a lot of things that function in science and are obligatory for the scientist, first of all philosophy and methodology of science. Now it is clear one thing:

Time of "narrow" specialist has passed, and to become "wide" specialist in modern conditions – will not suffice one life. Modern understanding of the model of a good specialist, a scientist-professional reminds a funnel: good various education with a wide scientific horizon, narrowing in the depth of its specialization. This image is conditional, because a peculiar breadth of the methodological outlook should be present in the most specialized depths. Only such a scientist can understand the place and importance of his specialty at all levels of the unified science.

In this regard, the philosophy of science also performs a general cultural function, not allowing scientists to become ignorant at a narrow professional approach to phenomena and processes. The real trouble is when a narrow specialist begins to think and make decisions outside of his narrow region, namely, it is often necessary in management work, in politics, ecology, in related fields of science, and even in everyday life.

Question to repeat:

1.Characterize the correlation between philosophy and science.
2.What studies philosophy of science?
3.What is the meaning of the scientific and anti-scientific orientation of science philosophy?
4.Name the philosophical and methodological problems of science.
5.Characterize outlook, ontological, epistemological, cognitive, methodological, axiologic, sociocultural problems of science.
6.Characterize philosophy and methodology of science in light of philosophical doctrines of positivism, neo-positivism, postpositivism.
7.Compare structuralism, phenomenology, postmodernism, cultural and historical philosophy of science, hermeneutics in philosophical-methodological plan.
8.What disciplines are studying science?

2. Science and scientific outlook.

2.1. Special components of science. Languages of science. Science as the production of new knowledge.

Science is an extremely complex system consisting of many elements of a lot of connections. If the structure of science is simplified, it can be built up to four main components. Then the definition of science will look like this. Science is the area of research activity, which includes scientists, scientific organizations, scientific knowledge and special means of their receipt and expression. Of course, such a short definition misses many significant features of science, for example, the fact that the meaning of science lies in the production of new knowledge, so these components should be considered in detail.

Scientists are specially trained specialists who create scientific communities and perform scientific work in special institutions. Professional scientists appear with the appearance of science as professional, not amateur activity. It is impossible to specify the exact time, but it is approximately at the threshold of XVI-XVII centuries, when scientific activity becomes "position", "work" in the sense of paid activity and the source of existence. However, one can remember old Greek sophists: they first began to take money for training a special knowledge, which is a retroactively in some sense can be called scientific. But it was not their source of existence. A instructive example can be given from the life of Demokrita, the famous old Greek philosopher of the V-IV turn to the N.C. In the city-state of Abderi, where he lived, there was a strange law, at first glance. A citizen who spent his property has been brought to court.However, the strangeness is quite clear: A dissolving citizen could not pay taxes and thus undermine the foundations of the state. Demokrit, having received a recession, has spent it on a trip to the East, where has acquired important knowledge, which has carefully recorded. When he was judged for a corrupt inheritance, he presented a manuscript containing knowledge as a justification. The court justified it: Perhaps, the citizens decided that knowledge is a worthy premise of capital. Yet in antiquity, as well as in the middle ages, the knowledge that we now enter into the scientific, was conducted not by professionals, but by fans. For example, Pierre Abelyar or Mykola

Kopernik, whom we now call scientists, they were not, they were church figures, who performed first of all church duties. The contribution to the science of such figures is great, which gives grounds to consider their scientist, which, of course, is not accurate.Often it does not matter, but some of these inaccuracies make it difficult to understand the biographical facts or the meaning of scientific discoveries. In modern conditions the problem of the role of fans and professionals in science is very acute, but it is later in the relevant sections.

The activities of prominent astronomers of the XVI-XVII centuries, Iogan Kepler and Tycho Brage are more like professional, because they served as court astronomers and, according to the duty, observed planets and stars. However, their main task for the post was not scientific activity on production of new astronomical knowledge, but complication of horoscopes. Their horoscopes had to science only the relation that more accurate observations allowed to correct the horoscopes, which were mostly "failed". The other thing is that at this time there were already scientific communities, communication between scientist, personal and on the corespondence, and publication of scientific discovery was a very prestigious business.

Scientists usually join formal (official) or informal communities.

Scientific organizations and institutions. The first scientific societies appeared in Italy in the XVI century. Many well-known thinkers and public figures took part in them, headed by the invited honorary member Galileo Galilej. They were engaged in the promotion of scientific knowledge, organized regular meetings, exchange of ideas and even conducting experiments.

The great role in the formation of science was played by the Royal Society of London in the XVII century. It has become an important organizing start of scientific activity: gained support of the state, developed principles of scientific activity and program, began to publish scientific results. It is the emergence of scientific institutions, scientific publications, systematic professional activity that has become the beginning of science.

Scientific organizations and communities publish scientific works of scientists and assign scientific degrees and knowledge, which is a formal sign of the scientist.

Modern scientific organizations have a complex structure, including national academies of sciences, scientific and research institutes, laboratories, departments and others. They often enjoy the financial and organizational support of the state, but they can be independent, with their financial and organizational structure. Scientific communities, both formal and informal, play a major role. It is a voluntary association of scientists, both professionals and amateurs.The main sense of the community is the exchange of scientific information and promotion of scientific knowledge. But often scientific societies carry out social and cultural tasks, for example, ethical, as a society of Max Planck, whose statute is an ethical ideal of the scientist, and even political as the Paguoshsky movement fighting for peace, for international security, for prevention of thermal nuclear war.

Scientific knowledge, the production Council of which there is science, is knowledge, which possesses special features, for example, the possibility of testing and a special organized structure, for example, theory. More detailed scientific knowledge will be considered later in the corresponding section.

Special methods, methods of obtaining knowledge and special means of their expression and communication, for example, logic and special **language.**

A special role is played by the language of science, which is characterized by the unambiguous, clear and precise meaning (and also interpretation) of understanding and symbols. Much of the perfection of the language of science is connected with the development of mathematics, its means and methods.

The language of science is the usual natural language (if it is not fully formalized), in the list of terms of which added special terms and signs for expression of scientific understanding. They form scientific laws and statements. In the language of science, some sections of logic and mathematics are also introduced to draw conclusions from theories.

The real language of science exists within scientific communities, and the adoption of this language also means the adoption of this system of views, as well as this method of understanding scientific problems. It is possible to speak about language of classical mechanics, quantum mechanics, etc.

The language of science gives and a certain vision of the world, with its sense, pictures or as they say, with its ontology. Some researchers even believe that different ontologies are incompatible. So-known American logic, philosophy and mathematician Willard Kuain formulated the principle of ontological relativity, according to which each scientific theory is primarily a special language describing the objects of this theory. Another theory will operate with different terms, i.e. will have a different ontology, so describe other objects. Therefore, it is impossible to compare them. It turns out that objects, whose existence is foreseen by one theory, that is, one language, are not obliged to be considered existing in relation to the theory formed in another language. For example, epilepsy, which exists as a disease for modern scientific medicine, will be "the devil's obsession", if you accept the language of archaic medicine.The principle of ontological relativity is some exaggeration of the state of affairs in science, but still records an important problem of science: problem of mutual understanding. Since theories speak different languages, researchers rarely understand each other well, especially in the case of a new theory or in related fields of science. What about the remote one from one field of science? Therefore, in particular, the philosophy and methodology of science has the idea to apply in the purposes of mutual understanding of germeneutics. Indeed, in a number of cases it works, but the universal means of understanding is not found.

For mutual understanding of the media of different theories often use metaphors, analogueies, etc., which in turn raises the problem of clarification of the language of science.

In addition to the above-mentioned components of science, we will highlight four of the **most important specific features of science.** In fact, it is possible to name such specific characteristics much more, especially concerning scientific knowledge, scientific activity, scientific norms. But these characteristics as philosophical and methodological problems will be discussed in the further topics. Now we will note only those that relate to science in general.

Activity on the increase of new knowledge. In science there is a huge array of knowledge, which was once produced, which is studied by future scients and other experts, which is put out in various educational and scientific literature. But it does not determine the essence of science, although without it it would not be. The essence of science defines new knowledge. The whole sense of studying existing knowledge is to develop new knowledge on its basis. All components of science are directed to this: training of scientists, organization of scientific institutions and communities, scientific methods, and scientific language. When writing and protecting theses is the first condition: scientific novelty. Of course, the production of new knowledge is possible only on the basis of old knowledge, even if the old knowledge is rejected, that sometimes happens in science, it was still the precondition of new, more faithful, or acceptable knowledge. Therefore, in scientific works the new knowledge takes relatively little place.The majority of people, as a rule, occupy the old, existing, stable knowledge as a prerequisite, the basis, the initial material of the new. In this sense, it is important to show how new knowledge is connected with the old one. If someone gives knowledge that does not have a connection to the old, existing knowledge, then it has no relation to science and is an obvious sign of the non0scientific. All scientific discoveries, new "crazy" theories, which entered the science and glorified their authors, who, by some sign, have overstated the existing knowledge and even rejected some former positions, somehow or otherwise connected with the old knowledge and rooted in it. This is called inheritance **in** science. Scientific continuity is an integral part of scientific novelty.

Another characteristic feature of science is **self-value of science,** i.e. production of knowledge for the sake of knowledge. At first glance, it sounds unusual, because we are accustomed to practical application of science. Moreover, in scientific works, for example, in dissertations, it is necessary to specify practical significance of offered ideas. The requirement of practicality is conditioned by the desire to avoid the full conjecture of scientific hypotheses and to demonstrate their potential usefulness. In fact, much of the scientific results have no practical application. For example, more than 90% of mathematical theoretical provisions are not applied. But not because it is impossible, but because there is no such possibility.The self-value of science has its philosophical and psychological roots in the aspiration of mankind to absolute knowledge, in the desire to engage in Absolute, to eternity. A typical example can to see in the activity of Archimedes, a great mathematics, physics and engineer of the III century BC from Syracuse. He was famous for the famous engineering structures: projectile machines, spherical mirrors that focus on solar rays and that burned the enemy ships, and many other practical examples of the application of the theory in practice. Recently, many of his technical inventions, considered legends and exaggerating, were reproduced.But Archimedes was proud not of this, but of its theoretical findings, which had no practical significance, for example, the discovery of the law-based ratio of cone and ball, inscribed in the cylinder, and the cylinder itself (ratio 1:2:3). He even told to build on his grave a ball, inscribed in the cylinder, as a memory of the main business of his life. The thing is that already in ancient times it was clear that any creations human hands are perishable, like man himself, grounded abstract ideas of the mind are perfect, imperishable, eternal and in this sense involved in Absolute. The penetration into this imperishable, eternal, self-valuable world of scientific ideas, which is famous old Greek philosopher Parmenid, who lived at the threshold of VI-V centuries before the century, called a real life, and became the first task of human science.Another thing is that a person has learned to practically use something from this imperishable world for his own world of decay, unfortunately, often to their own detriment by absolutizing the practical meaning of science. The idea of progress, in particular, scientific progress as a practical application of knowledge, has only a few centuries, and whether this time was better in the history of mankind, the issue is very controversial. In any case, the practical application of knowledge has proved controversial: together with huge achievements, the same huge negative consequences have been realized, for example, in the form of global problems and the civilization crisis, which can destroy humanity. People cannot solve the main problem: to find a balance between theoretical achievements of science and their practical realization. It is a task both scientific, philosophical and methodological. The main efforts should be directed to its rapid decision.

Another feature of science is **rationality**. The rationality of science is a rejection of the image and emotionality of everyday experience and healthy sense, as well as other ways of attitude toward the world, such as art and religion. Rationality is also a rejection of belief, characteristic of mythological or religious consciousness, and transition to a support for reason, argumentation, substantiation, evidence. The problem of scientific rationality, its types and norms, as a philosophical-methodological problem, will be the subject of consideration in further topics.

The fourth feature of science is **systematic** as a special organization of science. It means that scientific activity, functioning of scientific organizations, and above all scientific knowledge is United in the system on the basis of certain principles. For example, scientific activity is subordinated to production of new knowledge. It is aimed at training of scientific personnel, functioning of institutions and organizations, their financing and structurization, and much more. Scientific knowledge is also necessarily systematized, for example, organized in the form of theory, with its strict structure, obligatory elements, forms of representation etc.

While characterizing science in general, one more important point should be emphasized. It is often said that science recognizes the world. This expression is extremely inaccurate and capable of generating a lot of misunderstandings. The point is that science has to deal with its specific objects, not just with the real world. The object of science is a fragment of reality, with which the subject (scientists) enters active interaction in the process of representation and scientific activity with the use of different means, methods, methods. Therefore, one cannot say whether the real subject coincides with the subject that describes science. In real scientific practice, for example, a scientist physicist has a case not with objectively existing elementary particles, but with experimentally "made" parts, or with corresponding theoretical objects, which represent objectively existing particles.In this regard, it is useful to distinguish, on the one hand, the object of experiment or the object of physical theory, and on the other - the physical object. The same is true in any other field of science. Naïve man, and some scientists themselves, the object of theory is identified with the real object, which generates ungrounded illusions. For example, an economic object like some system of economic management in theory is an ideal construction in pure form, as an ideal gas in chemistry, or absolutely black body in physics. And it is possible to expect a practical effect from him only in the observance of many conditions, which still need to be further investigated. In order to avoid misunderstandings, one has to name objects, another – objects of research. And what is the name, in principle, does not matter. In Soviet scientific literature, for example, objects were called real things, and objects were called their theoretical idea.In modern Ukraine, the subject of the study is to call something real, and object – a corresponding theoretical construction.

2.2. Classification of sciences. Humanitarian, social, technical and natural sciences. Science, engineering, production.

Science is divided into the fields of knowledge, special sciences, scientific disciplines. Scientific discipline is a field of scientific knowledge, which has a rather certain visually area and rather developed scientific research methods. Developed scientific discipline may include separate sciences. The concept of scientific discipline is largely related to teaching. In medieval universities, they said: discipline is what a student studies, and what a teacher teaches is a doctrine. In modern conditions, such definition does not play a significant role, but it should be taken into account that traditionally science is included or transformed into one or another discipline in many ways for the sake of the convenience of teaching, from which the differentiation of scientific knowledge and corresponding training of specialists is gradually developing. Within the same disciplines and their differentiated sections corresponding scientific researches are carried out.

The classification of sciences is an important scientific and philosophical-methodological problem. Any classification plays a huge role in scientific research, including the classification of sciences. One or another way of classification reflects both the state of science and its role in society. You can coal a world-view, methodological, axiologic role of classification of sciences. After all, and or another classification defines the understanding of the world as a whole, used as a guideline in scientific activity, determines the value of one or another sphere of scientific knowledge.

Classification of sciences suggests disclosure of their relationships on the basis of certain principles and establishment of their hierarchy in the form of logical grounded location. The classification of knowledge was done quite a lot. Let us highlight some of those, which reflect the relevant epoch, and which were important for the further development of mankind.

One of the first attempts to systematize and classify the accumulated knowledge, which is now usually called the pre-science or in the expanded sense of ancient science, belongs to the great old Greek philosopher Aristotle, who lived in the IV century BC. In antiquity all knowledge, except for the everyday, coincided with philosophy, but Aristotle understood different functions and roles of different kinds of knowledge and divided it into three groups depending on sphere of application: theoretical, where knowledge is conducted for the sake of himself; practical, which gives guiding ideas for behavior of a person; creative, where knowledge is made to achieve something beautiful.

Theoretical knowledge Aristotle, in turn, divided into three parts. 1) Phyiscs, which studies the varios position of bodies in nature. "Physics" in Greek just means nature. Nature is changeable, and thus, imperfect, feels sensually, and the feeling can be mistaken. Therefore, Aristotle's physics calls the second philosophy, in the sense of not completely perfect, but important, though because knowledge begins with it. 2) The first philosophy, which was later called metaphysics, that is, that goes after physics and is carried over physics, over nature. It was a science about the highest principles and the first reasons of everything that exists, not accessible to the organs of flair and what is found by mind, is notionally. The first philosophy is to find a land, supernatural, intangible, supersensual, real estate, that is eternal.3) Mathematics. Greeks did not know Roman figures, nor, especially, Arabic numbers, they wore geometrical nature and were a way of representing the physical world, in contrast to modern understanding of mathematics. Therefore, the ancient mathematicians should be called philosophers more quickly. Interestingly, the formal logic created by them as a science of thinking, Aristotle did not enter into knowledge, and considered it to tools of any knowledge. For this purpose the word "organon" (tools) was used, which in the next century will have a great significance. Many modern researchers consider logic to be science, and mathematics to be an organons of sciences.

In the XVI-XVII centuries, when the formation of the classical naturalness, the classification of sciences was made by Francis Bacon. For the initial principle he took the cognitive abilities of man: Memory, mind, imagination. As a result, three major groups of sciences were defined: 1) history, in particular, natural and civil; 2) philosophy in the broad sense of the word (theoretical sciences); 3) art, in particular poetry and literature. In the second group Bacon allocated the first philosophy (or actually philosophy). It was divided into natural theology, anthropology and philosophy of nature. Anthropology is divided into human philosophy (which includes psychology, logic, theory of knowledge and ethics) and civil philosophy (politics).At that Bacon believed that the sciences studying thinking (logic, dialectics, theory of knowledge and rhetoric) are the key to the rest of all sciences, because they contain "organon", which give the mind instructions and warn him against mistakes.

It is interesting to compare the classification of Aristotle and Bacon. It is more complicated in the Bacon, reflecting the fact of increasing knowledge in those two thousand years, which divide these thinkers. Further, in the Bacon a huge role plays a theology, which is obviously and implicitly included almost in all sections, which is also not surprising because of the indivisible rule of the Christian religious world. Bacon, like Aristotle, the decisive role in the formation of knowledge has seen in philosophy, but also understood the great importance of empirical knowledge, which is rapidly growing, within the framework of philosophy of nature. Different thinkers understood organon. If for Aristotle it were, mostly deductive conclusions, for Bacon - inductive as a way of generalization of empirical material.

The remarkable classification of sciences in the prominent German philosopher of the early XIX century Hegel, which he gives, proceeding from his comprehensive philosophical system of dialectical idealism, which assumed the principle of development and the hierarchical system connection of all that exists. All knowledge is divided into three sections: 1) the philosophy, which in Hegel is called logic, which coincides with the dialectic and the theory of knowledge, and includes teaching about life, essence and concept. 2) the philosophy of nature, which is divided into mechanics, physics, which includes chemistry and organic physics, the structure of which is spread from geology, through plants to the animal world.3) Philosophy of the Spirit, which, as well as other sections, is divided into multilevel triades: A) subjective spirit, which includes anthropology, phenomenology and psychology, b) objective spirit, which covers different aspects of social and historical life of mankind, c) absolute spirit, which is known for the development of philosophical knowledge as science. At all its artificial Gegelivska classification of sciences presented the idea of development of reality and knowledge about it as a whole system from primitive stages to thinking.

Absolutely another principle of classification of sciences offered the founder of positivism Auguste Kont. Unlike the division of sciences by the abilities of the human mind as a Bacon, or a demanding philosophical scheme as in Hegel, it is the basis of the classification laid those objects, which are studied by the relevant sciences. His rather complex classification himself Kont proposed to simplify and present all sciences in the form of three pairs: A) initial, mathematical-astronomical; b) intermediate, physical-chemical; c) final, biology-sociological.It is indicative that, as a relative of sociology, the center of sociology was designated as a higher degree, and as a founder of positivism excluded from the classification of philosophy. Such a sharp turn from the Gegelivs' ideas to the Kontovsky, which are divided only a few years, is at first glance surprising. But, at the same time, it is clear, because at this time the development of natural sciences, especially chemistry, and the whole complex of social and humanitarian knowledge has accelerated significantly.

At one time, the classification of sciences Friedrich Engels, which is based on the dialectic-material principle of forms of movement of matter, was a great influence. The sciences were in the evolutionary-step order: the sciences about the unlived nature, about the living nature, about the society, about thinking. Engels did not complete the classification: either did not have time, or did not understand its unpromising. With a certain condition and many difficulties of such classification, he correctly noted that at the intersection of the basic sciences can expect fundamental discoveries.

At the beginning of XX century the original classification of sciences was offered by the famous Russian, Ukrainian and Soviet scientist, one of the founders and the first president of the Ukrainian Academy of Sciences Vladimir Vernadsky. He divided scientific knowledge into two types of sciences. The first is a science that studies the laws that relate to the whole reality. The second is science, objects of which are only on the planet Earth. This gave him the opportunity to allocate in a special object noosphere as a border area of research of some sciences about land, about man and about space. The classification of Vernadsky also helped to formulate an important opinion, which is especially relevant now, concerning unity of all disciplines that make up a single science.

It is important to emphasize that the rapid development of science outpace any classification. In modern conditions it is extremely difficult to choose the basis for a good detailed classification due to the interdisciplinary and complex nature of many modern researches, received knowledge and the sciences, when the subjects of research are hard to distinguish, and methods are mutually penetrating. It is especially necessary to take into account that many theories are not subject-oriented, but problematic, that is, they are created not for research of some subject, but for solving a certain problem. However, can science be classified on solved problems?

Despite numerous difficulties, the classifications of sciences are still carried out, because they are of great importance, not only outlook or methodological, but also purely practical, for example, for organization of training of specialists of certain branches of economic, state or cultural life, for organization of scientific researches, for creation of specialized scientific councils and assignment of degrees of scientific qualification etc.

Based on different needs of classification of modern sciences are conducted on different backgrounds. On the subject and method of knowledge distinguish sciences: 1) on nature – natural sciences: chemistry, physics, biology, 2) on society — social sciences: political science, sociology, legal, economic sciences, 3) on human inner world, expressed in various texts, – humanitarian sciences: history, literature, psychology, 4) on technology - technical sciences.

There may be other classifications. However, the boundaries between separate sciences and scientific disciplines are conditional and moving, as conditional and classification itself.

By the general nature of the tasks solved, as well as by the degree of closeness to the production of science divide into two large areas: fundamental, which identify the most general (fundamental) laws of reality, and applied, such, oriented on application of the results of scientific knowledge for the solution of production and socio-cultural issues. However, if you carefully follow the connection with production and in general with practice, it will appear that the influence of fundamental sciences is much stronger than applied, because applied sciences are very strongly dependent on fundamental and use their elaboration. Just this influence is not immediately marked, but the end. Applied sciences give, as a rule, a quick effect, therefore it seems that they are more important. But as soon as funding for basic research is weak, applied sciences are beginning to suffer very quickly.

2.3. Peculiarities of scientific outlook, difference from artistic, philosophical and religious development of the world.

In general, the world view of personality, group or epoch depends on the mastering method of world development. In ancient times, this way was myth, respectively, the outlook was mythological. In antiquity in connection with popularity of philosophy mythological outlook has been removed philosophical. Although philosophy was spread among a relatively small number of people, its influence on the subsequent epoch and especially on the formation of knowledge was huge. In the middle ages practically unexpectedly used religious outlook, but among the educated layer of monks in this world view well fit philosophical ideas and knowledge about nature. In connection with the development of scientific knowledge, and especially when the science was formed, scientific outlook began to compete with religious and even philosophical.In the modern world, the world view of people is defined by their system of education and education, where scientific, philosophical, religious and other ideas are intertwined. Therefore, in the pure form of one or another type of world view in a separate indicator is found very rarely. Yet, since science in the modern world is a decisive factor, and modern civilization is not accidentally called scientific and technical, science and scientific knowledge prevail in the minds of modern people. The idea of the structure of space, the emergence of life, evolution of man and other world-view knowledge defined by science, do not prevent many people, including scients, to believe in God. Yet their worldview is more scientific than religious. Religion and God in their system of the world are rather connected with the non-scientific layers of consciousness, for example, with ideas about good and evil and generally with morality.All this shows that in modern reality no form of world development can have absolute predominance. Therefore, it is appropriate to speak about the types of outlook not in personal terms, but in terms of what exactly and or another form of development of the world has worked and offers a person. In this sense, one can distinguish the worldview of scientific, philosophical, religious, artistic, everyday. Possible and intermediate types, if the forms of development of the world are mutually penetrating, for example, scientific-philosophical, philosophical-religious, etc.

The scientific world view is presented primarily in the scientific picture of the world. The scientific picture of the world, of course, does not include all scientific knowledge, but only the most general idea about the mood, fundamentals and appearance of the world and its main elements: space, Earth, plant and animal world, man. The world view also includes the idea of knowledge, its origin, methods of receiving, reliability. Scientific world view includes an idea about scientific knowledge.

As for the knowledge of science of the world, one important circumstance should be considered. Cognitive activity, in particular, scientific activity, studies philosophy. However, science, having reached a certain degree of maturity, begins to recognize itself, and in studying scientific knowledge they work together.

Let us distinguish some specific features of scientific outlook in comparison with other ways of development of the world.

Science and art. An important distinguishing feature is that the picture of the world, represented by science, differs objectivity, that is uninterested scientists in one or another of its ideas. Other forms of outlook differ subjectivity, especially art. This art is valuable in its own way, because the subjective vision of some problem by a great artist or writer is not only interesting and complete, but is the greatest achievement of mankind. However, if in science the basic unit is scientific concept, then in art is an artistic image. The artistic and visual development of the world is necessary for a person, because in bright, psychologically easily perceived form it influences the person, it creates corresponding feelings and emotions.And the feeling on which art is based, as well as the mind on which science is based, is an integral part of human essence. Thus, the scientific concept will never be able to replace the artistic image, as the image will not replace the concept. Therefore, it is senseless to oppose science and art, humanity will not cost without any other. Reflecting and understanding the world in the images, art appreciates the single, unique, in which the most important is focused. Even the artistic type as a general idea of something, always presented in an individual, unique form. And in science, the repetition of the observed data is the highest value, according to the repetition of the hidden law, that is, the form of generality, for the sake of which there is a science.

With all the originality and differences of science and art, there are many common among them. First of all, it is a creative character of activity, both a figure of art and a scientist. In addition, the image and metaphoricity inherent in art often play a huge role in understanding the subject of scientific research and its knowledge. One can recall the planetary model of an atom or "the encryption of hereditary information in genes", and the term "scientific picture of the world" itself suggests some image. Scientific and artistic creativity is impossible without intuition, although its role varies in these spheres, but there and there it is present.

Science and religion. It is assumed that the world is really such, as science describes it, but not because it possesses authority, but because scientific knowledge is independently justified by special observations, experiments, special forms of intelligent arguments. This science differs from religion based on faith, on the authority of the Holy Scripture, in general on the provisions accepted without justification. Educated people, especially familiar with scientific knowledge, often needed justification of religious provisions, because of this there were corresponding disciplines similar to science, for example, theology (teaching about God). But in theological considerations and substantiations still the faith is higher for knowledge, authority is higher than proof.

Unlike the religious and mythological development of the world, science is oriented toward natural, not supernatural, determinate phenomena; it seeks to find the cause, not the preset goal; it possesses the critical ability to review the old positions in contrast to the uncritical assimilation of religious dogmas and orders. Many of the above-mentioned provisions of science can be countered with religion, as is often the case. There were historical times when religion pursued science, relying on different mechanisms, in particular state ones. There were other times when science, on behalf of the state, pursued religion. However, in principle, both of these outlook may well coexist, which can be seen in many countries. After all, they mostly talk about different things, and the basic dogma of religion, for example, the existence of God, science cannot make the subject of study.Moreover, many people need faith in something wonderful, supernatural, saved, absolute.

Science and everyday world view. Science differs from the everyday knowledge, which is characterized by unsystematic, random. Everyday consciousness plays a very important role in human life, as it accumulates life experience. Folk wisdom, as a collective image of everyday knowledge, always deserved attention and helped in solving simple life problems. But science rises above everyday tasks, above individual everyday knowledge. Unlike everyday consciousness, science goes beyond the limits of the direct given, oriented on objects and ways of activity, which can take place in the distant future. Science is directed at special objects, which are not built into objects of built experience, uses a special language, which is not everyday into the natural language, is based on a special system of means – scientific equipment, special methods and so on.The end of the end, the everyday world is the result of the everyday knowledge.

Everyday knowledge is a special type of rationality, a form of spiritual development of the world, directly connected with real life.

The specifics of the knowledge you build can be summarized in the following provisions:

1.The result, and at the same time a fundamental principle, is a healthy sense, not, for example, a theory or a law of science.

2.Acts in syncretic form, including knowledge, belief, values, norms.

3.Has a special type of system, order, where the main orientation is not objectivity as in science, but the interests of the subject, practicality, viability of the result.

4.Functioning the field of built-in experience.

5.It is oriented on the obvious, doubtless fact.

6.More is connected with the sensual and emotional attitude to the world.

7. Functioning the basis of natural language facilities.

8.Uses a special model of the world and a special way of substantiation of knowledge: obvious, tradition, faith.

Scientific knowledge is connected with everyday knowledge and healthy sense, but at that time it is opposed to them.

Healthy sense – knowledge that is formed in everyday life, belief, norms, values that are the basis of people's activity. Healthy sense accumulates experience, takes into certain traditions, therefore takes part in practical, and in scientific cognitive activity, has, as a rule, implicit expression, is not subject to the everyday practice of rational processing. Often the representations of healthy sense are contradictory, incomplete, superficial, non-critical, therefore limited.

Scientific knowledge in general is opposed to a healthy sense, rises above it, overcoming its oblivion, stagnation, situational awareness. At the same time, science cannot replace a healthy sense, it remains an important component of public and personal life, because it is not only a limited thinking, but also a vital wisdom, tested by practice vital knowledge. A healthy sense is present in science as a property of a subject, which relies on a healthy sense and its own, and a whole epoch. It is included in the pre-term knowledge in which the "removed" and everyday experience, and general principles and norms of scientific research. It is actively investigated in the methodology of science. The American philosopher of the second half of the XX century Marx Vartoffsky calls it the nucleus of thinking.British philosophy of the end of XX century Steven Tulmin believes that healthy sense is an intellectual source of theoretical knowledge. Here it is important to note the following. Of course, in individual life of a person healthy sense and everyday experience has great importance, much more than science or philosophy. Without science or philosophy, an individual can live, and without healthy sense and everyday knowledge – nothing. However, to engage in intellectual professions on the basis of everyday knowledge and healthy mind will not succeed, will have to go on the higher level of knowledge. Of course, the formation of the scientist and then his intellectual activity and everyday experience and healthy sense influence, although not decisive. But for humanity, science and philosophy are much more important than everyday experience, and in scientific or philosophical knowledge, healthy sense is a subject of laughter and criticism.

Specifics of science and philosophy as forms of world development. Science is similar to philosophy on many signs, for example, on the use of exact concepts, on criticality, reflexia, substantiation of their provisions. This science learned in philosophy, which used the specified qualities in antiquity, which differed from mythological worldview. But science differs from philosophy several features. Science does not use philosophical categorical apparatus, which allows to think about the most general things, so often their essence from it is washed. Therefore, the problems of the essence of the world, the essence of man, the sense of life or life in general and others can only be the subject of philosophical research. However, science uses some methods that reinforce logical substantiation, for example, experiment.However, science and philosophy are not in a state of confrontation, but complement each other and influence each other, which is especially noticeable in the philosophy of science.

At one time almost all available knowledge was included in philosophy, why it was often called science of all sciences. However, already in antiquity, a lot of knowledge gained some independence, for example, medicine, astronomy and especially everyday knowledge. In the XVII century, science, as a special way of mastering the world, was separated from philosophy and the process of the allocation of independent sciences from philosophy continues to this day. Today, no one is surprised that psychology or political science is no longer part of philosophy. However, new scientific theories, disciplines, independent sciences arise not only from philosophy, but also from the science itself, as a result of differentiation, integration and other processes in science.The modern mass of knowledge is so large that no sphere of human spirit, and philosophy in particular, can not take it in itself. Philosophy cannot replace medicine, biology, mathematics, physics. But it cannot be one of the sciences in a number of others. And although there were attempts to introduce philosophy as a science, for example, in Marxism, they were unsuccessful. Philosophy is not a science, it is another way of mastering the world, which is called "philosophy". None of the ways of world development can replace another, because each of its tasks has its own role.

Science solves the relatively partial problems of humanity: technical, economic, educational, legal, etc., limited to certain parts of the world. However, for this we need to know and what is not connected with practical needs, for example, the world, people, society. Science performs a function that foresight, which is sometimes associated with human curiosity. Whatever it may be, but science far outpace the practical needs of society, and often forms them. However, as Hegel correctly noted, science is limited by the discontented desire of the final. Philosophy is interested in the world as a whole, unity of all essence, the essence itself. If the science is interested in the basis and beginning, then philosophy is the first basis and the beginning, if the science is important reason, then philosophy is the first reason, if the science determines the general, then philosophy is comprehensive. It should not be seen anything humiliating for science, and exalted for philosophy, or useful from science and useless from philosophy, as sometimes do think not very educated people. Just these are different aspects of life and its knowledge. Humanity needs both in equal measure. Attempts to exaggerate the role of philosophy or science in the history of human opinion had no long-term success, but had some positive value. First, they turned out to be unconvincing, and secondly, they showed the role and importance of philosophy, science, and eventually the optimal point of view.

In science the achieved result is crucial: new knowledge. In philosophy, which has accumulated a huge volume of knowledge, the result is also important. But the way to this result is more important in philosophy. That is why the old knowledge in science is rejected and replaced by new, and in philosophy the old knowledge is not rejected, because it is the result of a certain way of thinking and mind, which has an impossibly greater significance than the result, and it is this way of achieving the result that should be studied.

. Science prefers to find one of the best solutions to the problem. Philosophy aims to present all possible results, each of which is not worse than the last ones. This is a consequence of the critical function of philosophy, when every thinker tries to find another way of achieving the result, offering other principles, other substantiation, other facts. Since each of the philosophical luminaries has built up their foundations in perfect way, it is impossible to find mistakes in their reasoning, so opponents are looking for other ways of solving the problem. Philosophy has no such provisions that would remain beyond criticism and refutation.

Philosophy has an active effect on life, as well as science, but in another way, namely through the formation of new ideals, norms, values. Like any form of world development and system of knowledge, it is divided into relatively independent disciplines: ontology, epistemological, anthropology, social philosophy, history of philosophy, philosophy of religion, methodology, philosophy of science, dialectics, logic, ethics, esthetics, etc. The main tendencies of modern philosophy development are connected with the comprehension of such problems as the existing world and place in it of man, fate of modern civilization, unity and variety of cultures, nature of human knowledge, existence and language, etc. One of the central places is occupied by the problems of philosophy of science.

At the end of this question, we will emphasize the following. The modern world view, which is based on science and philosophy, includes also the non-scientific ideas and tests the influence of other forms of development of the world. As a result, the very image of science presented in the scientific world is somewhat corrected.

Note some **important features of modern world view:**

- the truth is not the only thing, it depends on a number of reasons, for example, the way of interpretation;
- scientific knowledge is often conducted not for the sake of truth, but in accordance with the tasks of its future application;
- humanity develops not only on reasonable grounds, possible, "victory" ideas, which at all can not be justified scientific;
- science and rational thinking is not the only basis of social and political decisions, scientific approaches in society work together with the non-scientific;
- countries and peoples can develop in different directions, the fate of each of them is not repeated and not always as a result of rational and scientifically grounded choice;
- a generally important may not have advantages over private, whole - before a not true, true - before the essential, scientific - before the everyday.

2.4. The role of science in modern education and formation of personality.

Science is somehow related to all areas of human activity. The big role of **science in education.** The scientific picture of the world is the basis of modern education. The meaning and content of any level and any form of education are relevant scientific disciplines, even if it is religious education, which includes, first of all, the mastering of theological material, or philosophical, which requires, first of all, the mastering of philosophical knowledge. Scientific knowledge is an integral component of the organization of the education system itself. To the appearance of science, education was based on the imitation. The student lived in the family of the teacher and gradually learned knowledge, profession, and even way of life.However, and then the beginnings of scientific knowledge played not the last role. But when science became an independent form of world development, the process of education began to be built on the scientific platform. Pedagogy seeks to introduce scientifically grounded approaches, which take into account the peculiarities of neurophysiological, mental and emotional-strong-willed sphere of activity of the students and the educational ones. The role of science in education extends to all components of the educational process: goals and tools, initial principles and results, forms and methods, etc.

Significantly, the educational system itself suggests a scientific approach, in particular, the application of scientific novations can radically change both individual structural elements of the educational process and the entire system of education. At this stage philosophy is often connected, offering a certain type of philosophy of education. However, it is connected with one or another scientific concept: psychological, pedagogical, physiological, didactic, economic, etc.

The process of education must have its logic, forms, methods. standards, principles and to be purposeful. Therefore, without a scientific approach, the organization of education is impossible. However, there are many issues, controversial provisions, unresolved problems. One of the major problems is the following: in what sense of pedagogy or didactics can be considered science? Are they closer to art or to everyday generalizations? What pedagogical model meets the standards of science? What scientific principles and norms work in the process of education organization? There are also more single questions: How appropriate education specialization is, how justified the ratio of active and passive forms of education, how science forms the world view of the indicator and so on. This type of question is philosophical and methodological. Many components of the light cycle depend on the answer to them.

In addition, in the course of education is the formation of personality. And this is not only the transfer of some or other knowledge, but also the attraction to cultural and national traditions, the development of creative abilities, ethical and esthetic education, and so on. In other words, many places take a non-scientific form of action on studying and attraction not only to science, but also to other ways of world development. Yet science is the strongest factor in shaping human attitudes toward the world.

It is important to emphasize that changes in science and technology, as well as other civilization changes, should be promptly taken into account in the content plan of updating of the material being studied, and in the plan of orientation on new realities in civilization, culture, science. Active forms of education become topical: business games, trainings, studying of typical and unusual situations, information technologies, etc. But can they completely replace traditional methods? A very topical philosophical-methodological question: How to organically fit the humanitarian component into the scientific and technogenic educational process. Despite many problems, the huge role of science in education is obvious.

Science, as it was shown before, includes scientists who are subjects of the cognitive process. Scientific work is their professional activity. In connection with the special role of science, the profession of the scientist has considerable prestige. Like any profession, it has levels and grades expressed in scientific degrees, ranks, posts, and should be confirmed by scientific activity, for example, scientific publications, their quantity and quality, various forms of recognition, for example, the awarding of prestigious prizes.

In connection with the differentiation of science **many kinds of scientific and research activity have arisen**, for example, theorists, who are more serious to the production of theoretical knowledge, experiments, engaged in planning and conducting experiments, analysts, inclined to substantiation and refinement of the expressed scientific ideas, novations, which are difficult to organize new ideas, are talented and beautiful performers, are beautiful. there are individuals who work well independently, and collectives that work perfectly in the team and so on. A very serious problem is to determine not only the propensity to scientific work, not only the branch of science, where the scientific potential of the individual is best realized, but also the propensity to a certain kind of scientific activity.

Scientific knowledge, deeply penetrating into all spheres of human activity, can be relatively early to reveal its future carrier and creator, but it is necessary to improve the forms of such detection and encouragement.

Dissemination of scientific knowledge is important not only in the preparation of future scientists. It is important to form **scientific awareness** among those people who will not be professionally engaged in science. Without this kind of foundation, science may not be understood in society, perceived as unnecessary or harmful.

Modern science is sometimes called a **Big science**, taking into account the well-developed system of organization and production of scientific knowledge, developed system of scientific communications. At the end of XX century. the number of scientists in the world exceeded 5 million people. Science includes about 20 thousand disciplines and several hundreds of thousands of scientific journals. And the matter is not only in these quantitative indicators, but in the role played by modern science, which on the one hand transforms society and the person, on the other hand it sometimes becomes dangerous. That is why it is necessary not only to develop, but also to study thoroughly what many disciplines do, in particular philosophy and methodology of science.

Many scientific results are given to multiple expertise, in particular humanitarian ones. Science cannot lose its ethical and humanistic sense, otherwise it is from the phenomenon of culture, will turn into its antipot and become a burial ground of mankind. Therefore, in the system of education and personal education, the science should receive a comprehensive lighting.

A particularly important comprehensive and holistic understanding of science and its connection with other world-view forms at the **university stage** of professional education of the future scientist. In technical universities, especially in the post-Soviet space, remains an influential wrong and harmful philosophical-methodological setting, which is beginning since the Soviet times. According to her, philosophy, or other humanitarian discipline, should help the specialist in his formation, find himself there, in his discipline, in his professional thinking. This role of the maid was evident in the Soviet times, when philosophy served the ideology, as it once was considered the servant of religion. Therefore, the role of the maids of science, in particular applied science, as well as any engineering specialty, seemed obvious.. In this case, thinking and worldview specialist is narrowed to an obscene narrow limit, leads to professional thinking and professional outlook. Wits call it professional cretinism. But the cretin does not realize himself a cretin. Not having a conscious, general scientific, philosophical, humanitarian training, he is to judge everything from the position of his specialty: philosophy, science, education, public interest, politics, about the family and so on The inferiority of such a position is obvious for a well-educated person, but not for a "narrow" specialist. Of course, specialty should be narrow, but special knowledge should fit into broad education, in humanitarian world view, in philosophical-methodological and general scientific ideals and norms, but not vice versa.On the contrary, it is dangerous even for the science itself. Its disintegration on independent special knowledge, methods, disciplines without orientation on general scientific norms, values, ideals and so on can destroy science, because then every sphere of knowledge, not taking into account, for example, general scientific norms, will declare itself independent, specific science, with its own vision and application. The difference between science and false science, anti-science and generally non-science then will not remain. Everything will be science, but there will be no science. Will science and technology civilization survive without science? The answer is obvious: No.

Question to repeat:

1.Name some components of science.
2.What is the main task of science?
3.What are the classifications of sciences?
4.What is the difference between scientific outlook and artistic outlook?
5.What is the difference between scientific outlook and philosophy?
6.Define the difference of scientific and religious development of the world.
7.What role of science in modern education?
8.How does science participate in formation of personality?

3.The emergence of science and the main stages of its development.

3.1. The problem of the periodization of the history of science. Elements of science in the era of antiquity, medieval times, Renaissance.

Periodization of science. As a special form of knowledge and a special way of mastering the world, science arose in Europe, at a New Time, in the XVI-XVII centuries. Prior to this knowledge was everyday, religious and philosophical. Within the framework of philosophy there were separate knowledge which later entered into independent fields of science, for example, Euclid geometry. If they are summed up, they will form a kind of very valuable array of knowledge, which can be called a pre-science. Within the framework of philosophical systems there were separate fragments of knowledge, important both for further development of philosophy, and for development of other forms of development of the world: art, religion, science. In this regard, sometimes they talk about ancient and medieval science. The word "science" here is understood not in full sense, but in partial, for example, as some important knowledge, different from the everyday one. And the fact that it was philosophical in this case does not matter, because even now some aspects of philosophical and scientific knowledge are almost indistinguishable. In addition, when the logic of some discipline is being formed, its knowledge is also included in the structure of its knowledge, although there it is little other context and other sense.

Such an approach is, by and large, incorrect, because the socio-cultural sense of knowledge is ignored, and it is unrightly modernized. But from the point of view of presentation of the logic of development of human opinion, logic of development of philosophy and science it is to some extent justified. However, the appropriate stipulations always needs to be done, otherwise there is confusion. For example, political scientists often lead their science from the old Greek philosophers and many have a reason why Plato hated democracy, although it is now proved to everyone that it is the best form of social order. And the fact is that he understood democracy in a different sense than modern one. His "democracy" is closer to the notion of "ochlocracy".

Similarly, the case with the old Greek mathematics, which was a philosophical knowledge, and, say, in the Pifagoryans was a way of understanding the world, rather than mathematical knowledge in modern sense, that is not used for studying nature or creating a technical structures. Here is a typical example. Pythagoras came from Egypt "Egyptian rope", which had great practical significance. He was an ordinary rope, which was tied knots at an equal distance from each other, so that the motie consisted of twelve equal sections. If you lay the rope on the ground in the form of a triangle so that there are three cuts on one side, on the other four, and on the third - five, then against the larger side will be a straight corner. The construction of a direct corner was invaluable for building walls, marking sites, building channels, etc.Pythagoras theoretically summed up the relationship of the sides of the rope, creating his famous theorist Pythagor that the square of hypotenuse equals the sum of the squares of cathetes, which, unlike the rope, did not have any practical significance. Practical sense will be more than two thousand years later, when a theoretical mechanics appears. The Pythagorsky Union was engaged in such things for the little-understood practical people then and today for reasons, for example, in search of a special harmony. Moreover, the Pifagoryans also and carefully concealed their theoretical findings, trusting them only chosen, otherwise the simple upholstery or some comedian would simply inhabitant them, just as it ridiculud. So was the Heraclit ridiculed by the idea of the general change of all existing, or Aristarkh Samoski by the idea of the Earth movement around the Sun.Aristarkh was ahead of the Copernicus for two thousand years, but the first scientific revolution, the nucleus of which is a heliocentric system, is called the Copernican and quite rightly. But this is in the following sections. In this regard, Aristotle can reveal the embryos of almost all modern sciences, both natural and humanitarian. And even earlier in Egypt, Babylonia, India, China we find separate elements of astronomy, ethics, logic, mathematics, etc.

All signs of science correspond only to the knowledge which is formed in the late XVI, — the beginning of the XVII century, when together with a special knowledge, different from art, religion, philosophy, there is both scientific professional work, scientific communities, and scientific publications.

The most reasonable point of view is the following periodization of science:

1.Prescience, which includes knowledge of antiquity, Middle Ages and Renaissance. Sometimes they add knowledge, known to the vicars of Babylon and Egypt, as well as those that existed in ancient China and India, although this is a very controversial point of view, despite the great importance of such knowledge for that time and even for the modernity.

2.Science, divided into three stages:

– the classical science (XVII-XIX centuries), which emulates everything related to the subject and its means, seeking objective and true knowledge, and the ideal of which is mechanics and laplacian determinism, and the image of the world is a clock mechanism;

– non-classical science (the end of XIX – the first half of XX century), which takes into account dependence of knowledge on means of activity of the subject, and the ideal of which is quantum theory and statistical determinism, and the image of the world – stream;

– post-classical science (the second half of XX is the beginning of XXI century), which takes into account the correlation of knowledge not only with the peculiarity of the means of activity of the subject, but also with its valuable and target structures, and the ideal of which is the synergy and self-organization and "casual" determinism, and the way of the world – integrity and development.

Reasons for the emergence of science. Researchers identify different reasons for the emergence of science.

The simplest explanation is that science is caused by practical needs of a person. This can be confirmed by a number of examples. But there are no less examples of the fact that science is not connected with practical tasks. In addition, practical needs in the knowledge arose immediately with the emergence of a person, but to lead the beginning of science from that time it would be senseless.

Another point of view is that science arose accidentally from the unification of the old Greek deduction and the experiments of Galiley. This point of view was followed by the great scientist Albert Einstein, a well-known Anglo-American scientist Derek Price and others. This position is poorly justified. The emergence of such an important phenomenon as science should be legitimate, not accidental, or at least have some serious and deep grounds.

An interesting point of view was presented by the British scientist of the XX century, specialist in ancient Chinese science, Joseph Nidem. Science, in his opinion, appears in the civilization of unstable type, when there are "extra people", that is not occupied in traditional social structures. This situation, in particular, occurred in Europe at the end of the middle centuries, and is connected with the principle of inheritance. Fief inherited a senior son. The second son went to military service. The third is in the monks. And the next son was not a social place. They became wandering lyricians, were hired on the ship and went to open new lands, became alchemists or simply, learning at university, sat at home and thought. In other words, these people formed the social group in which only future scientists could form. Such a reason cannot be discounted from accounts, but certainly it could not be the only one.

These positions are interesting in their own way, although they are not generally accepted. However, if they are not recognized as such, they can not be taken into account at all.

The most influential point of view is to take into account the complex of conditions of socio-cultural and world-view, such, which were formed on the eve of the XVI century.

First of all, serious socio-economic and cultural shifts have begun: Industrial society is changing the agrarian civilization. The development of the industry, the technique is conditioned by science, and the science itself moves forward by industrial needs, although not only them – there are other, not less, but perhaps more, important factors. Of course, bourgeois revolutions in the Netherlands and England played their role, and later in other countries that provided the relevant legislation, in particular, free working hands, which prompted the development of factory production, construction, mining and military affairs, navigation, and most importantly, that ensured relative freedom of the world, which is very important for scientific activity. In all these changes, an experimental science, in particular mechanics, fits well, but first of all – the mathematics of natural science, without which there would be no mechanics.

The last circumstance should be emphasized especially, because the main reason for the mathematization of science should be sought not in production, as economists, in particular Marxists, but rather because the outlook and faith became more free, which allowed to form the appropriate philosophical doctrine, which "allowed" to apply mathematics to the study of nature.

The fact is that even from antiquity was known the main difference between mathematics and physics. Mathematics is engaged in absolute constant essence. For example, the sum of the corners of the triangle does not depend on its shape, nor on its size, nor on other factors that change, it is unchanged. Unlike mathematics, the physics that studies nature has a case with things that change. Thus, it is impossible to apply mathematics to physics. Galiley began to make the first timid attempts of this kind, which he deserved, mostly taunts and misunderstanding, although he remained in the centuries of his words "the Book of the Universe is written in the language of mathematics". And rigid canons of Catholic faith did not promote free scientific and philosophical searches. The Dekard in France, where the influence of the Catholic Church was not so powerful, was a little easier.It was he who managed to build a philosophical teaching that laid the foundations of rationalism as a universal method of knowledge, justified, in particular, by his idea that God, who created a spiritual and material substance according to the same laws. In material substance, ie in the physical world, he laid together with movement and peace, and also number. Therefore, the mind, opening the laws of nature, forms them in mathematical language. This idea stimulated the work of Descartes and other scientists on research in mathematics and theoretical mechanics and in general stimulated the stormy mathematics of science.

Changes in the religious worldview were important factors that led to the transition to a new stage of social development. They received the name Reformation. First of all, it is about Protestantism, initiated by Martin Luther (Lutheranism) and Jean Calvin (Calvinism) in the first half of the XVI century. Religious changes were accompanied by a significant criticism of Catholicism and its theological-philosophical provisions. In particular, the idea was grounded that the mind could not grasp the faith that meant criticism of the scholasticism, which in turn expanded the possibilities of empirical, research knowledge. This formed the basis of the science that was formed. Having established faith and knowledge, Protestantism approved the use of intelligence for land affairs, so it is possible to use science for its benefit, for example, for the factory business. In general, any work proclaimed the desired God, and that the entrepreneur had succeeded, meant .In general, any work was declared the desired God, and the fact that the entrepreneur had succeeded meant that God was going through him. For example, in the middle ages, the Likhvara activity (the origin of the banking business) was perceived as sinful, so the Likhvar often sacrificed his considerable statue of the church, hoping to earn the forgiveness of sins. From the point of view of protestantism, the likhavar is as useful worker as well as a farmer. Now the likhvar of his article sought to increase, and passed on to the heirs, who developed it further. Without the prosperity of the banking business, industrialization would be impossible. It is not by chance that many thinkers, for example, Max Weber, in opposing Marx, link the formation of capitalism first of all with the emergence of a Protestant faith, not with economic mechanisms, as Marxists believed.Protestantism welcomed, through its religious provisions, all the adaptations, technical improvements, scientific discoveries, applied in the case, giving the space of scientific creativity.

However, the positive role of the new religious worldview in the emerging sciences should not be exaggerated. It is enough to remember that it is Protestant, not Catholic theologians, who have obtained in their countries labor bans Descartes. The fact is that in Protestantism God always interfere in earthly affairs, for example, passing the success of the chosen. And in Dekart's philosophy God created a world which then develops according to divine laws, and God, accordingly, is clumsly interfering, so the world as if developed by itself.

Thus, world-view changes, as well as cultural, economic, philosophical and so on, they were controversial, but all of them in aggregate formed the complex of external conditions in which science emerged as a new cultural phenomenon, as a new way of mastering the world.

At the same time, one cannot ignore the internal factors of knowledge development, inherent to it internal logic, regularity, continuity. Every further thinker and scientist stood on the shoulders of the predecessors. Only taking into account external and internal factors together will give an accurate picture of the emergence of science. Therefore, it is important to find out what knowledge in the epoch of prescience led to the formation of science.

The prerequisites of science in the era of Antiquity. Scientific preconditions are usually distinguished, starting with antiquity, although surprising knowledge can be found before, for example, in civilizations of the ancient East, India, China. They concerned mathematics, chemistry, medicine, pharmacology, psychology. In the Sumerian civilization there were amazing knowledge, with the help of which the sumerians found the pottery circle, wheel, bronze, colored glass, established the duration of the year almost equal to the modern idea. Striking knowledge of ancient Egyptians, relating not only to the construction of the pyramids, but also to the mummification, the trepanation of the skull, the growth systems, etc. But all these "eastern" knowledge had at least two specific features that prevented them from becoming scientific. First, the knowledge that was of a religious and mystical nature prevailed, possessed only be priests, therefore their use had a sacred ritual character. Secondly, knowledge, especially practical, had a prescription character. Calculation of areas and proportions, calculation of produced, calculation of taxes was often carried out with the help of various tables with ready solutions. There were no theoretical generalizations, namely they are one of the most important features of scientific knowledge. The first old-Greek thinkers often went to the east for such a kind of amazing knowledge, but did not accumulate them in this prescription form, but gave a theoretical form. True and their theories were not yet fully scientific, they were demanding philosophical, but it was an important step on the way to science.

The specifics of the world's development by civilizations of the ancient Mesopotamia, Egypt, China and India are determined by the way of thinking, which differs from the European one: there is no rational study of the world, theoretical solution of problems, and generalizations that reach the theoretical or philosophical level are closely intertwined with the religious-mythical perception of the world. Mythological world view is an important form of peace development, but without its elimination one cannot speak about science. This does not mean that the ancient eastern way of thinking and life is worse than the European one. Perhaps it is even better, because it assumed harmony of man and nature, unlike the European, based on the root nature and such that brought modern humanity to the abyss of global problems. But the end of the European road was realized, which brought the whole world, including the East. He was born in ancient Greece.

At first, old-Greek civilization, like all others, was based on mythological perception of the world. A prerequisite for the emergence of scientific knowledge many researchers of the history of science consider myth. Myth, in some sense generalization of available knowledge, because of which some experts consider it a precondition of science. Indeed, many myths, especially cosmological reminiscent of naive theories, although their poetic story quickly resembles a fairy tale. But the myth is not a fairy tale, but an image of thinking, a way of understanding the world, Kazka is something external in relation to thinking: both the fairy-tale and the listener understand the fiction of the fairy-tale plot and characters, although in fairy-tales there is a great educational and educational value. But myth is another matter.Mythological subjects and characters are perceived as real. Myth is something internal in two sense. Myth is inside the person and is projected on the world, because of which the world looks anthropomorphic. A person lives inside the world and look at him from the side and somehow assess, somehow to treat him with confidence or distrust can not. Such a question does not even arise in mythological outlook. In this sense, mythological knowledge is of great importance, but the conception of science cannot be.

All myths of cosmogoni describe first the state of chaos, and then its arrangement. For example, in Greek myths first dominated titans, as the identity of chaos, and then they were won by Olympic gods, as the identity of order, harmony, beauty.

In the myth necessarily there are story (narratives) about the past, about the first ancestors, about the first subjects, which is similar to philosophical theories, and a description of the present, and sometimes the future, which reminds the science. Here is the impression that philosophy and science have originated in myth, especially since in mythological thinking, as in any other, there are rather complicated mental operations and procedures: Abstraction, otototoshenie, comparison and others.

The formation of the prerequisites of science is connected first of all with the emergence of philosophy, which led to the cultural revolution in ancient Greece in the VIII—VI centuries to the century. The reasons for such a coup are diverse. One of them is the transition from a traditional society to an unconventional one, which has demanded new mental operations and new forms of development of the world. In the simplified form it can be described so. In a traditional society, knowledge transfer goes from generation to generation, and knowledge growth is realized through specialization. Integration, and thus, a reasonable generalization operation, are absent, because the combination of professional skills is nothing to do. But there are pirates. In order to combat them, integration, which requires mental operations, connected with generalization, is necessary. Generalization is the most important form of thinking on which philosophy and science are based. Moreover, ancient Greece was a huge territory where there were independent cities-states with their own, different laws, forms of government, rituals and even ruling myths. In this, the Greeks significantly different among themselves. At the same time, they United a lot: both the community of language, and the world-view community, and cultural unity. This could not help ask the question: How is unity in diversity? Here is one step to the formulation of the main philosophical question: What is common in different things?

One way or another, but philosophy as an independent worldview, as an independent combination of knowledge appears exactly in ancient Greece. In the rest of the regions philosophy was not distinguished from mythological ideas. Modern outings of old Chinese or old Indian philosophy is philosophical knowledge, distinguished by a back-to-back number of ancient syncretic integrity. As already noted, it should not be seen in this lack or damage of the eastern world, just it was different.

Among the other reasons of philosophy and science, the spirit is also noted competition, is characteristic of the policy structure, and the invention, which generates disputes, and the need for substantiation, reference of statements. Philosophy helped not only to find proof arguments, but also provided the general knowledge from which the grounds for partial output were drawn. Philosophy was not engaged in generalization of experience, as then the science, which takes over everyday experience and contradicts it. Philosophy has drawn its "ideal" objects in non-experimental structures, for example, in language. Thus, Demokritis, creating his teaching about atoms, thought in this way. Everything consists of something.The story consists of paragraphs, paragraphs from speeches, sentences from words, words from letters, and letters can not be further spread, they cannot be divided, they are indivisible. This analoguey is easily transferred to the world as a whole. Everything consists of the indivisible first-gloss – atoms (an atom in Greek means indivisible). The Atomistic teaching became the most important acquisition of antiquity, which was not a scientific knowledge, but later the science of new time will be built. The same can be said about old-Greek mathematics, which was also a pre-scientific knowledge, without which science of new time could not be carried out.

Since scientific knowledge is oriented on the search of subject structures which cannot be found in everyday practice, the most important thing as a pre-scientific theory played Parmenida's teaching about life. Parmenid came out of the fact that the "speech" world, which surrounds us, cannot be a real life, because it is a variable, divided, moving as a fire in Heraclius. The real life is indivisible, real, the only, eternal, but it can only be found by reason, and the feeling fixed only the changing world and eternal truth cannot give. Many researchers consider this idea to be a key idea, and hence the beginning of scientific thinking, which is truly "reach" by eternal, unchanging laws.Indeed, scientific knowledge is very similar to the Parmenidovsky world of real life. The great thinker of the XX century Martin Gaidegger was expressed figuratively: the atomic bomb first exploded not over the Hiroshima, but in the Parmenidovskyi's life scientist. In other words, after the proclamation of the Parmenidov idea of being, mankind has gone on the way of its search, what has taken place philosophy, and then science, having created scientific and technical civilization, which has generated both creative efforts and destructive forces of the type of atomic weapon.

In antiquity a lot of knowledge was developed, some of which was used by science of new time, as geometry of Euclid, part was forgotten and re-discovered again, part is lost forever. But the main thing that has turned out to be the achievement of the ancient civilization and that has formed the prescience – the basis of the future science, is the creation of a special intellectual space with the most important ideas and methods. They include the idea of Parmenidov's existence, atomic doctrine, aristotelivska logic, the concept of theory, theorems, the evidence is similar. In this space, even wrong ideas, which were later rejected by science, were of positive importance, developing thinking, mental procedures, methods of substantiation and building of knowledge, etc. An example can be a physicist Aristotle, in which there was a difference in the super-monthly world, where there is an ideal circular movement of bodies, and a sub-monthly world, where movement is imperfect. Thanks to the idea of circular movements Aristotle so presented the movements of planets and stars that more than two thousand years his painting of space was only supplemented and not looked at the appearance of scientific astronomy.

The prerequisites of science in the middle age era. The medieval epoch covers about II-XIV century. In the first place, the struggle of Christians with pagans has been in the destruction and destruction of works of pagan culture, in particular, texts containing ancient knowledge. The Christian world view was self-sufficient and did not require predecessors. He started and ended in God. On the one hand, this meant a fall in the role of knowledge, on the other, it meant the beginning of the formation and development of another culture of knowledge based on religious faith in the religious world. Only later did Christian culture once again discover the ancient authors, adapting them to the Christian world view. This is especially true of Aristotle, whose teachings in the second half of the Middle Ages enjoyed a great influence.This explains the fact that the formation of science of new time was connected with criticism, although not always fair, many aristotelian ideas.

Middle-age knowledge, which consists in Europe, from the point of view of that time should meet the obligatory requirement: to be general and prove. On the one hand, it was the preservation of ancient ideas, on the other – it came out of the Christian faith: the creator, according to the idea of which the world exists, could possess only the general and proven knowledge. There is no need to prove it, it is enough to believe. Moreover, attempts to understand or justify God's ideas lead a person to an absurdity that once again confirms the truth of faith. One of the first Christian hunters, Tertulian even declared the formula: i believe, because it is absurd! Accordingly, the Holy Scripture (Bible), and then the Holy Transfer (texts of the parents of the church) became the only source of real general knowledge. Human knowledge as relative, inaccurate, partial could not even compare with him, so nothing and try.Therefore, it is clear why the thinkers of nature were interested only in the confirmation of the greatness of God.

The priority of faith over reason existed in the first half of the Middle Ages, and from the middle of the Middle Ages (IX- XII centuries), with the development of sholasticism, with the emergence of universities of trust to reason increases. In the XIII century, the great Christian thinker **Homa Aquinas** even proclaimed the principle of harmony of faith and mind and provided five proof of the existence of God. From the point of view of modern representations of his evidence is rather naive, but at one time it was a grandiose innovation, which allowed to raise the authority of knowledge considerably. Philosophy, formed as a comment to the sacred texts, turned into a service of theology and lost the role played in antiquity.But, just for the sake of justice, it should be noted that gradually religious philosophy has found extremely important problems, whose significance went far beyond the scope of comments, and the attempts to discuss them and the decisions made the mental space in which it was possible to formulate extremely valuable ideas, some of which serve as the basis of science of new time. In this sense, we can talk about the pre-science of the middle centuries. Therefore, it is not necessary to think, as some authors believe, that the middle centuries were a complete darkness and a break in the development of mankind.

It should be borne in mind that the medieval knowledge is permeated by **symbols and teleologically**. Thus, because all in the world of creation of God, things symbolize first of all the Divine Power, the Divine Beauty, and so on. Teleology follows the fact of divine creation: everything is appointed by God for some purpose. Symbolism and teleology played a positive role, recording visible and invisible harmony of the world. But the future science will not be easy when subjects begin to be considered as they are in fact, combining them with the general harmony will not be easy.

In the middle ages there were spheres of activity: astrology, alchemy, natural magic, etc., which prepared the possibility of birth of science. Some authors consider these disciplines, in particular alchemy and natural magic, an intermediate stage between philosophy and technical craft, as they represented a fusion of cojecture and primitive empiritism. Natural magic then called research and knowledge of the critical forces (as we would say laws) of nature. In the framework of such magic prayers and spells are used, but also methods of influence on subjects reminding experiment are formed. Such experiments and observations recorded in the XIII century Albert the Great, who was then awarded the title of a comprehensive doctor for his most extensive knowledge.He observed darkening, volcanoes, flora and fauna, systematized and commented on Arab and ancient Greek philosophers, especially Aristotle. He conducted several successful chemical experiments, in particular, highlighted the arsenic in a clean kind. He is considered a philosopher, a theological scientist, that in the middle age was almost the same. In the XX century he was canonized by the Catholic Church and proclaimed the patron of the scientists.

Such experimenters as Albert the Great, although below the level and rank, were in the middle ages a lot, and in total they received significant results. This gives grounds to some modern authors to consider the main driving force of science development its internal logic, in particular to perceive of investigations, experiments and other features of science long before the new time. The internal logic of science development can certainly not be overestimated, but it is also inappropriate. The so-called external circumstances were much stronger. In particular, those investigations that were put at the middle ages cannot be called experiments, and the sense of them was not as if to show the greatness of God, his idea, his power, etc. However, within the framework of religious world view the preconditions of the future science were determined.

In the middle age, there were many educated people among the monks, who we call scientists for their broad knowledge. Many of them taught at universities, set up even adjusting church canons to the needs of teaching. Of course, they deserve respect and recognition, not by chance many of them put monuments. To some extent, they prepared the ground for the emergence of science of new time. It is possible to name both the early Middle Ages, especially Aurelia Augustine, and the late Middle Ages, where apart from Albert the Great and Homy Aquinas great popularity were Anselm Kentenberian, Pierre Abelyar, Jean Bouridan, William Okkam and others. Okkama, for example, belongs to the famous methodological technique **"shaver Okkama",** which is still used by scientists: from two hypotheses under other equal conditions, it is necessary to choose one that contains less assumptions, and the other cuts off as a razor.

A dispute that continued for several centuries is important for the future of science. It would seem to have touched on a purely theological issue. Among the thinkers there was a dispute about what is more important: The divine mind, with the help of which God conceived and planned the existing world, or the Divine Volia, with the help of which God created this world. The dispute was conducted in the context of clarifying the nature of common understanding. In the simplified form, the meaning of the dispute lies in the following. Some who made up the philosophical-theological direction of **realism** considered not the very things that exist, but their general concept – universal, born in the Divine understanding, which are primary in relation to some things of nature. Objects of nature, in their opinion, represent only the forms of the general understanding, which a person knows the mind, without appealing to feelings. That is, both for God the mind is primary and for man. Roughly speaking, God first thought the concept of "fruits", and then created apples, plums and others with his Divine will. Thus, the sense of human knowledge is to understand in general terms, because they are important, not knowledge about specific things.

In contrast to the realists, their opponents made the direction, which got the name of **nomolism** (from Latin. nomen – names). They considered only the very things that really exist, and the general concepts (universali) are only the names of things. According to nominations, universali exist not before, but after things, things are recognized by the beginning of human experience. Roughly speaking, God created apples, plums, etc. by Divine will, then God summed them up to the concept of "fruits", and human mind can, though in primitive form, repeat this way, pushing away from the beginning experience. That is, for man, as for God, the mind is secondary (after will, feelings).

Thanks to the realists, the apparatus of proof reasoning, convincing reasonable substantiation, logical output, for example, was improved. Thanks to the nominations increased confidence in the initial research data, the empiria. In some sense, the nominalists were ideologists of the future empirical nature, and the realists were ideologists of the future scientific rationalism.

Among the authors of the medieval pre-science one cannot but notice the thinkers of the **Arab Middle Ages**, who, in particular after the Arab conquering, have made a significant influence on European intellectual activity. The works of the thinkers of those countries, which were found in the territory of the Arab caliphate, were translated into Arabic. So were translated works of Ptolemy, Euclid, Aristotle, Archimedes, etc., which after some time have returned to Europe already in Latin, thanks to which Europeans have overopened them. The Greek influence in the form of systematization, substantiation, stringency, reflected on works of the Arab authors, who did not forget about their traditions, in particular, they gave many examples and tasks of a practical character, clarifying and developing many ideas. The mathematical works of al-Khorezmi, who lived in the IX age, in the XII age were translated into Latin and four centuries served as textbooks in Europe.On his behalf, the term "algorithm" came into the European science. Philosophy and logic al-Farabi, who commented and developed the logic of Aristotle, encyclopedier al-Biruni, who translated on the Sanskrit works of ancient authors, philosophy, poet and scientist Omar Hayam, philosopher, mathematician, astronomer and doctor Ibn-Sina (Avicina), philosophy, and doctor Ibn-Rudsh and others are the pride of Arab and European intellectual thought.

However, the significance of those knowledge left by medieval thinkers, both Europeans and arabs, for the future science should not be exaggerated, nevertheless they had a philosophical-theological sense and did not meet the norms of science, although they played a significant role. Much more importance for the future science was not scientific facts, but ideas that prepared intellectual ground for future scientific theories. Among them, apart from the nomolistic ideas already mentioned, we will distinguish two most important: the idea of double truth and the idea of implicit assumptions.

The meaning of the **idea of a double truth** lies in the following. God created the world, so he invested his knowledge in it. This Divine knowledge is represented in the holy books. Thus, a person can draw knowledge both by studying the Bible and studying nature. As a result, we can talk about two pictures of the world that cannot be narrowed one by one, because, at the end, they have one source – God. Later, the idea of a double truth became the idea of two Divine books: The books of the Holy Scriptures, and the books of nature. Thus, the divine authority justified the possibility of studying nature, which is little decisive for the emergence of science.

Similar sense had the **idea of imaginary assumptions.** The main question here was: will it be impossible for God that is impossible for human mind? The answer here is unambiguous: for God there is nothing impossible, he is omnipotent. For example, he could create the universe endless, which contradicts the mind of the human, but not the mind of the Divine, or in the center of the universe, he could put the Sun, not the Earth. In his view, it was possible to make such an assumption from him, and mathematical and astronomical calculations. For example, Mykola Kopernik was thinking about this, creating his heliocentric system. That is because it was a clear assumption, not an ontological statement, the Copernicus model was supported by the Church. It was used for more accurate calculations related to the reform of the church calendar and the transition to the new Gregorian calendar.Even when a half-century later the teachings of Copernicus were banned by the Church as a heliocentric system of the world, its heliocentric model was allowed and used for all sorts of calculations.

The idea of imaginary assumptions was used in different contexts. For example, if God is a omnipresent, then for him still, where to stay, in the super-monthly or sub-monthly world, for him these worlds are equal, homogeneous. After all, according to the representation of the time coming from Aristotle, and based on church establishment, these worlds are the opposite and can not be homogeneous. But without the idea of world homogeneity would be impossible Newtonian mechanics.

Thus, many ideas that could be attributed to the heretic sense and ban, and relevant books to destroy, were saved for science due to the idea of imaginary assumptions.

Prerequisites of science in the epoch of revival. Earlier it was shown that the preconditions of science were formed within the philosophical outlook, as in antiquity, and religious, as in the middle ages. Another world-view form – art – was of great importance for science. The influence of art on the formation of the pre-conditions of science is especially noticeable in the epoch of revival. Revival is usually defined as reproduction in new conditions of ancient ideals, especially ideals of harmony and beauty. Of course, this is true. However, the epoch, which was called the Renaissance, has made so much of its own, kind, that the ancient ideals made relatively small part among its acquisitions and innovations. It should be borne in mind that if we consider economic activity, the epoch of revival has almost nothing new. Therefore, some historians, especially economic historians, do not allocate the time of the Renaissance from the epoch of the Middle centuries.But in the sphere of art and in general in the spiritual sphere changes took place very radical. This applies to philosophical ideas, and ideas from the field of painting, and generally creativity.

In the Renaissance, a new philosophical concept of **pantheism** emerged, which in translation means God in nature or God everywhere. From this concept the important result was: if God is present everywhere, then God is a spark in man, and because God is a Creator, so man can be a creator. That is, pantheism as if rehabilitated and allowed creativity, which in the middle age was impossible. It was seen as the devil's redevelopment of God, so all activities were carried out within strict canons, in particular, the field production, especially the production of icons. Here it is interesting to note that the middle-age thinkers were creative people, and their creativity they demonstrated in their ideas. But their activities were often not realized as creative, and if they were realized, they had great problems with the church authorities and colleagues. Renaissance Pantheism is a creative expression, and it becomes an excellent feature of many kinds of activities: from tailoring to painting. The authorship of the created thing became a matter of pride, so the tailor or other masters on their works put their own mark or name, especially painting. In the middle age it was impossible, the establishment of authorship was connected with the violation of the ban on the sacred Canon and was carried out for the determination of punishment. That is why the great thinkers of the Middle Ages, which left a noticeable trace in philosophy and theology, had such difficult fate.Homa Akvinsky, for example, whose church, after his death, was ranked as saints, and his philosophy (tomism) has declared angelic philosophy, for life for this philosophy has been seriously criticized and even once church conviction, which was an extremely painful blow for him. If the author did not violate the ban, but was a hand-over, repeating, for example, the sacred Scripture or the Holy Transfer, he was not the author in the true sense of the word, his name was of little importance only in professional terms for potential customers, for example, when writing churches or for future students, and the biography of few people interested and with creativity not connected. For the medieval monk who rewrote and commented on the Holy Scripture or the Holy tradition, it was more important to convey precisely the

Divine idea or ideas of the church's parents than to express his personal opinion.Only in the period of Renaissance, when a person begins to consider himself a creator, pressing God in his valuable picture of the world and dissolving him in nature, human creativity rises at an unprecendented height.

The great artist, the titan of Renaissance Leonardo da Vinci brought into painting the idea of a **picturesque perspective.** So before artists did not write. Substantiating the necessity of this creative breakthrough in painting, he stands out among other arguments: **it is necessary to write as the eye sees.** This meant confidence in the feelings that appear to mean no less than mind. It is symptomatic that Galiley will then explain the role of science in a similar way to that of philosophy: if philosophy penetrates into the essence based on reason, science should describe what "sees" the feeling. Of course, science should use special language, precise concepts, quantitative mathematical methods, ideal objects, so as not to jump into ordinary everyday experience. But the main thing is that "sees eye". That is why Galley added a great role to scientific observation, using special surveillance means.It was a huge creative breakthrough, which was established far from right away. Distrust to telescopes, lenses, even to glasses did not last for one century.

Art in different ways, through creativity, ingenuity, special techniques, image of subjects of research, etc., influenced the formation of science. In particular, the first scientists were great "mastakov" in the construction of devices, experimental installations, in the image representation of their calculations, models. They often had to take the lessons of painting, because they needed sketches in a variety of cases: and when studying flora and fauna, and when exploring geographic or mineral objects, and even in astronomical or technical considerations.

Renaissance thinkers have done a lot for the future of science. Let us remember here two, the most famous: Mykola Kuzansky and Giordano Bruno.

Mykola Kuzansky, Cardinal of the Roman Catholic Church, the largest thinkers of the XV century, philosopher, theologian, teacher-encyclopedia, mathematician, church-political figure. One of his main philosophical ideas was pantheistic, according to which God is dissolved in nature. Because God is absolute and infinite, then nature is endless, so it has no center, or, in other words, the center can be anywhere. Hence, the Earth cannot be in the center of the universe. Neither the Earth nor the Sun can occupy any special, privileged position. This is little of great importance for the formation of scientific astronomy. His ideas have had a significant impact on Giordano Bruno, Leonardo da Vinci, Nicholas Copernicus, Galileo Galiley, Iogan Kepler and others.

Giordano Bruno, a philosopher-pantheist was a simple monk, and he violated the rite, which was at those times a serious crime. His ideas are close to Kuzantz's student, in particular, he proved the endless universe. But his output was radical. So he justified many worlds, considered stars as numerous sun, criticized the Aristotles-Ptolemy system, in the center of which the Earth is located, opposed to it the heliocentric system of the Copernicus, adding to it ontological sense, which was contrary to church conception. He was charged in the heresies and burned to fire after almost eight-year investigation, during which, being a brilliant polemist and outstanding thinker, managed to release all the world-view accusations and prove the substantiation of his position. I couldn't only justify my understanding of the Holy Trijka and the violation of the black ritual, which defined the death sentence.

3.2. The emergence of classical science. Development of a new model of scientific research.

Peculiarities of science of new time. The period of the XVI-XIX centuries is related to the new time. At this time there was a classical science, which is usually identifity with classical natural sciences, since social and humanitarian disciplines are formed later, in XIX-XX centuries.

Science of New time has raised many questions in a new way, among them:

– about the cognitive activity, its essence, tasks, methods

– on scientific knowledge, its peculiarities and originality of its formation

– the place and role of science in society.

As a result of answers to these questions formed a new outlook on the necessity of human control over nature on the basis of knowledge of its laws, as well as a new image of the world and style of thinking. As a result, the scientific world view was formed, which was used by other world-view forms: philosophy, religion, art.

The ancestor of science by right is considered **Galileo Galiley** (1564-1642). He established the principle of relativty movement, for the first time formulated purely physical, i.e. not anthropomorphic, laws of nature: the law of free fall of bodies, the law of inertia. The law of inertia is of particular importance. If ancient Greeks knew the law of inertia, the heliocentric system would have arisen for two thousand years earlier. Its author, Aristarha Samossky, criticized the "killing" argument, based on the ignorance of the law of inertia: if the Earth moved, then the counter wind from it would all blow.

Galiley was called Columbus of the sky: he found spots in the sun, mountains and the west on the moon, phases of Venus, a collection of stars on the Chumak way, etc. But the main thing is not even these discoveries, but those methods that laid the foundation for Galiley's achievements, and those world-view conclusions that came out of them. They defined the science of the new world outlook.

Galiley began to apply the **method of observation**, using all sorts of devices, and placing objects in special conditions, which gave the beginning of another scientific method – **experiment**. His observations were not just observations, but purposeful activity, as well as experiments, with the use of idealizations, abstractions, theoretical assumptions, mathematical thinking and analysis, which distinguished his investigations from routine research, and provided independent output, which could not be achieved by medieval "experimentators".

The main feature that allows us to talk about science from the point of view of special knowledge is when not just theory is created, but a theory in which empirical facts and dependencies between them are produced as an investigation from theoretical postulates that are not their simple generalization, but a jump of opinion to such generalization, which allows to lead investigations, which was not in the initial experience, that is to predict new facts.

The above methods allowed Galiley to establish a feature of science, unlike philosophy. Philosophy penetrates into the essence of things, therefore it is not interesting investigations and description of external, visible and observed characteristics. This is exactly what science should do, which through the description of the observed will establish a law-based relationship between the properties of things.

A typical example was Galiley's reasoning about the fall of bodies, which later were called a imaginary experiment. In works Aristotle stressed that the heavy body falls more easily. This was confirmed by the usual observation: apples, falling from the branch, fall faster than the letter that broke from the same tree. But the fact is that the everyday dogtrail and scientific research is not the same. There was no antiquity research.

Galiley thought so. How will the total body composed of a heavy and light body fall? On the one hand, it should fall faster, because the heavy part will accelerate the fall. But, on the other hand, it should fall more slowly, because the part will slow down. Both are legitimate, so this phenomenon must be warned in reality, creating the appropriate conditions. So was born the famous field experiment, which conducted Galiley with his pupils. They simultaneously and variously throw objects of different weight, for example, a musket ball and a cannonball, and observed, time. Objects reached the land almost simultaneously. From this point on, the aristotelian idea is wrong, that the movement has other characteristics, that it should be studied by new, scientific, means.

Observations of the sky also gave unexpected conclusions. After all, according to Aristotelian scientist, which, as is known, was confirmed by various very convincing arguments, and most importantly, church decisions, bodies of the supermonth world are made from pure ether. Meanwhile, the telescope showed something different, meaning the supermonthly world is actually different, perhaps not different from the terrestrial one, in any case, it should be studied by new, scientific, means. Interestingly, about a hundred years later one of the followers of Galiley showed in the telescope the spots in the sun to his students, for which he received the recovery on the ground that Aristotle does not recall the solar spots, so, seen in the telescope is not worth anything.

Of course, the former picture of the world was so rooted in the culture that the Galilev methods of research and output could not rest it much, and it will continue to rule, as well as the religious world itself. But the main thing is that the beginning of science was laid, and scientific ideas were picked up by other researchers.

At this time, the philosophical-methodological problems are of particular importance. This is due, on the one hand, to the success of the empirical nature science, and on the other, to its limited, insufficient theoretical and undeveloped nature. The successes had to be considered, and white spots were covered by speculative considerations. There is a rather painful process of division between philosophy and science, between aristotelian painting of the world and new natural science, which is known philosophy and methodologist of the end of XX century von Wrigt called aristotelivska and Galejevska science.

The great role in this process, as well as in the examination of the place and role of the new science played by **Francis Bacon and René Decard,** about which was already discussed in the first section in connection with the philosophical-methodological comprehension of science. Here you should add the following. In the work "New organon" bacon substantiates the role of the guidance in scientific knowledge, calling it new knowledge of thinking. Indeed, the new science needed exactly the inductive generalizations of the empirical material. But until now, the organonom (instrument) of thinking was considered aristotelian deduktia. That is why the bacon was to criticize the aristotelovsky ideas, because they were supported by the church, which had almost indivisible power.It is obvious that the criticism of Aristotle was also a criticism of religious outlook. For the thinkers of the time that the holiday believed in God, it was not only an act of personal courage, but also a difficult intellectual task. The works of "Great Restoration of Science", "Nova Atlantida" and others describe the prospects of a new science, which will completely transform the life of people and add such results to the subjugation of nature, which will obscure the legendary Atlantis. Understanding of the transforming role of science allowed the bacon to formulate the motto: "Knowledge is power".

René Descartes, like Bacon, understood the enormous role of science in society, but that knowledge was essential, and scientific activity is effective, a corresponding scientific methodology is needed, to which Dekart makes a huge contribution. His work "thinking about the method", "Rules for the management of the mind" contain the development of rational and analytical methods, which, on the one hand, has thrown away, but, by and large, supplemented the empiriko-didactic methodology of Bacon. In the future, the followers of Descartes (Spinoza, Lebnitz, etc.) made the philosophical direction of rationalism, and the followers of the bacon (Lok, Yum, etc.). – direction of empirism and sensualization. Both have made a huge contribution to the development of philosophical-epistemological, philosophical-methodological, philosophical-world-view problems of natural science.

To establish a new, scientific, picture of the world, the works of **Iogan Kepler** (1571—1630), which established laws of the movement of planets relative to the Sun, were of great importance. In addition, he proposed the theory of solar and monthly blackings and ways of their prediction, clarified the distance between the earth and the sun and made other important discoveries.

In a number of great scientists of new times, who created new science, especially the role of **Isak Newton** (1643-1727), whose scientific heritage is both large and diverse. Newton's main work is "Mathematical starts of Natural Philosophy" (1687). In this and other his works, Newton formulated the concepts and laws of classical mechanics, gave a mathematical formulation of the law of global gravity, theoretically grounded the laws of Kepler, thus creating the celestial mechanics, and from a single point of view explained the large volume of research data, including the irregularly moving Earth, Moon and planets, sea castings and tides, etc.

However, the following fact is important. All the scientific achievements of Newton fit into the religious picture of the world, where God gave the role of the Creator of all the existing, especially absolute space and time, within which processes described by Newtonian mechanics were developed. Science, because of its description, which was clearly defined by Galiley, cannot rest initial religious provisions, for example, prove or refute the existence of God.But it can give a thorough criticism of many church institutions and participate in the formation of scientific outlook, creating its foundation, but it cannot complete it on its own, does not allow specific. Here we need the general philosophical knowledge. Religious worldview will be hijacked only by philosophical theories of the French thinkers of the 18th century.

But Newton completed the scientific revolution initiated by Copernicus, as a result of which the fundamental foundations of the scientific picture of the world were laid, which differed significantly from the ancient philosophical and religious medieval.

His mechanics are a classic model of scientific theory of deductive type and a standard of scientific theory in general, keeping its value till now. The importance of mechanics turned out to be so great that the image of the new picture of the world became mechanical. That is, nature began to represent, as a huge mechanism (not an organism), like a clock, which goes exactly, legally, without any purpose or free will and other life forces. The fact that this world clock created and led the Creator, no matter for science, because, based on the new picture of the world, the scientist could be free from philosophical-theological prejudice and, by the example of mechanics, to build the theory of any scientific object.

The main content of the mechanical picture of the world, created by Newton, is set to the next. The whole universe and all its objects from atoms to man are a combination of indivisible and invariable particles, which move in absolute space and time. They are interconnected by the forces of gravity, which are instantly transferred from the body to the body through the void. Therefore, any phenomena are strictly conditioned by the laws of mechanics, so if there were a comprehensive mind (the demon of Laplace), it could definitely predict and calculate any events.

The famous mathematician, mechanic, astronomer Pierre-Simon **Laplace** (1749-1827) has done a lot to approve the mechanical picture of the world and, from here, mechanical cause and law, as a result of which the concept of mechanical determinism, which was also called Laplace determinism.

In XVI-XVII centuries **a new style of thinking** was formed, which can be called scientific. The further development of science has made it correct in connection with the appearance of non-classical and post-classical features of science, but the essence remained intact:

– attitude to nature as a self-sufficient natural object, devoid of anthropomorphic and symbolic sense

– refusal of naïve built experience and physical and physical thinking of antiquity and middle ages

– application of quantitative methods, measuring equipment

– creation and use of devices

– approval of the cause-effect determinism and rejection of the teleological, organic and animistic determinants.

In general, the **features of classical science** can be brought to the following.

1.The leader of science is natural science, in particular, Newtonevska mechanics.

2.The ideal of science is objective reflection of the object.

3. Scientific research should include mathematical means and scientific methods: observation, experiment, measurement, as well as special mental procedures, which were later called theoretical methods: analysis, induction, dedukation.

4.Scientific knowledge should be grounded both by rational and empyritic means.

5.Scientific knowledge is different from philosophical, religious, from art.

6.The scientific style of thinking is based on determinism, in particular Laplace.

The classic ideal of rationality. In the XVII-XIX centuries developed and wide spread of the natural-sense ideal of rationality, called classical. Although in many of their manifestations the science of XX-XXI centuries is experiencing non-classical and post-classical manifestations, they are not comprehensive and in addition have accepted a number of classical characteristics. The natural and scientific ideal of rationality, although it is called so, but its main feature is not the aiming at natural objects, but the search for laws, that is, stable, such, repeated, frequency, which are desirable to be verified by empiric means. It actually became a general scientific, classical.

Among the requirements of classical rationality, which is obviously or implicitly presented by the scientific community, usually appears relatively small set, introduced in consciousness in the course of study and in general socialization of the scientist. It is enough in normal conditions. This is the so-called standard model of rationality, which includes the following features: clarity of thinking and accuracy of its articulation, taking into account logic requirements, proper substantiation. The scientific rationality is often supplemented by the requirement of search of laws in the objects studied, application of mathematical apparatus and quantitative methods, possibility of formalization of knowledge, the causal model of explanation, theoretical and system organization of knowledge, foreseen by possibilities. The list can be extended depending on the scientific discipline and the rigorism of the researcher.

3.3. Scientific revolution of the end of XIX - beginning of XX century. Non-classical science.

At the end of the XIX century there was a new scientific revolution, which changed in the first place the style of thinking, but also some fragments of the scientific picture of the world and scientific outlook, although the basic ideas and norms of science remained

The first manifestation of the new scientific revolution was the **Maxwell's theory** of electromagnetic phenomena, which gave a mathematical description of processes, not bringing them to mechanics and atomic structure of the world. Thanks to the research carried out by the English scientists Michael Faraday (1791-1867) and James Maxwell (1831-1879), the picture of the world included not only corpuscular, but also a continuous of ideas.

Faraday discovered the relationship between electricity and magnetism, advanced the idea of the existence of an electromagnetic field and introduced the science of the concept of electric and magnetic fields. Maxwell created the theory of electromagnetic field, foreseen existence of electromagnetic waves, put forward the idea of electromagnetic nature of light. Thus physical reality appeared not only as a substance, as it was in the mechanical picture of the world, but as a field.

True, Amper, Ohm, Bio, Savar, Lenz, Joule and other scientists whose names bear the laws of electrodynamics, for a long time tried electromagnetic processes to be reduced to mechanical, but unsuccessfully. That is why the idea that the basic laws of the world are not the laws of mechanics, but perhaps the laws of electrodynamics. However, some time later, this idea refused in connection with the discoveries in the sphere of the microworld.

The limited mechanical picture of the world also appeared in **geological and biological** studies.

The English geologist Charles Laiel (1797—1875) has developed a study on the slow and continuous change of the earth surface under the influence of constant geological factors, which also did not fit into the mechanical concept.

The French biologist Jean Baptiste Lamark (1744–1829) created the first concept of the evolution of living nature. In his opinion, species of animals and plants are constantly complicated in their organization as a result of the influence of the environment and internal aspiration to perfection. Although Lamarq declared the principle of evolution as a general law of the development of living nature, he did not reveal the real causes of evolutionary development.

In contrast to Lamarca, another famous French biologist Georges Kyuvee (1769-1832) did not recognize the changes in species, explaining the change in fossil-based techniques to the so-called “disaster theory” that ruled out the idea of the evolution of the organic world. Kyuve argued that every period in the history of the Earth ends with a global catastrophe, for example, lifting and lowering of continents, floods, layers breaks and so on. As a result of these disasters killed animals and plants, and in the new conditions there was a new look, not like the previous one. In the theories of Lamarca and Kyuvee, there were many demanding, but at the same time their ideas deserved attention both in terms of understanding the limitations of the mechanical approach, and in attempts to identify and summarize new facts. By the way, the current science in the history of the Earth and in the general picture of the evolution of life includes global disasters.

In 1838-1839, German students Mattias Schleiden and Theodore Schwann created **a cell theory** that showed internal unity of origin and development of all living.

In the middle of the XIX century Robert Mayer and James Joule independently opened **the law of conservation and transformation of energy.** A few more scientists can be added to the list of primary students, which shows that the discovery was prepared by all the progress of science, has taken place in the air. This law showed that heat, light, electricity, magnetism, which were previously appointed isolated, interconnected, move under certain conditions one in another and are only different forms of the same movement in nature.

In 1859, **Charles Darwin's theory** was published, which showed that plant and animal organisms, including humans, were the result of a long natural evolution whose driving forces were heredity and variability, as well as natural selection. Later, Darvin's theory was confirmed by genetics.

All the above-mentioned discoveries of the XIX century showed that the reality is much more complicated than it shows the mechanical picture of the world, that the style of scientific thinking cannot be brought to the mechanical, but in general the new science goes on the right way, confirming the success of its vision of the world.

Revolution in nature at the end of the XIX-early XX centuries. New revolutionary discoveries touched, mainly the structure of substances.

In 1895-1896 William X-ray was opened the rays of X-ray, Antoine Henry Becquerel the phenomenon of **radioactivity,** Maria and Pierre Curie glad that Rentgen was the first in the history of physics to be awarded the Nobel Prize, and a little later the last three were also awarded the Nobel Prize.

In 1897, the English physicist Joseph John Thomson opened the **electron.** In 1911, the English physicist Ernest Rutherford discovered an atomic nucleus, which is concentrated almost all the mass atom, and predicted the existence of a neutron. These discoveries showed the unreliability of the former ideas about structural disunity, simplicity and indivisibility of the atom, that is, the very foundations of the former scientific picture of the world.

In 1900, the German physicist Max Planck opened **the quantum** of action and showed that the emission and absorption of electromagnetic radiation is discrete, quantum, which has narrowed the Maxwell electrodynamics. There were two incompatible ideas about matter: On the one hand, it is absolutely continuous, on the other – it consists of discrete particles. The opening was presented by a number of philosophical and methodological issues, and the concepts of the disappearance of the matter appeared.

In 1913, the Danish physicist Neil Bor proposed a revolutionary model of the atom. He suggested that electrons that revolve around the nucleus of several stationary orbits emit energy in portions when moving from one orbit to another. And during the transition of the electron to the far from the orbit nucleus there is an increase in the energy of the atom, and vice versa. This model was named **the quantum model atom** of the Rutherford-Bora atom.

In 1905 Albert Einstein proposed **a special theory of the relative,** which was then generalized and called the general theory of the relative (1916). The theory of relative, unlike Newton's mechanics, proved the relative of space and time. At that, four-dimensional space-time, in which there are no forces of gravity, is rooted the ratio of non-Euclidean geometry, where the sum of angles of the triangle can be more or less than one hundred eight degrees depending on the positive or negative curvature of the space, and at speeds close to speed light spatial dimensions are reduced, and the course of time is slowed down.

In 1924, the French physicist Louis de Broyle put forward a hypothesis that the elementary particle is characterized by opposite properties: Continuity and discontinuity (quantization). Soon this hypothesis was confirmed experimentally by Ervin Schroeder, Werner Heisenberg, Max Bor.

In 1927 Heisenberg formulated of **uncertainties ratio** that establishes the impossibility of simultaneously defining the coordinate and momentum of microobjects, as a result of their contradictory corpuscular-wave nature. The principle of uncertainty became one of the fundamental principles of quantum mechanics. In the philosophical-methodological aspect, he characterizes statistical regularities of microparticles movement. The principle of uncertainty changes the notion of causality by defining it in the form of statistical regularities and probable dependencies.

All the mentioned discoveries in the field of physics played a huge role in the development of science as a whole. This is evidenced, in particular, by the fact that all the above-mentioned scientists were awarded Nobel Prizes. Their significance went far beyond the limits of physics and even science, becoming a universal cultural heritage. Not by chance, many of these scientists were prominent public figures. The great importance of their ideas for philosophy, it is indicative that besides scientific works they wrote philosophical works, actively participating in philosophical disputes.

Of course, the formation of non-classical science is caused not only by physical discoveries, although they were of decisive importance. In other spheres of science, there were also radical shifts. In cosmology began to form a **model of the nonstationary universe**. In 1929, the American astronomer Edwin Habble, by the way, also the Nobel Prize winner, revealed the effect of "red landslide". This meant that the galaxies are scattered, that is, our universe is expanding. From the theory of the universe, which is expanding, the fact of its beginning has come out, and its age has defined approximately 15 billion years. Hence, the most important philosophical point follows: the idea of evolution concerns not only the Earth, but also the entire universe.

In chemistry, the great importance was not only the stormy development of inorganic chemistry, especially the creation of the periodic system of chemical elements Dmitry Mendeleyev, but also the formation of organic chemistry, and then the emergence of quantum chemistry. Sociology, psychology, in particular, appeared Freidism as medical, psychological and philosophical concepts began to develop actively. It is symptomatic that the formation of Freidism was influenced not only by the ideas of doctors engaged in psyche, but also by ideas of natural investigators, for example, Darwin, as well as philosophies, in particular, Lebnitz, Gartman, Schopenhauer. The significant influence of Lebnitz with his monodology, not any atomist. It seems that in the period of the rule of the atomic-mechanical picture of the world freudism could not arise. The important thing is that in the first half of the XX century we began to think about the theories of systems that will get their development in the post-classical science.The creator of the general theory of systems Karl Ludwig von Bertalanfi noted that these minds were caused by dissatisfaction not only by non-violent vitalism, but also by mechanicism. Mehanicism, although he met scientific principles, but had, as it turned out, a limited scope of application.

Philosophical-methodological peculiarities of non-classical science.

Non-classical science has preserved many important philosophical-methodological acquisitions of classical science, among them incompatibility, consistency of thinking, with preservation of logic laws. In particular, the law of the excluded third, which demanded the rejection of one of the two contradictory opinions, the holiday was observed, although microobjects were sometimes attributed to mutually exclusive characteristics. But this was justified by the corresponding theory. Thinking not should be contradictory. The requirement of strict understanding, theories, output, evidence, application of scientific methods, mathematical models, etc.

Changes related to the following scientific requirements.

1.Scientific knowledge should still be objective, that is independent of desires, advantages, interest of the subject, but in the description of objects it was necessary to take into account the influence of scientific means of the subject, especially macrodevices when studying microobjects. In other words, rejected unilateral absolute objectivism.

2.We have thrown out absolute reductionism as a requirement of the construction of all phenomena to the atomic structure of the world. But some or other forms of reductionism were quite acceptable: some or other biological phenomena were sometimes led to chemical interactions, or psychological phenomena could have biological origin.

3.We have thrown away mechanism as a picture of the world and absolute principle of knowledge. But in some areas of science, for example, when investigating the movement of large masses on the Earth, and in general a number of applied sciences mechanics kept its value and was irreplaceable. Moreover, the search for a mechanism of any phenomena, even those where mechanics did not work, remained an absolute methodological requirement.

4.They were thrown away, it would seem, the unshakable provisions of classical science: Absolute space and time, indivisible atoms, invariability of chemical elements and species of plants and animals, invariability of stational universe, etc. It became clear that the scientific truth is relative. But there remained a requirement that scientific laws remain unchanged as a reflection of the stability (albeit relative) phenomena studied. The absolutization of change would mean a complete chaos in which science is impossible.

5.The idea of determinism has changed. Statistical determinism comes to change in Laplace determinism.

6.The clearness and the obvious, which the classics dreamed about, is no longer mandatory conditions of scientific principles, but the principle of observation remains. Scientific theory cannot talk about non-observational objects, because objects that cannot be observed do not exist.

7.While preserving the classical ideals of knowledge substantiation, for example, in experiment or in confirmed theory, a new ideal has been introduced: the principle of correspondence, formulated by Bor: the new theory should not reject old, but include it as its ultimate case. For example, classical mechanics is the ultimate case of quantum mechanics: When the masses of objects are increased, the laws of quantum mechanics are replaced by the laws of classical mechanics.

8.If classical science in general was far from philosophy, some even opposed to it, then non-classical science is closer to philosophy, realizes the philosophical value of its discoveries, theories, output, and the value of philosophy for the creation of scientific ideas. The frontier area of knowledge was formed: Philosophy and methodology of science.

Question to repeat:

1.What is the problem of the periodization of the history of science?
2.What are the options for the periodization of the history of science?
3.What is the most justified periodization of science?
4.Name the elements of science in the period of antiquity.
5.What are the prerequisites of science in the Middle Ages you can call?
6.Describe the prerequisites of science in the epoch of revival.
7.How did classical science emerge?
8.What was the new model of research?
9.What discoveries made the scientific revolution of the end of the XIX - early XX century?
10.Name the peculiarities of non-classical science.

4.Features of modern science

4.1 Post-non-classical science. Modern understanding of determinism

Post-non-classical science. If the difference between classical and non-classical science with their considerable resemblance is still quite noticeable, then the difference between non-classical and post-non-classical science is not quite so conspicuous. Therefore, the allocation of the post-non-classical period is not recognized by everyone, especially in the West. The arguments of opponents of such selection are quite justified: in science, the differences between individual temporary segments of science are always, and it is not necessary to call every segment a separate stage, but in connection with the avalanche -like growth in the non-classical science of scientific discoveries, many of which can be interpreted as epochal, separate one period from the other is very difficult and the like.

However, human civilization after the Second World War has acquired significant features, among which can be specified both scientific and technical revolution, technological revolution, and emergence of global problems and phenomenon of globalism. It is no coincidence that the theory of the technological era, the third wave, the information society and others emerged as an attempt to comprehend these processes. And science in all such phenomena plays a determining role. Therefore, it is quite justified to allocate this period of science development. Moreover, in the post-war science itself it is not difficult to find special essential features. Those readers, who seem to be an extra emphasis on the special post-classic period of science, will have to attribute these features to the non-classical science, as sometimes done in literature.

Scientific discoveries and preconditions of the post-non-classical period.

1. In 1953. Francis Crick and James Watson deciphered the DNA structure, for which they were awarded the Nobel Prize. However, prepared this discovery, in one or another degree, a whole group of scientists, which shows that in modern science the lone discoverer is impossible and any discovery is rooted in the works of many previous scientists and contemporaries. It was a decisive step in the development of genetics, which opened the way to other important discoveries in this field. During a short time many sections and directions of genetics, in particular genetic engineering and a wide range of practical applications of scientific knowledge, starting from creation of organisms with pre-set advance properties and ending with cloning of living creatures. All this has put row of problems that go beyond genetics and the very science, for example, what is a person: Is the result of a genetic code or a special unique creature? Can one clone a person and for what purpose? Is society or the state entitled to prohibit unwanted scientific research? Is scientific knowledge necessarily to have practical implementation? What is the responsibility of the scientist for scientific discovery? The list of these problems can be continued. It is obvious that all of them have a philosophical and methodological meaning.
2. In the second half of the XX century there was a digital revolution as a result of the development of computer technology. Thanks to it, various objects and phenomena can be represented in digital recording, ranging from photography or sound to the genome. It is difficult to overestimate the importance of digital technology for scientific research, especially the cutting edge of science.

3. In the second half of the 20th century, synergetics was formed and its ideas and methods began to be widely disseminated. Synergetics is called the theory of self-organization and development of complex open non-equilibrium systems of any nature with non-linear internal processes. The term «synergetics» was proposed by one of its founders, the German theoretical physicist Hermann Haken. But the Belgian physicist Ilya Prigogine stood at the origins of this approach.

Synergetics has an interdisciplinary natural science character, but its categories are often extended to biological, social, and ecological processes, positioning it as global evolutionism. It has often happened in the history of science when some theory turned out to be promising and effective. At one time, mechanics seemed to be a universal theory on the principles of which any explanation could be built, later cybernetics was presented as a universal control theory"equally suitable for describing any regulatory processes, now synergetics is considered as a universal model of evolution. Therefore, the extensive use of synergetics often causes criticism. At the same time, the development of synergetics and its various applications continue, posing various philosophical and methodological problems of evolution, determinism, order and chaos, rationality, etc.

4.In the second half of the XX century, system representations acquired great importance, since science faced very complex formations that have special internal structures, connections, interactions, and traditionally called systems. Attempts to comprehend systemic education have been made before. For example, at the beginning of the XX century, Alexander Bogdanov in his fundamental work "Tectology" framed system representations as a theory of systems, and somewhat later the first general theory of systems was proposed by Ludwig von Bertalanfi. But the real boom in systems research was experienced in the 50s and 70s, when several general theories of systems were created. Among them, the parametric General Theory of Systems of Avenir Uemov, an outstanding philosopher, methodologist, logician, who worked in Odessa for a long time, stands out. He created an independent scientific school of systems research. It is important to note that the representation of objects as systems allows us to identify special systemic patterns that are not revealed in ordinary research, and in a number of cases they can be of decisive scientific or practical importance.

Main features of post-non-classical science.

The importance of humanitarian knowledge. In post-non-classical science, the growing importance of humanitarian knowledge is realized. This is due not only to its rapid development, but also to the fact that many concepts and methods of humanitarian knowledge have proven acceptable in other sciences. In addition, many modern objects of science are human-sized, so it is impossible to study them without the humanities. Many researchers believe that since the rapid development of natural and Technical Sciences led to a civilizational crisis and put humanity on the verge of survival, only the humanities will help to get out of this situation. In any case, the scope of their application is now expanding and attempts are being made to technologies them, especially for conducting various humanitarian examinations.

Overcoming the gap between the object and subject of cognition. Modern science carries out a grandiose global experimental dialogue with nature, which implies active human intervention not just in a single subject, but in nature as a whole. Here, passive observation, as in classical science, is simply impossible. Often, scientists are tasked with learning how to manage physical reality, forcing it to act within the framework of a research scenario, and often as close to theory as possible. Therefore, a person, as the only possible observer, cannot be isolated from the world around him, make him independent of his own actions, from the process of acquiring and developing knowledge. That is why many researchers believe that today there is a clash of problems related to natural science with issues raised in the field of sociology, psychology, ethics and other social and humanitarian disciplines. In addition, the scientific explanation and description of "human-sized" objects necessarily involves the inclusion of axiological factors in the explanatory provisions.

Updated rationality. In the second half of the XX century, the historical, changeable nature of scientific rationality itself has been revealed. A model of flexible rationality has emerged. Flexible rationality demonstrates the compliance of individual standards of reasoning of the cognizing subject with certain psychological, ideological, and methodological "matrices" that are not reduced to each other, which makes the process of cognition multidimensional. The scientist often has to, especially in modern complex research, move from one method to another, for example, from quantitative to qualitative and vice versa, from one theory or paradigm to another, even sometimes from one picture of the world to another, where the researcher actually simultaneously changes the model of rationality. How rational is this transition and the change in rationality itself? This question may not be realized by the researcher and only then get rational coverage, as is often the case in the history of science. And within the framework of one approach, the research path is not always rational, carried out by inspiration, assumptions, intuition, insight, Special Research sensitivity and other non-rational components of mental activity. The modern researcher is forced not so much to look back at the norms of rationality, but at the research task. Flexible rationality is more adequate to the research task: to use rigid or flexible requirements, causal or narrative schemes of explanation, quantitative or qualitative methods and theories, to be determined by certain values and advantages: to formulate the typical, general, natural, or vice versa, to show the individual and individual. But in both cases, the basic classical standards of rationality remain unshakable: the laws of logic must not be violated, thinking must be clear and consistent, not confusing, and the organization of knowledge must be systematic, not a chaos of impressions.

Knowledge includes the subject's goals. If classical science has eliminated the subject's Goal (s) from its knowledge, then post-non-classical science returns it. In this regard, the interest of modern scientists in Aristotle's Teleology has increased, which classical science has treated in every possible way. At first glance, this looks like a paradox, but in fact it is easily explained. In classical science, Teleology, defining the goals of each subject and phenomenon, hindered the establishment of the mechanism of these phenomena, hindered the search for laws. Modern post-non-classical science can supplement the mechanism and regularity with target characteristics. This is especially important when studying super-complex human-dimensional systems, where human goals can be defining. However, the human dimension, subjectivity, and teleonomicity of modern research objects should not cancel out scientific objectivity as impartiality, as a rejection of the subjective arbitrariness of the scientist.

The narrative nature of theories. The meaning of classical theories was that the explanation was carried out through the law, that is, the ideal was a nomological explanation. They tried to extend this ideal to humanitarian knowledge, in particular to history, trying to find laws there. However, this proved impossible. Most modern authors see in narrativity and other specific narrative structures included in descriptive and explanatory procedures, the inviolable specifics of the humanities, fundamentally different from nomological explanations. The famous French postmodern philosopher of the late XX century, Jean Francois Lyotard, even suggests replacing explanatory theories with narratives. Indeed, researchers point to the presence of narrative structures in many, if not all, scientific theories, which is sometimes understood as a manifestation of narrative rationality and explored as a narrative twist in epistemology. The famous modern American historian Hayden White in his" Metaistory " clearly defines: explanations of historical events consist of a combination of logical-deductive and tropologically-figurative components. And a little further, it emphasizes even more clearly the inadequacy of the scientific "nomological-deductive" paradigm as an instrument of historical explanation. As for the inadequacy of the "nomological-deductive" paradigm, this is a clear exaggeration, which does not proceed at all from the fact of the narrativity of historical and other humanitarian explanations. But it is true that narrativity often looks like the opposite of nomological forms, especially if the emphasis is on narrativity or other non-homological structures of the theory.

Qualitative methods. If the ideal of classical and even non-classical science was quantitative research methods, then in post-non-classical science qualitative research methods are widely used, especially in the Social Sciences: economic, political science, sociological. The initial philosophical and methodological setting of qualitative approaches is the rejection of ideas about an objective or neutral observer, who allegedly does not affect the subject of observation. It is assumed in advance that the researcher has his own subjective position, which must be taken into account. In Sociology, for example, in addition, research focuses primarily on the study of an individual aspect of social activity or public consciousness, namely, the real experience of life of specific people in specific circumstances. But through the prism of the individual, broader social problems related to social groups, movements, and social institutions in a particular social situation can also be traced. Quantitative data, in particular statistics, can also serve as additional sources of information, but their analysis will also be carried out on the basis of an analytical approach. Depending on the research objectives, the opposite may also be true: qualitative studies will be an additional source of data for quantitative methods. In this regard, quantitative and qualitative approaches should not be contrasted, they are rather additional. The emphasis on the individual in qualitative social research is also found in relation to empirical material. These are primarily unstructured certificates selected from a variety of documents: texts of interviews and observations, personal and official documents, photos, video sources, etc. Primary data are data on people's subjective thoughts, expressed most often by spatial expressions, less often by gestures, symbols that reflect their views. This is often associated with the future of sociology as a turn from general and averaged patterns to the individualization of sociological knowledge and reorientation to local cultural and ethnic problems, to the real humanization of sociology. Perhaps this position is as extreme as appealing exclusively to quantitative methods as if they were the only scientific ones.

Picture of the world. The picture of the world of post-non-classical science includes teleological and anthropic characteristics. In cosmology of the late XX-early XXI centuries. the anthropic principle was formed, which establishes the connection between human existence and the physical parameters of the universe. According to the anthropic principle, the universe should be considered as a complex self-organizing system that includes humans. The inclusion of man in it cannot be rejected as required by the scientific objectivism of classical science. The essence of the anthropic principle is that the presence of an observer not only changes the picture of observation, but also in general is a necessary condition for the existence of the material foundations of this picture.

There are two varieties of the anthropic principle. Weak option: our position in the universe is necessarily privileged in the sense that it must be compatible with our existence as observers. Therefore, the emergence of man in an expanding universe is natural and must be associated with a certain epoch of evolution. A strong option: the universe and, therefore, its fundamental parameters must be such that observers can exist in it at some stage of evolution. In any case, it turns out that a person could only appear in the universe with a given set of physical constants and other properties, that is, the appearance of a person as if it was appropriate and pre-established.

Modern understanding of determinism. Philosophical and methodological studies of the phenomenon of post-non-classical science are often associated with the spread of synergistic ideas. Among them, at least two were of particular importance. First, giving a general character to the "arrow of time", which expresses the irrevocability of not only social, but also natural processes. This required a revision of the classical ideas about the laws of nature, since it meant a symmetric world in time, the formulas did not distinguish between the past and the future, which is why classical laws were almost impossible to detect in socio-cultural processes, and in natural science to represent development. Secondly, giving unpredictability and randomness a "legitimate" character. In systems far from equilibrium, fluctuations increase like an avalanche, and it is impossible to unambiguously predict the trajectory of objects and future states of systems. Even if it is possible to determine the trend, it is not a fact that at any moment it will not change to the opposite. For example, the history of mankind is not reduced to fundamental laws or to a simple statement of events. Therefore, the study of the exclusive role of individuals involves, first, the analysis of the social and historical mechanisms that made this role possible, and secondly, the study of the activities of these individuals, without the existence of which the same mechanisms could give rise to a completely different history. That is, some mechanisms of any process, in particular physical, chemical, biological can strengthen "imperceptible" accidents that eventually lead to the emergence of a new one, as happens in natural selection, when the mechanism of fixing heredity fixes and transmits small random changes by inheritance that help the body survive. This is how irrevocability works, where there is an event, change, evolution, and where there is no dynamic equilibrium and classical laws that do not take irrevocability into account. Synergetics attempts to synthesize the arrow of time, that is, irrevocability in the natural sciences with reversibility, on which scientific laws are based.

All this means the need to revise the principle of determinism. In classical and non-classical versions of determinism, the future state of the object was easily predicted. This is not possible in an unstable object. Therefore, changes in such an unstable system are responsible for randomness, not necessity. Where the trend is defined, classical or non-classical (probabilistic) determinism operates, and when the trend becomes uncertain and the object is unstable, post-non-classical (random, nonlinear) determinism operates.

Biological forms of human existence are inseparable from socio-cultural ones, which makes both himself and society non-linear, unstable, complex, irreversible and poorly predicted systems. At the same time, many actions are so simple, clear and predictable that it would be strange to shoot cannons at Sparrows. In stable systems, irrevocability and fluctuations can probably be ignored, but it is not entirely clear in which cases a classical approach is sufficient and in which a post-non-classical one, such as a synergistic one, is required.

4.2. Main features of modern science. Modern features of the connection of Science with production. Not institutional science.

The main features of modern science. Modern science includes the main features of post-non-classical science, but it is not limited to them. First, non-classical and classical approaches and ideas work successfully in certain areas of Science and areas of its application. Classical theories of physics, chemistry, and biology cannot be undone by non-classical or post-non-classical concepts. At the same time, the post-non-classical stage of Science Development gave rise to the study of special objects to which the previous ideas are unsuitable. Examples include super-complex systems, objects with a nonequilibrium state, nonlinear processes, unregulated systems, etc. The concepts and methods of synergetics apply to some of them.

Dissemination of synergistic ideas. Due to the spread of Synergetic ideas, such concepts as dissipative structures, bifurcation, fluctuations, Strange Attractors, nonlinearity, uncertainty, irrevocability, etc. have become very popular. Each such system appears as an" evolutionary whole", formed from chaos. Synergetics proceeds from the fact that combining different structures is not reduced to their simple addition, but there is an overlap of their localization areas, as a result, it turns out that the whole is no longer equal to the sum of the parts. The difference between the synergetic view and the traditional one is the transition from the study of simple systems to complex ones, from closed systems to open ones, from linearity to nonlinearity, from the consideration of equilibrium processes to instability.

It is important to emphasize that the ideas of synergetics were formulated under the influence of philosophy, especially Hegel and Marx, which was repeatedly emphasized by the outstanding Belgian scientist Ilya Prigozhin, who was at the origins of synergetics. This once again confirms the deep connection between science and philosophy.

Convergence of natural and humanitarian Sciences. for the end of the XX-beginning of the XXI century. it is characterized by the convergence of natural and humanitarian Sciences, Science and art. For a long time, natural science has focused on understanding "nature in itself", regardless of the subject of activity. Humanities-for the understanding of Man, the human spirit, and culture. For them, the priority was the disclosure of meaning, not so much explanation, but understanding, the connection of social knowledge with value-target structures.

Ideas and principles, being developed in modern natural science, especially in synergetics, are increasingly being implemented in the humanities, but the opposite process also takes place. The development of self-developing "human-dimensional" systems by science erases the former impassable boundaries between the methodology of Natural Science and social and humanitarian cognition. There is a tendency to converge scientific and technical and humanitarian and artistic approaches, science and art.

Increasingly, **scientists are turning to the traditions of eastern thinking**, which is associated with the awareness of the limitations of European rationalism and its methods. The topic of "East-West" is actively discussed in the literature today. The difference between the two types of cultures was noted long ago, as well as the orientation of modern man-made civilization to Western rationalism, which has now become universal. But understanding the prospects for Human Development suggests the possibility of a new synthesis of the Western tradition, based on experimentation and quantitative methods, and the ancient Eastern worldview, which represents the world in a model of spontaneous variability and self-organization.

The object of modern science has changed. The object of modern science is increasingly becoming systems called human-sized: medical and biological objects, environmental objects that often include the biosphere as a whole, objects of

Biotechnology, for example, genetic engineering, systems "Man-Machine", "Man-computer" and so on. Changing the nature of the research object leads to a change in research approaches and methods. If at the previous stages science was focused mainly on understanding an isolated fragment of reality, which is increasingly narrowing, then the specifics of modern science are increasingly determined by **comprehensive research programs** involving specialists in various fields of knowledge, interdisciplinary and transdisciplinary research. Often, the methods of some theories are applied to others, which raises methodological questions, in particular about the conditions and norms of adequacy of methods.

Active application of philosophy in all sciences. The widespread application of philosophy is primarily associated with the appearance in science of human-sized objects and problems of global evolutionism, global ecology, which leads to the formulation of marginal, philosophical questions. As a result, the philosophical and methodological function of philosophy is connected, but also the ontological, epistemological, ideological, and axiological functions. All this requires the philosophical training of scientists and the involvement of appropriate specialists-philosophers, because not every philosophical doctrine is suitable in this or that case.

Methodological pluralism. In modern science, the one-sidedness of any methodology is recognized. Therefore, it is impossible to limit the methods of your research to the only correct method of thinking or the most correct theory or philosophical attitude. Modernity requires a broad scientific outlook and a good general education from any specialist.

The role of extra-scientific forms of understanding the world. Intuition, fantasy, imagination and other similar factors and means of understanding reality play a huge role in modern scientific research. In modern science, they often talk about the aesthetic side of knowledge, about beauty as a heuristic principle, in relation to theories, laws, and concepts. Beauty is not only a reflection of the harmony of the surrounding world, but also the beauty of theoretical constructions. Apparently, a good theory is also a beautiful theory. The search for beauty in the world and the search for unity and symmetry of the laws of nature are one-order things. It seems that of the two opposing hypotheses, the true one will be the one that, all other things being equal, is more beautiful. Not the least role was played by unconventional ways of understanding reality, which are mostly poorly understood and often unreasonably rejected by classical science. The line between science and non-science became more mobile, which led, among other things, to the success of non-professional "scientists". However, the number of anti-scientific concepts has also increased, the fight against which is becoming an important task of the philosophy and methodology of science.

Easing strict rationality requirements. In modern science, the role of personal knowledge associated not only with intuition or inspiration, but also with a personal picture of the world is being strengthened. There are other non-rational forms of attitude to the world that are used in scientific research. After all, rationalism has always been identified with science. This means that extra-scientific factors significantly influence scientific research. However, it does not follow that unscientific theories that reject the classical demands of rationalism have a right to exist. The impact of non-science on science may be positive, but the substitution of scientific theories by extra-scientific, anti-scientific, and pseudoscientific theories and methods is unacceptable. The current situation in science increases the requirements for the professionalism of the researcher.

The connection of Science with production. An essential feature of modern science is a new scheme of communication with production. If earlier, many branches of science developed as a response to production needs, then the scientific, technical and technological revolutions of the second half of the XX century made significant adjustments to this scheme. For example, discoveries in the field of chemistry almost instantly turned into production cycles. Almost directly from scientific laboratories, the production of plastics, synthetic materials, and artificial fertilizers emerged. With the development of gene theory and the advent of genetic engineering, the production of genetically modified products was formed. Similar examples can be given for digital technologies and related products.

Thus, the current scheme of connection between science and production can be expressed as follows: **Science-Technology-Technology-production**, where the leading role belongs to science, and not only at the initial stage, but also at all subsequent ones.

In the technical and technological applications of science, both narrow-profile and complex, significant changes continue to increase, especially in connection with the development and spread of digital technologies. The essence of these changes is expressed by those new concepts that are becoming widespread, behind which there are new scientific and scientific-production realities.

Among them:

- Transdisciplinarity, when several different sciences are combined, and the methods of one of them are used in all the latter, bringing unexpected valuable results. Often, politicians, cultural figures, and generally caring people are involved in transdisciplinary research.

- Non-institutional science, when temporary scientific or production groups are organized to solve some partial scientific or engineering problems, which quickly and efficiently solve the tasks set.

- Crowdfunding, when the financing of a scientific project is not carried out by the state or sponsor, or the owner, who are waiting for the corresponding profits, but by a group of interested people who, for some reason, care about the solution of the problem, and not fame or profit, although one does not exclude the other.

- Crowdsourcing, when not so much specialists are involved in solving scientific or innovative production tasks, but people with creative abilities or relevant experience in innovation and communication activities, and often on a voluntary basis.

- Prosumerism, when consumers actively participate in the production of the product they consume.

The number of so-called non-institutional studies is rapidly increasing, when a special private financial fund and a relatively small group of scientists, managers, and applied scientists who do not depend on official scientific or state structures are organized to solve some medical or even technical, technological, or consumer problems. This allows you to focus your efforts on quickly solving a specific task. Success is also ensured by a flexible organization. Sometimes criminals also resort to this type of research activity for the illegal manufacture of weapons, explosives, drugs, poisons, etc. actually, scientific research, in particular the search for new solutions, is sometimes given a large place in such projects, but it often turns out that the information available in science is quite enough. You just need to skillfully and quickly find the necessary information and use it effectively. Therefore, not only theoretical and applied scientists, but also good managers and information technology specialists play an important role in such research groups. Often you can't do without lawyers, designers, PR technologists, etc. in such groups, the combination of traditional and latest knowledge, technologies, and specialties attracts attention. Often, this practice uses the huge potential of amateur non-professionals, both to perform simple work that requires a lot of time, and to search for new innovative ideas.

4.3. Complex nature of scientific research. Discipline, interdisciplinarity, transdisciplinarity in modern science.

In the methodology of science of recent years, **new phenomena and trends of modern science**, which is often called post-non-Classical, are actively discussed. The latter term, introduced into Soviet methodological literature by Vyacheslav Stepin, took root mainly in the Soviet and post-Soviet space and did not gain universal recognition. The main reason for this, perhaps, is the orientation of the term not so much on the peculiarities of scientific activity, but on some advanced areas of science, where the difference between modern concepts and classical and even non-classical theories is especially noticeable. **The signs of post-non-classical science** usually include synergistic ideas about super-complex objects that self-organize, their nonlinear evolution, human-dimensional nature, etc., which implies the complexity of scientific research in such cases. The allocation of a special post-non-classical stage in the development of science is quite justified, since it corresponds to real processes occurring in the scientific sphere, especially when it is important to trace the evolution of scientific ideas. But as a complex characteristic of modern science, the term is not so effective, so many authors, especially in the Western methodological literature, practically do not use it. At the same time, a significant part of the methodologists of science, using the term "post-non-classical science", include here not only the features of science itself, but also many phenomena that go beyond science: engineering, environmental, medical, entertainment and other complex projects. Although such complexity takes place, nevertheless, in many such projects, science does not always play a decisive role, moreover, in them and even in purely scientific research projects, classical scientific ideas are often enough, especially in Interdisciplinary Scientific and technical complex research. In general, the complex nature of scientific and production projects is a feature of modern science, but it is not necessary to correlate it only with post-non-classical definitions of science.

Comprehensive research is carried out using a variety of methods and techniques that can sometimes be combined into a system, but not always. The point of a comprehensive study is to cover the maximum or optimal number of important parameters of the object being studied. Most often, scientists of various specialties cooperate in a comprehensive study, sometimes close, but often quite far from each other.

Comprehensive research poses many **philosophical and methodological problems**. Among them:

- How the object of complex research is defined.
- What determines the set of disciplines or specialties required in such a study.
- What discipline should be leading in a comprehensive study?
- How different methods that need to be integrated in comprehensive research relate.
- Whether a single methodology for a comprehensive study is possible or whether the sum of methodologies should work.
- How to develop a common scientific language for comprehensive research.
- Whether to present the object under study as a system and, if so, what system methodology to use.

- Whether it is possible (or necessary) to represent the result as an integrated whole, or whether it should be the sum of independent parameters of the object under study.

- How to determine the main goal, who should be the organizer, who should finance, what should be the output of scientific products.

- What is the nature of the research itself: monodisciplined, polydisciplined, interdisciplinary, transdisciplined.

In the methodological literature, ideas of **transdisciplinarity** have recently become widespread, which in some cases replace arguments about interdisciplinarity, and sometimes are combined with them. **Interdisciplinarity**, as a concept and concept, became widespread when the specialization of scientific knowledge went so far that many problems "stuck out" and required the involvement of ideas, methods, technologies from related and even "remote" disciplines. And often problems arose at the junctions of various research fields. Interdisciplinarity implied cooperation, a kind of synthesis of various disciplines, approaches, and methodologies. At first glance, it reflects the eternal desire of Science for universalization, which is often true. However, the resulting generalized knowledge often means the emergence of a new discipline at the intersection of the previous ones and differentiation from the "parents" with subsequent refinement and further specialization. An example is Social Psychology, which emerged as a kind of generalization of sociology and psychology, but which was a special discipline that differs from both sociology and psychology in almost all respects. Interdisciplinary approaches have led to the emergence of so-called binary scientific disciplines, such as biophysics, geochemistry, and Astrophysics. What prevails here: integration or specialization? More like the second one. Perhaps only when solving technical and technological, rather than theoretical interdisciplinary issues, integration prevails over specialization.

Perhaps the first peculiar program of interdisciplinarity was Pythagorean philosophy, which can also be considered a scientific (pre-scientific) mathematical concept. So, the phenomenon of interdisciplinarity has the features of tradition and can claim an attribute status in science. A modern example of interdisciplinarity is Biotechnology. The achievements of theoretical genetics and Molecular Biology are combined with physical and chemical technologies. New scientific and technological methods have been formed that allow manipulating genes and changing organisms or creating new ones, which is of great importance in Crop Production, Animal Husbandry, medicine, and so on. Recently, humanitarians are increasingly involved in such studies both as external experts and as direct participants. In fairness, it should be noted that interdisciplinarity is sometimes declarative in nature. This, however, does not negate its positive effect when applied adequately and in terms of overcoming disciplinary limitations and excessive specialization. Some authors find examples of interdisciplinarity in the field of education and pedagogy, but educational plans and strategies are rather an example of polydisciplinarity.

Polydisciplinarity (multidisciplinary) preserves the originality of each discipline, each approach, does not involve synthesis, although it is mandatory to take into account the results obtained by "subcontractors". Cooperation in this case is complementary and cumulative. This is exactly the case in educational processes. Each discipline is taught to students or schoolchildren independently with a slight connection, preferably without special integration, with the exception of some special disciplines (mathematical sections of special sciences or modern technological methods). It is assumed that various subjects themselves integrate in the student's head into the scientific worldview, special knowledge, and so on. This does not always happen, and we often deal with specialists or just educated people who do not have a synthesis of knowledge in their head, but "shelves" with separate, independent, sometimes even encyclopedic knowledge. However, they are rarely used effectively.

In some cases, polydisciplinarity is necessary in science. The study of man, biocenoses, the Earth, and global problems is possible only by many different independent Sciences, and their integration into something universal is very doubtful. However, polydisciplinarity is not able to provide the holistic vision of the object that is extremely necessary. After all, a real multidisciplinary object is single, integral and its scientific representation must be the same, otherwise it is difficult to consider it understandable and recognizable.

Taking into account the complex and incredibly diverse nature of scientific research, along with interdisciplinary and multidisciplinary models, we can also distinguish a rapidly gaining popularity transdisciplinary strategy. Transdisciplinarity, at least by design, is able to overcome the limitations of interdisciplinarity and polydisciplinarity (multidisciplinary).

Transdisciplinarity means not just going beyond individual disciplines, but a holistic, holistic vision of the subject of research in all its complexity. If classical science tends to simplify the complex, which gives rise to differentiation and, accordingly, interdisciplinarity, then modern non-classical (post-non-classical) science tries to embrace reality in its complexity, multi-level, multidimensional nature, which is specifically emphasized in the sixth article of the Charter of transdisciplinarity: "in comparison with interdisciplinarity and multidisciplinary nature, transdisciplinarity is multidimensional and multidimensional." In real research practice, transdisciplinarity turns into the application of the cognitive strategy of a particular discipline in another science, which is often carried out in joint projects. Transdisciplinarity, as a rule, means the integration not just of various theories and technologies for the sake of a practically important result (vertical integration), but the integration of various methods, in particular special ones, with parallel working Sciences (horizontal integration), aimed at obtaining a new theoretical result, at solving scientific problems themselves. It is transdisciplinarity that best meets the ideal of unified scientific knowledge. At the same time, it leaves room for deeper integration of Science with various forms of culture. "The transdisciplinary vision is resolutely open in its exodus beyond the field of Exact Sciences, demanding their dialogue and their reconciliation with the humanities and social sciences, as well as with art, literature, poetry and spiritual experience," reads Article 5 of the Charter of transdisciplinarity.

The founders of the transdisciplinary strategy are Jean Piaget, who founded the International transdisciplinary Center for genetic epistemology, as well as Lima de Freitas, Edgar Morin, Basarab Nicolescu, whose signatures as editors are under the Charter of transdisciplinarity. It should be noted, however, that the transdisciplinary methodology is in the initial stage of its development, as evidenced by the presence of several charters of transdisciplinarity, different schools (Swiss, French, American, Chinese, Russian, etc.), the lack of a common understanding on many issues.

Transdisciplinarity involves combining the efforts of not only scientists of different disciplines, but also political leaders, artists, and businessmen. Among other things, this creates the problem of correlation between professionalism and unprofessionalism in transdisciplinary research: a scientist's exit to another scientific field will always be a risk of being accused of unprofessionalism. Although the democratic norms of the Charter of transdisciplinarity call for listening to a different voice and taking it into account, it is not so easy to realize such a wish, to turn it into a norm, given the elements of amateur aggressiveness, incongruity, and sometimes considerable harm. Thus, the development of transdisciplinary strategies, among other things, requires solving the problem of the relationship between professionalism and amateurism in science.

Questions to repeat:

1 What is post-non-classical science?

2. describe the current understanding of determinism.

3.What are the main features of modern science?

4. What is the complex nature of scientific research?

5. What is the role of Science in solving global problems?

6. describe the discipline, interdisciplinarity, polydisciplinarity, and transdisciplinarity in modern science.

7. What is non-institutional science?

8. What are the features of the connection between science and production in modern conditions?

5. Fundamentals of science

5.1. Ideals and norms of science.

The foundations (foundations) of science are its necessary prerequisites for its existence and development. Philosophy and methodology of science analyzes three blocks of these foundations: ideals and norms, the scientific picture of the world, and philosophical foundations.

The ideals and norms of science express its value values in target attitudes. The ideal captures the idea of the perfection of forms, types, and organization of knowledge that have developed at a certain stage in the development of science. Norms represent the requirements for knowledge or scientific activity that are characteristic of a given era.

Ideals and norms are presented in the following forms: evidence, validity of knowledge, its construction and organization; descriptions and explanations. For example, from the point of view of certain scientific and philosophical trends that prevailed in a particular era, knowledge must be justified in experience, as empiricism proved, or, conversely, in reason, as Rationalism believed; organized inductively, as Francis Bacon wanted, or vice versa – deductively, as Rene Descartes believed; the explanation must be teleological, as Aristotle and his followers claimed, or causal - mechanistic, as modern science believed.

Ideals and norms vary by level.

1) the general ideals and norms of science distinguish it from other forms of knowledge. Thus, the validity of knowledge by reference to authority in science is not an ideal, but in religion it is.

2) ideals and norms of a certain stage, scientific development – the style of scientific thinking of the era. Thus, for classical science of the XVIII-XIX centuries, the ideal was an unambiguously deterministic explanation, and for science of the XX century-probabilistic and statistical, for example, in quantum mechanics, where it is impossible to unambiguously determine the behavior of an electron.

3) ideals and norms of Science in certain disciplines. Thus, in classical mechanics, mechanicism emerged as an ideal and norm of explanation and description, and in physics at the turn of the XIX-XX centuries - energetism as an ideal of explanation due to the special success of thermodynamics at this time. According to energetics, the last Foundation of the world was not mechanical atoms, but energy.

5.2. scientific picture of the world. Humanitarian picture of the world.

The scientific picture of the world is a synthesis of generalized ideas about the world obtained in various sciences with a predominance of more developed ones. It has a figurative character and functions as a model, predetermining Scientific Search, understanding, and choice of research tools. Thus, the science of the XVII century was characterized by the image of a clockwork mechanism, by the type of which the structure of the world was understood, and for the science of the late XVIII - early XIX centuries – the image of a wave, flow, which was associated with the success of hydrodynamics and influenced electrodynamics, optics, etc. Recently, the picture of the world has been humanized, when a person as a subject of knowledge is no longer excluded from it.

One of the first concepts of the scientific picture of the world was introduced into the methodological context by the famous German physicist Heinrich Hertz (1857-1894) in his fundamental work "principles of mechanics set out in a new connection" (1894). The generalized characteristics of the subject of research are introduced into the picture of the world with the help of such representations:

- about fundamental objects, from which they assume the construction of all other objects that are being studied by the relevant science;
- about the typology of the studied objects;
- about the general patterns of their interaction;
- about the space-time structure of reality.

All these representations can be described in a system of ontological principles, with the help of which the picture of the studied reality is explicated and which act as the basis of scientific theories of the relevant discipline. For example:

- the world consists of Indivisible corpuscles;
- their interaction is carried out as instantaneous transfers of forces in a straight line;
- corpuscles and the bodies formed from them move in absolute space and absolute time.

This is how they describe the picture of the physical world, which was formed in the second half of the XVII century. and later received the name of the mechanistic picture of the world. The transition from mechanistic to electrodynamic (the last quarter of the XIX century), and then to the quantum relativistic picture of physical reality (the first half of the XX century) was accompanied by a change in the system of ontological principles of physics. It was especially radical during the formation of quantum relativistic physics. Then there was a revision of the principles of the indivisibility of atoms, the existence of absolute space-time, and Laplace determinism.

By analogy with the physical picture of the world, we can distinguish pictures of reality in other sciences: in chemistry, biology, astronomy, etc. among them, there are also historically alternating types of pictures of the world, which is revealed when analyzing the history of science.

The importance of the world picture for real scientific research is especially evident when science begins to study objects for which theories have not yet been created and which are studied by empirical methods. In addition to the direct connection with experience, the picture of the world has indirect connections with it through the foundations of theories that form theoretical schemes and laws formulated in relation to them.

The picture of the world can be considered as a certain theoretical model of the reality under study. But this is a special model, different from the models underlying specific theories. They differ in the degree of commonality: many theories, including fundamental ones, can be based on the same picture of the world. For example, Newton-Euler mechanics, Ampere-Weber thermodynamics, and electrodynamics were associated with the mechanistic picture of the world.

Types of pictures of the world. In the methodology of Science, the term "picture of the world" has long existed, which is often supplemented with the words "scientific" and "general". The general scientific picture of the world should include broad horizons of systematization of knowledge and integrate the most important achievements of natural, humanitarian and technical sciences. meanwhile, the idea of the general scientific picture of the world was formed almost exclusively on the basis of the analysis of Natural Sciences, which is why it has long been practically identified with the natural picture of the world. This has little known basis, since natural science could speak of the entire universe as if on behalf of an omniscient subject. In addition, the Natural Science picture of the world has many well-studied and actively used functions in cognition, especially ontological and methodological ones. However, at the end of the XX century, the seemingly unshakable foundations of the general scientific picture of the world were criticized. Scientists have come to realize the vulnerability of ideas about the disinterested observer and the limitations of universal rationalistic scientific ideas that underlie the overall scientific picture of the world. The development of the humanities, the penetration of their concepts and methods into the social and Natural Sciences, forced the methodology of science to increasingly turn to the categorical basis and methods of the humanities. modern methodological and scientific theories include the values and goals of the subject in the scientific picture of the world and theoretical descriptions. However, it is hardly legitimate to talk about the emergence of a humanitarian picture of the world in the same sense that fits into the concept of a natural science picture of the world, if only because the subject of the humanities does not cover the entire world. There is no symmetry of Natural Science and humanities here. The term "humanitarian picture of the world", if it is permissible to use it in relation to the whole world, the universe, has not so much an ontological or methodological as a metaphorical value content. Therefore, emphasizing the human attitude to the world as opposed to the Objectivist scientific "cold" approach, they talk about the "warm picture of the world" as a system built on the concept of intentionality, the need to "color the world with value, fill it with content, make it participatory to man and universal culture", the need for a dialogic, "meeting" approach to the world, etc. However, "cold" and "warm" approaches are additional, as well as monologue and dialogic, ontological and axiological, object and subject, etc. They can be successfully applied to both the world of things and the human world. Consequently, the humanitarian scientific picture of the world, for all its specifics, can be drawn in a similar dual way.

At the same time, the presence of a common scientific picture of the world implies the existence of separate scientific pictures of the world, "disciplinary ontologies". They are generalized schemes-images of the subject of research, with the help of which the main characteristics of the studied reality are recorded. These images are often referred to as special pictures of the world. The term "world "is used here in a specific sense – as a designation of a certain sphere of reality studied in this science:" the world of physics"," the world of biology"," the world of psychology", etc.

The idea of different worlds has a long intellectual tradition. Already in ancient Greek mythology, three independent worlds were distinguished: space as the embodiment of Order, Chaos as its absence, and Tartarus as the world of death. In ancient philosophy, in particular Aristotle, the sublunar and supermoon worlds were distinguished. For a long time, there was an idea of the macrocosm as the natural world and the microcosm as the human world, which were supplemented, in particular, by G. Skovoroda, the symbolic world of words. Moreover, the macrocosm, in turn, allowed for many worlds. Modern science speaks of the multiplicity of worlds both as self-sufficient types of reality studied, for example, by Astrophysics and placed in one picture of the world, and as fragments of one reality studied by different sciences, giving different pictures of the world. The most studied example of a picture of the world is the physical picture. But if the world of physics and the physical picture of the world, for all their differences, coincide in the breadth of coverage of reality, if the world of biology and the biological picture of the world also relate in this sense, then probably the same can be said about the world of humanitarian knowledge and the humanitarian picture of the world. When the latter goes beyond its own world, it ceases to be a "disciplinary ontology" and acquires a metaphorical, axiological sound. But if there is a world of humanities, it is logical to talk about the scientific picture of this particular world. Then the scientific picture of the humanitarian world, or the scientific humanitarian picture of the world, which is general scientific, can perform the same functions in relation to its subject that any separate, special, scientific picture of the world performs. The humanitarian picture of the world, inferior to the natural picture in the breadth of coverage of reality, is hardly inferior to it in significance.

In this regard, a natural question arises: is such a scientific humanitarian picture of the world possible, not as a metaphorical and axiological one, but as a disciplinary ontology or a set of disciplinary ontologies? Regarding the Natural Science picture of the world, such a question does not arise due to the principle of unity of the "natural" world accepted by many, for example, its atomic-molecular or field nature. After all, biological phenomena can be considered at the molecular level, even taking into account anti-reductionist reservations. At the same time, the world of psychology and the world of literary studies, the world of linguistics and the world of sociology are not as close as the physical and biological worlds. Nevertheless, taking into account the textual and discursive nature of humanitarian knowledge as an essential sign of the unity of the world presented in this knowledge, we can talk about a single World of the humanities and a single scientific humanitarian picture of the world. If so, firstly, will such a picture be relatively independent along with the natural as its essential complement, secondly, will it not claim the status of a general scientific picture of the world, displacing the natural as outdated and limited, and thirdly, will it perform the same methodological functions that the natural scientific picture of the world successfully performs?

The answer largely depends on the meaning of the terms "picture" and "world".

The term "picture" in relation to the world did not arise by chance and is an expression of a certain stage in the development of human cognition, awareness of separateness, opposition of a person and the world around him, subject and object, comprehension of a certain attitude to the world, namely, distancing from the world, and not inclusion in it. The idea of human inclusion in the world as a cosmos was characteristic of antiquity. This view was largely preserved in the middle ages, although the idea of human domination over nature gradually gained strength, since Christian ideas recorded a significantly higher status of man in relation to nature. And in the late Middle Ages, the idea of two books became popular, one of which was the Holy Scriptures (the Bible) and the Sacred Tradition (the works of the

Church Fathers, whose pen was moved by the creator), and the other – the book of nature, which is also written by the Creator as the creator of nature, and therefore does not contradict the first. Therefore, the study of nature, as well as the study of the first book, is also value-based. It was supposed to be studied by science, in particular, according to the idea of Galileo. The motives of the picture of the world in the book of nature can be clearly traced. The idea of a picture of the world became predominant in the Renaissance and modern times. At the same time, the idea of the subject and object as its picture of the world was formed. In philosophy, Rene Descartes clearly distinguished subject and object. But Leonardo da Vinci also emphasized that objects should be depicted as the human eye sees them, from which a new and unexpected idea of a picturesque perspective arises. Probably, the argument "write what the eye sees" also influenced Galileo, who presented science as a description of nature, as opposed to philosophy, which knew its essence. Apparently, the picturesque work of the Renaissance and its theoretical (read - humanitarian) justification significantly influenced the formation of the idea of a scientific picture of the world.

The word "picture" by its very meaning sets the context, sometimes implicit, of its use. First of all, the term "picture" implies an image, that is, a fixation of what a person considers important, main, essential, and not an exact copy of the original. An exact copy is probably impossible, because the eye does not see everything, and the mind and senses do not need everything. In other words, a person as the author of a picture distances himself from the depicted world, loses the indissoluble connection with it, as he previously made the world his own. This means, on the one hand, that a person as an author begins to feel his power, the ability to freely construct the world, and on the other hand, a detached, "cold" attitude towards the world as something alien is formed. Man is no longer a particle of the cosmos, but a detached observer who needs precise, objective knowledge, and a creator who constructs both this knowledge and his own, human world, on which the dual attitude of his own is reproduced-alien, subjective-objective, warm-cold, constructed-reflected with the predominance of objectivity and "coldness".

The vision of the world as a picture is especially confirmed in the course of the formation of classical science, primarily mechanics, although the prerequisites are formed in the previous era, when the Wizard-Alchemist becomes a scientist, a master technician, and between man and the world gradually builds his mechanical picture. Over time, the image of the world as a mechanical clock was replaced by the image of flow and field, ideas about genes and civilizations, the biosphere and Noosphere, the non-stationary Universe and synergistic processes penetrated the picture of the world. But still, almost the main goal of the scientific picture of the world is to present the mechanism of functioning or development of the Universe, Man, and society. Such a desire to" mechanize " the dead world has a certain meaning: such a world is easier to explain, easier to manage, morally justified in it to dominate and use it. The idea of the mechanism adapts to the idea of the nature, dynamics and structure of the world.

The meaning of the concept of a picture of the world in the humanities.

The meaning of the concept of a picture of the world in the humanities can be reduced to the following:

- awareness of our ideas as a picture of the world allows us to consciously use these ideas;
- understanding your views as one of the possible pictures of the World Opens, respectively, the way to reflection, critical analysis and possible revision of unsatisfactory ideas;
- complements the object vision of the world, helps to overcome the existing naturalism in humanitarian knowledge and in its objectified forms and naive belief in the exclusively reflective nature of knowledge;
- it opens up the possibility of competition of worldviews and / or their coordination in accordance with general humanistic principles (tolerance, democracy, humanity) ;
- a conscious transition from picture to picture can be implemented in accordance with cognitive goals and the material being studied;

- awareness of the limitations of ideological attitudes provoked by the relevant pictures, for example, historical or social reality;
- since in humanitarian theories, especially qualitative ones, the experiment or quantitative calculation is difficult, and the world picture may become one of the factors that legitimize the theory;
- the picture of the world, systematizing and generalizing (although this generalization is not marginal), allows you to have a holistic view of the relevant reality or the problem being studied;
- can function as a research program, directing the formulation of problems of both empirical and theoretical search and the choice of means of solving them;
- it can be useful in an integral understanding of the processes that took place in science, because it is not legitimate to present science only as a logic for the development of scientific ideas and exclusively in a disciplinary form (the discovery of photography as a convergence of the history of technology and the history of art and literature);
- it will help to implement the principle of complementarity in relation to humanitarian knowledge.

Complementarity of World Pictures.

The emergence of humanitarian worldviews, both disciplinary and general, is an inevitable consequence of the development of humanitarian knowledge.

A number of objects studied in the humanities may not soon or even ever become objects of natural science, such as literary texts. Accordingly, it is possible to find similar objects in natural science that are not studied in the humanities, although all natural science as a set of texts in a certain sense can be the subject of the humanities. However, many objects can be "returned" either by the natural science, then by the humanitarian side, then by the quantiative, then by the qualitative aspect, in particular, depending on the applied approaches, paradigms, theories, methods and other means from the arsenal of natural and humanitarian Sciences, which are more or less involved in the pictures of the world. In addition, general scientific components are also inscribed in the pictures of the world, which are particularly well developed in natural science. Depending on the research objectives and the tools used, the same objects look like different phenomena. In some cases - as human, humanized, subjective, dialogic, individual. In others-as independent, objective, monologue, typical, generally significant. The situation with the complementarity of objects of scientific activity, as well as human experience in general, resembles the complementarity of objects of the Microcosm, which "acquire" certain properties depending on the chosen means of description. The principle of complementarity formulated by Niels Bohr in connection with the interpretation of quantum mechanics has universal methodological significance. In its most general form, this principle requires that "additional" classes of concepts be applied to recreate the integrity of the object under study, which, when taken separately, can mutually exclude each other.

One gets the impression that the modern general scientific picture of the world is mainly a natural scientific picture of it. The idea that the general scientific picture includes ideas of the humanities is rather an exaggeration and a declaration. V. Stepin describes an idyllic situation in which the general scientific picture of the world "integrates the most important achievements of natural, humanitarian and technical sciences – these are achievements such as ideas about the non-stationary Universe and The Big Bang, about quarks and synergetic processes, about genes, ecosystems and biospheres, about society as an integral system, about formations and civilizations, etc. They are first developed as fundamental ideas and representations of relevant disciplinary ontologies, and then incorporated into the overall scientific picture of the world."

It seems that in reality the situation is different. The pictures of the world of the humanities, both disciplinary and general humanitarian, themselves are distinguished by the opposite and within this opposite, and not only when compared with natural paintings, they also "bite", they mutually exclude each other, for example, monologue and dialogic, objectivity and subjectivity, quantitativeness and qualitativeness, disinterest and value. Therefore, we can talk about complementarity, understood as additional approaches, theories, paradigms, and corresponding pictures of the world: both in the sense of complementarity of humanitarian disciplinary pictures, and in the sense of complementarity of pictures of the world of Humanities and Natural Sciences, and in the sense of complementarity of general scientific and general humanitarian pictures of the world. The basis of complementarity is many factors: the chosen goals, methods and methods of research, the nature of objects that have both independent of the subject and dependent properties, different theories and paradigms, different pictures of the world. This is true even when you consider that some pictures are just forming and the need for them has not yet become a well-understood need. This refers to the general scientific humanitarian picture of the world, and the picture of the world of some, if not many, humanitarian disciplines.

Accordingly, in addition to the widespread distinction between humanitarian and natural science approaches in the literature as different approaches to one single world, when only metaphorical and value content is attributed to the humanitarian picture of the world, it is necessary to take into account the possibility of distinguishing them as approaches to different worlds, for example, to the physical world and the textual world. In addition, approaches are different within the humanities, the knowledge of the world of which requires both general science and specificity, which is fixed, among other things, also by the complementarity of all humanitarian pictures. The general scientific component in each is a consequence of the unity of Science and does not allow them to run away to incommensurable disciplinary apartments.

You can give answers to the questions formulated at the beginning of the topic.

First, the general scientific humanitarian picture of the world is relatively independent along with the natural one.

Secondly, it does not claim the status of a single general scientific picture of the world, does not displace the natural one, as if outdated and limited, but works with it on complementary principles.

Third, it is able to perform methodological, cognitive, and constructive functions in addition to axiological ones.

In addition, in the humanities, similar to natural science, there are disciplinary pictures of the world – pictures of the world of the humanities: historical, literary studies, sociological, psychological. Humanitarian images of the world are fundamentally complementary. In their "cold" version, they distance themselves from the recognizable object and require an objective, non-objective representation of reality. In the "warm" version, having a narrative form of expression, they must take into account the textuality of their object, which significantly depends on the procedure for constructing knowledge about it by the subject. Pictures in this case, for all their uncertainty, dialogicity, textuality, narrativity, may well be objective, that is, not depend on the arbitrariness of the subject, express certain urgent needs of society, humanity, the state, be recognized in scientific communities, intersubjective.

Thus, developed humanitarian knowledge requires humanitarian pictures of the world, both disciplinary and general Humanitarian, the distinctive feature of which is the addition.

5.3. Philosophical foundations of science

Philosophical foundations of science – philosophical ideas and principles that justify ideals, norms and the picture of the world. Thus, Mathematical Natural Science could not have appeared without Descartes ' theory of substances, where it found its justification.

The philosophical foundations of science, sometimes directly and directly, sometimes through ideals and norms or the scientific picture of the world, play an important, though not always explicitly expressed role: they regulate and organize scientific activity and its results, closely intertwined with certain philosophical concepts. An example is mechanicism, which has long dominated philosophy and science. Mechanics is a philosophical and methodological concept, the essence of which is to absolutize the place and role of laws and principles of mechanics. According to mechanics, any complex or unfamiliar phenomenon can be explained on the basis of mechanical models and laws of mechanics. Mechanicism is a special case of reductionism. Reductionism is a philosophical and methodological concept whose adherents absolutize the status of the principle of reduction, assuming a complete reduction of the complex to a simple, more highly organized form to a less organized one, for example, biological dependencies to chemical ones, that is, they allow the possibility of explaining the essence of biological processes based on the laws of chemistry or physics. In other words, within the framework of reductionism, the qualitative specificity of more highly organized forms of reality is denied.

At present, science and philosophy are separated from each other and it seems that science does well without philosophical teachings. In fact, scientific activity necessarily includes philosophical principles and provisions, regardless of the desire of researchers. Moreover, philosophical presence and influence go through two channels: inside science and outside. This happens as if by itself without special effort on the part of scientists or philosophers. But the effectiveness of science, like philosophy, increases significantly when these channels are studied. Often a scientist uses philosophical attitudes in his activities unconsciously, and in such cases his statements about independence from philosophy look a little ridiculous. Meanwhile, it is useful to understand this connection, for example, in order to change the philosophical attitude, or even try to abandon it. The great German philosopher and scientist Gottfried Leibniz pointed out that philosophy permeates literally all human activity, that a huge mass of concepts came from philosophy, and that it is from them that almost all our reasoning consists, and not only theologians and philosophers, but also politicians and doctors are forced to use something metaphysical after every third word that goes beyond physical sensations.

Any philosophizing appeals to rational grounds, argues and justifies its statements. Philosophical concepts proposed by thinkers are provable, logically developed, consistent theoretical constructions. The construction of a philosophical theory is a systematic and consistent unfolding of some initial assumption that represents some initial view of the world. In this regard, philosophical theory is always an exemplary theoretical knowledge. All sorts of theories, including scientific ones, are built on this model. The only difference from scientific theory is that philosophical theory does not rely on an experimental basis, since this is impossible in principle, otherwise it will not be a philosophical theory at all. It has already been noted above that the meaning of philosophical knowledge is not at all in empirical confirmation. It is also important that philosophical theories are never accepted by the philosophical community on faith, without strict evaluation. They are subject to rational discussion and must withstand conceptual criticism, which often leads to alternative theories.

In certain historical periods, philosophy has its own ideals and norms of validity and acceptability. Philosophical concepts, like scientific theories, are subject to criticism and evaluation. They are compared, rejected, or, on the contrary, accepted, or simply considered one better than the other for some reason. It should be borne in mind that until the second half of the XX century, philosophical theories were quite complete, so the reader had to choose not a separate idea, but accept (or reject) the entire construction. In modern philosophical concepts, conscious eclecticism is often present as a tribute to the modern eclectic worldview, so the reader can accept any ideas from different concepts without paying attention to their inconsistency.

In foreign literature, philosophical and methodological components and aspects of scientific activity are usually called Metaphysical. This term reflects the initial Aristotelian understanding of philosophy as a doctrine of the most general properties of what exists in general, of the ultimate foundations of being and knowledge. In the first half of the XX century, the philosophy of science was dominated by the tendency of hostility to traditional metaphysics, which developed under the influence of positivism. However, later a very useful role of metaphysics in science was discovered and the saturation of science itself with various kinds of metaphysical components. The attitude towards metaphysics has become more respectful and tolerant. It became clear that the general metaphysical background is a necessary and insurmountable prerequisite for scientific knowledge in general.

In a general sense, we can say that philosophy gives the scientist basic theoretical and methodological principles. They are revealed in detail through the description of the functions of philosophy in scientific knowledge. The list of functions and their names are quite conditional some of them can be combined, while others can be divided and detailed. We note here the following: critical, background, heuristic, value, interpretive-communicative, clarifying, guiding.

Functions of philosophy in scientific knowledge:

1. critical function means revising existing ideas, established concepts and generally accepted ways of thinking, going beyond tradition and looking at the subject from a different angle. Trying to find the right guidelines, the scientist sometimes refuses modern philosophical propositions, sometimes even out of ignorance of them, and returns to early metaphysical doctrines. A similar situation developed in the initial period of modern times in the XVI-XVII centuries, when the very foundations of Aristotelian and Scholastic metaphysics were called into question. Then scientists in search of a more adequate picture of the world turned to the ancient teaching about the atoms of Democritus, Epicurus, Lucretius.

The role of the critical function of philosophy increases markedly during periods of Scientific Revolutions, whereas in the normal period science seems completely autonomous in relation to philosophy. When Max Born, a prominent German and British theoretical physicist, one of the founders of quantum mechanics, and a Nobel Prize winner in Physics, said that he was more interested in the philosophical side of science than special results, he was not complimenting philosophy at all. Just during the revolution in physics, when the formation of quantum mechanics was taking place, it was impossible to build a new physical picture of the world without philosophical ideas.

2. preliminary function. Many scientific concepts were originally formulated in philosophy: causality, interrelation, relation, essence, element, system, etc. in addition, philosophy provides science with initial propositions, initial assumptions called precondition knowledge. Background knowledge, although not always philosophical, necessarily underlies any, even relatively simple scientific research and even any scientific procedure. Thus, using the procedure for measuring the speed of a moving body, classical mechanics is based on the premise of the absoluteness of the properties of watches and rulers that do not depend on their speed. In Leibniz, the development of differential calculus was significantly related to his general metaphysical ideas about continuity. Clearly expressed philosophical attitudes ensure greater significance of the final result or hypotheses put forward, which often affects the financing of a scientific

project. Putting forward general principles that go far beyond existing experience has become the norm in traditional philosophy. Scientists are used to using this attitude almost without thinking, constantly going beyond the empirical material obtained and no longer wonder on what basis the generalized results can be transferred to a broader field. The usual and natural ideas for a scientist that nature as a whole is one, constant, stable, simple in its fundamental foundations are actually metaphysical hypotheses, a prerequisite for knowledge in science. And in philosophy, these provisions are formulated and justified.

3. the heuristic function. Philosophy has always been a supplier not only of ideas and regulators for the worldview, but also of theoretical subjects for scientists. Certain plot moves of philosophical thinking can tell a lot to a scientist. It is known, for example, that Werner Heisenberg used ideas and images drawn from Plato's works to understand quantum mechanical concepts. The fruitful philosophical ideas and concepts that formed the educational arsenal of scientists naturally manifest themselves in the structure of scientific theories, as, for example, happened with Democritus ' atomistic idea. As a result, knowledge that previously belonged to the traditional metaphysical field can end up in science. Karl Popper was one of the first to draw attention to the positive role of metaphysics in science, who schematized this process as a movement from myth to logos, and then to science.

4. value function. An essential requirement, one of the regulators of scientific research, is the requirement of disinterest and objectivity. This requirement excludes the researcher's subjective attitude to the object, in particular value preferences. That's right. However, in a broader context, scientific knowledge is impossible without various forms of value-personal involvement of a scientist in the scientific process, especially in modern science. But value relations are in line with general metaphysical ideas about good and evil, about the permissible and unacceptable, about the inevitable and transitory.

5.interpretive-communicative function. In the course of specialization of scientific knowledge, philosophy acts as a means of communication for various fields of knowledge. Currently, philosophy is aimed at bridging the gap and contrasting natural science and social and humanitarian Sciences, justifying their unity. The Austrian physicist and philosopher Philipp Frank argues that in general, the most important function of the philosophy of science should be to build bridges between natural science and humanitarian knowledge. Communication between scientists and representatives of other areas of intellectual activity is usually carried out on the territory of philosophy, in line with philosophical ideas, since various discussions about the place of modern science in society are impossible without philosophical argumentation. It is significant that in many ways society sees science through the prism of the philosophy that interprets scientific knowledge, adapts it to the public consciousness, includes in its modern worldview not only through traditional philosophical categories, but also through various images and metaphors, key topics and ideas, as well as gives social and environmental forecasts, etc.

6. clear function. Today, science is becoming more extensive, differentiated, and overloaded with factual information. Understanding what is really happening in this group of Sciences and modern science in general is a very important task for disciplines that study science, and above all, philosophy. The most important type of clarifying activity is work in the field of the foundations of a particular science. Mario Bunge calls this process of clarifying the content of theoretical systems home cleaning, when the excess is swept out and everything is put in its place: hidden intuitions and assumptions are revealed, methods of argumentation are determined and justified, a test for consistency and completeness of the theory is carried out, internal connections and relations between its original and derived concepts are understood.

7. guide function. The famous philosopher and historian of science Joseph Agassi showed how often the criterion for choosing certain scientific problems is their significance for philosophy. This is especially true for basic research, of course. Science deals mainly with those problems that are important and interesting from a metaphysical point of view and that can confirm and systematically reveal fundamental metaphysical ideas about the structure, dynamics and foundations of the world. This means that philosophy plays a guiding role in science, coordinating the process of scientific search itself, stimulating scientific interest. Philosophy not only helps

Science in its independent search, but also leads science in its overall research strategy. Philosophy sets stable guidelines for science, being a kind of program for future scientific development for science. In this regard, philosophy is sometimes compared to pre – battle intelligence, and science is sometimes compared to troops using intelligence data. It was said above that the importance of philosophy for science increases during periods of Scientific Revolutions, when philosophy becomes an instrument of criticism, but its role is also more significant: it is often the driving force of Scientific Revolutions themselves. The historian of science Alexander Coire shows that the scientific revolution of the XVI-XVII centuries, which initiated the birth of classical science, was primarily associated with the philosophical revolution, with a change in global ideas about the universe as a whole. The new philosophy first of all rejected the scholasticity of Aristotle's understanding of the cosmos; it replaced the previous ideas about the cosmos as a finite hierarchically arranged world with new ideas about an infinite and homogeneous universe. Moreover, it is interesting that the foundations of modern science were not new data from experiments or observations at all. Coire demonstrated that the experiments of the XVII century, for example, on measuring acceleration, were not at all accurate, and they could not form theoretical mechanics. The leading factor in the construction of mathematical mechanics was not direct experimental data, but a change in the philosophical attitude.

Questions to repeat:

1. What are the ideals and norms of science?
2. What are the forms of existence of ideals and norms of science?
3.name the levels of ideals and norms of science.
4. what is the scientific picture of the world?
5. How is the scientific picture of the world changing?
6. How does the scientific picture of the world affect scientific research?
7. What are the philosophical foundations of science?
8. What is the role of the philosophical foundations of Science in scientific research?
9. How do humanitarian and natural worldviews differ? 10. describe the functions of philosophy in scientific knowledge.

6. Science in a socio-cultural context.

6.1. science as a social institution. Scientific communities and the state.

Socio-cultural context of science. In previous topics, Science was considered as a form of activity of scientists and as a set of knowledge. But it is included in the socio-cultural context, and socio-cultural factors are included in all the structural components of Science, and science is also a social institution. This means that it depends on many factors operating in society, that science determines its priorities in the social context and itself largely determines social life. Science should be considered in a socio-cultural context because, firstly, it predetermined the very emergence of science, secondly, it determined those social needs that predetermined the development of science, thirdly, science began to play a large, and over time, decisive role in society, which, in turn, required state and public management of Science, and fourthly, science, especially Modern, has become not just a phenomenon of culture, but the foundation of modern culture and Universal Civilization.

The social essence of science is now also manifested in the fact that it is woven into all spheres of human relations, into all modes of production and consumption, into the activities of people in all manifestations of social and spiritual life, into interpersonal and Intergroup communication, into individual material and spiritual, theoretical and everyday life.

Scientific knowledge has long been in the public domain. They are stored in aggregate social and historical memory, which manifests itself in various forms from library collections to monuments and street names. The stages of scientific evolution are even adjusted to the change of socio-historical epochs: the science of antiquity, the science of the Middle Ages, the science of the Renaissance, the science of modern times, and modern science. Scientific knowledge is determined by the norms and ideals inherent in a particular era. Socio-cultural factors penetrate the very essence of science, even in areas that seem far from the social environment, for example, in scientific explanations. Scientific explanations are based on scientific concepts and laws and are regulated, at first glance, by purely internal scientific regulators. But this is only partially true. For example, Darwin's evolutionary theory contained the scientific concept of" natural selection", but Darwin introduced the equivalent concept of" struggle for existence", devoid of purely scientific meaning, but important in the context of the Victorian era, which was literally riddled with political struggle. And the term "struggle" provided an understanding of evolutionary subtleties. In the era of the formation of classical Natural Science, the anthropomorphic concept of "force", by and large meaningless in science, began to be actively used in various scientific disciplines: "gravity", "current strength", etc. in such cases, science has to make significant efforts to clarify its concepts, freeing them from socio-cultural, philosophical, religious contexts. It is impossible to do this completely, so the positivist dream of "pure" science cannot be realized. But the problem of scientific accuracy and rigor remains.

Science adapts to the socio-cultural environment, develops in line with cultural traditions. The scientist's thinking style and the tasks that he solves are largely determined by the socio-cultural norms of the time in which he lives. At the same time, the socio-cultural environment itself is changing under the influence of scientific achievements and their practical implementation. Science is a significant driving force for socio-historical progress. It contributes to ensuring continuity in the development of civilization and feels its potential. The degree of development of science indicates the level of civilization of society and vice versa.

Each scientist relies on the achievements of his colleagues, which in total make up the total memory of the human race. He stands, in Newton's expression, on the shoulders of giants. Science requires the cooperation of many people, it is intersubjective. Modern complex and interdisciplinary research emphasizes that many scientific results are the direct fruit of collective efforts, and indirectly all scientific results are the result of collective human scientific creativity. Nevertheless, science includes the process of individual creativity, the unique features of the mental activity of the creators of Science, and the degree of creativity of the scientific team. Studying the involvement of a scientist in various scientific groups, his role in the scientific community is an important task that can significantly increase the effectiveness of scientific work.

Modern science covers a huge field from University and academic science to industrial laboratories. And even non-institutional science has a social context, since it is embedded in the structures of society. Modern science depends on many factors that determine its development, among which there are not only consumer requests, economic needs and priorities of corporations or states, but also intellectual, philosophical, religious, aesthetic factors and many other cultural and social phenomena that affect both the formation of a scientist and his activities through various social channels.

Science is influenced not only by various social factors, but also by the type of cultural and civilizational development itself. For example, if you compare agricultural and industrial civilizations or traditional and man-made societies, it is easy to note a different attitude to innovation, without which science is impossible. Traditional societies adhere to stable patterns of behavior, stable stereotypes, and canonized forms of thinking. Technogenic society prefers renewal, rethinking accepted foundations, using new opportunities, destroying traditions, and the highest value is not canon, but novelty. In a sense, the symbol of technogenic society is the Guinness Book of World Records, in contrast to the Seven Wonders of the world that formed in traditional society, which symbolize creative completeness, as if demonstrating that everything grandiose, beautiful and unusual has already happened. Providing scientific development, man-made civilization itself turns out to be a guided science.

Science as a social institution. The concept of" social institution " expresses the fact of social consolidation of a particular type of human activity. Institutionalism involves the formalization of all types of relations of this type and the transition from unorganized activities to the creation of organized structures that involve hierarchy, power regulation and regulations. In this regard, there are political, social, and religious institutions, as well as family and school institutions that regulate the relevant types of relations and activities.

As a social institution, science was formed in Western Europe in the XVI - XVII centuries., and as a social institution, science claimed some autonomy. Thus, science became involved in the system of social division of labor, taking on specific functions, and, above all, the production of theoretical knowledge. Science as a social institution included not only the system of knowledge and scientific activities, but also scientific institutions and organizations, as well as the system of relations in science.

As a social institution science includes the following components:

a set of knowledge that has a certain form of social presentation, and their carriers that have a certain social status;

• specific cognitive goals and objectives sanctioned in one way or another by society;

certain functions, in particular social or socially determined ones;

• specific means of cognition, socially regulated;

special institutions;

• forms of control, expertise and evaluation of scientific achievements;

the hierarchy of scientists;

regulations and formalization of professional growth;

certain sanctions.

An important prerequisite for the formation and form of development of science as a social institution is the presence of systematic education with a well-thought-out structure and hierarchy. Therefore, some prerequisites for institutionalization are seen in the schools of Ancient Greece, in medieval monastic schools and in universities that arise in the XII century. university education on the one hand spread knowledge, and on the other – prepared capable people for professional scientific activities. The modern system of Higher Education has preserved many features of the activities of universities in the Middle Ages. Elite universities demonstrate the values and privileges of intellectual development as much as possible.

Various scientific communities can be considered a manifestation of institutionalization: a community of all scientists, a national scientific community, a community of specialists in a particular field of knowledge, a group of researchers studying a particular scientific problem. However, not all of them are formalized in the institutional sense, and sometimes form temporary independent non-institutional associations. In this sense, they talk about non-institutional science, emphasizing its independence from official scientific structures.

In science, there are **scientific schools** that function as an organized scientific structure united by a holistic and promising research program, a single thinking style, or a common approach. They are usually headed by outstanding scientists, and then by his students. Sometimes they distinguish between classical scientific schools that arise on the basis of universities that were widespread in the XIX century, and modern, disciplinary, scientific schools. The latter are focused on a specific research program within the discipline and do not have such unity as the classical ones. Scientific schools together sometimes form **a scientific direction in which the efforts of many scientists are combined to implement a common topic.**

The most common form of organizing scientific research is scientific groups. They can be monodisciplined or interdisciplinary, which can be divided into problem groups. The research team usually includes diverse scientists with different scientific orientations. Therefore, it is easy for them to solve complex problems, but they cannot form a scientific direction. However, both of them develop science, and you should not think that any organization is better.

The scientific community is divided into professional communities. Although they are not formally united, they are still united in understanding the basics of their discipline, language, worldview, and scientific ideas. Since they differ in subject orientation, communication, communication, and mutual understanding between different scientific communities are very difficult. Therefore, in the philosophy and methodology of Science, the question of the unity of science, scientific ideals, values, and norms is relevant.

Science as a social institution should stimulate the growth of scientific knowledge and provide an objective assessment of the contribution of a particular scientist or research team to science. In this regard, science is responsible for the acceptance of certain scientific achievements, which is carried out by accepting or not accepting scientific research for publication. However, it is clear that a huge responsibility falls on the appropriate structure, for example, a scientific journal, which should protect science from low-quality products and stimulate scientific progress. Institutionality provides social support for those types of scientific activities and projects that can contribute to the development of Science for the benefit of society. Scientific practice within the framework of science as a social institution also provides for possible restrictions on the freedom of scientific research, if, for example, they do not correspond to the ideals of humanism, or pose a threat to society or state security. In this case, the question rests on the adequacy of the relevant state system, its ideology and policy. An attempt to reduce institutional pressure on science and increase the scale of scientific research gives rise to non-institutional science. Therefore, in particular, non-institutional forms of scientific activity in the modern world are becoming a reality, but they can hardly be overwhelming.

State and science. A more important social phenomenon is the state. State and political influence on science is carried out in various directions, but first of all it is the so-called state interest. On the one hand, it has the right to exist based on the presence of states with different organizations, goals and interests. But on the other hand, the state interest may be contrary to general human norms or simply come into conflict with the general goals, ideas and norms of science. For example, such a characteristic of the state interest as secrecy, which extends to the implementation of special state orders, in particular the development of new types of weapons, is of great importance. Scientists are interested in the openness of their ideas, in their dissemination, recognition, and information. In addition, secrecy is often contained not in hiding a particular study from other countries, but in hiding it from their own people or even from all of humanity. For example, they initiate technologies and developments that are dangerous, harmful, and threaten self-destruction for humanity. Science that works for the military sphere produces not only chemical and biological weapons of mass extermination, but also infrasound, radio frequency, genetic and ethnic weapons. Infrasound weapons cause panic, the desire to run away from the source of action, the loss of self-control by the individual, complete or partial destruction of his psyche. Ethnic weapons, as a type of chemical and Biological, are aimed at defeating certain racial groups. It acts on the body, causing irreversible changes, negatively affecting the usefulness of the offspring. Such and similar developments are under the patronage of state bodies. They are unlikely to meet any human interests, but individual power groups may need them. Philosophical, methodological and moral problems arise here. How to put such developments under the control of the international community and how legitimate it is to interfere in certain state secrets, what is the measure of responsibility of scientists performing such developments, and so on. Philosophers and methodologists of science especially warn against a situation where the use of science loses its moral and humanistic meaning. Then the problems of control over the activities of scientists, issues of intellectual, social and moral responsibility, personal aspects of decision-making, problems of the moral climate in the scientific community and team become acute.

Such concepts as National Science, the prestige of the state, and reliable defense have not lost their significance. But they significantly depend on the forms of government. In closed societies, secrecy takes on hypertrophied proportions, which harms the state itself and science. In addition, in a closed society of a totalitarian or authoritarian type, the state seeks to fully control Science, which negatively affects its development, although individual branches of science can develop very successfully, but not science as a whole. In Soviet times, the problem of the ideological clash between science and power was particularly acute and painful. A number of Sciences were declared pseudoscientists and persecuted. This negative experience and the positive experience of Democratic states shows that freedom is important for the development of Science, and even state funding of certain projects or basic research that do not pay off should be determined primarily by science, not by the state.

Freedom of science does not contradict the form of organizing scientific work on a closed principle, when groups of promising scientists-developers of some important or secret problem are placed in relatively isolated conditions from the outside world. This tendency, in a hypertrophied form, was characteristic of the Soviet Union, when some repressed scientists were involved in scientific work as prisoners together with free scientists, whose situation was not much different from them, since all were gathered in a closed, isolated territory. Later, in more liberal Times, Scientific towns were created, which were even attractive in some ways, although not in everything. Now a number of Japanese companies and Microsoft operate on the principle of relative isolation.

The relationship between science and power can be traced by examples of the involvement of leading scientists in the process of justifying important state and management decisions. In a number of European countries and in the United States, scientists are involved in government, discuss problems of state structure and state policy. At the same time, science has its own specific goals and objectives, and ways to solve problems, especially in terms of perspective, truth, and so on. Therefore, it is not typical for the scientific community as a whole to turn to the authorities or the people as an arbitrator, and it is unacceptable for science and interference of the state or the people in the process of scientific search. At the same time, humanitarian and environmental problems of science must necessarily be under the control of society: the media, public organizations, and government agencies.

Science should not be guided by the ideological principles of a particular type of state, otherwise it turns into pseudoscience. The true goal of state power and state regulation of science should be to ensure the growth of scientific potential for the benefit of humanity.

Science, especially fundamental science, is a financially costly enterprise. It requires huge capital investments, which are sometimes beyond the power of an individual state. Therefore, the costs are often borne by large international corporations, for which it is not so much profit that is important, but awareness of the development prospects. Thus, the creation of the club of Rome, a very authoritative and influential organization that unites scientists and experts from Western Europe, North and South America, etc., became possible not on the basis of state funding, but only thanks to funding from the Italian company Fiat and the German concern Volkswagen. These corporations were directly interested in analyzing the energy and raw materials problems associated with the opportunities and prospects for expanding the sales markets of the industry. The club of Rome, having a huge influence on the development of science on a global scale, discussing the prospects for the development of global science, however, did not have a staff and a formal budget, and posed problems in a broader perspective than corporations needed.

The current state of science requires more and more diverse forms of Organization of scientific activities. International research projects, organizations, and centers have become widespread. An example is CERN, the European Organization for nuclear research, which constantly involves 20 countries that finance work in the amount of about млрд 1 billion. more than 10 thousand scientists from more than 100 countries are employed in individual CERN projects, such as conducting experiments at the LHC (Large Hadron Collider).

6.2. Science as a profession.

Profession of a scientist. An important manifestation of the social context of Science and its institutionalization is the transformation of scientific work into a profession. Scientific activities are carried out by specific people specially trained for this activity, scientists. At the same time, scientists perform various functions: they conduct teaching work, or help a young colleague master this type of activity, are mentors or scientific supervisors of other scientists, conduct organizational or administrative work, act as experts on other scientific works, etc. In all cases, they use their knowledge and skills to produce new knowledge. In this regard, sometimes even science is defined as follows: this is what scientists do. Socially, a scientist is a type of profession with its own traditions, written and unwritten rules, algorithms, levels, gradations, and so on.

Like any type of profession, scientific work and readiness for it requires meeting some special requirements. First of all, these are professional knowledge and skills that allow you to solve professional problems. It is good if it is related to vocation and abilities. Then the scientific work turns into a" related work", as the great philosopher of the XVIII century, Ukrainian Socrates, Grigory Skovoroda put it. But in addition to this, other qualities that are not inherent in other fields of activity and other professions are also required.

Despite all the obvious nature of this thesis, it is very difficult to formulate these qualities. To do this, it is necessary to study and summarize the biographies of famous scientists. But the problem is that writing a scientific biography is incredibly difficult, because it is not known what exactly is needed or can be singled out as a determining factor in scientific success. Nevertheless, the sociology of Science, the psychology of scientific creativity, science studies, philosophy and methodology of Science and other disciplines have identified a certain set of qualities that allows you to effectively do scientific work. Let's name some of them.

- Concentration. It involves abstracting from everything that does not relate to the issue under study, hence sometimes there is inattention, forgetfulness, inattention to life circumstances. Therefore, scientists are often portrayed as absent-minded, funny, "not from this world." Some scientists were able to become great thanks to "nannies": wives, girlfriends, daughters who took on everyday life's worries. But their names are not known to science and they are not awarded Nobel Prizes. By the way, feminist movements often raise such issues, and quite rightly.
- Criticality. This is a special type of scientific thinking that allows you not to take information on faith, double-check certain results, both other people's and your own, filter out dubious, unreliable data, etc. sometimes criticality takes on hypertrophied dimensions, which looks strange outside of science.
- Unconventional. This usually applies to thinking, but sometimes it also flows into the behavior of scientists, making some scientists extravagant.
- Accuracy, rigor of thinking. Some authors consider this quality to be the most important and not without reason, since the scientific result largely depends on it. Sometimes this line passes to behavior and attitude towards other people, which often causes difficulties in communication. Such a person is sometimes called a pedant, a cracker, boring, boring (in the sense of bringing to nausea).
- Striving for the truth. Real knowledge is not compatible with compromises, which often causes a rather difficult fate for a real scientist.
- Rationality. Scientific knowledge requires compliance with standards of rationality. This does not mean that non-rational methods are not involved in any way, but they are all subordinated to the rational form of expressing the results obtained and the ways to them. This sometimes also flows into everyday life, creating the impression of a"cracker"person.

Scientists are often referred to as the elite of society, calling the scientific community the intellectual elite, as opposed to the political or artistic elite, or the business elite. But there are certain levels among scientists, and the highest of them is often called the scientific elite, and sometimes the superintelligent elite. The superintelligent elite includes Nobel Prize winners. This is a small cohort of scientists who have made the greatest personal contribution to the research development of all spheres of human activity.

All representatives of the intellectual elite are characterized by high productivity in all periods of their activity. There are often two" bursts " of activity. The first falls on the age of 32-36 years, the second — 42-46 years. Recently, due to the increase in life expectancy, there has been a third surge in scientific activity in 60-65 years. However, these are average indicators, and there may be discrepancies in individual terms.

Society ranks any profession in one way or another. Scientists are no exception, although there are specifics here.

First, there are academic degrees, titles and corresponding positions with official salaries and surcharges.

Secondly, a well-developed incentive system:

- election of a particular scientist as a full member, corresponding member, honorary member of academies, scientific institutions and societies;
- awarding prizes and medals for scientific activity;
- inclusion of biographical references about scientists in special biographical reference books and encyclopedias;
- participation of scientists in the work of editorial boards, publications with a high scientific index;
- participation in the work of specialized councils for the defense of dissertations;
- high citation index of a scientist's publications by members of the world scientific community.

The presence of ranking and rewards, on the one hand, contributes to the development of science, on the other, has very undesirable consequences, such as the "Matthew effect". It was formulated by the famous American sociologist of Science Robert Merton, taking a quote from the Gospel of Matthew: "to anyone who has, it will be given and multiplied, and from him who does not, what he has will be taken away." Merton means that already recognized scientists receive new awards, awards, citations, publications, etc. much easier than their not yet recognized colleagues. However, it should be emphasized that the Matthew Effect is present in any field of activity: in economics, education, literature. And science, being an open, critical and self-critical system, criticizes this effect, and although it is still present, it is still in a less explicit form than in other areas.

6.3. ideology and science. The phenomenon of ideologized science.

Ideology and science. The socio-cultural essence of science entails its value component. This was always the case, even when each scientific discovery was associated with specific names of scientists and their personal feat. And even more so now, when scientific discovery is carried out most often by a team of scientists. In any case, in general, science is perceived by an individual scientist or community as an external, independent, and objective structure. However, since science is included in the economic, social, political, and cultural process, it is forced to respond to various, in particular, ideological demands of society. It appears as a political tool. Not only is scientific policy implemented, i.e. certain leadership, funding, and stimulation, but science is also used for Political Purposes and influenced by science for certain political purposes. The latter can be done through ideology.

The history of Soviet science shows how Marxist ideology completely controlled science, being suspicious of its advanced frontiers developing in the West. Therefore, the fight against cybernetics, genetics, archeology, mathematical logic, quantum theory, even systems theory and the methodology of science was conducted, which at first glance was meaningless and even harmful for the state itself. The social conditionality of Science turned into an ideological dictate. Ideology, on the one hand, sought to declare itself scientific in order to have the moral right and right to interfere in science, on the other hand, to belittle the role of science as dependent on social phenomena. Official science, especially dependent on the authorities in financial matters, is forced to support the fundamental ideological attitudes of society, provide intellectual arguments and practical tools that help preserve the privileged position of State-ideological priorities.

It should be noted that the degree of ideological pressure was felt by science in different ways. Social and humanitarian sciences are always the most dependent on ideological action, and natural sciences are usually the least dependent, but not all of them. Since the only correct methodology was proclaimed Marxist-Leninist philosophy, in particular, materialistic dialectics, those theories that somewhat differently raised the question of interrelations and management, as cybernetics, development and evolution, as genetics, did not take into account the meaningful ideas of dialectical logic, as mathematical logic, or the concepts of historical materialism as parametric theory of systems, were subjected to versatile criticism, sometimes accompanied by prohibitions and persecutions. Technical sciences, which are largely limited by Applied goals, demand from production and consumption, and the degree of implementation, are at first glance independent. But if the state controls production and distribution, then applied sciences also become ideologized.

The characteristics of ideology include its deliberate distortion of reality, dogmatism, intolerance, and lack of refutation mechanisms. Science professes opposite principles: it strives for an accurate and adequate reflection of reality, is often tolerant of competing theories, never stops there, and is prone to scientific refutations.

Any government, any political order requires justification, proof of its necessity, and in the case of transformations, revolutions, justification that the new order is better. This is served by an ideology that can be progressive or reactionary, profess universal values, or private, narrow-class or narrow-national. It can be very developed, but it can be undeveloped and poorly expressed. But its main feature is as follows. Expressing the interests of the elite that came to power, or the goals of transformative reformers, ideology represents certain interests as generally significant, universal, and national. This is served by the corresponding values adopted from the universal or national Arsenal, or specially invented. They usually have a very serious theoretical justification, which is generally not surprising, since ideology is part of theoretical consciousness. For these purposes, new political, legal, ethical and even aesthetic theories are created or used, often philosophical doctrines, economic justification is used, etc. there is an illusion of the scientific nature of such an ideology, and it is incredibly difficult to show its unscientific nature in some details, and it takes a very long time for a general refutation.

Such, in particular, was the Marxist ideology, which proclaimed beautiful universal ideas of people's happiness, freedom, progress, personal development, etc., which many generations of thinkers and ordinary people dreamed of. Moreover, it was honestly proclaimed that this is a separate interest of one class, but it coincides with the objective course of historical development, so it can be considered universal. The philosophical concept of historical materialism, the historical theory of natural changes in socio-economic formations, and the corresponding economic theory were built. The best achievements of philosophical and scientific thought of that era were used. At one time, much was said about the achievements of the Marxist concept, in Soviet times, of course, with great exaggeration, and in post-Soviet times, many shortcomings were indicated, often also with exaggeration. However, both supporters and opponents often forgot that Marxism was primarily an ideology, although very similar to science. Let us turn away from what Karl Marx wanted to create, and he did not seem to be going to build an ideological or even philosophical system, believing that his concept would find itself in separate Sciences. Let's keep in mind what happened. And it was the ideology that came out, that is, in the expression of Marx himself, a perverted, false, illusory consciousness. And in the Marxist-Leninist version, it developed precisely as an ideology with the involvement of myths, narratives and metanaratives, although a lot of effort was spent to prove its scientific nature. The tragedy of the Soviet period of our history is a clear demonstration of what can happen when ideology subordinates science to itself. Naturally, this is only one touch of our history, but it is significant.

It is now obvious that the danger of ideology increases many times in a totalitarian or authoritarian society when it becomes dominant. Its danger is not always felt by the individual and mass consciousness due to the numerous myths, especially historical ones, which bloom luxuriantly in such favorable conditions.

Scientific ideology is impossible by definition. Ideology is always an expression of one or another interest, and science must be disinterested, unbiased, and objective. If science is not objective, it is no longer science. Even if ideology pursues the best goals, it must be controlled by science, otherwise inadequate, interested interpretations are inevitable, which sometimes look like falsifications.

Socio-historical memory, ideology and science. Socio-cultural and socio-psychological factors, in the context of which science exists and develops, require careful scientific research, in particular, the study of ideas about historical and social consciousness and its relationship with science, cognitive and social mechanisms of remembering and forgetting information. An example is socio-historical memory, which is often referred to simply as historical memory. Historical memory correlates with cultural memory, as well as with the social and cultural reality that existed before and exists in the present tense. That is why almost all humanities disciplines are related to it.

Historical memory is a multi-faceted construct. It is present both in the individual consciousness and in the public consciousness, both in various texts and in material objects. Formed in the course of socialization of the individual on the basis of education and personal impressions, historical memory is constantly reinforced with new information and various material monuments, but it is also periodically, although not often, "reset" under the influence of many factors. First of all, the choice of what should be remembered as a historical landmark event is made by the individual himself. However, it is influenced by those actions that form historical memory both through it and directly. This includes literature, the media, and politics, but first of all ideology. Among the phenomena that shape memory, science, both historical and other social and humanitarian disciplines, is given an unnecessarily small place. Both the memory carriers and the subjects that form it rarely resort to science. Moreover, in everyday consciousness, historical memory and historical science practically do not differ, which is why, in particular, the illiterate slogan "You can't rewrite history!». Illiterate because history has to be supplemented and rewritten in connection with the discovery of new documents or in connection with the identification of errors and direct deception regarding the historical past.

Historical memory is a very complex product in terms of content, origin, functions, and purpose. On the one hand, it reflects historical reality, but on the other hand, it is artificially constructed. Memory has an objective basis, because it speaks about real events, but includes subjective speculations, legends, and myths. It is based on reliable evidence recorded by science, but also on dubious, or even fictitious or falsified data. Historical memory includes rational arguments and conclusions, but it is emotionally colored, which makes the discussion of individual problems extremely painful. It includes objects of pride, but often also shame. Memory includes everything important, but at the same time carefully selected, which is why many of the important things are forgotten. It reflects the mass consciousness, but is also the fruit of the creativity of theorists. Memory includes values, but also neutral scientific facts, contains universal values, but also narrow-group values. Memory in some ways consolidates society, in some ways divides it. It involves everyday experience, but also complex reflection. Historical memory is the result of scientific research, but also the fruit of the efforts of ideologues.

At first glance, it even seems that because of this complexity and contradiction, it is very problematic to present historical memory as a system. Experts in systems theory, however, are sure that anything can be represented as a system. And rightly so. The only question is whether it makes sense to do so. Indeed, in the case of such complex and contradictory objects as historical memory, system representations do not seem to clarify the essence of the matter much. In any case, no such attempts were made.

The bearer of historical memory is individuals who are part of a certain community of people: humanity, ethnic group, People, nation, a certain social group such as caste, class, profession, etc. in each of these occurrences, individuals remember approximately the same thing, which allows for appropriate identification. In this sense, historical memory performs an important function. It allows a person to solve the problem of identity, and many social entities to solve the problem of legitimacy.

The selection of what is to be memorized and perpetuated in textual and material forms is carried out by various social entities that can represent the key meanings of historical memory. Among them are education and upbringing systems: from school textbooks to museums and toponymy, fiction and art, in particular folk art in the broadest sense of the word: from epic songs to household products. Ideology and science fit into these formations in a decisive, but not equivalent way. In particular, ideology supplies certain values and is responsible for their comprehension and propaganda, science supplies historical facts and is responsible for explaining them through theories.

Socio-historical memory is often considered as a kind of Mirror that reflects the events, actions, and thoughts of people of the ancient or recent past. So, Herodotus at the beginning of his "history" writes that he wants to describe events with their causes, so he is interested in the descriptions of eyewitnesses or interpreters as such. He was not interested in the questions that humanitarians and politicians are now concerned about, namely the mechanisms of memory formation, its "correctness" or "incorrectness". But if the latter questions arise, it is obvious that historical memory is not always an adequate mirror of historical and social reality. Understanding memory may imply its independent value. The main question here is: what, by whom and how it is filled, what should be remembered and what should be forgotten.

If in the first case the work is done mainly by scientists, then in the second – mainly by ideologists. These two approaches may coincide, which is usually the case in a totalitarian or authoritarian society, where historians, and not only they, do ideological work. But, in principle, these approaches perform different tasks.

In the first case, science works, in particular historical, where the concepts of Truth or at least intersubjectivity, the concepts of historical reality and historical fact, historical method and theory are relevant, although their understanding may differ, which in turn is an important subject of methodological analysis, requiring the involvement of philosophers and methodologists.

In the second case, value attitudes prevail. It is good if they have a universal, humanistic meaning. They include lessons from the past that should not be forgotten, forms of respect for historical figures and their universal achievements, which implies a relatively neutral and calm emotional attitude. But there are values that are more emotionally loaded, including ways to condemn crimes against humanity, forms of mourning and honoring the dead, ways to honor and exalt fighters against evil and injustice. There are also values that affect ethnic, national, class, and group interests, colored by a strong emotional charge. They become a way of self-esteem, or even exaltation, special pride, and often the focus of finding identity. In short, historical memory includes certain values and value orientations, which provides them with great educational significance. Such phenomena in Ukraine, as in the world, were the Holocaust, Holodomor, victory over fascism, etc. But often, the values that determine what is called the historical memory of humanity or the people express narrow national or even narrow group interests that do not coincide with universal values. Then a constructed myth is passed off as historical memory, which is not only far from reality, but also sometimes corruptly harmful to the bearers of this myth themselves.

Unlike science, which strives for objectivity and therefore for the full coverage of evidence, memory is always selective and correlates with oblivion. The immoral and unsightly are forgotten, and what does not correspond to a particularly understandable identity is replaced. In this respect, the phenomenon of identity serves as a selection of evidence and everything that should be remembered and forgotten.

Everything negative, especially one's own individual or collective guilt, if remembered, is more often correlated with individual experience, and even that is usually justified, and the guilt, as a rule, is assigned to others: neighbors, enemies, enslavers. The "general" experience is usually glorified. In some cases, historical memory includes awareness of crime, shame, or guilt, but this occurs at the expense of a special "correctly understood" historical construction.

A kind of" memory deficit " is always present. It is designed to be filled by scientists-historians, as well as representatives of other scientific disciplines: cultural scientists, ethnographers, etc. often this function is performed by politicians, but based on certain political and ideological doctrines that do not differ in stability, generality, or scientific nature.

However, the purpose of scientific historical or cultural construction is not to supplement or correct memory, although such a task can be solved along the way, but to recreate historical (it is also socio-cultural) reality. Naturally, it also requires taking into account the historical memory reflected in certain documents, but they should not be considered as special, verifying phenomena. The famous contemporary American historian Alan Magill correctly noted:"history needs memory, but it should not follow memory."

There are common sources in historical memory and historical science, primarily eyewitness accounts. They are an extremely valuable material. It can probably even be argued that without eyewitness accounts, there can be neither historical memory nor historical science. Nevertheless, such evidence cannot be called sufficiently reliable. When witnesses are still alive, their memories and comments are highly emotional and selective, especially about the recent past. When a relatively long time passes, witnesses often remember not so much what they saw and experienced, but what they read and heard about the events they witnessed and participated in. And after the death of direct witnesses, their memories and testimonies, emotionally "eroded" and faded, are sometimes reinterpreted, and simply gradually forgotten. Therefore, modern researchers strive to document evidence not only in writing, but also visually, in order to preserve the emotional intensity of such evidence in their memory.

However, emotions are not the best companion of historical evidence. It is known that some war criminals or suspected criminals escaped punishment because of the inability of witnesses to translate emotions into a rational form of expression revealed during court proceedings. In addition, there were often contradictions in eyewitness accounts due to the selectivity of memory, especially emotionally colored. Often, the memory of eyewitnesses was prone to later impressions, which significantly distorted the evidence. And some historical themes and testimonies acquire a sacred character, which is important for historical memory, but hinders unbiased research.

Even Johann Droizen, the famous German historian of the XIX century, distinguished historical traces and sources. A historical source is sometimes called deliberate evidence, because it is usually conducted by an author who sought to convey to posterity the events of his time. Often these are honest attempts to objectively describe certain events. But such descriptions contain the author's interpretation, sometimes explicit, and sometimes implicit, not obvious to the author himself. Therefore, the reliability of the source as evidence of an event is low. The interpretation itself is of scientific interest, but not as evidence of truth, but as evidence of the expression of certain ideas. The latter distort the picture of reality, often beyond recognition. Hence the understandable aphorism common among methodologists of science: "lies like an eyewitness!». This does not mean that the evidence should be ignored. On the contrary, they need to be collected and stored. But, first of all, they need a scientific, not ideological approach, a well-chosen methodology and methodology. Their different roles for historical memory and historical science should also be understood.

More reliable are historical traces, sometimes called unintended evidence. Such traces are left by people without" historical intent", they are inscribed in the cultural and historical context, are part of historical reality, and are very valuable for the researcher because of their objectivity, since contemporaries do not give them an assessment. For example, if the "word about Igor's Regiment" refers to sources where both Chronicles and even a significant part of historical chronicles should be attributed, despite their declared objectivity and independence, then the latter include records on clay tablets, birch bark, etc. containing everyday information. Of course, they must also be rechecked and cannot be automatically attributed to irrefutable absolute facts. If a scientist uses such a record of food prices, which a servant made for a master many centuries ago, then it is necessary to make sure that the servant was honest and did not intend to deceive the owner with "Postscripts". So, from such evidence, which, despite the possible deliberate deception, is historically unintentional, it is impossible to deduce the real prices of products of that time automatically. Similarly, reports and other documents of Soviet party and state bodies stored in archives may be reliable evidence in many respects, but not in relation to the exact reflection of the essence of these reports, because they significantly distorted reality. Despite all possible options and reservations, the advantage of traces over sources for science is obvious. Therefore, although both are used by researchers, historical memory prefers sources, and historical science prefers traces.

Historical science is not monolithic. It has at least two fundamental paradigms. The first one correlates historical knowledge with educational goals that are determined by ideological and political guidelines. In this case, even with the desire for impartiality, subjectivity of interpretations and a departure from objectivity often prevails. It is this paradigm that requires the historian to preserve and replenish historical memory. It is known that up to the XIX century, historical works assumed the mandatory use of an artistic expressive style, which directly correlated with the ideological and educational factor. In this sense, even the father of history, Herodotus, can be attributed to writers. His "history" contains stories about kings and heroes, morals and Customs, mixed with wonderful events and various signs, so it is no coincidence that it is considered the first prosaic work of European civilization.

Even in the works of the greatest German historians of the XIX century Leopold von Ranke and Johann Gustav Droizen, who did a lot to establish scientific criteria in historical knowledge, to establish a scientific approach in history (that is, to establish the second paradigm). history is not so much knowledge about a certain object as a means of self-knowledge and personal development.

With the development of historical science, its tasks begin to differ significantly from the tasks of historical memory, it ceases to serve historical memory and often comes into conflict with it, which is characteristic of the second paradigm.

The second paradigm of historical science is formulated by positivist-oriented researchers. Although some of its elements, for example, the idea of cause-and-effect laws and determinism in history, arose earlier, however, Gabriel De Mono's aphorism

"We do not raise any flag" characterizes a conscious and comprehensive rejection of ideological, political, nationalist, and party bias. At the same time, a historian can be both a patriot and a supporter of political doctrines, but not to the detriment of scientifically oriented history.

The second paradigm, which was formed in the XIX century, significantly replaced the first, but did not cancel it. Unlike classical Natural Science, paradigms rarely displace each other and often co-exist in the humanities. Sometimes they fight each other, especially during a period of ideological confrontation. In the USSR, the class-party approach was proclaimed the only true one, especially in comparison with bourgeois objectivism, and the imperative was explicitly proclaimed: Soviet historians must be passionate, militant Bolshevik propagandists.

More often, both paradigms get along, as is the case in democratic countries, but the scientific approach still takes priority. Although it is understood in different ways: from quantitative history to microhistory, but the ideological and political bias of the first paradigm is not openly welcomed, and continues to exist in a veiled form. One of them is the belief that scientific history is designed to support and shape historical memory. This should hardly be considered the main task of history, but historical science can do a lot to construct an unbiased historical memory. This possibility becomes relevant, especially in the post-Soviet space, where national and ethnic issues of the past are still insufficiently studied and sometimes interpreted with obvious emotional exaggerations, and where, due to the lack of good popular history books, fertile ground has developed for the spread of historical myths and pseudo-teachings, especially within the framework of folk history, which, however, also takes place in world practice.

Valery Bebik, a Ukrainian professor of political science, an analog of the Russian academician Anatoly Fomenko, a good mathematician, but a false historian, worked in the field of modern folk history. Bebik, being an amateur in the historical, cultural, and philosophical fields, published several works about the ancient roots of Ukrainians, their hundred-thousandth history and outstanding culture, in particular, about the Ukrainians, their ancient philosophers, etc. Such ideas can not even be called hypotheses, they are more like a grandiose practical joke or hoax, but they find their supporters not only among the not very educated public, but also among educated amateurs.

If the production of folk history belonged to a new literary genre such as historical fantasy, it was unlikely to meet with criticism from the scientific community, and if there was literary talent, it could become a phenomenon in literature. After all, historical novels of the classics of the genre or historical detectives of Boris Akunin enjoy well-deserved popularity, where historical reality is reproduced and to a certain extent modernized, and serves as a beautiful, interesting background for an equally interesting plot, and does not claim to be a scientific description. But the trouble is that many works of folk history do not refer to themselves as a "light" genre, but take a swing at the status of at least a scientific hypothesis, or even a well-founded theory, and it is in this form that they are perceived by readers, and even fall into the educational literature. What awaits those students who have learned folk history, believing that they have joined the science?

Questions to repeat:

1. What is science as a social institution?
2. What is the scientific community?
3. How are scientific communities and the state connected?
4. What are the mechanisms of state regulation of science?
5. describe the mechanisms of non-state regulation of science.
6. What is the profession of a scientist?
7. How are science and ideology related?
8. Describe the phenomenon of ideologized science.

7. Moral norms and values of science.

7.1. Value-normative regulators of science.

Scientific and moral. Recently, the moral problem of a scientist's responsibility for his discovery has been actively discussed, especially in genetic engineering, biotechnology, and biomedicine. Scientists were faced with a real prospect of engineering the design of organisms with pre-defined properties, replacing pathological genes and thereby getting rid of severe hereditary diseases and various abnormalities. However, the line between norm and deviation is very ambiguous. The danger of irreparable consequences for Humanity, which lurks in such research, forced scientists in 1975 to adopt a moratorium on a number of studies. Later, when strict safety measures were developed, for example, weakened microorganisms that can only live in laboratory conditions were constructed, research resumed. However, some scientific studies, such as cloning, are currently prohibited in some countries.

There is a lot of controversy in scientific and popular publications about this. In the discussions, in particular, it is noted that a person can construct a new form of life, but he will not be able to return it to oblivion. Do we have the right to do so? There are more and more such questions, and you can't do without philosophical and methodological analysis in search of answers. So there was a special science – bioethics. The main problem of Bioethics has a philosophical and methodological sound: whether a scientist should be completely free in his research or science should be strictly regulated. There are no unambiguous answers, but it is clear that without taking into account the social and moral responsibility of a scientist, the modern development of science is impossible.

Although there is no unambiguous solution to such moral problems, there is no doubt about the priority of the principles of morality and humanity over the principles of science. It is important that moral principles are formulated adequately to humanity and not distorted for use in the fight against objectionable scientists. The problem of ethics of science has become one of the central ones in the philosophy and methodology of Science, which attaches special importance to the latter, since the very existence of humanity and its future largely depend on compliance with moral norms in science.

The problem of value neutrality of science. Since science is involved in a socio-cultural context, it raises a number of problems that are not purely scientific in nature, but significantly affect science. These include the ethical problems of Science, which, because of their increasing importance, have formed a special discipline called the ethics of science. It can be considered as part of the general ethics, but due to its special importance for science, it is often considered in line with the philosophical and methodological problems of science.

The main problem of ethics of science is the problem of correlation between scientific knowledge and values. Until recently, the prevailing opinion was about the value neutrality of science, that is, scientific activity itself is indifferent to values. Therefore, value judgments about science do not concern itself, but various external factors responsible for the application of scientific results, for example, the state, business, and politics.

The thesis of value neutrality goes back to the principle of the famous eighteenth-century Scottish philosopher David Hume, according to which statements about what exists and statements about what should be are logically diverse, since arguments about facts do not lead to any judgments about what is due. In the development of this idea of value neutrality of scientific results, there were arguments that science has only an instrumental meaning, that is, it deals only with means, and the question of the goals and meaning of human actions should be attributed to religion, philosophy, ethics. It turns out that scientists are free from discussing ethical issues and from responsibility for the consequences of applying scientific results. This thesis is quite controversial in principle, and today, due to the crisis of man-made civilization, the responsibility for which science fully shares, has almost no supporters. Indeed, a scientist is an adult, a mature person, and cannot hide like a child behind someone's decisions. Of course, he often cannot overcome power or other social forces, but this does not remove from him the responsibility for his discovery or invention.

The concept of the ethos of science by R. Merton. An important role in the development and study of ethical norms in science was played by the American scientist Robert Merton (1910-2003). In contrast to the thesis of the value neutrality of science, he identified those regulators of science that just have a value character. Merton's merit is to draw attention to the problems of the ethics of Science in the middle of the XX century, in particular, the formulation of the four main imperatives of scientific ethics. Merton's concept caused a lively discussion, which significantly advanced this discipline. Although he was sometimes criticized from different positions, but his main ideas survived their time and have not lost their significance to this day. Merton rightly believed that the goal of science is to produce reliable scientific knowledge. To achieve this goal, it is necessary that the scientist adheres to four main imperatives:

- Universalism, that is, knowledge has an extrapersonal character. This is certainly true. Classical mechanics is called Newtonian mechanics in honor of the great scientist. But it is used not because it was founded by Newton, but for completely different reasons. The name of the creator is not of fundamental importance for scientific knowledge itself. But at the same time, the scientist's personality and vision of the problem play a crucial role and affect the final result. But a scientist cannot sign his results like an artist in a picture, and, by and large, this is not important in science, but in art, on the contrary, it is very important.

- Collectivism, that is, the need to Communicate Discoveries to other scientists, for example, through publications, free use of other people's ideas, the choice of necessary data without personal preferences, but on the basis of scientific character. However, at the same time, there are scientific schools and directions in science when the results of "their own" seem to be the best. But if the "honor of the uniform" becomes predominant, science will cease to exist. If the results are hidden, they will lose their scientific status. Yes, the results obtained in secret laboratories are not considered scientific, if only because no one can evaluate and double-check them.

- Selflessness, that is, the organization of scientific activity as if there are no interests other than understanding the truth. This demand is expressed by the famous saying attributed to Aristotle: "Plato is my friend, but the truth is more precious." This is, in principle, correct. But it is also true that in science, the scientific ambitions of a scientist, the desire to assert one's primacy, such a concept as the honor of the nation, and just payment for the work performed are of great importance. In other words, there is a certain "benefit". But if it prevails, science will lose its meaning.

- Organized skepticism, that is, the exclusion of uncritical acceptance of research results. At the same time, there are authorities in science who are referred to, there is a certain distrust of young scientists, or scientists from another scientific school and direction. In other words, the requirements identified by Merton in their pure form are not so common, but they are mainly what drives science.

In real scientific practice, there are various deviations from ethical requirements and norms. There are also embellishments of results, and a special, impressive, effective presentation of them, and hiding failures, etc. sometimes verbal phrases hide the true state of affairs. For example, the article says: "it is well known that ...", and in fact it means:"I couldn't find the exact links." Or: "three samples were selected for special study", and in fact behind this is: "the results obtained on other samples did not give any basis for conclusions." Research work is not always meets ideal ethical requirements. Merton himself in the mid-1960s in his work "ambivalence of scientists" notes that scientific activity is most often regulated by two opposite (ambivalent) factors: the norm and the antinorm. For example: to publish a scientific result faster, but carefully check it; to perceive new ideas, but not to obey blindly intellectual fashion; to know all previous works, but not to allow erudition to suppress independence. Thus, along with norms in science, there are also anti-forms, and they can have a positive meaning. Ethical norms of science are not scientific laws. Rather, they are restrictive in nature: not so much to exclude behavior that deviates from the norm, but to limit it.

7.2. Prohibitions in science. Code of professional ethics of a scientist.

Ethics and deontology. Professional code of honor of a scientist. Within the framework of general ethics, a special field is distinguished, called deontology (from the GR. Deon - due), the ethics of Duty. This term was proposed in the XIX century by the English philosopher Jeremiah Bentham to refer to the theory of moral behavior. For example, medical deontology, as part of medical ethics, covers the problems of medical relationships with patients and their relatives, as well as the relationships of medical professionals with each other. In relation to science, the deontology of science can be considered as part of the ethics of Science, which studies the ethical aspects of professional activity, in short, what a scientist should and should not do. Based on this, the Professional Code of honor of a scientist is formed.

- Accuracy, thoroughness, accuracy of scientific conclusions, calculations, observations, citation.

- Impartiality in evaluating your own and other people's scientific results. This also means the ability to separate ideas from personalities, the ability to take criticism in your address without resentment, and to criticize others constructively.

- Respect for colleagues, regardless of age, title, or merit.

- Scientific honesty, which prohibits appropriating other people's results, manipulating data, or presenting unreliable material. A scientist who violates the Honor Code loses the respect of colleagues and is considered a dubious professional.

Modern scientific ethics. Scientific activity is subject to a broader system of ethical norms, requirements, prohibitions, written and unwritten rules that determine what is acceptable in science and what is not. In general, they are broader than the ethics of duty and are more general in nature, complementing the ethics of Duty. These include the following prohibitions and requirements:

1. ban on plagiarism. A scientist cannot pass off other people's research or results as his own. This is punishable by law and morally condemned. In principle, this is a kind of scientific honesty, but it has an independent meaning, since plagiarism is harmful to science. It increases scientific repetitions and takes up time when you need to specifically prioritize an idea.

2.Prohibition of falsification, i.e. deliberate distortion or manipulation of experimental or observational data. This is also a variant of scientific honesty, but it has a special independent meaning. The spread of falsifications is extremely dangerous and can seriously slow down the development of science. An example is the famous Piltdown story. There are serious reasons to suspect amateur archaeologist Charles Dawson that it was he who in 1912 mystified the scientific community by forging the skull of an ancient man, allegedly found by him. At first, scientists considered the fragments found to be evidence of the existence of the missing link of evolution, a transitional type from ape to human. The scientific community has lost several decades on this false path in a fruitless theoretical and archaeological search. In fact, "Piltdown Man" is a masterful forgery, a combination of the sawn bones of the skulls of an orangutan and a modern man. The falsification was proved forty years after the discovery, and now there are scientific and technological opportunities to accurately identify the author of the falsification. The circle of suspects is already small, but the degree of suspicion against Dawson is aggravated by the fact that after his death, not a single fragment of Piltdown's skull was found, and almost four dozen of his other finds were declared falsifications. Perhaps Dawson's colleagues and acquaintances participated in the hoax, for example, the writer Arthur Conan Doyle, whose novel "The Lost World" has points of contact with the Piltdown hoax, the famous theologian Teilhard de Chardin, who found one of the bones that later turned out to be a fake, zoologist Martin Heaton, in whose things fakes similar to Piltdown and other participants in that story were later found. It is significant that Smith Woodward, almost the only professional paleontologist among the participants of the Piltdown epic, arouses the least suspicion compared to other amateur participants.

This is how **the general principles of moral norms are set out**:

a) norms governing everyday scientific activities:

- accurate compliance with the rules for obtaining and selecting data in force in a particular scientific discipline;
- reliable organization of protection and storage of Primary Data; clear and complete documentation of all important results;
- the rule of "systematic skepticism": openness to doubt, even about your own results and the results of your team's work;
- understanding of implicit, axiomatic assumptions; vigilant attitude to attempts to accept wishful thinking caused by personal interest or even ethical reasons; cautious attitude to the probability of misinterpretation as a consequence of the methodically limited possibility of establishing the object of research (overgeneralization, excessive generalization). (B) rules governing relations between colleagues and cooperation:
- the obligation not to interfere with the scientific work of competitors, for example, by delaying feedback or transmitting scientific results obtained to a third party, subject to confidentiality;
- actively promoting the scientific growth of young scientists;
- openness to criticism and doubts expressed by other scientists and work colleagues;
- attentive, objective and unbiased assessment of the work of colleagues; unbiased attitude.

(C) rules governing the publication of results:

- mandatory publication of the results of work performed at the expense of state funding (the principle of public availability of basic research results);
- appropriate presentation of unconfirmed hypotheses and recognition of errors (the principle of scientific culture that allows for the possibility of errors in science);
- honest recognition of merits and proper assessment of the contribution of predecessors, competitors and colleagues (the principle of merit recognition).

In the following paragraphs of the norms of scientific ethics of the Max Planck Society, more specific requirements are formulated regarding cooperation, publications, possible conflicts, ways of dealing with violators, etc. the adoption of the norms of scientific ethics as an official document regulating scientific research in an official scientific organization is evidence that ethics in science becomes not just a good wish, but an important factor in successful scientific research and obtaining scientific results. 3.the requirement of novelty and validity of the knowledge offered to scientists. To do this, a scientist must know what is being done in his field of science, must refer to his predecessors and colleagues in publications if he uses their results to obtain his own, or vice versa, criticize them in a reasoned manner if he does not share their point of view. That is, new knowledge in science can only be obtained within the framework or on the basis of a certain tradition. There is no science outside of tradition, just as there is no science outside of novelty. The requirement is of particular importance, since continuity is the most important feature of science.

disinterest - the scientist's willingness to agree with any well-founded arguments, even if they contradict his beliefs, or the author of that argument is unpleasant to him. Disinterest is a variant of impartiality and objectivity, but it has a special independent meaning, since in some scientific projects there may be a great interest, for example, material, and then even in the case of obvious impartiality and objectivity of the study, the scientist himself or a team of scientists may be under suspicion and it will be necessary to contact a disinterested expert to remove suspicion.

The latter requirement is sometimes questioned on the grounds that the humanities are often associated with certain interests, in particular, political and ideological. And in natural science, belonging to a particular scientific school often interferes with scientific objectivity and a disinterested approach. Even more often, this situation occurs in Applied Research, where scientists are extremely interested in a particular result. At the same time, it is obvious that the rejection of this requirement will lead to the destruction of science. Well, the famous contemporary American historian Allan Magill said: "one of the functions of the historical profession is that it must always resist political vigilance and examine the past with care and diligence, without paying attention to the possible consequences." It is obvious that the function indicated by Megill concerns not only the profession of a historian, but also any scientific profession. In 2000, the Senate of the Max Planck community, one of the most influential and authoritative scientific communities, developed and adopted norms of scientific ethics. It is significant that these are not just wishes and recommendations for scientists, but norms that are mandatory for members of the community. For their violation, investigations and various penalties are provided, including dismissal, deprivation of degrees and the right to teach, and criminal prosecution. Many norms repeat those mentioned above, while others are adapted to take into account the specifics of work in this scientific organization.

7.3. Freedom of scientific creativity and social responsibility of scientists.

The problem of freedom, control and expert assessments of research activities. On the one hand, scientific activity by definition implies a free intellectual atmosphere. On the other hand, science is involved in the socio-cultural context and cannot be isolated from it. In the era of the formation of classical science during the XVI-XVIII centuries, there was a long struggle of scientists for the independence of Science, for its separation from other spheres of public life, primarily from philosophy, religion, and art. In the XVIII century, science took place as an independent field of activity. Moreover, it began to define many aspects of social life, for example, engineering and technical activities, topics discussed in society, and even fashion for behavior and clothing. For example, at social events where high-born, noble nobles gathered, they began to invite rootless scientists, while until recently they were forbidden to enter there. Education becomes a sign of development, high society reads scientific treatises. But more recently, even kings were illiterate. To make complex scientific propositions clear, encyclopedias are beginning to be created that perform the function of promoting scientific knowledge. It is becoming fashionable to go without wigs, because the naturalness that science focuses on flows even into everyday life. For example, clothing becomes lighter and more elegant, huge men's heels disappear, under which thick parquet cracked during Dancing, and heavy closed dresses of ladies, because they are unnatural. Women of high society have recently refused to breastfeed their newborns, passing them on to "mothers". Mothers were called serfs-women who had recently given birth to children, they were taken to the master's house to breastfeed their master's children. But now the noblewomen are beginning to feed their babies themselves, as this is natural. It is no coincidence that the XVIII century, thanks to the authority of science, is called the age of reason and enlightenment, providing considerable freedom of scientific research. But in the XX-XXI centuries, when the digitization of all social and cultural life became universal and widespread, the problem of freedom, independence or autonomy of science takes on a different meaning. The peculiarity of the current stage of human development is that no sphere of social life can remain outside public control, whether it is education or production, state structures or business, healthcare or military affairs, and, of course, science.

The west of the period of the 60s and 70s of the XX century was characterized by a sharp loss of public confidence in science. This coincided with a general movement of the public against all kinds, especially hidden forms of power and domination. They criticized various abuses on the part of the authorities, especially on the part of secret state security structures, the lack of control over state decisions and political agreements in general, the ideological orientation of education, the media, and the arts. Science, as the most important factor of state policy in relation to the entire public life, also fell into the field of sharp criticism. During that period, there were many scandalous revelations, as well as street protests that reached riots. In principle, it was a very complex phenomenon of culture and counterculture, in which science and attitude to it played a significant role. As an example, it is enough to recall at least the notorious antipsychiatric movement, accompanied by both revealing publications and protest demonstrations, which were sometimes accompanied by bursts of vandalism against psychiatric institutions. Not the least important thing here was the information that in the Soviet Union psychiatric clinics were under the jurisdiction of the Ministry of internal affairs, not health, that is, as if they had the function of punishment, not treatment, and dissidents were sometimes placed there. The closeness of psychiatric clinics around the world, the isolation of their scientific and therapeutic activities from public understanding led to these violent protests. Various protest actions in general were largely due to the severity of socio-ethical problems of scientific and technical modernization. In particular, the public strongly demanded control over science and scientists. This gave an impetus to the search for new forms of relations between science and society. And there have been notable changes since then. Individual scientists sometimes require more freedom for science, but these are usually individual cases.

Today, **the topic of public control** over free scientific activity no longer causes such acute disputes, thanks also to the scientists themselves, since the discussion of its problems in the socio-cultural and moral-ethical context has become an essential aspect of scientific activity. It is important that a significant part of the initiative in this case belongs to the scientists themselves. Scientists have created a number of public organizations and movements aimed at maintaining peace, ensuring environmental safety, etc., for example, the Paguosh movement of scientists for Peace, Disarmament and international security, created back in the 1950s, and many others. There are also numerous ethics committees with the direct participation of scientists, and various examinations are conducted, in particular, environmental, humanitarian, etc., to evaluate scientific projects and research conducted. An important result is an almost general understanding of the importance of ethical analysis of scientific activity, which resulted, in particular, in certain restrictions on scientific research for ethical reasons. An essential part of the activities of ethics committees and other public organizations is monitoring compliance with such restrictions. These limitations themselves are widely known. They relate primarily to social, psychological, and biomedical research. Thus, research that violates human rights, encroaches on his personal freedom, dignity, and privacy is recognized as immoral and strongly condemned. This also includes experiments related to misleading subjects, as well as topics that can infringe on the dignity of a person or make him shy in the case of research in the intimate sphere. Here are some examples. In psychology, laboratory experiments are often used not to test hypotheses, but to demonstrate their obvious truth, when it is not the hypothesis that is being tested, but the art of the experimenter. In addition, in psychological experiments, there is sometimes an unaccounted interaction between the researcher and the subjects, when there is an influence of the experimenter's expectations on the reactions of the subjects, or when the subjects involuntarily behave in accordance with the experimenter's expectations. Here, moral questions are combined with the methodological problem of a reliable, good experiment. Morally reprehensible experiments are now considered experiments in which subjects are involved in actions that are morally questionable or unacceptable under normal conditions. From this point of view, for example, the well-known psychological experiments conducted in the 1960s by the famous American psychologist Stanley Milgram, especially those concerning the problem of subordination to authority, are called into question. Although the experiments were conducted on a voluntary basis, the subjects had to commit morally reprehensible actions. In addition, it is not known whether they would behave in the same way under normal conditions. In other Milgram experiments, the subject had to give other people electric shocks. Although the effect of the current was only simulated, the subject did not know about it. In short, discussing the ethical side of planned research is now a common practice.

If the question of public control over science is not in doubt, then the following is a rather serious problem: Who and in what forms should exercise **control over science**.

First, control over science in general or over individual scientific research is impossible without the participation of scientists, since only the specialists themselves, the scientists themselves, can act as experts. But self-control will not give the desired effectiveness.

Secondly, the discussion of scientific problems requires the involvement of broad segments of the public, that is, people who do not understand anything about the problems themselves.

Third, reasonable control of scientific activity should be based on a well-thought-out system of administrative, legal, economic, and political measures, but what form should it take, and who should initiate the elements of this system?

One thing is clear: today a scientist cannot close himself in his professional interest, he must be able to consult with the public, explain and argue, prove his views, and withstand criticism of social and ethical considerations, including incompetent people. The practice of scientific research in developed countries demonstrates a very significant fact: scientists themselves actively raise the issue of the expediency and ethical acceptability of certain projects, participate in the work of various expert examinations and councils, are able to speak in the media, as well as defend their rights in Parliament, government, and local authorities. Of course, all this is easier to implement in a society where there are good democratic traditions, a high level of education and professionalism, and moral health.

And for countries with undeveloped democratic traditions, not quite high-quality training of specialists and undefeated corruption, the problem of expert assessments becomes incredibly difficult. A scientist who is a member of the expert council should be impartial, but this is sometimes hindered by his personal interest or the interest of his colleague in the research "shop", whom it is desirable to support, or, conversely, not to support. It is obvious that the code of honor of a scientist should prevail here, but this requires a stable tradition of his action. Further, the entry of a politician into such a council worsens the problem, because a politician is by definition an interested person, since he represents a particular political group, is interested or not interested in the project. A rare politician with a high level of education, morality, and professionalism can rise to the general interest. Participation in the Council of a businessman is also associated with the risk of supporting a certain business group. He was not taught the ability to negotiate with competitors, and only an educated person can do it independently. A good way out of this impasse can be provided by a broad discussion of this project in the media. But this requires a high level of journalists, an appropriate level of mass public to judge which project will be interesting and important, and other conditions. That is why you need a good education of any specialist, in any field of activity, it is no less important than professional knowledge, it determines the level of society itself.

The problem of effective evaluation of research projects also remains acute. After all, their comprehensive consideration requires a detailed interdisciplinary approach, the participation of representatives of various fields and not only scientific ones. As a result, such examinations often clash between values and preferences. Therefore, the main issue is the reasonable coordination of divergent arguments and opinions. Analyzing a set of goals, means, and values is quite difficult. It is usually impossible to identify any main evaluation criterion. As a result, you have to use many criteria and find reasonable compromises. Of course, any clash of interests in different areas is always difficult to resolve. But the best solution is always found if there is an attitude to cooperation.

The problem of responsibility. A large number of people are always involved in any events of modern society. Therefore, the problem of responsibility becomes very complex. After all, collective responsibility is a rather vague concept. When performing a large-scale project, the responsibility of individuals is usually dispelled, and often when investigating various incidents, it is assigned to secondary employees. And sometimes, on the contrary, the manager is made solely responsible for everything, as for example, in the event of the Chernobyl disaster. Meanwhile, the main problem with the obligation of responsibility is that it should be real: everyone should be really responsible for their own contribution to the overall project or longer-term activities. This means that mechanisms should be developed that clearly state who is responsible for what and in what forms. It is clear that this is a legal and moral problem. In modern conditions, when scientific and technological capacities are so large that their impact can lead to a regional or global catastrophe, the topic of sharing responsibility becomes quite acute.

Today it is actively discussed. There is even a point of view that today the doctrine of responsibility itself should be revised, it is necessary to make a transition from the traditional responsibility of the perpetrator for what happened to the responsibility of warning, protective. This view is increasingly being established: the greater the technological capabilities of a manager or actor, the greater the amount of knowledge required to predict possible consequences, and the greater the responsibility for these consequences it should bear. The issue of responsibility in the context of modern scientific and technical and technological capabilities remains acute, controversial, open to discussion, requiring serious analysis. This problem is still far from being solved. The condition for its successful solution is the openness of scientific and technical projects for public control. After all, where secrecy and closeness are initially practiced, the ground is created for permissiveness of some and constant potential guilt of others, a convenient environment is created for various abuses and bad faith.

Questions to repeat:

1. What is the essence of R. Merton's concept of the ethos of science?
2. What are the moral prohibitions in science?
3. name the key points of the code of professional integrity of scientists.
4. describe the moral limits of freedom of scientific creativity.
5. What is the social responsibility of scientists?
6. How can ethical standards determine the success of scientific research?
7. What are the features of modern scientific ethics?
8. What is the limitation of the concept of value neutrality of science?
9. who should exercise control over science and in what forms?

8.This is the essence of modern science and professionalism.

8.1. main ethical problems of science

The main topics of ethical discussions in modern science. Discussions of ethical problems of modern scientific research are grouped mainly around the goals and meaning of Science, the means of research activity used, and the consequences of applying scientific discoveries and developments.

1. goals and meanings of science. The meanings of scientific activity are not separate from the goals, because in any activity the meaning becomes clear when the goals are known. Ethically reprehensible are those goals of scientific activity that are obviously inhumane, both in relation to man and in relation to nature. But who will start proclaiming such goals? Even some terrorist group or extremist movement, organizing an inhumane scientific development, will necessarily be covered by one or another decent, or even progressive justification and slogan. Sometimes the state or ideological interest comes into conflict with universal norms of morality, for which even a new ethics can be created. So it was with the fascist ideology. It was much the same with Marxist-Leninist ideology, when morality was proclaimed a function of revolutionary interest. The state interest can be covered by the goal of creating super-dangerous types of weapons with unpredictable consequences: growing virulent strains of microorganisms, developing psychotropic or manipulative means of targeted action on humans, planning large-scale environmental changes through super-powerful nuclear tests or creating new types of living organisms. Such plans should at least be comprehensively and openly discussed with appropriate sanctions against their authors.

2. the means of research activity used. Goals and means are in an ambiguous ratio. Nevertheless, it is well understood that in the modern world, decent goals should imply appropriate decent means. The slogan" the end justifies the means " should become a thing of the past, it is unsuitable for current realities. But often scientists covered up unsightly funds with quite decent goals. Recently, there has been evidence that the great physiologist Ivan Pavlov used not only dogs in experiments on salivation and conditioned reflexes, which is well known, but also street children, which has long been hidden. During the Second World War, German doctors in experiments on prisoners in concentration camps received unique data. But after the war, the world medical community decided to forget these results for an inhumane way to get them. In modern biomedical research, there is sometimes a complex ethical dilemma: experiments involving risks to life and health or suffering of subjects can produce results that will save many other human lives. Is it possible to sacrifice units of human persons in the name of the well-being of many? The answer is unequivocal: no! The general principle of resolving this issue was formulated in the Convention on human rights and biomedicine, adopted in November 1996 by the Parliamentary Assembly of the Council of Europe. It explicitly states that the interests and welfare of the individual should prevail over the interests of society and science. There, another extremely important principle was formulated in Article 5: the informed consent rule. It consists in the fact that the subject must give preliminary voluntary and informed consent, and on the basis of knowledge of the goals, objectives, consequences, and risks associated with the test. The rights and interests of those who are unable to give such consent for

objective reasons, such as children or incapacitated adults, should also be reliably protected. Ethical standards and requirements for the means of conducting biomedical research apply not only to humans, but also to animals. Indeed, there are facts of cruel or cynical indifference to laboratory animals. However, humanism is gradually entering this sphere as well. In 1985, the International Council of medical scientific societies (CIOMS) adopted "international guidelines for biomedical research using animals", the meaning of which is to minimize the number of animals used in research and the amount of suffering to which they are exposed.

There are also ethical problems of scientific activity of a slightly different plan, in which the goals and means of scientific research are inseparable. For example, the problem of prioritizing ongoing developments and their financing, when the question arises whether it is morally acceptable to develop expensive technologies that will bring relief or improve the quality of life to only a small number of people, while the more pressing problems of society will remain unresolved. Or a similar problem: how big should the funding of science as a whole be, given that the funds allocated for the development of science automatically reduce spending on social needs. There are known huge costs for creating experimental equipment for fundamental physics or for Space Research. More than млрд 6 billion has already been spent on the construction of the Large Hadron Collider (LHC) and experiments. dollars. Does humanity have the moral right to spend this money on science in the face of unresolved problems of hunger and poverty on the planet?

Problems of this kind affect many individual and common interests and cannot be evaluated in any one plane. When discussing and making decisions, it is necessary to use a set of criteria concerning the importance, relevance, and prospects of research, taking into account the fact that it is impossible to predict the effect of basic research, and without them science is impossible. Of course, the voice of the public must be taken into account, and scientists must inform the public about the means to achieve scientific goals.

3. consequences of scientific activity. It would seem that this question is clear: the one who acts must be responsible for the consequences of his actions. However, not everything is so simple. Humanity has not learned to anticipate and calculate the consequences of its actions well: they plan a good deed, but the result is exactly the opposite. Hegel saw in this the irony of history, which, by the actions of short-sighted people who do not know how to comprehend historical goals, realizes its special goal. Modern philosophical ideas reject the pre-set goal, but they are well aware of the discrepancy between human intentions and results. However, this cannot be an excuse for the negative consequences of scientific activity, especially given the huge possibilities of foresight that are inherent in modern science.

A scientist should be responsible for the consequences of his decisions on an equal basis with a politician, administrator, doctor, teacher and generally a representative of any profession. This applies primarily to Applied Research. However, the possibilities of foresight in modern basic research are also quite large. In our time, science is developing purposefully, theoretical propositions control empirical search, for example, in physics, theoretical calculations are so perfect that experimental surprises are unlikely. Therefore, predicting the consequences, including basic research, becomes an urgent task. Perhaps, only at the very beginning of the study of an unknown phenomenon, it is impossible to determine the consequences. For example, when Marie Curie was asked what the practical significance of the phenomenon of radioactivity is, she replied: No, it's just interesting. But two decades after that, the development of the atomic bomb began. The ethical task of a scientist is to see possible consequences in time and warn the general public about them.

Of course, scientists are still responsible for the tragic consequences of the discoveries of nuclear physics, the special use of atomic weapons, and modern environmental disasters, ranging from pollution of the atmosphere and the world's oceans to disruption of the ozone layer. Meanwhile, many consequences could have been predicted much earlier, for example, thanks to computer simulations. In the era of the rampant arms race, a model of nuclear winter was created, that is, the consequences of the exchange of nuclear strikes by the USSR and the United States were calculated. It turned out that huge destruction, casualties and radioactive contamination are not the worst consequences. Much more dangerous is the incredible layer of dust that will envelop the Earth and block the sun's Rays for many years, as a result of which a nuclear winter will come, photosynthesis will stop, plants and animals will die quickly enough, and humanity will not have enough reserves to survive somewhere in bunkers this period of time. Such models of foresight, made in time and widely discussed, can prevent numerous disasters.

Compliance with ethical standards, in particular professional scientific ethics, is becoming the most important factor in modern science. Today, Science uses such powerful and poorly controlled forces that only the simple negligence of an experimenter can cause regional or even global destructive changes, putting at stake the stability of environmental parameters, the health and well-being of all the inhabitants of the Earth. It is no coincidence that many research projects of our time cause long-term discussions. Modern scientific research in the field of high energies, reproductive technologies, biochemical synthesis, etc.is very serious in its consequences so that they can be left without close public attention.

Many ethical questions go to the philosophical and ideological level, for example, whether man should rule over nature, humble and modify it, as the first scientists of modern times believed, and what came from religious and theological ideas that man is the crown of creation and nature is given to him for use. Now it is becoming increasingly clear that only the harmony of Man and nature will save humanity. But will a scientific and technological civilization, which sees nature as a resource for meeting its growing needs exponentially, be able to rebuild, reassign its needs, its economy, its social systems, and its science to the goals of harmony?

Ethics of Science and the practice of cognition of the XXI century. In modern scientific research, directly or indirectly, the object is the person himself, which threatens the health and existence of not only the subjects, but also those to whom the research results will then be applied. Nuclear physicists were the first to face such problems and experience the unintended consequences of experiments and other research procedures. Now these risks and threats also affect the field of molecular biology, genetics, medicine, psychology, etc. The variety of ethical problems in general form is usually divided by modern authors into ethical problems of physics, biology, genetics, and technology.

Ethical problems in nuclear physics.

In 1938, the fission of the uranium atom was discovered, which was accompanied by the release of a huge amount of energy. This has put practical applications on the agenda and raised a number of ethical concerns.

- Is the use of such destructive weapons justified? Einstein and other scientists are widely known for calling for the use of atomic weapons, although they have not been effective. In August 1945, American atomic bombs were dropped on the Japanese cities of Hiroshima and Nagasaki, causing huge destruction and human casualties. The subsequent arms race has put humanity in front of the threat of atomic destruction.
- Are atomic weapons tests justified? After all, as a result of testing, the environment is seriously polluted and a threat to the health of a huge number of people is created.
- Is the proliferation and accumulation of nuclear weapons justified? Projects to put nuclear weapons into space for political reasons were discussed. It seems that humanity must have a reliable mechanism to prevent hasty political decisions, when the security of one country poses a danger to all of humanity, including the population of that country.
- Is the risk of using nuclear energy for peaceful purposes justified? The risk is associated not only with possible disasters such as Chernobyl. The storage and processing of nuclear waste is a serious problem.
- Is the risk of spreading radioactive contamination justified? There are projects for storing nuclear waste on the Moon and other planets.

Ethical issues in biology:

- The danger of biologizing trends. Many negative traits of a person based on the results of scientific research can be recognized as innate, for example, a tendency to violence, aggression. However, such data, as well as data on the innate desire for leadership or education, should be carefully checked to avoid hasty generalizations and practical decisions. Humanity has experience of negative consequences of biological concepts, when social factors were reduced to biological ones, which justified, for example, the system of colonialism.
- The danger of hasty conclusions and generalizations from genetic research. It is unacceptable to return to pseudoscientific theories of the genetic determination of intelligence that justified racial or sexual inequality.

Bioethics. These ethical problems were formed in research conducted at the intersection of biology and medicine and have direct access to health practice and government programs.

- Attitude to the patient. Who is the patient during research or treatment: a carrier of a particular disease or a full-fledged person? The answer to this question also depends on the attitude to the patient, for example, to inform or not to inform him about the course of the disease and the prospects for treatment.

- Impact on a person. Fundamentally new medical technologies and drugs increase the possibilities of exposure to humans. How does this relate to human freedom and individual rights? Modern biomedicine expands the technological possibilities of controlling and intervening in the natural problems of the origin, course and end of human life. How to prevent abuse in this matter?
- Risk of destruction of the original biogenetic basis. Various methods of artificial human reproduction, replacement of affected organs and tissues, replacement of damaged genes, active action on the aging process leads to unpredictable situations, the analysis of which lags behind reality.
- The danger of unpredictable human transformation. Stress loads, carcinogens, environmental pollution, consumption of genetically modified products and various medicines and devices seriously affect the stability of the gene pool.
- The need for ethical expertise. Commercialization is spreading in almost all areas: doctor-patient relations, organ transplantation, manufacturing and sale of medicines, the use of technological innovations in operations and conservative treatments.
- The problem of interfering with the human genetic code. Genetic engineering makes it possible to influence and change the human genetic code. Apparently, this is justified in cases of treatment of hereditary diseases. However, the danger is that organisms involved in genetic experiments can exchange genetic information with other people. The results of such interactions can lead to uncontrolled mutations. Many experiments in the field of genetic engineering indicate that its immediate and long-term consequences are unpredictable. There will be no temptation to systematically improve human nature, for example, in order to increasingly adapt it to the loads of the modern artificially created man-made environment.
- The problem of manipulating a person. Problems of impact on the human brain and manipulation of the psyche make up a special group of problems. The fact is that such means of manipulation are comparable in nature to tranquilizers and drugs. Some brain structures, when manipulated, can produce hallucinations, inadequate behavioral reactions, and change a person's emotional states. There are experiments related to the implantation of electrodes in the brain, which by weak electrical actions prevent the occurrence of drowsiness, create a feeling of cheerfulness, a surge of energy, and help relieve tension. How safe is it for health, how much does it correspond to personal uniqueness, freedom of choice, and Human Rights?

Ethical issues of cloning. Probably, all the problems of genetics have an ethical meaning, but the problems of cloning occupy a special place. The rapid development of genetics and successful experiments in mammalian cloning have raised the question of human cloning and creating an artificial organism. The term "cloning" comes from ancient Greece. klon is a branch that was previously associated with vegetative reproduction of plants by Buds, shoots, etc. Some organisms, such as amoebas, also reproduce by producing clones, that is, genetically identical cells. Now cloning is called the artificial creation of a creature that is genetically identical to its parents. Active study of cloning in order to create the appropriate technology began in the 60s. XX century, and the reproduction of mammals falls on the 90s. at the same time, the discussion of the effectiveness of cloning for Agriculture began. But first in the popular, and then in the scientific literature, the issue of human cloning began to be discussed. Technologically, this was not possible at that time, but the problem turned into an ethical plane: in the case of cloning, we will get copies of adults, copies of our relatives, friends, and in general create the multiplicity in which it will be impossible to distinguish a natural person from an artificially created one, which raises a huge number of questions.

In 1998, Chicago physicist Richard Sid announced his intention to start work on human cloning at a symposium on reproductive medicine. There were also those who wanted to participate in this experiment: a group of doctors and a group of people who wanted to find their copies or be donors. However, a broad discussion of this problem revealed the immorality of such studies, and they were banned in many countries. Church structures, in particular, the Vatican, which preaches Thomas Aquinas ' slogan about the harmony of faith and reason, that is, in fact supports the cooperation of religion and Science, spoke sharply negatively on this issue.

The prospects for cloning are mixed. On the one hand, obtaining copies of valuable animals and plants, such as elite cows, horses, Fur-Bearing Animals, as well as preserving endangered animal species is incredibly promising. Experts also talk about self-locking technologies, because callus can serve as food, a special substance in the form of a cluster of dividing cells, of which any can give life to a new organism-a plant. The synthesis of animal and vegetable proteins, the production of insulin, etc. can have a huge economic effect. And since preserved DNA can be found in fossil bone remains, it becomes possible to restore extinct species by cloning.

But, on the other hand, cloning will inevitably lead to the reproduction of freaks, since, as you know, the goal set does not always coincide with the result. In addition, it is not known how the cloned organism will behave in real life, since it is not clear how the genetic program correlates with the actual needs of the organism.

The idea of cloning geniuses might seem tempting. But it is questionable in a somewhat unexpected way: geniuses often suffer from serious pathologies: schizophrenia, epilepsy, neuropsychiatric disorders. The idea of cloning geniuses can turn into a threat to the human genotype.

It is obvious that the theoretical understanding of the consequences of cloning lags significantly behind the empirical success. And the methodology of science has long established that such a situation is unacceptable. On the contrary, theoretical growth should be faster than empirical growth. The opposite can ruin science.

And one more important detail. Due to environmental and other problems, it is highly doubtful to conduct a pure cloning experiment. Unpredictable mutations are possible, resulting in an unknown life form, and it is very problematic to return it to oblivion, like driving a gin into a bottle.

The cloning problem is multi-faceted. There are medical, ethical, philosophical, religious, economic, technological, legal and other aspects. They need to be discussed with large-scale experiments, and even more so with practical applications, you can not rush.

These problems are evidence that ethical regulation of science is today a vital necessity, a condition for the functioning and development of science.

Above, we discussed the ethical regulators of Science and the ethical responsibility of scientists for their scientific activities in terms of possible physical harm from the consequences of their activities. But there is another side of ethical responsibility – responsibility for the intellectual damage that unscrupulous scientists or amateur non-professionals can cause by invading the field of science.

8.2. Professionalism, amateurism and amateurism in science.

Modern science differs significantly from the science of a century ago, when only natural science knowledge could claim the status of scientific and in this sense was opposed to humanitarian. With the development of science itself, the development of the processes of differentiation and integration of disciplines, the interweaving of subject, problem and methodological areas of scientific activity, it became increasingly difficult to separate Natural Science and humanitarian knowledge on a scientific basis.

The current science is increasingly losing its subject character and becoming problematic. Solutions to almost all modern scientific problems are located at the intersection of different subject areas, producing integrated approaches with the active participation of humanitarian knowledge. This applies not only to institutional science, but also to various forms of organizing research and development, so to speak, "in private", which is usually referred to as non-institutional science. No even slightly important scientific or scientific-technical solution is complete without humanitarian expertise and other humanitarian involvement. The demand for humanitarian knowledge is significantly increasing, and at the same time the requirements for its scientific nature are also growing, in particular for knowledge of the human spirit itself, as a traditional subject of humanitarian knowledge. Moreover, not everything that happens in modern humanities, as, indeed, in other scientific disciplines, meets the classical ideals and norms of science.

An interesting difference between modern science and classical science is its democratization, when non-professionals work together with professionals in science. And not only as" service personnel", the number of which is constantly increasing, which can be observed by viewing the list of participants in any contractual Cathedral topic, where scientists themselves do not always make up the majority. But in this case, we are talking about something else. In modern science, amateurs (amateurs) who give exactly the scientific result are represented quite widely, although not everywhere.

A striking example of the participation of amateurs in science is the discovery of the newest star SN1987A. in astrophysics, it is known that when the newest star is formed, it is possible to record a neutrino flux about three hours before its appearance in the visible spectrum. However, to" catch " the most visible radiation, you need to point the telescope at a certain time in a certain part of the sky. This certainty is not given by theory – it is necessary to observe almost the entire firmament. But there are not enough professional astronomers on Earth for this. Thousands of amateur astronomers come to the rescue with controlled computers, telescopes with special optics, special sensors, etc. all this, of course, is generally inferior to professional support, but it is quite enough to record many empirical data. After all, often the question is not in the power of telescopes and other equipment, but in the number of observers. Communication between professionals and amateurs interested in celestial bodies is carried out through global research networks. The first person to see the newest 1987A was semi-professional Ian Shelton and a little later several other amateur astronomers, and one of them took a photo of the explosion, confirming.

Shelton's data. It is clear that it was not without a decisive role of professional astrophysicists who discovered the key phenomenon-neutrino fluxes, and also provided theoretical justification for the forecast and further interpretation of the phenomenon, but would hardly have been able to fix it, at least at such an early stage. This is how one of the greatest astronomical discoveries of the XX century took place. It is no coincidence that professional astrophysicists and amateur astronomers became co-authors of the published article about this discovery.

With the help of amateurs, combining observations with large and small telescopes, professionals have established what a triple asteroid looks like in the main asteroid belt. This will help you determine the density and internal structure of the asteroid without having to visit the asteroid itself. Knowing the internal structure of asteroids is key to understanding how the planets of the Solar System formed. Such cooperation between professionals and amateurs no longer surprises many people. Even special projects are organized that use amateur work for Science, for example, in line with the search for possible smart signals from space or the study of images of space objects, that is, where you need in its own way interesting and prestigious, but for a professional boring, painstaking, very long work, which is accelerated (and cheaper!) thousands of times due to the mass participation of participants.

It is clear that the development of new theories or the analysis of empirical data, as well as determining the direction of research, is left to professionals. It is possible that such cooperation between professionals and amateurs can be organized in medicine, biology, sociology, political science, history, literary studies, psychology, pedagogy and other disciplines, where it is often the factor of a large amount of empirical material that can be provided by amateurs that is important. Astrophysical experience will be very useful.

This applies to both institutional and non-institutional science. The latter is actively expanding its scope, remaining within the framework of science. Often, scientific or production teams are created with their own independent sponsorship or personal funding to solve a specific, say, medical or technical practical problem that first needs to be understood scientifically and theoretically, sometimes with an important independent scientific result. Many innovative projects are similar in nature. In such temporary scientific or scientific-production teams, there are many people who are forced to combine professional and non-professional functions, close to science and far from it, and in general, strictly speaking, non-professionals who perform both scientific and financial, organizational, managerial, legal and other functions. In this regard, the question is often asked: Was the well-known American engineer-entrepreneur, pioneer of the era of it technologies Steve Jobs (or similar persons) a professional, and if so, in what field, in what specialty, what was it expressed in and how to learn it? Without resorting to reasoning on this issue, we will only emphasize that the problem of non-professional participation in production, business, management, and especially in modern science requires careful study.

Active participation in strict science of non-professionals can be associated with a weakening of the ideals of Science, with a blurring of the boundaries of Science and non-science. However, this impression will be incorrect. However, a large number of non-professionals increases the risk of mistakes, fraud, and falsifications. But, for example, astronomy, being a strict science, has reliable tools for screening out and cutting off "empty rock", not inferior to the ideals of science. Here, the role of amateurs is limited to empirical material, they do not have access to "theoretical wilds" that require special, namely professional training. In the humanities, theories, on the contrary, are sometimes less complex and more understandable to non-professionals. Therefore, their claims to theoretic nature are more noticeable here.

Amateur participation in the humanities can also be provided with positive examples. An impressive fact of the effective invasion of historical science by an amateur is the scientific activity of retired engineer-colonel from Odessa Georgy Pyadyshev in the 70-80 years of the XX century. He reasonably justified the " verkhnedonetsky "version of the route of Prince Igor's campaign described in the"lay of Igor's Regiment", which differs from the officially recognized one. It consistently fits into the friendly and family relations of Prince Igor with Khan Konchak, and his enmity with other polovtsians, and difficult relations with the Kievan princes, and many linguistic, geographical and military-political features of the interpretation of historical sources. Interestingly, at first the editorial board of the magazine "history of the USSR" rejected the article of the amateur. However, Piadyshev came to Moscow and insisted on his speech to the Academic Council. He was given 15 minutes. The answers to the questions, which lasted almost two hours, ended with the unanimous decision of the Academic Council to publish his article in the main historical journal. This to some extent meant accepting an amateur into the ranks of professionals, although there was no corresponding diploma.

It is well known that the presence of a diploma, or its absence, says little about the level of professionalism. It is necessary to demonstrate knowledge of the subject, Scientific Outlook, knowledge of methods, objectivity, criticality, etc. at the same time, as it seems, an important factor of professionalism in science is methodological awareness, first of all, an idea of the criteria of scientific knowledge. Almost all amateurs sin by the absence of this, since they have not received appropriate training, but, however, some professionals who ignore this point for various reasons: gaps in education, professional inconsistency, subjectivism, uncriticism, and often the so-called "professional cretinism", when a narrow specialization is not supported by a broad scientific outlook.

There are not so many examples of successful amateur activities in the humanities. Although there are much more amateur historians, linguists, and literary critics here than in astronomy. And there are many more not very good professionals. This is due to many difficult problems, in particular, with the Soviet heritage, when humanitarians were preparing not so much for scientific work as for ideological struggle, as well as with a drop in the level of training of specialists and with a drop in the level of professionalism in the post-Soviet space, including in science. As a result, not all professionals, let alone amateurs, can clearly separate science and non-science. It is no coincidence that it is in the countries of the former USSR that historical myths and pseudo-teachings are so easily spread, especially within the framework of folk history, patriotic pseudo-history or pseudoscience "New Chronology", which have taken root in the cultural sphere, in particular on television, in film production.

In such cases, the problems of professionalism, science, and morality are brought together. Any person involved in science as a professional or amateur must have a certain set of professional knowledge and skills, ideas about the norms of Science, and an appropriate level of morality.

The noticeable spread of amateur "science" in the humanities is often associated with their obvious harm, as in the case of the "New Chronology" of Academician Anatoly Fomenko or with the history of the ukrovs of Professor Valery Bebik. Nevertheless, such false theories are not so difficult to distinguish from scientific theories due to the obvious contradiction with the ideals of scientific nature. But often the problem is that some sections of humanitarian knowledge are not methodologically developed for compliance with scientific standards.

Fortunately, this does not apply to all humanities disciplines. For example, in structural linguistics or in concrete sociology, you can find strict theories that meet the most stringent criteria of scientific knowledge and are not inferior in this sense to astrophysical or other strict scientific theories. The use of mathematical methods in history and literary studies also brings some of their sections closer to the classical ideal of science.

At the same time, whole fields of humanitarian knowledge do not correspond to the mentioned canons. This applies to a range of pedagogical or psychological concepts, theories of social work, certain sections of history, literary studies, etc. Here, even among the professionals, success is often provided not by the scientism of the method or other scientific toolkit, but due to the talent and art of the worker. Further theoretical generalizations of successful experience sometimes remind the theories of ad hoc (for this case) and rarely can be successfully used. In such cases, there is a fertile ground for dilettantes. An example is an attempt to create **gelotology** as a psychological science about the healing function of laughter. It starts with Norman Cousins’s case, an American journalist, who soon became a psychologist. He fell ill with a rare disease called collagenosis, quickly losing the ability to move and suffering from terrible pain. Doctors have virtually given up hope for him. Then Cousins began to watch comedies and laugh for 5-7 hours every day. He soon got better and then made a full recovery. We can be happy for Norman, but the problem is that this case is unique. And science and its practical implementations need generality, which provides regularity and predictability, that actually takes place in any good theory. However, it was after such a sensational case that empirical scientific research on the psychology of laughter began to be conducted in America, and laughter therapy started to develop as one of the methods of psychotherapy. Doctors in some countries try to use laughter even in the treatment of alcoholics, drug addicts, and cancer patients. However, no one has reported that the efficiency of these methods is off the charts. And this is not accidental. As long as there is no reliable theory, it is impossible to develop a good methodology.

A characteristic example of **dilettantism in literary studies** can be unsuccessful attempts to apply Bakhtin's theory of Menippean to other literary works. If Mykhailo Bakhtin brilliantly implemented his approach to Rabelais's work, then Menippeists such as Alfred Barkov, who used his ideas as a method for Pushkin's "Eugene Onegin", for Bulgakov's novel "The Master and Margarita" etc., clearly failed.

Non-professionals, such as Cousins or Barkov, who are introduced to science, are more likely to produce low-quality hypotheses, which are used to build pseudoscience. A positive point can be seen in the fact, that in this way they draw attention to important problems. And so that there is no harm from their invasion, science must have a strict toolkit (scientific, methodological, and ethical) to cut off non-scientific "slag". It is obvious, that there are few such strict and reliable tools for cutting off non-science in humanitarian knowledge. Therefore, the question of the criteria of scientificity, their observance in humanitarian knowledge, and, accordingly, the methodological preparedness of the participants of the scientific project and their ethical level, is so relevant.

The modern stage of science development demanded some revision of the classical idea of science. In particular, strict requirements for theory, method, and means of expression were relaxed.

In general, it is necessary to distinguish **three areas of knowledge** in humanitarian knowledge. The first corresponds to strict scientific standards. It practically doesn't differ from natural sciences. Mathematical models and strict methods are used here, and verified theories are created. They limit knowledge by the conjunction of at least the following features: reasonableness, explicitness, general significance, referentiality, valence, and reflexivity. This includes many sections of linguistics, some sections of literary studies and psychology, quantitative history and sociology, etc.

The second area uses more blurred scientific standards, soft criteria of rationality, non-strict methods, narrative explanations, and philosophical concepts. However, it strives to adhere to many principles of classical science: evidence, reasonableness, derivability and verifiability. This includes a large part of literary studies, some sections of psychology, qualitative non-quantitative history and sociology, microhistory and pedagogy.

The third important area of humanitarian knowledge, which can be called humanitarianism itself, is non-scientific, in the sense, that consciously refuses a number of requirements of science: from objectivity as literary criticism, from naturalness in explanation, resorting to the recognition of higher forces as theology, from experiment as a philosophy. The coexistence of such different disciplines under the single roof of "non-science" emphasizes the conscious discrepancy with certain generally accepted standards of science. This doesn't reduce its merits at all, on the contrary, it makes them freer and less bound by restrictions.

The differentiation between these three areas of knowledge is particularly relevant for humanitarian knowledge, in particular in terms of a clear distinction between science and non-science, humanities and humanitarianism, professionalism and dilettantism. It is also justified by the possibility, on the one hand, to “finish” some disciplines to the ideals of rigorous science, on the other hand, to outline the sphere of humanitarianism, where this is impossible and unnecessary, and where the way for a fundamentally different, additional, description of humanitarian objects opens, where, however, the professionalism is also needed. All this is the field of professionals. Perhaps, the role of amateurs is not in the creation of scientific theories or methods, but in finding and primary processing of empirical material for professionals, which can take place in any field of humanitarian knowledge. Amateurs can be good organizers, sponsors, managers, and so on, especially in “small projects” of non-institutional science. Perhaps, dilettantism is more harmful than amateurism.

Dilettantism is most often associated with ignorance. However, etymologically, dilettantism was connected with amateurism, especially if we consider the origin of the word from the Italian “diletto”, which means pleasure. An amateur does science because it brings him pleasure. And if it is related to talent, an amateur can give a head start in front of some professionals. Therefore, it is important to distinguish amateurism in science and dilettantism. Amateurism compares with love for science, which helps to overcome one’s own ignorance. A dilettante usually remains at his dilettante, unprofessional level. Amateurism can be both useful, as shown above, and successful, turning into professionalism, which will be discussed below.

Many outstanding discoveries in science were made by amateurs who didn’t receive special education, but actually became professionals, jumping over the barriers of traditional education and institutionalism.

Unprofessional amateurs, together with professionals, played and play an important role in science. It is important that amateurism can be different. An amateur like Chekhov’s “scientist neighbor”, a kind of anti-professional, can do nothing for science, except harm. While a scientist who has good knowledge in some area may succeed in a frontier scientific area. This is an example of borderline amateurism, when an adjacent, border area of science is mustered, and a scientist becomes a professional in this border area too. A typical example of such borderline amateurism can be considered the discovery by the professional chemist-pharmacist Hans Oersted of the connection between electric current and magnetism, which made him a generally recognized great physicist. In fact, it should be considered that he had good knowledge in the field of physics, and was generally distinguished by a broad outlook: it was not by accident, that he received the gold medal of the university for an essay on literary studies, while being a student. However, for university education at the beginning of the 19th century, versatile education was not uncommon. A fundamentally important role was also played by an Oersted’s fascination with Schelling’s idea of the fundamental connection of all various natural phenomena.

Such borderline amateurism, which turned into high professionalism, was characteristic of natural science in the late 18th and early 19th centuries, when classical physics and chemistry were being formed and developed, and many scientists worked in both borderline fields of science. It is enough to mention Henry Cavendish, who became the founder of pneumatic chemistry, and who made many physical discoveries. In this case, it does not matter that for reasons insignificant from the point of view of professionalism, publications in chemistry took place during his lifetime, and in physics - a century later, already after these discoveries were made by other scientists and received their names.

The English scientist Michael Mulcay calculated that among the innovators and discoverers there is a disproportionately large share of people from other disciplines. Isn't this evidence that true scientific professionalism is borderline amateurism? Professional formation of scientists is carried out in different ways. The traditional way for talented people through colleges and universities was not always available to everyone, often for economic reasons, but also due to the fact that their talents didn’t show up immediately or couldn’t be realized. It is possible to single out forced, overcome amateurism, when, without having a special education, a person became a scientist, a professional, mastering some field of knowledge on his own. Karl Gauss, having found out outstanding mathematical abilities in early childhood, independently studied the works of Newton, Euler and Langrage in college, which allowed him to become a great mathematician. George Boule, who didn’t show special mathematical abilities in his childhood and youth, nevertheless mastered mathematics on his own, began to publish works on mathematics and logic, entered the history of science as one of the founders of mathematical logic, and created Boolean algebra.

Borderline and forced amateurism can be temporary, as in the above-mentioned unique cases, when scientists were able to become professionals in a new field, but mostly it is not completely overcome, especially in modern, rapidly developing science, when problems are often formulated at the “intersection” of sciences and solved in complex studies. It turns out that during a short period of time, the scientist is involved in many complex studies, and these decisions often go beyond the boundaries of the specialty. In the letter case, interdisciplinary amateurism is revealed. In a known sense, every scientist faces a situation of his own amateurism, when he produces new knowledge that becomes an element of professionalism only after its adoption by the scientific community, that doesn’t always happen. And there is no guarantee that a professional will be guaranteed more successful here than an amateur.

The story of an amateur who became a professional, especially a professional of a higher level than his colleagues, almost always means a struggle against the narrowness of the scientific horizon, limited intelligence, lack of a creative approach, traditional thinking, everything that prevents understanding and recognition of scientific discoveries. However, it should be borne in mind that such traditional specialists play their important and useful "violin" in science. Science is also impossible without them, just like without creators. These are the workhorses that "prove" scientific discoveries, "incorporate" them into scientific disciplines, acting as a kind of cement that binds scientific blocks together. Thousands of such unknown or little-known professionals with template, stereotyped thinking ensure the evolution of science, its connection with other cultural formations, and its application. They become a brake on science only when they come into conflict with the "creators", that does not always happen. Usually creators are associated with scientific revolutions, and conservatives with "normal" science. However, "creators" can also lead science down the wrong path, especially when the time for scientific revolutions has not come, or when they have unsuccessfully entered an unfamiliar scientific field. Then they may turn out to be producers of pseudoscience, like A. Fomenko or V. Bebik.

Therefore, encouraging creativity, risk-taking and looseness, breadth of outlook, unconventional thinking, which is especially noticeable in amateurs, we should not reduce the role of deep and narrow professional knowledge, the ability, where it is necessary to think in a patterned, linear and uncreative manner. This is also useful, you have to learn it and preferably have a talent for it. The problem is how to "organize" those and others! This is extremely relevant in modern conditions, when revolutionism, innovation, traditionalism and patternedness are neighbors and complement each other. Modern disciplines that study science, especially psychology of science, sociology of science, methodology of science, scientific studies, etc., have a lot of experience in the organization of scientific activity, in particular with the involvement of non-professional amateurs.

The question of how to protect science from amateurs and dilettantes generating pseudoscience remains open. Such a function of protection was performed and performed by solid specialized scientific publications, weeding out unprofessional ideas and their authors, which, unfortunately, sometimes included future authorities who were not understood and underestimated in time. However, in today's information society, pseudoscience develops and spreads more efficiently than science through a variety of distribution channels, starting from some scientific publications that don't have effective means of control, and ending with the Internet.

Thus, the spread of dilettantism and amateurism in science actualizes the issue of compliance not only with scientific criteria, but also with the norms of scientific ethics. A scientist must be aware of responsibility for his activity, both for results and for concepts, be aware of possible damage, both physical and intellectual.

Questions to repeat:

1. Name the main ethical problems of science.
2. Describe the main topics of ethical discussions in modern science.
3. What is bioethics?
4. Describe the ethical problems of cloning.
5. Give examples of specific ethical problems in certain sciences.
6. How are professionalism, dilettantism and amateurism connected in science?
7. What is scientific professionalism?
8. In what cases can dilettantism and amateurism be useful in science?
9. What is the harm from dilettantism in science?

9. Philosophical and methodological context of the structure and dynamics of scientific knowledge.

9.1. Philosophy of science about empirical and theoretical knowledge.

The philosophy of science distinguishes the main structural subdivision - the horizontal "section" of science: empirical and theoretical levels.

There are several reasons for distinguishing empirical and theoretical levels in scientific research. In particular, these two levels in scientific research differ:

- on the epistemological orientation of the research;

- according to the type, nature and specificity of the acquired knowledge;
- on methods used in research and forms of knowledge presentation;
- by cognitive functions;
- on the ratio of sensory and rational correlates of cognition and on a number of other signs.

The empirical level of science is the level that is characterized by the activity of the subject with visible objects, often those that are perceived by the senses. Therefore, the methods of scientific cognition that operate at this level and the forms of scientific cognition that function at this level are called empirical (for example, such forms as scientific fact or empirical law).

The categories "theoretical" and "empirical", which reflect the appropriate levels of scientific knowledge (and cognition), are basic, initial epistemological and methodological "units", on the basis of which further clarification and detailing of structural representations of scientific knowledge is possible. In other words, it is assumed, that further structural subdivisions in scientific research are possible only within the theoretical and empirical levels: everything that goes beyond the scope of theoretical or empirical knowledge, various intuitions, assumptions, insights, do not belong to the "body" of scientific knowledge.

The empirical level of science assumes:

1. The study of the object at the level of the phenomenon, not the essence, which usually implies a description, rather than an explanation.
2. Establishing simple, experimental dependencies, for example, speed is the distance divisible by the travel time.
3. Direct study of the object using, for example, measurement, observation and experiment.
4. Special language - empirical terms, for example, temperature and pressure. Although the terms always depend on the theory, they are still specific.
5. Special tasks are solved here: selection of facts and their classification. Scientific facts are the foundation of science.

The theoretical level of science is the level characterized by the subject's activity with abstract idealized objects. Therefore, the methods of scientific knowledge operating at this level and the forms of scientific knowledge that function at this level are called theoretical.

The theoretical level of science assumes:

1. Studying the object at the level of the essence, not the phenomenon.
2. Theoretical laws are obtained on the basis of abstract models or as a conclusion from theoretical principles, for example, formulas of the theory of relativity.
3. Indirect study of the object, for example, with the help of an imaginary experiment or model, for example, studying the atom on the Bohr-Rutherford planetary model, since the atom is not accessible to direct observation.
4. The language of theoretical description, special concepts-constructs, by which the theory is constructed, for example, "ideal gas" and "material point". Scientists attribute properties to these concepts that real objects do not have, without that it is impossible to understand the essence of what is being studied.

5. Special tasks are solved: theories are built, explanations and scientific forecasts are made.

Thus, the main cognitive task of the research subject at the empirical level is the description of phenomena, the collection of scientific facts and their primary generalization, along with verification and confirmation (or refutation) of theoretical systems. At the theoretical level, the main cognitive task is the essential explanation of the studied phenomena, their conceptual and theoretical generalization and, ideally, the construction of a scientific theory for them.

The clearest difference between the selected two levels of scientific knowledge is revealed in the nature of the obtained results (in other words, the forms of scientific knowledge). The main form of knowledge obtained at the empirical level is a scientific fact and a set of empirical generalizations, for example, in the form of empirical laws. Theoretically obtained knowledge is fixed in the form of a scientific problem, a scientific hypothesis, theoretical laws, principles and scientific theories, in which the essence of the studied phenomena is revealed. Accordingly, the methods used in obtaining these forms of knowledge also differ. The main methods used at the empirical level of cognition are observation, measurement, and experiment. Theoretically, such methods as idealization, axiomatic and hypothetical-deductive methods, mathematical modeling, formalization, etc. are used.

Empirical and theoretical levels are relatively independent, for example, theoretical and experimental physics work with their own languages. It is not uncommon for theoretical physicists and experimental physicists, working seemingly within the same discipline, to misunderstand each other.

At the same time, both levels are closely interconnected, line between them is quite conditional. The theoretical "load" of empiricism should be especially emphasized. The last one cannot be independent.

The concepts of "empirical" and "theoretical" should not be confused with the concepts of "sensory" and "rational". The latter refer to cognition in general. Both sensory and rational are used at both levels of science: at the empirical level, where rational processing of sensory data is required, and at the theoretical level, where sensory and visual representations cannot be dispensed with. Only with a degree of convention we can say that the sensory-visual dominates at the empirical level, and the abstract-rational dominates at the theoretical level.

It is worth to consider in more detail the problem of the ratio of pairs of categories "sensory - rational" and "empirical - theoretical". Before the formation of the second pair of categories in the methodology and philosophy of science, the first pair was used to characterize any (not only scientific) cognitive situations. As for the categories "empirical" and "theoretical", in this context they are used to characterize scientific cognition and its results. "Sensual" and "rational" characterize only human cognitive abilities, but not stages or types of knowledge. When used in human cognition, they are not separated from each other. There can hardly be sensory (along with rational) knowledge as such, although empirical and theoretical levels of scientific knowledge can be distinguished. The ratio of sensory and rational correlates in empirical and theoretical knowledge is different. In empirical knowledge, the sensory correlate dominates, and in theoretical knowledge, the rational one. The different ratio of sensual and rational correlates is reflected in the methods used at each level. It is clear that the method of observation used at the empirical level is based mainly on sensory cognition. But to the extent that observation has a purposeful nature, and its results are recorded in linguistic form, it also includes the use of rational cognition. Similarly, whereas theoretically the ability to abstract, conceptual thinking is mainly used, the rational moment dominates in it. But to the extent that any concept is associated with a certain set of perceptions, ideas and visual images, it also contains a sensory component.

It should also be borne in mind that empirical and theoretical knowledge differ from each other by their orientation of reflection and can be transformed into each other by transformations of reflections. Empirical knowledge does not exist apart from theoretical knowledge, and vice versa. Explaining the observed phenomena, we build theoretical knowledge, using the same observations to develop or substantiate theoretical constructions, we implement empirical research. It all depends on what task we set.

Despite all the differences, there is no clear boundary between empirical and theoretical knowledge. Thus, empirical research, although focused on knowledge and fixation of phenomena, constantly breaks through to the level of essence, and theoretical research seeks confirmation of the truth of its results in empirical research. A scientific experiment, being one of the important methods of empirical knowledge in factual sciences, is "theoretically loaded", and any abstract theory in factual sciences must have, at least in the final result, at least an indirect empirical interpretation.

However, despite all the blurring of the boundaries between empirical and theoretical knowledge, the introduction of these categories marked progress in the development of the methodology of science, as it contributed to the development of our ideas about scientific cognitive activity. In particular, the structure of scientific cognition was clarified, a constructive approach to solving the problem of empirical substantiation of scientific knowledge was formed, the specificity of theoretical thinking in scientific research was revealed, the logical structure of the main cognitive functions was clarified, and in general, many fundamental problems of the logic and methodology of scientific knowledge were solved.

9.2. Forms of fixation and development of scientific knowledge. Philosophical and methodological meaning of scientific laws and concepts

First, we will give a general philosophical and methodological description of scientific law.

A scientific law is a form of scientific knowledge that expresses the objective connection of phenomena. But not every connection is a law, even more so – a scientific law, but only one that, in addition to objectivity, is also characterized by regularity, reproducibility (verification and confirmation), essentiality. In the language of science, a scientific law is expressed in the form of a conditional expression (an implicative statement with a quantifier of generality). Scientific laws are often divided into theoretical and empirical laws. A theoretical law is one of the most important elements of a scientific theory. Scientific laws must be distinguished from legal laws, laws (norms) of morality, and also from laws in the field of religion. A scientific law is one of the most important categories of scientific determinism. Scientific determinism is a type of determinism; it is a concept according to which the world is an ordered, regular whole, the dynamics of which are described by scientific laws.

Now about the scientific law in more detail. Obviously, the concept of "law" in the philosophical plan is defined through the concept of "connection" as one of the key concepts in the concept of determinism. At the same time, it is indicated that not every connection is a law, but only that which is regular, essential, necessary and general (common to all phenomena in the subject area of the law). For a scientific law, the connection must have, besides the mentioned properties, also objectivity, intersubjectivity, and reproducibility, that is, this connection can be repeated, for example, in some experiments. Scientific laws are, for example, the statements: "If a current flows through a conductor, a magnetic field is formed around the conductor", "The chemical reaction of oxygen with hydrogen produces water", "If a country does not have a developed stable society, it does not have a stable democracy". The first of these laws refers to physics, the second to chemistry, the third to sociology.

Scientific law is the most important component of scientific knowledge; it presents knowledge in a concentrated form, in the form of universal implicative statements (conditional sentences). However, the goal of scientific activity in general should not be reduced only to the establishment of scientific laws, because there are also such subject areas (first of all it concerns the humanities) where scientific knowledge is built and recorded in other forms, for example, in the form of narrative descriptions, chronicles or classifications. In addition, scientific explanation is possible not only on the basis of law: there are many different types of explanation. However, it is the scientific law in its laconic formulation that makes a strong impression both on the scientists themselves and on wide circles of representatives of non-scientific activities. Therefore, scientific law is often considered synonymous with scientific knowledge in general.

A scientific law is a universal, necessary statement about the connection of phenomena. The general form of the expression of the scientific law can be presented in this way: "For any object of a given subject area, it is true that if it has property A, then it must also have property B." The universality of the law means that it applies to all objects of its subject area. The necessity inherent in a scientific law is not logical, but ontological. It is determined not by the structure of thinking, but by the "structure" of the most real world, although it may also depend on the hierarchy of statements included in a scientific theory. Researchers distinguish three meanings of the universality of a scientific law. The first meaning: universality is determined by the nature of the concepts included in the law. Of course, there are different levels of commonality of scientific concepts. Therefore, laws can be ordered by commonality as more general (fundamental) and less general (derivative). The second meaning of universality refers to spatio-temporal commonality. The statement is universal in this sense, if it applies to objects regardless of their spatial and temporal position. Therefore, for example, geological laws cannot be called universal in this sense, since they characterize earthly phenomena. In this case, we can talk about the community (universality) of a lower level, regional and even local. Finally, the third meaning is related to the logical form of law-like statements - with the use of a special logical operator in the formulation of the law, which allows you to speak about any "object in general". Such an operator is called a quantifier. In universal statements, the quantifier of generality is used ("For all objects of the form A there is ...").

It should be noted, that from a logical point of view, a nomological (that is, one expressed by a scientific law) statement is no different from any other general conditional statement. In addition, the universality of the scientific law is also expressed in the fact that describing the essential aspects of one or another phenomenon, it refers directly not so much to real specific phenomena that take place, but to universal potential situations that can be realized when the appropriate conditions are met. In other words, the law "overcomes" the sphere of what actually exists here and now. In this regard, the famous American philosopher and logician Nelson Goodman (1906-1998) generally pays attention to the potential nature of laws and calls as a specific property of scientific laws the fact that conditional (or counterfactual) sentences can be derived from them, that is, those that describe not the actual state of affairs, but what can or could happen under certain circumstances. For example, the expression "If friction did not interfere, this stone would continue to roll" is a conditional statement based on the law of inertia. On the contrary, those thoughts that reflect only random properties of any object cannot serve as a basis for deriving counterfactual thoughts from them.

Classification of laws. The simplest (although not so defined) division of laws is the division by scope of their subject area into **specific** (for example, Ohm's law) and **general** (for example, the law of energy conservation and transformation). If we take into account the form of expression of laws, then they can be divided into **qualitative** and **quantitative**. The first are formulated purely verbally (through words), while quantitative laws allow a mathematical form of expression through the relationship of quantities.

If we keep in mind the nature of objects and predictions of their "behavior", then the laws are divided into **dynamic laws** (single objects "obey" them and their predictions are strictly unambiguous) and **statistical laws**, which apply to objects that include a huge number of elements, and therefore they give only probabilistic predictions.

If we consider the nature of objects, then we should distinguish, for example, **natural scientific** (laws of nature: physical, chemical, geological, biological, etc.) and **social laws**. At the same time, for example, social laws will have to take into account the significant role of the subjective factor, since the social objects to which such laws apply are people, persons who have, among other things, freedom and will.

Scientific concept. From a logical point of view, a concept is a minimal logical form of knowledge representation. Traditional logic gives the concept an important place in thinking. Although not only science uses concepts, but it is in a scientific activity that concepts acquire an extremely accurate and strict form. It is important to distinguish a concept from a representation (or image) that can arise in a person's mind when thinking about something or when perceiving language. Imagination is related to the sensory component of consciousness. The concept refers to the rational area. This means that regardless of what perceptual images a concept may be accompanied by in an individual's mind, it must be verbally expressed, become part of an opinion exposed to a reasoned report on its content, and must be understandable to another participant in the discourse (language interaction).

From a logical point of view, a concept is a form of thinking, a set of signs necessary and sufficient to indicate or highlight any object (or class of objects). In other words, if we have a concept of any object, then we have at our disposal information about some properties and relations of this object, which is sufficient to be able to identify it among other objects and use it in some system of knowledge.

In traditional logic, the **content** and scope of a concept are distinguished. Content is the semantic side of a concept, it is what is understood by the participants of linguistic interaction (discourse) when using one or another concept. But what does it mean to understand? This question is one of the most difficult in philosophy, and it is answered in different ways in different philosophical currents. The main thing here is the following: if a person understands a concept in communication, then the understanding he has achieved can be further implemented in a certain way. For example, a person can list the signs that he has identified in the object denoted by the concept, or, not knowing all the signs, he can name at least part of them and then explicate them, or at least (this is a minimum requirement) he can correctly use this concept in language practice.

The scope of the concept is the actual side of the concept, it is a class of objects characterized by this concept. Let's say that the scope of the concept of "table" includes all the tables that actually exist.

Note that the simple "scope/content" scheme, which works well for everyday concepts, does not fully correspond to the specifics of scientific cognition, because due to the highly abstract nature of scientific concepts, it can be quite difficult, and sometimes even impossible, to specify those real objects that should correspond to one or another concept.

Traditional operations performed on concepts include definition of a concept and logical division, which consists of dividing the scope of a concept into smaller units on the basis of some additional feature. The most common variant of separation is the classification operation.

Since the concept captures certain knowledge, the content of the concept, as a rule, can be expanded into a certain set of thoughts. For example, the scientific term "gene" already presupposes some concept of what a gene is. This does not mean that such a concept is the only possible one. It is only about the fact that when using a scientific concept, we can put forward at least one concept that gives a preliminary understanding of what is meant by this concept.

Formation and functioning of scientific concepts. Scientific concepts often come to science from everyday life (as, for example, in physics: force, work, etc.). However, in the scientific context, they acquire a specific meaning and specified content. The formation of scientific concepts is a purposeful activity, which is designed to give as a result a full-fledged scientific concept. In contrast to the everyday use of concepts, in which they are usually satisfied with the minimum content that is sufficient for the mutual understanding of the interlocutors, in science, when forming a concept, they try to record the most essential, important properties, relationships and regular connections of the object under study.

Formation of scientific concepts is a complex process. It includes many mental procedures: abstraction, idealization, induction, generalization, synthesis, etc. Science needs such concepts, the content of which would not be a chaotic set of signs, but would be a coherent logical system, a conceptual unity. This, in particular, was convincingly demonstrated by the famous German philosopher Ernst Cassirer (1874 - 1945) in his book "Cognition and Reality". He showed that the formation of abstract concepts in science does not proceed by simply rejecting irrelevant features, which would lead to the impoverishment of the conceptual content, but is based on some intellectual idea. A scientific concept, according to Cassirer, contains some productive principle, a logical project, that is, some generative relationship that leads to the systematization and unity of the entire class of objects named by this concept. For example, the concept of a number is based on a certain principle of construction of one or another numerical series as a conceptual structure.

In the natural sciences, concept formation is subject to the most important requirement of operationalization. **The operationalization of a concept** consists in finding out and clarifying in what ways it is possible to operate with this concept and the essence that is allowed by this concept: to check its presence, to measure or determine its gradations and degrees, to find out its relationship with another essence. One of the outstanding achievements of the English chemist and physicist John Dalton (1766 - 1844) can serve as a historical example. The hypothesis of the atomic structure of matter was known even before him, however, only Dalton was able to operationalize the concept of "atom", connecting it with the concept of atomic weight and introducing the procedure of measuring the latter into science. The general tendency of natural science is to get rid of non-operationalized, that is, ineffective, concepts. The requirement of operationalization is known in various variants, for example, as the principle of observability, formulated by the outstanding German physicist Werner Heisenberg (1901 - 1976).

In a number of humanitarian disciplines, especially those that claim the status of scientific, the requirement of operationalization is also mandatory. Since the content of the concept leaves a wide range of possibilities for its clarification, scientists enjoy a certain freedom of formation and use of scientific concepts. Scientific thinking should not be presented as an impeccably correct operation offered by "school logic" with precise concepts with a verified volume and content. Scientific knowledge is a creative activity that is based, in particular, on intuition and putting forward bold hypotheses.

The formation of scientific concepts should not be imagined only as a process of fixing something known. Often, the concept acts as a **research search tool**. In this case, concepts are introduced as names of supposed objects, and the question of the existence of these objects and their possible properties becomes another scientific task. The existence of some hypothetical objects later turns out to be confirmed, as in the case, for example, of the neutrino or the positron. Others, on the contrary, may later be neglected as inadequate (for example, caloric or phlogiston), but this is not evidence of the fallacy of the very method of introducing hypothetical concepts. After all, the main function of a scientific concept is to contribute to the further progress of scientific knowledge. In addition, concepts do not necessarily have to appear in scientific usage as immediately maximally specified, explicit. The history of science shows that imprecise, preliminary concepts that appear at the beginning of the formation of any scientific concept also stimulate scientific progress. The development of knowledge in any scientific field and success in clarifying the initial concept are two sides of the same process. But there are almost always specific problems related to the logical properties of scientific concepts. Therefore, it is hardly worth counting on the fact that it is possible to achieve an extremely clear and complete definition of any scientific concept, especially if it concerns theoretical terms.

The formation of a scientific concept is often the most important event, a great achievement in one or another scientific field. An example can be the situation in physics in the first decades of the 19th century. At this time, physics "groped" the concept of energy. It was believed that there is some factor that can appear in the form of motion, electricity, heat, magnetism, etc. It was also believed that these forms can pass into each other. But in order to turn this vague idea into a scientific concept, a number of problems had to be solved. First of all, it was necessary to find the general measure of this sought-after single factor. The vague idea of the unity of natural forces fueled the imaginations of natural philosophers who put forward various hypothetical versions. An intellectual breakthrough came only in the forties of the 11th century, when the possibility of identifying and measuring what is contained in various phenomena was shown from different sides. Finally, in 1853, the outstanding English physicist William Thomson (Lord Kelvin) (1824 - 1907) formulated the final definition of energy. The concept of energy and the related law of conservation of energy soon became the foundation of natural science.

The systematizing effect of a concept is designated in the fact that a new concept introduced into science can unexpectedly generalize previously independent fragments of knowledge, provide the integration of various fields into a single theory. Such a theoretical synthesis is always a great success of science.

In the course of scientific knowledge, scientific concepts also change, because concepts correspond to the current level of knowledge and ideas achieved by science. Being the result of the passed period of development, the concept is a conceptual support and a tool for further movement. The growth of scientific knowledge leads to rethinking the content of initial concepts, to redefining the scope of their applicability. As a result, it may become necessary to make a transition to a new concept. Therefore, the dynamics of science includes the "trajectory" of concepts that replace each other. In a certain sense, the history of science is the history of its concepts.

9.3. Forms of development of scientific knowledge. Scientific fact, problem, hypothesis, theory. Their philosophical and methodological meaning.

The most important forms of organization of knowledge (and at the same time its development) are scientific fact, problem, hypothesis, theory.

Observation protocols and empirical facts. Observation data contain primary information obtained directly in the process of observing the object. This information is given in a special form - in the form of observation protocols. The latter express the information received by the observer in linguistic form.

The observation protocols usually contain instructions on who is conducting the observation, and if the observation is built in the course of the experiment with the help of any devices, then the main characteristics of the device are given. Such additional information is included in the protocol, since the observation data, along with objective information about the phenomena, contains some subjective information that depends on the observer and his senses.

Objective information can be distorted by random external actions, various device errors, observer errors, etc. Therefore, these observations are not yet reliable knowledge, and the theory cannot be based on them. The basis of the theory is not observational data, but empirical facts. Unlike observational data, facts are always reliable and objective information; it is such a description of phenomena and connections between them, where subjective layering is removed. Therefore, the transition from observational data to empirical facts is a rather difficult procedure.

The transition from observational data to an empirical fact involves the following cognitive operations:

- rational processing of observation data, search for stable and invariant content in them; in order to form a fact, it is necessary to compare many observations with each other, to highlight what is repeated in them and to eliminate errors and random deviations;
- interpretation of the invariant content revealed in the observations to establish a scientific fact. In the process of such interpretation, previously acquired theoretical knowledge is widely used.

Establishing an empirical fact requires the application of a number of theoretical propositions, but then there is a difficult problem, which is that establishing a fact requires theories that must be supported by facts. This is a problem of theoretical load of facts.

Thus, the formation of a fact involves knowledge that has been verified independently of the theory, and the facts provide an incentive for the formation of new theoretical knowledge, which, in turn, if they are reliable, can again participate in the formation of new facts and so on.

In a scientific fact, as an empirical form of knowledge, one should keep in mind at least two components - ontological and epistemological. In the first case, the fact appears as a relatively stable (for example, in the sense of spatio-temporal characteristics) event; in the second case, we are talking about factual statements (expressions) with a stable true assessment.

A problem is a form of knowledge, organized in the form of a set of questions, for the answer of which there is not enough existing knowledge. That is why the problem is called knowledge of ignorance. New knowledge needs to be created to solve the problem. In this way, the problem differs from a scientific task (scientific problem), for the solution of which existing knowledge is sufficient. In this sense, it is sometimes said that a problem has no solution, that is, when the necessary new knowledge is discovered, the problem automatically turns into a task. The entire course of the development of science can be represented as a transition from setting problems to their solution, and then to a new setting of other problems arising from the solution of previous ones.

Sometimes a problem is interpreted as any question of practical or theoretical significance, while a pseudo-problem is a question which has significance, that only seems.

A hypothesis is an assumption formulated to solve a problem, consisting of unproven and unverifiable statements from which testable conclusions are drawn to compare them with facts.

Stages of hypothesis development:

1. Generalization of facts, that is why a hypothesis is called a form of comprehension of factual material.
2. Derivation of conclusions from the hypothesis, which are usually laws, that is why the hypothesis is called a form of transition from facts to laws.
3. Comparison of findings with facts, i.e. testing the hypothesis, after which the hypothesis is rejected or accepted.

A hypothesis must meet a number of requirements: cover as many facts as possible, be simple, be fundamentally testable, because hypotheses that cannot be tested in science do not make sense. A hypothesis must predict new facts. The principle of simplicity, for example, means that among competing hypotheses, preference is given to the simpler hypothesis.

Theory is a system of confirmed knowledge that explains and predicts a certain set of phenomena. In logico-linguistic terms, a theory is a system of propositions ordered by the relation of derivability. In a broad philosophical and methodological sense (for example, theory in the aspect of activity), theory is opposed to practice, empiricism, experiment.

Structure of the theory:

1. Initial foundations: principles, postulates, axioms without which the organization of knowledge included in the theory is impossible.
2. Idealized objects of this theory, for example, "absolutely solid body" or "ideal gas" in physical or chemical theories.
3. Logic, according to the rules of which certain statements are derived from others. It can be the logic of everyday language or a special logical-mathematical apparatus.
4. A set of laws and statements, as well as special concepts - the language of theory, for example, "charge", "current", "field" in physics, which have a special meaning.
5. Philosophical attitudes and value factors, often implicitly present in the theory, for example, a mechanical or expedient system of the world.
6. Empirical basis is a set of factors on which the theory is built.

The difference between a hypothesis and a theory in methodological terms is relative and is determined by the degree of verifiability and development of the hypothesis.

Theory requirements.

1. The theory must have a field of applicability where it successfully explains the facts. The boundary of this field is usually determined by more general theories.
2. The theory should have the sphere of forecasting unknown phenomena, which causes the possibilities of theory development. In particular, the narrowing of the sphere of the forecast indicates the disadvantage of the theory.
3. The theory must be formally consistent, i.e. it must not contain or derive statements that contradict each other. Otherwise, it will be possible to prove anything, and any arbitrary statement in it will become a law. Although real scientific practice does not correspond to this ideal, the requirement of non-contradiction is an incentive to improve the theory.
4. The desired semantic completeness of the theory, that is, every valid position in it must be provable. True, the Austrian logician K. Gödel (1906-1978) proved that some substantive valid statements of theories are unprovable in it, however, the requirement of completeness leads to the search and discovery of such statements and to their substantiation in other ways.

Scientific theory occupies a special place in science. It is a kind of border, the end of scientific research. Of course, scientists want the theory, as the fruit of long, sometimes centuries-long, often large number of people's efforts, to be perfect. However, this does not happen, although at first it seems that the ideal has been achieved. Taking this situation into account, Karl Popper formulated the principle of fallibilism (from the English fallibility), which requires the recognition of the fallibility and imperfection of all knowledge. Any concept's claims to infallibility indicates that it belongs not to science, but to ideology. Any knowledge that claims to be true can be no more than relative truth, or, in other words, only understanding. If we use the concept of truth according to Aristotle, any knowledge can correspond to its object only in certain relations, under certain conditions, be expressed in concepts that have a certain meaning only in the predictable system of knowledge. Absolute truth is only an ideal we are striving for. The relativity of truth does not deny its objectivity, since the relation of correspondence of knowledge to the object exists independently of us: we can think that our knowledge is true, but it is actually wrong, and vice versa.

It is often necessary to find out the influence of external scientific factors on this theory. The concept of intertheory serves these purposes.

Intertheory is the ideological surroundings of a certain theoretical system, which includes the experimental basis of the theory, imaginary experiments, mathematical theories, ideas and other elements from other fields of knowledge. The boundaries of the intertheory are defined by the framework of a certain scientific direction or the conceptual field of alternative theories. Like a scientific theory, it is a synthetic work, however, it is not as integral, less specialized, and it sets not only a vision of the world but a vision of possible ways of developing the theory.

An important role in the construction of hypotheses and theories is played by a **scientific principle** — a statement that is the starting point for the further development of the content of the theory. A law can act as a principle in a scientific theory. More generally, a principle is the starting point of an activity. If the latter is carried out in the field of science, then the principle is closely related to the method, that is, it makes sense to talk about the regulatory principle of scientific activity or the methodological principle, for example, the principle of observability, the principle of correspondence, the principle of symmetry, and so on.

The outstanding English philosopher, logician and methodologist of science Karl Popper developed an idea of the course of scientific research as an increase in knowledge in the form of a cycle of scientific research. This cycle consists, at least, of the following stages (phases): 1) formulation of the problem; 2) its analysis and putting forward hypotheses; 3) justification and selection of hypotheses and formation of scientific theory; 4) emergence of a new problem.

However, it is often necessary not to put forward a new theory, but to choose between existing ones.

The choice of a theory is a methodological problem, the essence of which is not only in the determination of professional qualities that allow a scientist to choose the best theory from some of them to explain facts or create an engineering object, but in the search for explicit and implicit methodological regulations that influence the choice of: the ideas shared by members of the scientific community, the ideals of this discipline, the thinking style of the era, general scientific norms, and so on. The choice of the theory is connected with the **verification of the theory** for adequacy. Verification is multi-level: actually empirical - comparison with experimental data (verification, falsification); intertheoretical - comparison with the ideological surroundings, with related theories; meta-theoretical – comparing the initial foundations of the theory, its logic with those generally accepted in this discipline or in science; epistemological and methodological - checking for consistency, systematicity, completeness; philosophical - determination of the validity of philosophical assumptions, socio-cultural inclusion, etc.

In the philosophy and methodology of science, a number of concepts have been produced, that clarify the process of acceptance by science of certain hypotheses and theories.

Verification is a concept used in the methodology of science to denote the process of establishing the truth (adequacy) of scientific statements - hypotheses, theories, laws, as a result of their empirical verification. Direct verification is a direct cheking of statements through observational and experimental data. Indirect verification – establishment of logical relationships between provisions that are indirectly verified and directly verified.

Verifiability of hypotheses - the possibility of verification, its conditions, schemes. It is the verifiability of hypotheses and other scientific statements that is the subject of logical and methodological analysis in the first place.

The principle of verification is a methodological requirement introduced in the Vienna Circle to distinguish between scientific and non-scientific knowledge. The

Vienna Circle was a famous and influential community of scientists that regularly met in Vienna in the 20s and 30s of the 20th century. Members of the Vienna Circle made a huge contribution to the development of the logic and methodology of science. According to the principle of verification, only those propositions of science that can be directly verified have the status of scientificity. The falsity of such a strong requirement forced the weakening of the principle to the requirement of principal verifiability of scientific statements.

Falsification is a concept of the methodology of science, which expresses the process of establishing the falsity of a hypothesis or theory as a result of empirical or theoretical verification. The logical basis of falsification is the rule of modus tollens. Falsification is successfully applied to isolated hypotheses when their inconsistency with facts or fundamental theories is revealed. In the case of a developed hierarchical theory, falsification requires the introduction of additional models, the development of special tools, experimental setups, and so on, while the falsified propositions are most often not rejected, but modified in such way to agree with the facts or with other theories. Final falsification is possible only on the basis of a better theory. According to the British philosopher and logician Karl Popper (1902-1994), who introduced the principle of falsification as a demarcation principle for distinguishing between science and non-science, the status of scientific, contrary to the positivist principle of verification, is possessed only by those propositions that can be falsified. However, as it turned out later, the principle cannot always be applied, since abstract hypotheses cannot be directly falsified, and falsified propositions are often modified rather than rejected. However, although the principle did not justify the idea, it turned out to be a useful methodological requirement.

9.4. Philosophical and methodological characteristics of theories. Scientific and technical and humanitarian theories. Types of humanitarian theories.

Theories can be classified on different grounds. There are undeveloped theories in which empirical generalizations prevail: Darwinian theory of natural selection, Pavlovian theory of conditioned reflexes, and developed theories that include theoretical laws, idealized objects, and a special inference apparatus. Empirical-descriptive theories should be distinguished from undeveloped theories, which are principally oriented on empirical material: taxonomic, paleontological, archaeological.

Hypothetico-deductive theories are distinguished as the ideal of logical organization of natural scientific knowledge. This is a concretization of the concept of axiomatic theory. Striving for this ideal allows you to make the theory more rigorous or more confirmed. However, abstraction from development and a number of complexities limits this methodological ideal.

The scientific and technical theory is a special kind of theory. The specificity of the scientific and technical theory is determined by its tasks - to reveal the internal correlation between the characteristics of the structure and the functioning of the technical object. This connection is driven by natural processes. From here the three types of characteristics: morphological (structure characteristics), functional (technical) and natural.

Technical theory occurs:

1. As a generalization of the structure and functioning of production, in particular, the physical nature and design features of technical devices.
2. As a practical application of natural sciences in the course of applied research.
3. As an exploration of the technical side of cognitive activity, creation of measuring tools, devices and so on.

The main function of technical theory is not explanatory, but constructive and technological. The peculiarity is not the power of prediction, but technological opportunities. In addition, the object of technical theory is the result of social activity, and not purely natural as in natural science.

Sometimes the need to create a general theory of technology is discussed. It should be a science that solves the problems of the best possible technological connection of society with nature.

When creating a technical theory, special principles are needed:

I. the principle of action, which determines the circle of natural science theories and the method of connecting them into a new field of knowledge, the object of which will be the future construction.
2. the principle of systematicity, which allows to consider the same task in different ways.
3. the principle of practical relevance, since present-day needs come to the fore.
4. the principle of manufacturability as the identification of step-by-step processes of object creation.
5. the principle of reliability as a determination of the degree of longevity of the object.

Humanitarian theories. Humanitarian theories should contain standard components, which would be enough to attribute them to scientific ones: initial principles, idealized objects, a set of laws and concepts, the sphere of technological implementations, object and subject, classifications. Differences between theories are revealed in the specificity of components, especially laws or other explanatory provisions, or system-forming concepts. Theories of the first type include laws, including those from other sciences, rules and norms that act as laws, and also such narratives that either include laws or can be transformed into laws. Theories of the second type use narratives, metanarratives, trends, linguistic figures, and language structures.

Subject and object of humanitarian theory. In the methodology of science, a distinction is made between the object and the subject of the theory. There is no unity regarding the interpretation of these terms among the authors, in particular, some call the subject what others call the object and vice versa. At one time, the following word usage, described by B. S. Dynin, was very popular: the subject should be understood as a material phenomenon (the moon, dawn, fire, and the like), which is realized by a person before and in addition to his application of the research method, the object of the theory should be understood fixed with the help of sign systems, properties and relationships that are revealed in the subject in the process of its research using the method. This understanding was in many ways determined by the Hegelian idea of the unity of the object and the subject. Without denying the essence of the matter, the terms are often interchanged. Currently, this interpretation is generally accepted. The object is both a material and an ideal phenomenon, for example, the theory or concept itself, or the inner world, feelings and thoughts of, for example, the author of a literary work or a natural science theory, which are subject to study. The subject is what is constructed by theoretical means.

The specificity of humanitarian theory is, in particular, that it can create not only its subject, but also its object. More precisely, to participate in its creation together with other discourses. This is the essential difference between the humanitarian theory and the natural science theory, which, although it constructs its subject, but does not construct its object. Natural (physical) objects exist by themselves. Therefore, the problem of correspondence of the theory to the object as a problem of truth arises here. In humanitarian theory and in general in humanitarian discourse, where various theories and not only theories can be present, a natural (physical) object is not represented, for example, the author of a literary work or a historical character as a biological organism or a set of physical quantities, because it is not important. Everyday consciousness and common sense can still relate Alexander Pushkin as the author of "Eugene Onegin" or Kateryna II as the founder of Odessa with people who actually existed, since their appearance and even character traits are well known. But in literary studies, the author of "Eugene Onegin" as an object that exists objectively, is represented by a complex construction in which the natural data of this curly-haired man are not present. Here, the author does not have breast volume, height, weight, nose length, eye color, and so on. Perhaps in the future there will be discourses and theories in which the connection of the specified properties with this literary work will be traced, but now the author of "Eugene Onegin" is something else.This is a collection of some thoughts and feelings that seem to hang in the air, since it has not been proven that they can belong exclusively to brown-eyed people, but not blue-eyed people, short people, but not tall people, brunettes, but not blondes. Moreover, that fragment of the inner world of the author, which is responsible for the conception and writing of "Eugene Onegin", is reconstructed on the basis of historical, cultural, psychological, literary and similar data, which in turn are constructions formed by historical, cultural, psychological discourses and theories. This is a humanitarian historical or cultural object in the form of a person, more precisely, his inner world, a text, an event, an act, which allegedly exist objectively. They can be considered objective only for the theory that constructs its subject based on them as an aspect or model of this object. A successful theory can even change the perception of an object, reconstruct it, which constantly happens in humanitarian disciplines, especially in history, demanding its rewriting, and serves as a reason for ridicule among laymen.

The difference between a humanitarian subject and a humanitarian object is that the first is constructed by a relevant theory, and the second by various theories, concepts, discourses and appears, as a rule, before the first. Therefore, one cannot talk about the truth of a humanitarian description - historical, psychological, literary as correspondence to the object - in the same sense as in the natural sciences. But we can talk about the adequacy of the interpretation within the framework of the relevant context, value system, theory, and so on. In this sense, not only the subject as an aspect of the object is created by the humanitarian theory, but also the object itself as a historical, psychological, literary reality, although in a natural, physical sense, the person or phenomenon being studied exists independently, regardless of assessment, physically realistically. We can talk about the objectivity of the existence of a humanitarian object only in the sense that the researcher has the right to consider this discourse or theory as a reality that exists independently of his research, the reality that requires study, not reconstruction.

Two types of humanitarian theories. Many humanitarian theories by their formal characteristics, in particular, system-forming initial principles, idealized construct objects, a certain conceptual apparatus, the presence of a subject and an object, etc., are similar to natural science theories and can be called scientific. Some of them, moreover, use rigorous methods, in particular mathematical, statistical, and other methods, discover laws and build classical explanatory models, and generally focus on classical scientific requirements.

The other part has specific features, for example, a narrative structure, where there is no appeal to laws, non-strict methods or an expansive understanding of methods, and in general they do not fully correspond to the classical general scientific canons, although such classical requirements like internal consistency or logical connectivity are still remain. Often these theories are not so strictly organized, but their productive ideas often allow them to function quite successfully, especially if they are taken from a popular philosophical doctrine or their herald who is a charismatic person. To reject such theories in science means to greatly narrow the field of humanitarian sciences. But it would also be imprudent to significantly expand the boundaries of science. The practice of scientific research itself determined the right way: it slightly softened the classical canons of science, in particular, by admitting into science narrative explanations, expansive interpretation of the method, etc. Humanitarians themselves, in contrast to methodologists, are not always concerned with previous substantiation of the scientific nature of their theories. And if a scientific result is obtained, it is difficult to blame the theory of being unscientific. There is a need to expand, modify or weaken the requirements.

However, theoretical knowledge is still usually, in one way or another, evaluated for verifiability, accuracy, formalizability, predictability, methodology as the presence of rigorous quantitative, structural and similar methods, as well as the obtained results, in order to fix it as a scientific or non-scientific theory. However, if in the natural sciences it is relatively easy to do this, due to, so to speak, the methodological nature of the natural sciences, then in the humanitarian disciplines it is not always the case. In natural science, it is difficult to imagine a theory without a method: any theory applied to research is already a method, not to mention the various methods within the theory. In the humanitarian field, not all theories are methodological in this sense. Some are recognized as scientific theories, although they do not represent a strict method of researching empirical material, but they have fruitful creative ideas, original approaches that allow to construct this object in a new way - to see the reality behind it in a different way. This is the case when they construct not only their subject, but also the object. Perhaps, in the future, such theories will eventually grow into classical scientific and methodological theories, but at this stage they have to be distinguished from theories oriented to natural scientific/general scientific ideals and norms.

Two types of theories are noted, which organize research practice in different ways, that can be called different approaches in research.

In the humanities, in particular, in philology and literary studies, in history and sociology, following the distinction between two types of theories, two types of approaches to the study of the reality expressed by these theories can be distinguished. These types of approaches are a bit of an abstraction, since in real research practice they are intertwined sometimes even in the arsenal of one researcher, not to mention the entire scientific community, moreover, they are not always used in full, but considering the heterogeneity of humanities, it is even more difficult to distinguish them. However, such a distinction would be useful for a number of reasons. First, the ambiguous status of scientific knowledge regarding a number of humanitarian theories does not always prevent their application in research. Secondly, not all humanitarian theories can be used as a method, but as an approach they work. Thirdly, allegedly non-scientific or non-methodological humanitarian theories can play a significant role in the development of humanitarian sciences, that is, strict scientificity, methodology and efficiency do not always coincide.

Let's consider how two types of theories and, accordingly, approaches are found in various social and humanitarian sciences: in sociology, history, literary studies.

Two types of theories in sociology. Quantitative and qualitative approaches in sociology. There are two types of theories, which determine the relevant approaches, that are most evident. Theories and approaches of the first group are oriented towards the classical ideals of science. Many of them can be called quantitative (from the Latin quantitas - quantity), since their task is the quantitative processing and analysis of a large amount of information, rather than obtaining it, proposing hypotheses with subsequent confirmation or refutation, striving to explain rather than simply describe phenomena . They are characterized by the establishment of regular relationships between individual characteristics of social phenomena for the formulation of theoretical models and a generalized forecast. Positivist attitudes are often proclaimed here, insisting on a clear fixation of empirical data and prohibiting the interpretation of empirical material, as it supposedly inevitably moves the scientist into the field of subjective philosophizing. Hence the orientation of sociological theories to the search for laws as a distinctive feature of science, which was emphasized by the founder of sociology, O. Comte. At the same time, mathematical and statistical methods and formalized procedures are considered the basis of reliable scientific knowledge in sociology.

The main disadvantage of quantitative methods is seen in the fact that they can measure only general characteristics, which are understood as typical. In addition, the collected information often becomes outdated quickly. Therefore, quantitative methods of collecting and analyzing information give a surface slice, without affecting, for example, the deep layers of social consciousness. This results in simplified ideas about the object being studied, unsuccessful predictions, and false conclusions.

Theories of the second group, which can be called qualitative (from the Latin qualitas - quality), rely on the so-called free, unstructured, interpretive, qualitative methods of data collection and processing. Some authors even try not to apply the word "method" to such theories, replacing it with a more general concept of approach, strategy, research practices, preferring to speak of methodologies as a set of attitudes rather than a sequence of actions. It is these terms that better characterize qualitative research as a special type of sociological research, which is fundamentally different from the classic "quantitative" one, not only in terms of collecting and analyzing primary information, but also in methodological reasons. To the results of qualitative research, since it is scientific, the same criteria of internal consistency, logical coherence and other scientific requirements are applied, as to the results of classical research. That is why qualitative research gives completely acceptable results in the scientific sense. However, even in this case, we cannot do without a sequence of actions called methods. But the emphasis is on something else. The target task is to understand the meanings of the actions or expressions of the people being studied.

The initial philosophical and methodological attitude of qualitative approaches is the rejection of ideas about an objective or neutral observer, which supposedly does not affect the subject of observation. It is assumed in advance that the researcher has his own subjective position, which must be taken into account. In addition, the research focuses, first of all, on the study of the individual aspect of social activity or social consciousness, namely the real life experience of specific people in specific circumstances. But broader social problems concerning social groups, movements, social institutions in a specific social situation can be traced through the prism of the individual. Quantitative data, in particular, statistics, can serve as additional sources of information, but their analysis will also be carried out on the basis of an analytical approach. Depending on the objectives of the research, it may be the opposite: qualitative research will be an additional source of data for quantitative methods. In this regard, quantitative and qualitative approaches should not be contrasted, they are rather additional.

Emphasis on the individual in qualitative social research is also evident in relation to empirical material. These are primarily unstructured testimonies, selected from various documents: texts of interviews and observations, personal and official documents, photographs, video sources, etc. The primary data are about the subjective opinions of people, expressed most often by sayings, less often by gestures, symbols that reflect their views. The future of sociology is often associated with this as a turn from general and averaged regularities to the individualization of sociological knowledge and reorientation to local cultural and ethnic problems, to the true humanization of sociology. Perhaps, this position is the same extreme as the appeal exclusively to quantitative methods as allegedly only scientific.

Compared to quantitative approaches, qualitative researches differ in the following characteristics. First, the processes and phenomena, as well as their meanings, that are studied are not strictly measured, or are not measured at all in terms of quantity, intensity or frequency. Secondly, phenomena are studied in their natural environment. Thirdly, they are interpreted from the point of view of the meanings endowed to them by individuals participating in the study, and not from the position of an allegedly alienated and disinterested observer. For example, in the answer to the question: "How did you like the book?" - we get the answer, which means the subjective value attitude characteristic of an individual, in his own words, based on his social experience, knowledge, value system. Such data are not analyzed mathematically, but by analytically revealing their meaning using various techniques, starting from the description and commenting and ending with coding as a special combination of data for building a theory, and categorization as conceptual clarification. Fourthly, the reports are written in a narrative genre and differ depending on the goals of the research and the addressee to whom they are intended: for the general public, for colleagues in the "shop", for scientific publication or discussion. Such a report, instead of a sciense-like, supposedly objective and disinterested presentation of the object, is a living story with a large number of quotes from the oral or written language of the researched, with interpretations, reflections, theorizing of the researcher about this social object. Compiling such a report, as well as for all research, requires not only high professionalism, but also a special "theoretical sensitivity" as a set of requirements for the researcher. "Theoretical sensitivity" implies the awareness of subtle differences in the meaning of data, the adequacy of the research situation, insight, the ability to understand and separate what is relevant from what is not. In other words, it means not only what can be taught, not only skills and abilities, but also talent, inspiration, intuition, literary gift and other subjective, poorly rationalized qualities of the researcher.

Qualitative methods of research are actively used to study the individual aspect of social life. As a process of developing a separate problem, they assume not only the presence of special data in the form of personal documents and textual materials with people's estimated expressions, but also specific methods of their collection, processing and analysis, which include theorizing and interpretations of the researcher, as well as requirements for the researcher, his experience , skills, conceptual flexibility, abilities and talents.

Opponents of qualitative approaches rightly see elements of subjectivism and arbitrariness in the researcher's reasoning about various types of texts and personal documents and, as a result, ambiguity and unreasonableness of interpretations. You can agree with this, but there are no research programs and researchers themselves without flaws. Weaknesses should be removed, and qualitative and quantitative approaches and methods should be used as complementary, considering their advantages and disadvantages.

Thus, it can be stated that qualitative methods in sociology study individual aspects of social life, use personal documents and textual materials with estimated expressions of people, include theorizing and interpretations of the researcher, require abilities and talent. They see elements of subjectivism and arbitrariness in them, which reduces their scientific significance. Quantitative approaches are objective and accurate, but they simplify and average the picture of the object. Both approaches should be considered additional.

Two types of theories in history. Quantitative and qualitative approaches in history. History is sometimes called the most humanitarian of the humanities. Humanitarianism here is manifested mainly in literature, first of all, literary fiction and literary imagery, without which no historical text can do. The "History" of Herodotus, for example, is considered the first prose work of European civilization.

The modern age, putting forward a stricter understanding of scientificity and even distancing science from philosophy, also gave justification for the humanitarian science of "spiritual sciences", preserving the deep dependence of the presentation of historical material on philosophy and literary style. The most famous historical works of this time contain psychological stories in the spirit of novels. A good historian, in addition to knowing the facts, must be able to feel the era being studied, like a writer the events depicted, for which it is not at all superfluous to have an artistic talent. Historian O. Thierry resorts to dramatic and pictorial means not in order to decorate his story, and not in order to attract the attention of the reader. Art here is not something extraneous to research, an addition to it. Thierry's scientific method necessarily includes the artistic method.

History became a science at the turn of the 18th and 19th centuries not only due to the careful development of folklore, archival, and literary sources, which, of course, were important, but also due to the awareness of the huge educational potential of literary and historical texts and the emergence of appropriate structures: departments, faculties, societies, diplomas and other attributes of academic status. The artistic style of historical works continued to remain an integral feature of historical science. Even adapted to the needs of historiography, hermeneutics as a method of understanding texts contains psychological, moral and expressive grounds. In the works of the greatest German historians of the 19th century L. von Ranke and I. R. Droysen, history is not so much knowledge about an object as a mean of self-discovery and personality development.

In parallel, a "positive" research history was created in the works of O. Kont, E. Lavissa, I. Tena. The work of a scientist-historian here was built according to a general scientific scheme, such as testing hypotheses with empirical data and their quantitative processing. Historians of the "positive" direction laid the traditions of active use of theories and quantitative methods of psychology, sociology, and economics.

Similar quantitative approaches in historical research include various theories, methods, and models. The unifying start is the use of quantitative means in them. But this application is quite different. Many quantitative methods can be reduced to two. In the first case, quantitative methods serve to process a large amount of auxiliary material, which is used mainly to illustrate these or other provisions, but does not determine the research itself. These can be methods of processing quantitative historical data on various computing devices or the corresponding type of sources containing a huge amount of information. In the second case, quantitative methods in the course of historical research are decisive. They are aimed at establishing regularities, for example, with the help of statistical methods and mathematical models, identifying trends and perspectives that were previously unknown, especially in connection with the tasks of analyzing mass phenomena. It is also possible to quantify qualitative data with further processing by one or other mathematical methods in order to test hypotheses, rather than to obtain statistical illustrations. An impressive result of the mathematical modeling of history was the modeling of the Peloponnesian Wars, as a result of which some seemingly inviolable empirical data, such as food prices, turned out to be significantly clarified and corrected.

A significant advantage of such approaches is that they limit the subjective opinions of the historian to a minimum. In addition, quantitative approaches are able to reproduce psychological, social, economic structures, putting a serious obstacle to the predominance of isolated, exceptional, unique historical phenomena. Finally, there is an opportunity to get rid of reproaches in the ideological commitment and philosophical dependence of the historian. Indeed, almost the entire XIX century and a large part of the 20th century historical science developed on the basis of the conceptualization of the idea of progress, and the appeal to philosophy was determined by the need for some general idea, in global history, without which an isolated historical event was deprived of understanding. An event or phenomenon was important, step-by-step if it became politically or teleologically significant. In other words, the minimum of scientificity was compensated by the maximum of ideologizing and philosophizing. Such a story naturally turned out to be a narrative. Quantitative approaches make it possible to translate stories into a quantitative table, classification, mathematical model, rigid logical construction.

Such quantification had a whole range of manifestations in historical science, but all of them focused on quantitative methods and, in general, on the model of scientific research adopted in the natural sciences. We can recall Marxist class analysis, where quantitative calculations were prominent, although historicism and narrativism in general probably predominated. Interesting results were obtained by the structuralist studies of the Annals school, which put society in general at the center of their research, trying to reveal what explains its deep structures, for example, mentalities that exist over large periods of time, which demanded a significant expansion and, accordingly, a quantitative analysis of empirical bases of historical science. Quantitative approaches in the history of sociology and economics within the concept of "serial" history should also be mentioned. Here, during the study of historical reality, the subject of consideration is not individual, isolated in time and space facts, events or individuals, but a number of homogeneous units representing a kind of time series. This allows reconstructing a coherent whole of economic or social reality from the same or comparable phenomena over a certain period of time. The most impressive quantitative study of this type was Le Roy Laduree's book "The Peasants of Languedoc", which dealt with a "history without people" based on a statistical analysis of the relationships between long cycles of population dynamics and food prices.

Quantitative methods have a certain sphere of effective application, but can this sphere be infinitely expanded or are there limits to the application of quantitative methods and mathematical models? Perhaps the boundaries are limited both by the goals of research and their scientific level, and by the possibilities and specifics of mathematical knowledge. Probably, it is problematic to present the evolutionary historical model in mathematical form.

Many historical phenomena can be studied in the same way as corresponding sociological or economic problems using the appropriate apparatus. Issues such as access to education, newspaper and book reading, or attitudes toward execution by the general population can be studied using statistical methods and charts, just as industrial and agricultural production or trade relationships are analyzed. In this sense, quantitative approaches in historical research are a kind of penetration together with methods and corresponding concepts from other fields of science, which must be adapted to the given disciplinary specificity. Sociological, mathematical and other methods used, for example, in the study of social classes, can be, according to a number of researchers, used for quantitative analysis, for example, of cultural elites in provincial academies. Accordingly, it is necessary to redefine, first of all, the content of such concepts as "culture", "mentality", "behavior", "social practice", etc. For other historians and methodologists, we are not talking about a radical expansion of the categorical apparatus of social and humanitarian disciplines and the adaptation of all concepts accompanying this or that method. However, one must be prepared for the fact that the use of "foreign", although adequate, methods could also create new problems. This happened when using sufficiently universal mathematical models developed within the framework of the theory of nonlinear dynamic systems and the mathematical theory of chaos. It turned out that this approach opens up perspectives for historians in establishing and analyzing the problem of alternatives of historical development. But history does not know conditional inclination!

Qualitative approaches, unlike quantitative ones, do not take into account quantitative methods, are not oriented towards the ideals of classical science. They insist on the inviolable specificity of historical and generally humanitarian research, often use philosophical principles, especially from the field of philosophy of history, and often from the modern philosophical doctrines. Their methodology is limited to a set of more or less certain requirements and does not include methods as a sequence of research actions. It would be a deep mistake to consider such research unscientific or insufficiently scientific, because the inviolable feature of humanitarian disciplines is really taken into account here, and important results are often achieved both in the research itself and in terms of identifying new research perspectives. Qualitative approaches are quite diverse. It can be the study of a separate historical character within the framework of microhistory. Indirect evidence, signs and omens are often used here. Preference is given to such a research procedure, when the historian goes from some particular case, which is extremely individual, and its reduction is impossible to a typical one, which is difficult to adapt to certain rules and norms. A specific feature of the microhistorical approach is really taken into account here. The presentation of concrete facts shows the real functioning of those aspects of society's life that would be distorted in the process of generalization or quantitative formalization. Therefore, in the well-known book "Cheese and Worms", the famous representative of microhistory K. Ginzburg does not seek to reveal either the regularities of the era or the typical behavior of historical agents, but simply reconstructs on the basis of documents the thoughts, feelings and behavior of a Friulian miller who lived in the sixteenth century and was convicted by the Inquisition and sentenced to death. He had the courage to express his own, extraordinary opinions, which differed from the official ones, regarding the main worldview issues: in the primary chaos, where, like cheese in milk, various elements were lumped together, worms appeared, from which God and angels appeared. Naturally, firstly, we cannot do without a high level of qualification, intuition, talent and other subjective qualities of the historian, which definitely affect the result, and which raise questions about objectivity, accuracy, etc. Secondly, there is a legitimate doubt in terms of the scientific nature of this historical description, since neither laws nor generalizations are revealed, neither classifications nor typologies are presented. In this regard, Ginzburg writes that to choose as an object of study only that which is repeated and therefore amenable to being built into a series or statistical aggregate, quantitatively, means paying a very high price in the cognitive sense. Exaggerated attention to such cases creates situations when, under the influence of philosophical doctrines, for example, postmodern ones, it is asserted that the most adequate knowledge of historical reality is not achieved through the development of quantitative methodology and not even through the systematic application of a formalized conceptual apparatus, if not of mathematics, then at least of logic, and within the framework of intuitive poetic thinking with its associativity, imagery, metaphorical and momentary revelations. Such historical research is indeed similar to literary creativity within the framework of a historical novel, but it differs significantly from it not in quantitative, but in research, factual and documentary accuracy, which excludes unprofessional fantasy, although it assumes a certain literary gift. Despite accusations of being unscientific, qualitative approaches are popular and produce results. Therefore, we should not expect their displacement by quantitative approaches.

In general, taking into account the successes and limitations of quantitative and qualitative approaches, it is possible to record their additionality, as in other fields of humanitarianism.

Two types of theories in literary studies. Quantitative and qualitative approaches in literary studies. Two types of theories also function in literary studies. The theory of literature (poetics) consists of separate theories, such as the theory of the organization of characters or the theory of composition, which can be called special, as well as general theories where general laws of storytelling, composition, character systems, language organization are formulated. All of them are united by the fact that these theories are built "in the usual mode": initial principles are announced, laws are formulated, terminology is developed, the empirical basis is analyzed, and so on. They can be verified, used as a method, they explain some set of facts. The result of their application is some knowledge, for example, about the researched work of art.

There is a second type of theory in poetics, which includes a set of some ideas (philosophical, cultural, sociological, political, etc.) and the mental process associated with them. Moreover, these ideas are applied beyond their original subject area, in particular, in literature or history, although they originate from psychology or philosophy. They do not give the truth, but a different result: they allow you to see the subject being studied in a new way. This theoretical creation is not completely defined, the limits of its application and related considerations are also uncertain, the approach itself is not universal, it does not provide a method of empirical research in the strict sense. Such a theory cannot be verified. Nevertheless, it gives a result: it ensures the novelty of the discourse, it gives an opportunity to sat new problems. An example can be feminist theory, which expanded, among other things, the literary canon or psychoanalytic theory in the form of literary interpretations in literary studies or even in psychoanalysis, for example, playing literary roles between the patient and the psychoanalyst.

The first type of theories focuses on the establishment of regular relations in the literary text, accurate knowledge, a strict research method, testability of hypotheses, disciplinary frameworks, a clearly defined object, operate with the concept of structure and rely on such empirical material that can be calculated and observed quite accurately. Theories of the first type largely correspond to the standard canons of classical science, in any case, they are oriented towards them. They are methodological in the sense that they contain strict methods that are used for research purposes and give a specific scientific result. In philology and literary studies, they are associated with the names of R. Jacobson, Yu. Lotman, M. Gasparov, V. Toporov, and others. In particular, with the help of comparative and statistical methods, Gasparov studied the rhythm, metric, strophes and rhymes of Russian and European poem, described the evolution of its forms against the background of the last three centuries, and set the task of describing the methods of connecting form and content, which objectively formed in poems, repetition of peculiar rhythmic and stylistic figures not within the framework of subjective personal aesthetic feelings, but precisely in a way that is verified and predicted, in terms of regularities. The use of quantitative methods allows, apparently, to include the modern theory of the poem in strict scientific theories thanks to the huge calculations of M. Gasparov on the poems of the 20th century and D. Taranovsky - on the poems of the 19th century.

The scientific nature of theoretical constructions is also connected with the search for structural relations in literary works and the transition to structural research methods. As at one time natural science tried to distance itself from philosophy, so the theory of literature tried to build its own building, focusing on the precise analysis of the literary object.

However, this method of constructing a theory of literature was not generally accepted in the research community. For example, the research activity of the famous M.M. Bakhtin embodies the second type of humanitarian theories. Theories of the second type rely on interpretation and understanding, consciously non-strict terms whose metaphorical power is more important than the stabilizing power of exact terminology, and on arbitrary imaginary constructions. They use theoretical propositions from other fields of knowledge and easily go beyond their subject area themselves. They are closely related to philosophical concepts, indifferent to verifiability, empirical material, truth. It cannot be said that these theories are better or worse than the first ones, they are different. It hardly makes sense to exclude them from literary studies as non-scientific. In particular, their task is a new presentation of the studied material, a fundamentally new vision of the subject, new research programs. The main thing here is not the empirical result, but new ideas and the mental process itself, which gives a new vision. The owner of the first theories, who mastered their methods, becomes a master of his craft and, applying the method, gets clear, reliable, verifiable results, developing these theories, although their boundary is obvious: a given specific group of objects. The second theories are practically endless, if only because the area of their application is unlimited and sometimes unknown in advance. Mastering such theories is much more difficult than clearly expressed methods of the first type, and having mastered them, you will not become a master, since they do not provide methods. But you will get that breadth of understanding, that possibility of going beyond disciplinary frameworks, that new vision that the first theories cannot give. In other words, the second theories are no less fruitful. These theories are represented by the names of A. Bily, A. Losev, M. Bakhtin, S. Averintsev, and others. Bakhtin's theories of dialogue, carnival, menippea belong to the second type and in this sense did not offer an exact research method. This, however, does not reduce the greatness of Bakhtin and his ideas, it is no accident that he has a huge number of talented followers, he is one of the most quoted thinkers of our time, and Bakhtin studies, as a study of his work, has several directions.

Theoretical developments and even methodological works of Bakhtin are a system of original approaches, creative tasks and requirements. This is a kind of creativity program. However, it is very difficult to use his theoretical propositions as research methods, if at all possible, because the actual methods are not specified as specific steps of program implementation. This is a matter of talent and creativity of his followers. Using non-methodological theories or their ideas as methods creates misunderstandings. An example is A. Barkov's attempt to use Bakhtin's idea of menippei as a method. It turns out that, for example, "The Master and Margarita" by M. Bulgakov and "Eugene Onegin" by A. Pushkin should be considered as Menippei. The interpretation of the novels as ingenious hoaxes will require a radical change in all Pushkin and Bulgakov studies. S. Epifanova proposes to present L. Tolstoy's "War and Peace" as a Menippeia according to all 14 points of Bakhtin's concept. The term "menippeia", introduced into the use of literary studies by M. M. Bakhtin, means a special genre formation of the serious-comedy type, which is characterized by author's mystifications, obvious and hidden absurdities in the author's text, scenes of scandals, eccentric behavior, inappropriate expressions, violation of the usual course of events, generally accepted norms of behavior, etc. Menippei are characterized by an exceptional freedom of plot and philosophical fiction, a combination of free fiction, symbolism and sometimes a mystical and religious element with rough naturalism, a depiction of unusual, abnormal moral and psychological states of a person. Many of the named signs and characteristics can be found in abundance in the above-mentioned works, as well as in most, if not all, works of world literature. However, from the fact that these signs are characteristic of Menippean, it does not mean at all that all works that contain them to one degree or another become Menippean. Bakhtin, in any case, did not make such a conclusion.

As it was emphasized, theories of the second type are not methodological, and their use as methods can lead to misunderstandings, which is what happened to A. Barkov. At the heart of Barkov's Menippean revolution in relation to Bulgakov's novel "The Master and Margarita" is the presentation of the researched work as a Menippean, the decoding of the author's allegedly hoaxing idea, the reinterpretation of the time parameters of the literary life of the thirties of the last century, especially the date of M. Gorky's death. From this, in particular, it appears that M. Gorky was the prototype of the Master.

Barkov also saw not just a new reading of "Eugene Onegin" by A. Pushkin, but its complete reinterpretation. If it is officially considered that the action of the novel takes place in 1819-1825, then Barkov moves it back for more than ten years. The basis was the episodes of the novel, similar to the one described in the third stanza of the second chapter, where Onegin, entering the inheritance, finds in his uncle's closet, among other things, the calendar of the eighth year.

On this basis, it is concluded that Onegin's arrival in his uncle's village took place precisely in 1808, which requires a revision of all dates one way or another related to the novel. Barkov did not see Pushkin's irony about this date, which in its turn required a literal understanding of Pushkin's ironic remark that uncle Yevgeny had a lot to do. Barkov has to prove that the landlord has many important matters, in which he is helped by the calendar, which, therefore, cannot be old. The thesis of the "eighth" year forces him not to see the obvious irony. Meanwhile, Pushkin recounts his uncle's affairs: he quarreled with the housekeeper, looked out the window and swatted flies, and played cards in a fool. In Barkov's opinion, forty years turned out to be too little for such a large number of cases. Hence his revision of all generally recognized "Onegin" dates, that, however, there are no in Pushkin's text.

At first acquaintance, we does not even believe in the seriousness of such research - we gets the impression of a grand raffle. The point here is not that the above-mentioned authors - Barkov and Epifanova - are amateurs, not professionals, but in insufficient methodological training, in misunderstanding the essence of methods and in their inadequate application. The "menippean method" looks more ridiculous in works on the menippeanization of children's fairy tales about Pinocchio or Moidodyr. Thus, in the menippesization of "The Adventures of Pinocchio" by A. Tolstoy, Malvina turns out to be Gorky's common-law wife M. Andreeva, Pinocchio is Gorky himself, the puppet theater is Mkhat, the country of fools is Soviet Russia, and so on (Maslak P. and O.).

In a more general way, the tendency towards rationalization and the use of precise, quantitative methods prevails in literary studies. However, apparently, there are limits to such a tendency, which determines the process of constant reproduction of theories of the second type. Boundaries are connected, at least, with the peculiarities of the perception of an artistic work, in contrast to the perception of a natural science object. The second type of theories is often quite closely related to literary and theater criticism as a non-scientific component of literary studies, for example in attempts to see a feminist or subconscious background in a literary work. This gives the critics a lot of space for interpretations, which are practically not limited by anything. However, other critics do not bother themselves with questions about the theoretical content of their interpretations. The first group is more related to another component of literary studies - commentary, where the scope of the commentator's imagination is significantly limited. The commentator must be "transparent" and based on facts - he cannot arbitrarily interpret the cultural or social context of the work. Substituting one for another may look original, but in reality it will bring nothing but confusion.

Questions to repeat:

1. What are the features of scientific empirical knowledge?
2. Name the distinctive features of scientific theoretical knowledge.
3. What is a scientific law?
4. Describe the scientific concept.
5. What is the philosophical and methodological meaning of scientific laws and concepts?
6. What is a scientific fact?
7. What are the features of a scientific problem?
8. What are the functions of a scientific hypothesis?
9. Describe the structure of a scientific theory.
10. What are the differences between scientific and technical and humanitarian theories?

10. Philosophical and methodological specifics of scientific knowledge.

10.1. Scientific knowledge, its features and peculiarities. Scientific and technical and humanitarian knowledge. The problem of demarcation of scientific and non-scientific knowledge.

Features and structure of scientific knowledge. The term “knowledge” is used in a narrow and broad sense. In the broadest sense of the word, knowledge is considered as some content of consciousness that we can, at least in principle, describe in some way. In this case, various views, religion, beliefs, intuitive ideas, understanding, superstitions, precondition, personal knowledge, etc. fall into the category of knowledge. Although some signs of knowledge are sometimes applicable to these forms of consciousness, for example, referentiality as belonging to some objects, all this knowledge is preferred not to be called when talking about it189arroww sense.

Knowledge in the narrow sense must possess the main features: reasonableness, explicability, general significance, referentiality, valence (for example, true or false), reflexivity. All the indicated signs are interrelated, for example, without explicitness or general significance (intersubjectivity) reasonableness is impossible, since knowledge must be somehow presented and perceived. Only the fulfillment of all signs (conjunction) gives what is called scientific knowledge in the strict sense. The degree of narrowness or breadth of the term "knowledge" is relative. But the expansion of the term weakens the scientific nature of knowledge. And certain characteristics are permissible even outside the boundaries of science. For example, belief, faith can possess explicability, but this property does not apply to intuitive knowledge. Reflection is possible regarding any content of consciousness and even other mental formations. Reflection turns all this into knowledge, but further reflection on the knowledge or its absence is optional. Some of the most important types of knowledge are not reflected and do not need this procedure. Yes, many abilities and skills are not described in any way, but are learned from examples of activity and reproduced with knowledge of the problem. It is hardly possible to say about such cases that people do not know what they are doing. Such knowledge or ignorance is simply not reflected. Perhaps this is what Socrates meant when he laughed at the countrymen who did not think about such problems: “I know that I know nothing, and you do not even know this.” Science is precisely what deals with knowledge in the narrow sense of the word.

The most important characteristic of knowledge is reasonableness. The reasonableness of knowledge is directly related to rationality. Rationality is considered as a form of reasonableness of knowledge, and is often identified with it. Possible variants of the specified ratio depend on the accepted criteria of rationality, which do not remain unchanged. For example, a strict criterion of rationality implies only theoretical or only scientific knowledge. For a weak criterion, it is enough to observe some rules and norms of thinking or activity.

Knowledge in the narrow sense of the word is closely related to science, although scientists use both intuition and various forms of implicit knowledge and so on. But in the final expression, scientists get rid of intuitions, implicits, insights, etc., presenting knowledge as clear, rational, grounded, explained, reflexive, generally significant. Therefore, scientific knowledge is a special type of knowledge, different from everyday, mythological, artistic, religious knowledge. It is obtained with the help of a special type of activity – scientific, which uses special means.

When they mean that knowledge belongs to science as a special field of activity, the following features are also often highlighted: 1 Reproducibility, that is, the possibility of repeating a scientific result in the presence of appropriate conditions; 2. Verifiability, that is, the availability of knowledge to various methods of verification; 3. Derivability as the possibility of obtaining non-obvious consequences; 4. Systematicity, presented, for example, in theory; 5. Predictability as the ability to predict the occurrence of certain occasions. However, some of them are a consequence of the above-listed signs of scientific knowledge, although in some cases they have independent value.

Scientific knowledge in the relevant sciences is organized in a certain way. The structure of scientific knowledge can be distinguished: sciences and scientific disciplines, forms of organization of knowledge, for example, hypotheses, theories, facts, problems. Levels are also distinguished, for example, empirical and theoretical, the foundations of science, in particular, ideals and norms, the scientific picture of the world, the functions of science and its methods are distinguished, paradigmaticity is noted as a specific feature of the functioning of scientific knowledge and its production, etc.

Scientific knowledge is a special type of knowledge, different from everyday, artistic, religious, philosophical, obtained with the help of special scientific means and special activity – scientific.

Along with the obvious, science includes **implicit knowledge**: hidden prerequisites of research, implicit meanings of theories, linguistic means, structures of certain actions and skills. Recently, in the methodology of science, prerequisite knowledge has been actively investigated. A special place is occupied by personal knowledge, which in many ways determines the research process, but is only partially included in the formulation of the result. The concept of personal knowledge was put forward in the 50s of the XX century by Michael Polanyi (1891-1976), English physicist, chemist and philosopher. The concept was not widely distributed, but it aroused considerable interest and contributed to the development of the philosophy of science.

The above-mentioned features of scientific knowledge were discovered mainly during the analysis of natural scientific knowledge, the acquisition and organization of which was considered a model for a long time. The rapid development of technology, and recently the humanities, has demonstrated the essential features of other types of knowledge, in particular scientific: technical, humanitarian.

Scientific and technical knowledge is a special type of knowledge, sometimes called project-technological (some authors consider the latter to be an independent type of knowledge), has the following features:

1. It is a normative order for activity, it usually acts as a technological recipe. This is the knowledge of "how" as opposed to the knowledge of "what" characteristic of natural science.
2. Presupposes a description of objects of activity – devices, mechanisms.
3. Presented by various theoretical schemes that provide solutions to many specific situational tasks.
4. Starts from the diverse theoretical constructions related to the same object and a wide range of methods of applied mathematics. Through simplifications, approximations, transformations subordinated to the intended result as the purpose, something new emerges that gives reason to attribute the obtained knowledge to scientific knowledge.
5. The cognitive installation in technical knowledge is subordinate to the project one. The formula works here: to know to do.
6. Quite often, purely methodical tasks are solved within the framework of technical knowledge.

Humanistic knowledge is knowledge that is usually associated with a person in some elevated, spiritual sense, and, first of all, with the products manufactured by the human spirit, where the term "spiritual sciences" came from. Humanitarian knowledge usually does not include knowledge about nature, in particular about human nature, about technology, about social relations and regularities, although many knowledges are located on the borders of the specified spheres and it is rather difficult to specify their exact address.

Humanist is interested in such areas of knowledge application that allow to understand another person, another culture, the personality of an artist, scientist, politician, to explain a certain cultural or spiritual phenomenon, to bring a new meaning to a certain area of culture or activity.

The exact definition of humanitarian knowledge appears to be very problematic, along with the drawing of rigid limiting lines. However, it is obvious that this knowledge is not about the external world, the world of nature, but about the inner world of a person, which is somehow expressed in language, human relations, material objects, where the socio-cultural meaning is recorded. That is, it covers the space of human meanings, values, meanings that arise during the creation and assimilation of culture. Since humanitarian knowledge does not describe nature, technology, society, it presents them not in a naturalistic, material way, but in a value-spiritual-semantic way, which requires, first of all, understanding and interpretation. In this plan, any natural object involved in socio-cultural activity is endowed with a valuable and semantic essence and acquires a humanitarian measuring, which can become a subject of study by humanitarians.

In general, humanitarian knowledge is knowledge about the inner world of a person, expressed in material and ideal cultural formations endowed with human meanings, values, and senses.

Signs of humanitarian knowledge.

1. Humanitarian knowledge talks about what was created by man for the purpose of self-organization throughout its history, and not about what arose naturally. These are the state and law, morality and religion, art, language, etc.
2. Humanitarian knowledge to a greater extent focuses on unique objects, such as individual personalities and works of art.
3. Objects of humanitarian knowledge, as a rule, are more complex than natural or technical ones, so they require dissimilar historical, legal, religious, literary, psychological, etc. data. Mainly due to the complexity of objects of humanitarian knowledge, quantitative methods are poorly applicable to it.
4. Objects of humanitarian knowledge are more prone to change. Legal laws, moral standards, religious beliefs, ideals of beauty are changing. But in the change of these phenomena, humanitarian knowledge reveals the same important meanings as in their stability.
5. Objects of humanities study (culture, history, language, personality, works of art, creativity, thinking) change their nature depending on what this knowledge approves. This is especially characteristic of past historical events, which in many respects look as they are described by historians, and then change their appearance when they are redescribed by other authors.
6. Humanitarian knowledge is related to both general scientific and special methods, for example, it "gets along" in another culture. This means a peculiar mood of mind and feelings, when the researcher understands what exactly the person of the culture being studied knows, sees and feels. Another method, which is peculiar to humanitarian knowledge, is the dialogue of cultures, with the help of which a given culture (through a humanitarian scientist) gets to know another culture being studied. Methods of understanding and interpretation are of great importance (now even beyond the humanitarian sphere).
7. Humanitarian knowledge (in contrast to natural science) constantly appeals to everyday consciousness, to everyday ideas.
8. Humanitarian knowledge (especially scientific knowledge) mainly deals with the text, which must be read and understood, in other words, enter into the text. This circumstance allows us to attribute humanities to a special group of sciences that understand, contrasting them with sciences that explain, to which all sections of natural science belong. Even when humanities knowledge talks about non-textual objects, for example, about sculpture, music, human behavior, they are usually presented as texts. Therefore, humanitarian knowledge focuses on special types of activities that generate these texts. Humanitarian activities include literary criticism, artistic creativity, education, self-education, etc.

9. If the knowledge of the natural sciences is considered as objective, which records the eternal laws of nature, then the knowledge of the humanities is considered to be reflections, it is knowledge about the knowledge itself, embodied in texts: thoughts about thoughts, texts about texts. It is necessary to make a reservation here. In the natural sciences, scientists quite often also engage in reflective activities regarding scientific knowledge. But, strictly speaking, this is a different sphere of activity, in particular methodological. Although it is often woven into the fabric of specific scientific activity, in principle it belongs to the sphere of philosophy and methodology of science, that is, to humanitarian disciplines. Therefore, a natural scientist in this regard often embarks on the path of humanitarian work.

10. Humanitarian knowledge performs a consultative and regulatory role, which mainly concerns the value orientations of people, in contrast, for example, to social theories (economic, sociological, legal), which can be laid as a basis for socio-technological solutions, that is, solutions that offer social technologies for practical change of social structures, connections, states and so on.

11. Humanitarian knowledge, especially scientific knowledge, uses specific concepts: understanding, discourse, text, narrative, etc., many of which have become general scientific.

Technical and humanitarian types of knowledge are closely connected, so closely that sometimes it is impossible to draw a dividing line. Their relationship is strengthened with the development of technology and new technologies. The modern technological situation largely forces us to look differently at the traditional approach to the relationship and even comparison of technology and art. If, in the old-fashioned way, we consider technology only as instrumental means necessary, in particular, for the creative artist to create his work, then we will ignore a whole set of problems that are characteristic of our time. After all, the very understanding of art undergoes changes due to the fact that new technologies, starting with photography and cinematography and ending with modern computer graphics, dictate new conditions for considering such a relationship.

At the dawn of the development of cinema, Henri Bergson criticized the “cinematographic method”, which supposedly replaces real life, its “natural” image, with a mechanical montage surrogate. Similar motives appear in Paul Virilio’s thoughts about television. The latter, in his opinion, destroys reality, replacing it with simulated television shows, which in the information world of a modern person turn out to be more catastrophic than real disasters, and reality itself does not fundamentally differ from its mechanically reproduced equivalent. Anyway, many aspects of cinematography and television, although they contain purely technical aspects that are in the conduct of technical sciences, are included in the sphere of spiritual production and are studied by humanities. It is obvious that the emergence of photography, cinema, and television caused the revision of many traditional ideas about art, the author, and the masterpiece.

If we try to establish strict boundaries of various fields of knowledge, then the emergence of many technical innovations or achievements of science and art must be recognized as a miracle, a happy accident. However, if you come to the socio-cultural context of the researched events at a time when the specified limits did not exist, or take into account the everyday life of inventors with various influences, then the miracle ceases to be so. The famous historian of the "Annals" school, Lucien Fèvre, draws attention to the fact that two centuries before the invention of the telescope, optics was already developed enough to, guided by theory, find such a combination and arrangement of lenses that would result in the device known to us as a telescope. If you follow the logic of the historiographic description of technical discoveries and do not go beyond the scope of technical knowledge, then it turns out that a new technical invention is an accumulation and almost random coincidence of different types of technical knowledge. However, this is not the case. Such inventions as photography and cinema could have happened quite earlier. In principle, everything was ready for such inventions several centuries before their official birth. R. Arnheim draws attention to the fact that the photograph emerged from an allegedly accidental combination of knowledge about chemical reagents with knowledge of the camera obscura. However, it is the coincidence of this ancient knowledge that led to the discovery of photography is questioned by him. In his opinion, photography appeared when it was able to become an assistant in the development of a realistic style in art, when it brought a characteristic mechanical imposition of a project image of the physical world. If this is so, then humanitarian knowledge, at least sometimes, is a necessary component of technical achievements. Therefore, without the humanities, an adequate presentation of the history of technology is impossible, and it is hardly possible to strictly distinguish the humanitarian and technical knowledge in the letter one.

Among the ancient Greeks, technique (techne) was associated not only with craftsmanship, but also with high art, a separate thing is a craft and artistic work, a product of techne, especially if it is associated with "episteme". For Leonardo da Vinci, painting and technical invention were of the same order. Only starting with Galileo, the universalism of the Renaissance is gradually overcome. Philosophy, science, art and technology find their own niches. It is difficult to say which discipline had a greater influence on another: technology on art, philosophy on science, and so on. It is important that there was such change, which turned, in Heidegger's words, the world into a picture, and humanity entered an era of separation and juxtaposition of subject and object. It is also significant that different fields of knowledge began to write their own paintings, the number of which rapidly increased in the course of the differentiation of knowledge, and integration trends, without reducing the number of paintings, sometimes only blurred the boundaries between them.

Scientific and non-scientific knowledge. Non-scientific knowledge is knowledge that is beyond the scientific boundary.

A significant part of non-scientific knowledge is often included in the category of humanitarian knowledge, and is in an ambiguous relationship with the humanities. This applies to theology, parapsychology, some sections of astrology, mystical practices and so on. The fact is that scientific humanitarian knowledge cannot cover the entire spiritual sphere. In addition, like any scientific knowledge, it is knowledge of an average degree of generality. Meanwhile, a person has an ineradicable need to know the general, ultimate, absolute beginnings of the human spirit or the most general characteristics of the spiritual universe, as well as being in general. In a theoretical-rational form, this is the sphere of philosophical knowledge, but in the past, and often now, there lies the area of searches for religious-theological or speculative-mystical forms of thought. On the other hand, a person needs knowledge about individual manifestations of the human spirit, for example, about creative impulses, intuitive or mystical insight. As Goethe noted, for an artist, true creativity begins as a "breakthrough to the highest and most difficult in art, to the understanding of the individual." The area of artistic knowledge, historical and humanitarian understanding is located here. Many things in this area are significantly different from the methods and norms of knowledge generally accepted in science.

Non-scientific knowledge, like scientific knowledge, is not a deliberate deception or a permissive fiction, it is carried out in certain intellectual communities in accordance with the traditions that exist in them, the norms and ideals of cognition, it relies on certain sources of cognition, which, although not recognized by science. The methods of production and distribution of non-scientific knowledge are significantly different from those adopted in science. But at the same time, the scientific community is not the only type of cognitive community.

Some authors (V.P. Filatov) distinguish three types of non-scientific knowledge: paranormal, pseudoscientific and deviant. The paranormal (from the Greek raga – near, near) includes the doctrine of secret natural and psychic forces and relationships that are hidden behind ordinary phenomena. This is the area of mystical teachings, spiritualism, where by surrendering to mystical contemplation as a higher cognitive ability, it is possible, as it seems to the adepts, to penetrate into the mysterious connections of the world. Proponents of pseudoscience emphasize their desire to use the scientific method, but their activities are carried out outside normal science, such as ufology or astrology. Deviant knowledge goes beyond the paradigms accepted at one time or another in science and deviates from the existing methodological and worldview norms and standards shared by the majority of members of the scientific community. Deviant directions can end with the creation of a recognized scientific program, or with the extinction of a similar direction, which rests mainly on the convictions of its creators.

Such a classification can only be called a working one in a first approximation, and not only because its foundations are blurred. Although it is not difficult to give examples from the field of humanitarian studies regarding paranormal, pseudoscientific, deviant knowledge, but many things from the humanitarian field will remain outside such a classification. This applies, for example, to philosophy, which, not being a science, cannot be called paranormal, deviant, or pseudoscientific knowledge. Calling theology a pseudoscience would also be value inaccurate, even though it is clearly not a science. Ideology or mythmaking, although they can use scientific developments, perform functions unrelated to science. In principle, the distinction between science and non-science in natural science is sufficiently justified and worked out. But in the humanitarian sphere, not everything is so clear, in particular, because the term "non-science" carries an explicit or implicit negative value, especially if we take into account the high status of science. In general, humanitarianism has a huge range of important disciplines that do not pretend to be science, but are of great importance for humanitarianism and the functioning of society in general. In particular, we are talking about literary (television, film, etc.) criticism. It belongs to the free sphere of public opinion, in which the individual beginning, subjective opinion, original view is more pronounced. Criticism acts as a free Interpreter of the text, a peculiar branch of research activity. Apparently, the critic should be considered a kind of writer, not a scientist, although he often uses the achievements of science, but he does it not for the benefit of science, but for the benefit of the social struggle, addressing the general public, in many ways shaping public opinion. Probably, the drawing of dividing lines between science and non-science (pseudo-science, anti-science) in humanities requires more caution than in natural sciences, taking into account, in particular, the value specificity of the above-mentioned terms. However, it is obvious that literary criticism will never become a science, unlike, for example, a literary commentary with all the subjectivity of the latter.

In other words, it is possible to single out a huge area of non-scientific humanitarian knowledge with different degrees of distance from science, of its individual components. With all the uncertainty of the demarcation lines and the possible movement of individual components over time, it is not difficult to state such areas that will never go beyond their limits.

Some signs of certain types of knowledge were formed during the study of scientific and theoretical knowledge and then were spread to other areas of knowledge. For example, in everyday knowledge, by analogy with relevant theories or specific explanatory models, elements of different types of knowledge can be distinguished: natural (about the sides of the horizon, for example), technical (how to fix an iron), religious (everything was created by God), linguistic (how to use language correctly), ethical (what is good and what is bad). Other signs are revealed when comparing different types of knowledge depending on the objects they describe, the use of special approaches.

The field of scientific knowledge includes only natural scientific, technical, humanitarian knowledge as an element of natural, technical and humanitarian sciences, and first of all, according to the narrow understanding of the term "knowledge". Sometimes the term "humanities" is preferred over the term "social-humanities" (previously they said – "social sciences"). But more often humanities are distin"uished from social scie–c"s, separating t"e latter into an independent field.

The term "science" in relation to humanitarian knowledge, both in the past and in the current literature, has often caused protest, especially when the so-called strict criteria of rationality are not followed or knowledge is interpreted expansively. In the latter case, we can use the relatively neutral term "humanities", which will include all humanitarian knowledge, regardless of the recognition of its scientific or non-scientific status. This is humanitarianism in the broadest sense of the word.

Perhaps it makes sense to include political science, sociology, cultural science, etc. sciences that deal with man and his objectified, reified products of the spirit, to social and socio-humanitarian sciences, and to the humanitarian – those disciplines that deal mainly with texts. However, inside the humanities, we will still have to single out those disciplines, theories, and approaches that are oriented toward general scientific ideals and norms. The rest will be what can be attributed to humanitarianism in the narrow sense of the word: orientation to the individual, not the general, to freedom, not necessity, and so on. The substantiation of the rationality and scientificity of this remnant (humanities in the narrow sense) is an important task.

The presence in science of such standardizing concepts as rationality, regularity, necessity, objectivity, and so on requires identifying their place in the humanitarian sphere. It should not be surprising that not all considerations about the human spirit belong to the humanities, just as not all considerations about nature enter into the field of the natural sciences. Some authors (V.N. Mezhuev), trying to bring terminological clarity to these issues, attribute to humanitarianism that part of knowledge about a person that remains after deducting "necessity", which is studied by sociology, political science, cultural science. What remains is human freedom, which supposedly constitutes the field of humanitarianism. However, it is preferable, at least intuitively, to associate the term "humanities" with the entire field of humanitarian knowledge, distinguishing there a special field of humanitarian science. Especially since we are unlikely to break the categories of "freedom" and "necessity", "regularity" and "accident".

The sphere of humanitarian knowledge and humanitarian sciences does not possess such integrity as natural science, despite all the complexity of the latter. But this is not an eternal weakness of humanitarian knowledge, but rather a testimony of the incredible complexity and diversity of its objects and, perhaps, future differentiation. For example, the field of historical knowledge and historical sciences is so peculiar, has so many applied directions, like no other field of science. The same applies to psychology, in which the natural-scientific, humanitarian, and social spheres are distinguished. Although narratology in a certain sense connects humanitarian and not only humanitarian studies, it also promises to grow into a huge independent field of knowledge.

10.2. The concept of truth in science. Concepts of truth and its criteria.

The problem of truth. Scientific knowledge in the course of scientific research undergoes a special check for truth. The truth characteristic (it is sometimes called the valence of knowledge) of any scientific statement is its property of being true or false. Understanding truth, its characteristics and criteria is a complex philosophical problem.

<u>The problem of determining the truth.</u> There is a classic definition of truth, which was formulated in antiquity: true knowledge is that which corresponds to reality. This definition is also called Aristotelian. On the basis of this understanding of truth, **the correspondent concept of truth** (from the Latin. correspondere — "to answer") was built. A variant of it is the understanding of truth proposed at the beginning of the New Age by René Descartes: the human mind is characterized by a set of clear and expressive ideas that are truthfully correlated with reality.

The correspondent concept of truth seems convincing due to the fact that the understanding of truth as the correspondence of knowledge of reality is probably the most appropriate our intuitive ideas about truth in general, but its modern understanding is ambiguous. There have been attempts to clarify this concept. The famous Polish logician Alfred Tarski showed under what conditions the correspondence theory would not be logically contradictory or meaningless or even superfluous. However, insurmountable difficulties remained. Yes, the difficulty lies in the very concept of "reality," and strictly speaking, we never apply knowledge to reality itself, but compare one statement with another, accepting some of them and rejecting others.

There is another, also quite convincing, the concept of truth**: the coherent theory of truth** (lat. cohaere - "to be connected"). In accordance with it, those knowledge that is consistent with each other within a certain theory and can be tested for other properties are true: consistency, coherence, reasonableness. In modern philosophy, Gottfried Leibniz (1646-1716) advocated this approach, as opposed to Descartes: to be considered true, a theory must be logically consistent. The coherent concept of truth has its merits: it does not require going beyond the boundaries of the theory, since the comparison of some statements with others takes place within the theory, and in addition, it corresponds more to the realities of scientific research, especially in logic and mathematics or in mathematized disciplines.

The third concept is significantly different from the first two. It is characterized by rejection of the very concept of truth. It can be called elimination (from the Latin. eliminari - "to drive out"). Modern philosopher Bastian van Fraassen is a supporter. Fraasen believes that science strives not for the truth, but for the creation of theoretical constructions that would be adequate to empirics. In fact, agreeing with experience is the most we can achieve. However, with this approach there remains an eternal difficulty: how to establish this adequacy? Each scientist may have his own options and then have to appeal to the scientific community, which will accept or reject this knowledge based on some convention. This is how the conventionalist (lat. conventio — "agreement") concept of truth arose, which can be considered as a variant of the eliminative concept. Such a concept is convenient, but it does not solve the difficulties of concepts of truth, since every scientific theory is accepted by the scientific community precisely as corresponding to reality. Scientific conventions actually take place, but as a general principle, conventionalism is untenable, in particular, because it leads to a paradox known to the famous English philosopher Thomas Hobbes back in the 17th century. Hobbes's paradox is that if scientists start from agreements about scientific concepts and theories, and every agreement is arbitrary, then as a result all scientific knowledge, accepted as true, will turn out to be derived from primary agreements, that is, also arbitrary, and so science will never go beyond conventional truths.

A pragmatic concept. This concept of truth goes back to pragmatism, as a direction of American philosophy associated with the names of Charles Peirce, John Dewey, and William James. The pragmatist concept implies non-theoretical criteria: practical usefulness, efficiency. In some disciplines, especially scientific and technical, this criterion works. However, in general, such a criterion is unconvincing, since the effectiveness or usefulness of the theory in practice is still not a guarantee of its truth.

For example, the famous doctor of the 16th century Paracelsus successfully used iron salts to treat anemia, but the theory he based on it has long been recognized as untenable.

Marxist concept. It is sometimes considered as a variety of pragmatism, although it arose much earlier than American pragmatism, moreover, it was built in the context of philosophical ontology and epistemology. This concept, as a special case of the dialectical-materialist philosophy of Karl Marx, declares material practice to be the only possible general criterion of truth. But, firstly, this approach also introduces an extra-theoretical criterion of truth. True, Marx does this on purpose. He criticized previous philosophical materialism precisely for contemplativeness, that is, for not understanding the active transforming practical interaction of man with the world as the basis of knowledge. Marx considered all cognitive activity to be a moment of practice, therefore, within the framework of his concept, such a criterion is not contradictory. But only within this concept, which is not the best at all. His idea of the practical-transformative role of philosophy is especially questionable. The Marxist thesis "the only criterion of truth is practice" is an ideal rather than a criterion applicable in research.

The problem of criteria of truth. In scientific knowledge, one criterion is not used everywhere, but a sufficiently large and diverse set of them is used. When assessing the acceptability of some scientific provisions, they are used, as a rule, in a complex manner.

The criterion of **logical non-contradiction** is actively used. It is of crucial importance in the mathematical and logical sciences, since there we have no way of verifying mathematical or logical propositions by agreement with empirical data. The norm of non-contradiction can even be a criterion for the existence of a mathematical object. Thus, Henri Poincaré once put forward the principle according to which a mathematical object whose description is free of contradictions should be considered existing. A relative of the Poincaré principle is the requirement introduced by Leibniz for the logical possibility of one or another idea as a criterion of its truth.

Next, the **internal consistency** of the theory's provisions among themselves on the basis of some substantive provisions and conceptual relations, the general coherence of the theory, is important. In addition, the most important thing for the theory is the requirement of agreement with the facts, with the data of experience.

Scientific knowledge contains prerequisite knowledge, implicit assumptions, philosophical positions that become important in the evaluation of this or that theory. An example can be **fundamental ontological ideas** about the structure of matter, about the basic essence of the world, which significantly affects the ideas of scientists about what is true and what is not. We can recall the situation described earlier, when scientists at the end of the 19th century tried to reduce the descriptions of electromagnetic phenomena to atomistic ideas, since the atom was considered the fundamental basis of matter, and without it the electromagnetic theory could not be accepted as true. Maxwell intuitively felt that the last foundations of nature are more like fields than matter and forces.

Next, evaluation criteria play a big role in the acceptance of scientific theories as true. Among them, for example, aesthetic considerations. These include the feeling of the "beauty" of the theory, its harmony, perfection, simplicity, richness of interrelationships, the special feeling of "aesthetic pleasure" caused by the theoretical system. Thus, at one time, Einstein spoke about the internal perfection of the theory as the most important criterion for its truth.

The practical sphere often becomes an evaluative criterion of truth. If the theory shows its effectiveness in practice, then this is a significant argument in favor of its truth. This criterion is often used in scientific and technical knowledge. Criteria such as the broad applicability of the theory, or its ease of use, or the simplicity of the theory, especially in comparison with a more complex one, are of serious importance.

The famous German philosopher Karl-Otto Apel (1922-2017) proposed a variant of the conventionalist concept, which gained popularity in modern philosophical and methodological literature. He proposes to consider the criterion of truth not the valid agreement of the scientific community, which may turn out to be erroneous, but idealized. Then the truth will be some kind of ideal of our knowledge, but this ideal nevertheless works because it really orients scientific argumentation. Indeed, when a scientist argues his point of view, he is, as it were, addressing not real interlocutors, but an ideal community, an ideal rational audience. If a scientific theory can be accepted in an ideal unrestricted communicative community, then it is true.

However, there are opponents of the search for any general criteria of truth. Immanuel Kant also argued that the concept of a general criterion of truth is meaningless because such a criterion must be adequate for any subject of knowledge, and therefore indifferent to the specific features of one or another cognitive situation, which does not happen. However, the rejection of the general criterion of truth means that there are only specific criteria and situations of their application related to certain specific scientific questions. But then any criterion can be declared correct, which is pointless.

Thus, among the considered criteria of the truth of knowledge, there is no single correct or even the most popular one. Several truth criteria are used in scientific research. The question of the generality of the used criteria is, as a rule, not often asked, namely when a specific study or its result acquires a clear philosophical and methodological sound. But the scientist must know in which cases such a statement of the question is necessary and which criterion to give preference to in this or that situation.

10.3. The problem of substantiation of scientific knowledge. Empiricism, rationalism, Marxism, pragmatism.

The main problem in distinguishing knowledge from belief or preconceived opinion or judgment is the question of the substantiation of the knowledge. Some thinkers believed that it was doubtful that this question had any positive or negative answer. This is how philosophical skepticism was formed. Even ancient skeptics, such as Pirron, who lived in the IV-III centuries BC, noted that if knowledge requires substantiation, then this basis also requires its own substantiation, and so on to the infinity. Diogenes Laertius (III century AD) demanded to be limited to the reference only to your own opinion and never to speak ontologically - about how things are "really" going, that is, never ptetend to knowledge. The position about the impossibility of any knowledge has a long history and is rooted in the understanding of the world as absolutely fluid and changing. So even in the 5th century BC the legendary Cratylus, repeating the Heraclitean thesis about the changeability of the world, claimed that due to such changeability, nothing can be said about any object at all, since it cannot be marked in any way, and we cannot form an opinion about it, or we can say anything. Since it is not possible to construct an expression about things, they can only be indicated by gestures. By the way, such a formulation of the question required the search for something stable, which was discovered, for example, by the Eleats (Parmenides) in the world of the mind, the imagined world. Criticism of skepticism was conducted from these positions. However, it was not possible to put forward decisive arguments against skepticism.

The famous modern skeptic David Hume (18th century) noted that all science is based on the idea of causality, and the cause, in its turn, presupposes the prediction of events, which is how the laws of nature are revealed. However, Hume emphasizes, if causation, as the action of one thing on another, can be substantiated by our observations, then the future event is not yet substantiated by observations. Therefore, the forecast is the result not of laws, but of a habit based on our belief in the immutability of the laws of nature. We believe that if certain event happened in the past due to certain action, then it must be exactly so in the future. But is there a law of nature that would confirm the immutability of the laws of nature? This is only our assumption, that is, thought, belief, not knowledge. Thus, it turns out that all sciences, according to Hume, are a kind of psychology, since faith is studied by psychology.

When empirical natural science was formed, it seemed convincing to many to substantiate knowledge in sensory experience. Indeed, if, for example, something described is observed, what other substantiation is needed? In other words, the question rested on the reliability of the evidence of the sense organs, on which, for example, the method of scientific observation was based, although it was not reduced to sensory experience, but assumed it as a decisive argument. This is how **sensualism** (from the Latin sensus – feeling) developed, which considered sensations to be the only reliable source of our knowledge. The essence of sensualism was quite accurately expressed by John Locke (17th century): "there is nothing in the mind that was not previously in the senses", at our birth the mind is a tabula rasa (clean board). Similar to sensualism is empiricism, which believed that the entire content of our knowledge is exhausted by sensory experience, and the mind only connects sensory data. Such a position has its advantages, because thanks to it, knowledge is freed from fantasies, imaginary and non-existent properties, and the like.

For the modern scientist, who collected herbariums or specimens of rocks, sketched and described animals and natural phenomena, empiricism and sensualism were reliable forms of substantiation of scientific knowledge. However, for those scientists who were engaged in mathematics, such a position was unacceptable, because it was perfectly obvious to them that many truths of science were carried out by the mind without any appeal to sensations and experience. This applies, for example, to the creation of differential and integral calculus. This is how philosophical **rationalism** (from the Latin. ratio – reason) developed.

In this way, two ways to substantiate knowledge were determined - empirical (that is, based on sensory experience) and rational. The skeptics, especially Hume, showed that empiricism alone was insufficient to substantiate knowledge. Rationalism, on the contrary, believes that reliable substantiation of knowledge is possible only on the basis of the work of the mind. Rationalists believed that such knowledge is possible in logic and mathematics. Gottfried Leibniz, a younger contemporary of Locke, observed: "there is nothing in the mind that was not previously in the senses, except the mind itself." Thus, the mind proved to be self-sufficient, since only it can access not the separate and random, as in empirical knowledge, but the general and necessary, for example, the laws of nature. But such an ability of the mind remained mysterious. Descartes, for example, considered it innate.

The great German philosopher Immanuel Kant (1724-1804) carried out a kind of synthesis of sensualism (empiricism) and rationalism, based on a transcendental understanding of cognition, when not objects or their experiential understanding are considered, but the way of knowing objects, and before experience (a priori).

Kant, like other thinkers, believed that cognition begins with sensory perception, proceeds to a judicious systematization of sensory data, and receives the final assessment in the mind. But, first of all, the mind, according to Kant, evaluates only phenomena ("phenomena", not "noumenals"), does not give an answer to the question of how things are going "in reality". Secondly, Kant believed that, knowing any subject, we impose on the results of cognition and its course itself, our own means of cognition, first of all, the specificity of the senses and the peculiarities of our concepts, through which the subject is understood, and which subject itself we cannot know in principle. For this, Kant coined a rather accurate term "thing in itself", which is unrecognizable. This position was called agnosticism. As for the laws of nature, society, or one's own thinking, they are an expression of duty that has no place in nature. It exists only in interpersonal relations, which require: it is necessary to act in such a way! Duty, after all, is a consequence of only one "categorical imperative", that is, an unconditional requirement: act so that the principle of your behavior can serve as a general rule of behavior. According to Kant, this duty is attributed to all statements that are considered "objective" laws of science. Kant's agnosticism as the impossibility of achieving reliable knowledge and its justification in a certain sense reflects the real numerous difficulties of scientific cognition and correctly captures many of its moments. Kant himself said that he limited reason to give place to faith. But at the same time, agnosticism brings a certain pessimism on the researcher. And many scientists and philosophers wanted optimism, many believed in the omnipotence of the mind. Only now we understand that the omnipotence of reason is a mistake that Kant understood long ago, even though he could not predict where uncontrolled rationality would lead.

Criticism of agnosticism was made by many philosophers, in particular Hegel and Marx, who used several Hegelian ideas, but added a materialistic meaning to them.

Marxism tried to find the substantiation of knowledge not in the cognitive process, but outside it, declaring materialist social practice to be such a general basis. But obviously, if knowledge is considered as general, and its truth as absolute, then practice should be understood in a general sense. This is how Marxism understands it: practice is the entire infinite collective experience of humanity in transforming the world. In the philosophical sense, this is, on the one hand, a successful move, since such a general basis has been found, but, on the other hand, it is highly controversial, since practice is beyond cognition. In any case, the Marxist understanding of practice cannot be reduced, as less educated people do, to everyday experience or even to an experiment, that is, to substantiate a concrete theory, the Marxist understanding of practice does not give anything. But Marxism, like rationalism or empiricism, like Kant's agnosticism or Hume's skepticism, like any philosophical concept, cannot make it their task to give a specific recipe for the substantiation of this or that scientific statement. Philosophical study of the question of the substantiation of knowledge should solve the question in principle and at the general level. And the listed concepts did this, presenting all possible conceivable options. These concepts and the controversy surrounding them contributed to the understanding of the essence and principles of science in general and scientific knowledge in particular, contributing to the clarification of the basic principles of science. As a result, for example, it became clear that in each specific case the forms of substantiation of knowledge may differ depending on the nature of the knowledge itself. Empirical methods of substantiation work well in natural science, rational - in logical-mathematical knowledge, pragmatic - in scientific and technical knowledge. And specific means of substantiating knowledge in one or another case are excellently developed by science itself.

They tried to overcome the one-sidedness of empiricism and agnosticism within the framework of the third way - American pragmatism, which was discussed above. As a substantiation of the truth of knowledge, he referred to individual success in a specific matter. But it is known that even false concepts can bring success. For example, the geocentric system was successfully used by sailors. However, in technical sciences, practical success is a good criterion for the validity of knowledge.

Questions to repeat:

1. Name the features of scientific knowledge.
2. What is implicit knowledge?
3. What are the features of scientific and technical knowledge?
4. Name the distinctive features of scientific and humanitarian knowledge.
5. What types of non-scientific knowledge do you know?
6. Name and describe the main concepts of truth.
7. How is scientific knowledge substantiated in empiricism, rationalism, pragmatism?
8. What is the essence of agnosticism?

11. Philosophical aspects of the method and methodology.

11.1. Concept of method. Scientific method. Classification of methods.

The method and its functions. Scientific, practical and any other activity of people is determined by a number of factors. Its result depends not only on the subject and the object of activity, but also on how this process is carried out, what methods, techniques and means are used. These are the problems of the method.

Method (Greek methodos) — in the broadest sense of the word — "a way to something," that is, any way of human activity.

The main function of the method is the organization and regulation of cognitive or practical activity. Therefore, the method is usually reduced to a set of certain rules, techniques, methods, norms of a certain action. If it is used consciously, it looks like a complex system of sequential actions, orders, principles, requirements, which, on the one hand, guides a person on the way to the desired result, and on the other hand, represents the mechanism of achieving the result. The method disciplines the search for an answer, allows you to save energy and time, and move towards the goal by the shortest path.

Briefly, we can say: a method is an orderly activity to achieve a goal.

A good method serves as a kind of compass, along which the subject of cognition and action paves his way, allows to avoid mistakes. Francis Bacon compared the method to a lantern that illuminates the path of a traveler in the dark, and believed that we cannot expect success in studying any question without a method. It was emphasized above that he sought to create such a method, which could be an "organ" (tool) of cognition, to ensure man's mastery over nature. Bacon considered induction to be such a method, which requires science to proceed from empirical data, their generalization, in order to formulate the laws of nature on this basis.

René Descartes called the method "precise and simple rules", the observance of which helps to find new knowledge, allows to distinguish false from true, is indispensable for a researcher. It is not by chance that one of Descartes' main works is called "Reflections on Method". He emphasized that it is better not to dream of finding the truth than to try to do it without a method. Unlike Bacon, he considered the deductive-rationalist method to be the main method.

A significant contribution to the understanding of the method was made by German classical philosophy, especially Hegel, and materialist philosophy, especially Marx, who developed the dialectical method in sufficient depth. For its time, this was a serious step in the development of ideas about the method. Problems of method and methodology occupy an important place in modern philosophy.

Emphasizing the importance of the method, we should not go to extremes. Methodological negativism underestimates the method and methodological problems, considering all this as a minor matter that interferes with true scientific research. Methodological absolutism exaggerates the importance of the method, considering it more important than the subject to which they want to apply it, and turns the method into a kind of "universal key" to scientific discovery.

In modern philosophical and methodological literature, several mandatory characteristics of the method are distinguished:

– Objectivity, which implies the conditioning of the method by the object of cognition.

– Content, which expresses the dependence of the method on some theory. Many philosophers admit that the method is the same theory, but as it was turned with its edge on the cognition and transformation of the object.

- Operationality, which records the dependence of the content of the method on the subject of knowledge, on his competence and ability to translate the relevant theory into a system of rules, principles, techniques, which in their totality form the method. Sometimes, on the basis of some theory, there are modifications of the method that depend on the subject, the researcher. Therefore, the method has not only an object but also a subject basis.
– Praxiological (sometimes it is called axiological), which includes such properties as efficiency, reliability, clarity, constructiveness. A scientist periodically faces the question of choosing one of two or more similar methods. Considerations related to greater clarity, simplicity, comprehensibility or effectiveness of the method may play a decisive role in the choice.

The scientific method is a method of activity that includes certain means of obtaining scientific knowledge. The content of the method is a scientific theory. A theory can give rise to several methods, and conversely, a method can be a consequence of several theories, as a theory or a combination of them applied to research becomes a method.

Since any scientific method is developed on the basis of a certain theory, the effectiveness of this or that method depends on the content, depth, and development of the theory. In turn, the method is used for the further development of science, the deepening of theoretical knowledge. Thus, theory and method are at the same time in some sense identical and different. They are mutually transformed: the theory is transformed into a method with the help of development, formulation of the principles, rules, techniques arising from it, which are returned to the theory, where they "exist". The development of theory and the improvement of research methods are essentially one and the same process with these two sides inextricably linked. However, scientific theory and methods of cognition cannot be completely equated.

The main differences between theory and method consist in:
– the theory is the result of previous activity, and the method is the starting point and prerequisite for further activity;
– the main functions of the theory are description, explanation and forecast, and the method — regulation and orientation of activity;
– theory is a system of ideal images, a model that captures the essence, regularities of an object, and a method is a system of regulations, rules, and orders acting as a tool for further cognition;
- the purpose of the theory is the presentation of the object, and the method is the techniques and mechanisms of its research.
- the theory is the goal, and the method is the means of research.

In short, the theory or the laws, concepts, models, etc. extracted from it do not yet make up the method. In order to perform a methodological function, they must be transformed from descriptive and explanatory provisions into orientation provisions, regulatory principles, requirements, and sequences.

Classification of methods. Methods are classified on different grounds:
- based on the subject (object) of this science: physical, chemical, biological, sociological, psychological;

- based on the level of science: empirical, for example, observations, and theoretical, for example, formalization;
- based on the degree of commonality: general, for example, analysis, and separate, for example, spectral analysis;
- based on the specifics of the used means: qualitative, quantitative;
- based on tasks: research methods and methods of building theories, etc.

A very common classification of methods according to the degree of commonality and breadth of application, which is sometimes presented as a multi-level structure.

Philosophical methods. Any philosophical concept has a methodological function, is a kind of way (method) of thinking. For example, the analytical method is characteristic of modern analytical philosophy, intuitive for the philosophy of intuitionism, phenomenological for philosophical phenomenology, hermeneutics for philosophical hermeneutics, etc. Philosophical systems and their methods were often combined with each other. Thus, Hegel's dialectical method was combined with idealism, Marx's dialectical method was combined with materialism. Gadamer combined hermeneutics with rationalist dialectics. But these are examples of applying philosophical methods to obtain a philosophical result.

In addition, philosophical methods also work in scientific research. But here philosophical methods are not a rigid sequence of actions, but a "soft" variant of mental techniques. The main thing is that they have a general, universal character, are at the extreme levels of abstraction. Therefore, philosophical methods are difficult to formalize and mathematize, but this, in principle, is not necessary, since they have a special operational role. Philosophical methods set only the most general regulations of research, its general strategy, and they cannot replace special methods and, what is very important, do not determine the final result of scientific research directly and specifically. The more general the method of scientific knowledge, the more uncertain it is in relation to the detailing of specific steps of knowledge, the greater its ambiguity in determining the final results of research. Therefore, when materialist dialectics was applied with the "light hand" of Isak Prezent in Lysenkov's biology, and even with the support of the party leadership, it resulted in both the personal tragedies of scientists and the tragedy of science itself. We have a typical example of an illiterate attitude to philosophy as a general lock.

2. General scientific research methods. The main feature is the use of general scientific methods in almost all sciences. These can be mental procedures: analysis, synthesis, idealization, induction, deduction, abstraction, etc., which become methods in case of their participation in research, and not just in thinking. This also includes the methods of such theories that are used in various disciplines, for example, the methods of the general theory of systems, or synergetics. Their concepts perform a methodological role. For example, system-forming concepts: concept, structure, system, element, optimality, etc. Or the concept of synergetics: order, chaos, nonlinearity, uncertainty, instability, dissipative structures, bifurcation, whole, randomness.

3. Separate scientific methods are used in separate sciences. These are methods of mechanics, physics, chemistry, biology, sociology, linguistics, etc.

4. Disciplinary methods are used in one or another scientific discipline that is included in any branch of science or arose at the intersection of sciences. Each fundamental science is a complex of disciplines that have their own unique research methods.

5. Methods of interdisciplinary research are synthetic, integrative methods that arose as a result of various combinations of methods and approaches of various scientific disciplines. These methods are widely used in the implementation of complex scientific programs.

11.2. Concept of methodology. Levels of methodological analysis. Methodological concepts.

The term "methodology" is used in several meanings (which are not mutually exclusive).

1. A set of means, methods used in any activity. In this sense, any activity has a methodology, and even ordinary theory also involves some methodology.
2. Teaching about regulations of activity. As a rule, this is a philosophical methodology based on certain philosophical principles.
3. The field of knowledge that specifically studies the means, prerequisites, principles of any type of activity, and if we are talking about science, then the methodology of science deals mainly with the study of methods and principles of scientific research.

Traditionally, the problems of methodology were developed by philosophy, within which methodology was intertwined with the theory of cognition. In connection with the development of science and the process of its self-awareness, a special system of knowledge arose - the methodology of science.

Methodology, as a set of knowledge about the method, was formed during the generalization and development of those methods, tools and techniques that were discovered in philosophy, science and other forms of human activity. Initially, the problems of methodology, although they did not constitute an independent field, were developed within the framework of philosophy: the dialectical method of Socrates and Plato, the inductive method of Bacon, the rationalist method of Descartes, the antithetical method of Fichte, the dialectical method of Hegel or Marx, the phenomenological method of Husserl, and so on. Therefore, methodology is really closely related to philosophy and is usually not separated into an independent sphere. Another matter is the methodology of science, which has become an independent field of knowledge.

The methodology of science, in contrast to the method that offers a description of the sequence of specific actions and procedures, studies the regularities and regulations of mental activity in scientific research. Such regulations are both the methods and foundations of science, in connection with which scientific procedures and regularities of the development of scientific knowledge and scientific language, etc., fall into the sphere of the methodology of science.

Levels of science methodology.

1. Philosophical and methodological, where the initial philosophical and value attitudes of a scientist, the meaning of scientific activity, the scientific picture of the world are studied.
2. The general scientific level, at which the general scientific prerequisites, thinking style, ideals and norms of this scientific school or scientific direction are studied.
3. The level of special scientific methodological knowledge, which summarizes research samples of individual scientific and technical problems, criteria for selecting theories for engineering implementation, features of special scientific creativity.

Philosophical means of analysis can be present at all levels of scientific methodology.

The methodology of science as a teaching about scientific methods and regulations of scientific activity became at the end of the 20th century one of the most popular areas of research, it is actively developed and is considered the highest form of self-awareness of science.

Methodological concepts. Methodological concepts, in addition to the actual method, also include: approach, program, algorithm, regulatory principle, methodological principle.

The program is a collection of research tasks and methods of their implementation. The program is a rather broad concept and does not imply a detailed specification and an unambiguous result, but it has a clearly defined goal that usually unites a wide range of participants. In the narrow sense, a clearly designed sequence of operations is called a program, for example, a computer program.

An algorithm is a clear and unambiguous sequence of actions that inevitably leads to the solution of one or another problem. The method, in general, unlike the algorithm, does not assume an unambiguous sequence of actions and does not always guarantee the achievement of the set goal. The same method can be used in different conditions to solve different problems, and vice versa, one problem can be solved by different methods.

Approach is a more general concept than method. The approach is based on a certain idea, includes certain theoretical assumptions, in particular of the ontological order, research that goes beyond the object and the method itself. The approach acts as a theoretical basis for more specific methodological orders. A whole set of methods can be used within one approach. Therefore, the concept of "approach" is often used in situations where the initial methodological idea can be implemented by various methods. For example, there may be a search for the optimal method within the framework of one or another approach.

In addition, approach is a less defined methodological concept. Therefore, the term "approach" is often used in those situations when this or that subject area of science has not yet been methodologically formed. In this case, we are only on the approaches to the problem. In the initial period of research, it often happens that the approach is planned, but there is no clearly developed method yet.

Finally, approach is a less directive methodological concept. As a rule, the approach suggests alternatives in the form of other approaches. Therefore, the concept of "approach" is often used in situations where the very possibility of a single methodology is excluded.

In the methodology of science, the term **"regulatory principle"** is often used. Regulatory principles of scientific cognition are norms of cognitive activity in science, although they are less defined and less explicit than methodological principles. An example can be norms such as simplicity, beauty, harmony and the like, or principles such as the principle of simplicity, the principle of aesthetic perfection. The term "regulatory principle of scientific knowledge" is also used in a broader sense, characterizing, generally speaking, any norms of cognitive activity in science.

A methodological principle is a certain form of cognitive activity in science, and it is more explicit than the usual regulatory principles of scientific knowledge. Most of the methodological principles that work effectively in science were formed in physics and mathematics.

In the broadest sense of the word, the scientific method is not only a system of techniques, but also regulatory principles. Then the method will perform broader functions, ensuring not only the advancement of the research itself, but also carrying out a kind of guidance for it, setting, in addition to the result, its certain characteristics.

Since the scientific method is not an algorithm and does not guarantee in general the unambiguous achievement of the set goal, this makes scientific activity open to scientific projects, new approaches, new programs and methods, algorithms and techniques.

The list of methodological concepts can be significantly expanded if it includes not only concepts related to the method, but also concepts reflecting the functions of science, its foundations, models, and others widely used in the methodology of science.

11.3. The scientific nature of the methods. The problem of method in humanitarian disciplines

Different meanings of the term "method". The term "method" is used in theoretical considerations in at least four senses.

- Firstly, the method means a clear sequence of steps to achieve a result, which is especially characteristic of strict theories of classical science. As a rule, this is a rationally declared and substantiated sequence of actions with the use of special means and instrumental operations. Among general scientific methods, these include, for instance, the method of deduction, among special methods - the method of spectral analysis or the method of excavation in archeology.
- Secondly, the method is considered as a set of requirements that are presented to the research activity and that can be formulated with varying degrees of rigor and certainty. For example, the artistic method is understood quite unconditionally, but it is difficult to talk about the rigor of its application.
- Thirdly, the theory itself, applied for research, where the sequence of steps is quite conditional, can act as a method, at least because of the diversity of the components of the theory. If the theory is strict, then as a method it will correspond to the classical canons of science, if not, then it will be a method in the fourth sense.

- Fourthly, a method is often called an approach that has one or several ideas, and the sequence and nature of actions is left to the discretion of the researcher. In some cases, the approach and the method are clearly distinguished, for example, the systematic approach and the systematic method, but more often, unfortunately, such a distinction is not made, which is characteristic of many humanitarian studies.

It seems that all four, if not more, senses of the term "method" can be found in the humanities, which are usually indistinguishable. On the one hand, this is a consequence of the insufficient development of theoretical constructions, on the other hand, it is an unconscious desire to add scientific status to our reasoning.

According to supporters of a unified methodology, humanitarian knowledge is connected with general scientific methods, the presence of which is a proof of the scientific nature of humanitarian knowledge. Here, the method is understood, as a rule, in the first sense, that is, as a clear sequence of actions. However, many outstanding authors associate the humanities with special methods, for example, those that "understand". F. Schleiermacher pointed out the need for the consonance of the researcher's state with the inner world of another person. V. Dilthey especially emphasized the role of "transferring-oneself-to-the-place-of-another", empathy, compassion, adding a clear psychological shade to the interpretation. Here the method is understood rather in the fourth sense as a certain approach. And although "methods", like empathy, rather testify to the art of the researcher than they contain an ordered set of sequential steps, nevertheless, the appropriate level of knowledge provides the possibility of a special "use" in another culture. This means a peculiar mood of mind and feelings, when the researcher understands what exactly the person of the culture being studied knows, sees and feels. A typical example is given by the outstanding Italian philosopher and scientist, specialist in semiotics and medieval culture, literary critic and writer Umberto Eco, commenting on his famous novel "The Name of the Rose": "Once in the country we were burning fires, and my wife reproached me that I don't look at the sparks as they fly to the tops of the trees, to the electric wires. Time has passed. She read the chapter about the fire and asked, "So you did look at the sparks?" I replied, “No. But I know how a medieval monk would look at them."

Getting used to a foreign culture cannot be called a strict method of research, especially since it is impossible in its pure form, because it is impossible to move to another time, to forget about one's own culture, in which the researcher lives and works. In addition, it is not entirely clear how to translate the subjective feeling of use and empathy into an intersubjective, independent of the psychological state of the researcher, sequence of actions that make up the method in the first, strict sense.

Another way of research, which is characteristic of humanitarian research, is often called the dialogue of cultures. M. M. Bakhtin emphasized that a foreign culture reveals itself more fully and deeply only in the eyes of another culture. One meaning reveals its depths by meeting and coming into contact with another, foreign meaning; a dialogue begins between them, which overcomes the isolation and one-sidedness of the meanings of these cultures. At such a dialogical meeting of two cultures, they do not merge and do not mix, each preserves its unity and open integrity, but they mutually enrich each other. It is clear that such a dialogue requires the study of the language of another culture, the forms of behavior of people, the meaning of their symbols, that is, a high level of knowledge, the acquisition of which requires a considerable number of various methods. Dialogue, as well as empathy, cannot be reduced to a certain sequence of cognitive actions.

The methods of "using" another culture, the dialogue of cultures, cannot be called scientific methods, since they do not specify the generally significant sequence of steps that would produce a result. They are close to art, so they can be called scientific methods only in an expansive sense. As a rule, they are used by theories with non-strict requirements for the method, for the formulation of laws, which are limited to narratives, philosophical metanarratives, linguistic figures, etc.

The procedures of hermeneutics look stricter, especially in attempts to develop a specific methodology of understanding, for example in sociology, psychology, anthropology, without resorting to general philosophical generalizations. Criteria for the validity of hermeneutics procedures, principles of adequate interpretation, etc. are being developed. E. Betti, for example, in a polemic with Gadamer, tries, in contrast to philosophical hermeneutics, to add to "methodological" hermeneutics the limits of a strictly working method. He formulates special canons. Among them: the requirement that the reconstruction of the text conform to the author's point of view and the related requirement for the autonomy of the text, which has its own logic; the need to introduce into the research method the principle of the so-called circle of hermeneutics, when the unity of the whole is clarified through individual parts, and the meaning of individual parts is clarified through the unity of the whole; the canon of the relevance of understanding, which implies the absurdity of completely eliminating the subjective factor, since in order to reconstruct other people's thoughts, it is necessary to correlate them with our own "spiritual horizon"; the canon of semantic adequacy of understanding, or the canon of semantic correspondence of hermeneutics, is aimed at the interpreter and requires him to reconcile his own vital relevance with the impetus emanating from the object. In these canons, Betti saw a criterion for the correctness and objectivity of the interpretation of hermeneutics. In such attempts, there is a need to clarify the methods of humanitarianism in order to increase their rigor. Obviously, the first understanding of the term method as a sequence of steps is considered more attractive, although Betty's canons and requirements do not reach this level. Nevertheless, it is possible to state a conscious movement in the indicated direction. Betty is not alone in such aspirations. Y. Habermas proposes a rational reconstruction of the conditions of interpretation. E. D. Hirsch considers that an objective interpretation of a literary work, resulting from an adequate understanding of the author's text, is possible.

Other authors emphasized the approaches related to the individuality of humanities objects. This is how the concept of individualizing methods was born, in particular, in history (Rickert) and ideographic methods (Windelband), where the term "method" essentially means an approach or set of requirements.

A special group of methods consists of structural-semiotic methods that claim scientific explanation of the text as a sign system organized in a certain way. The attractiveness of such a methodological approach brings to life attempts to bring hermeneutic analysis and structural-semiotic analysis closer together (P. Ricker). Structural-semiotic methods are close to a strict understanding of the method and, along with the methods of linguistic analysis (the method of synchronous slices, distributive and transformational analysis, etc.) generally meet the classical requirements. They allow the relevant theories to be considered strictly scientific, as they are almost indistinguishable from the natural sciences, especially if mathematical methods are used there.

At one time, the great hopes of teaching humanities were associated with mathematical methods, because the desire for rigor, unambiguousness and other classical general scientific criteria are not alien to it. For example, in the 20th century, linguists realized that language is a system of symbolic relations, and is indifferent to the physical nature of signs and relations. Since mathematics also deals with pure relations, and the nature of objects is irrelevant here, it became clear that language can be studied by mathematical means. True, such a possibility became a reality only after in the 19th century mathematics began to build quantitative abstract models applicable to a wider sphere than the relations between quantities and spatial forms. One of the results of this meeting was the emergence of a new mathematical discipline - mathematical linguistics, the subject of which was the development of a mathematical apparatus for linguistic research.

At the same time, it turned out that the mathematical apparatus is applicable only to stable language structures, and far from all of them are stable, thanks to which language evolves. As noted by Lev Vygotsky, the founder of the cultural tradition in psychological research, our ordinary spoken language, due to its inherent fluctuations and inconsistencies of a grammatical and psychological nature, is in a state of moving equilibrium between the ideals of mathematical and fantastic harmony and in a constant movement, which we call evolution. Apparently, mathematical methods are not applicable to such evolutionary processes. However, on this basis, it makes no sense to criticize mathematics for not covering some cases. Other, possibly non-mathematical means are needed to describe the evolutions inherent in language. But precisely the clear clarification of the role of mathematical models, and in general the aspiration to the classical ideal of the theory, would make it possible to clearly distinguish the "fantastic" from the "mathematical" in the language and to find those areas where other methods are needed..

The noted methods and theories, as well as the mathematical methods used there, do not solve all problems in humanitarian research. The latter circumstance is sometimes interpreted as the impossibility or significant limitation of the possibilities of strict methods in humanitarian disciplines. Maxim Shapir, one of the well-known experts in the field of humanitarian sciences, claims that we are powerless to build a universal mathematical model of even the "simplest" and "superficial" phenomenon of spiritual culture - a phenomenon that people themselves have brought to life and all new modifications of which they constantly generate. The reason is banal: it is impossible to construct a mathematized picture of the universe governed by a set of relatively equal demiurges; any one of them will necessarily cancel the law established by the other. Indeed, a considerable area of humanitarian research is not covered by mathematical and other exact methods for various reasons.

Not least among them is the problem of adequacy of the method. It is especially relevant when the methods of one theory are used within the framework of another. The adequacy of the method is ensured by the fulfillment of at least two conditions emphasized by the famous Ukrainian philosopher, citizen of Odessa, Arnold Tsofnas. First, it should be relevant to the problems of the corresponding humanitarian discipline, that is, it should correspond to the meaning of the tasks solved in it. Secondly, it should be divergent - significantly different in the means used, that is, use a foreign language and methods of solving tasks that do not coincide with those that are familiar to professionals in this field of knowledge. There is an analogy with the primary use of mathematics in physics. However, the application of mathematics itself in humanities is limited, since it, fulfilling the divergent condition of adequacy, does not always fulfill the relevant one. Mathematics does not express purely human intentional and teleological relations and is not interested in relations along with correlates, in this case, interpersonal relations.

Adequacy requirements can be met by any general scientific theory, for example, the theory of information and communication, the theory of sign systems, etc. - due to its general scientific character. The only question is how adequate such theories will be and how large and significant the array of problems of the relevant humanitarian science they are able to cover.

General theories of systems are relevant in this regard. After all, there is no humanitarian discipline that does not talk about systems of social or personal life and activity, systems of human ideas, systems of values and norms, systems of social management, and the like. All of them, in one way or another, use the appropriate system terminology (concepts of reliability, stability, centrality, autonomy, regenerativity, isomorphism, synthesis of systems). Even if we accept Wilhelm Dilthey's thesis that the humanities, unlike the natural sciences, do not explain, but understand, then in this case the procedure of understanding is always a integral representation of the object, and integrity is one of the system characteristics.

The general parametric theory of systems (PTS) has advantages over other systems theories, which not only contains sufficiently strict definitions of all the mentioned concepts, but also establishes their correlations (regularities), without relying on quantitative representations, which are of little interest to humanitarians. And fulfilling the requirement of divergence, PTS uses formal non-classical calculus - the language of ternary description (LTD). In any of the humanities, it is possible to single out a systemological problem, which can receive an adequate representation and corresponding nomological explanations with the help of PTS and LTD. If quantitative analysis remains the ideal of "good" science, then the boundary between rigorous and not so rigorous sciences remains, and the general parametric theory of systems is one of the possible ways of their convergence.

Thus, in humanitarian knowledge, the concept of "method" is used in different senses. Those humanities theories that focus on the classical canons of scientism consider the method as a clear sequence of actions or use rigorous theories as a method.

Other theories consider the method as a collection of not entirely clear requirements, as a non-strict theory, some approach, or in another expansive sense. Here the rigor of the method is replaced by erudition, intuition, a special sense, and other outstanding subjective qualities of the researcher.

Questions to repeat:

1. What is the method?
2. What are the features of the scientific method?
3. What are the classifications of methods?
4. How are theory and method related?
5. Formulate the concept of methodology.
6. Compare levels of methodological analysis.
7. What concepts belong to the methodological ones?
8. What is the problem of the method in humanitarian disciplines?

12. Philosophical and methodological problems of rationalism and creativity.

12.1. Philosophical and methodological problems of scientific creativity.

Scientific creativity. The theory of scientific creativity is part of the methodology of science, which studies the facts of the creation of hypotheses, theories, new methods, and the like, as well as the circumstances associated with this. Many difficulties are caused by the unconsciousness and randomness of most creative acts.

The results of scientific creativity are sometimes divided into discoveries and inventions. More often, however, any result of scientific creativity is considered a discovery, then a distinction is made: what-discovery (discovery of spots on the Sun, Jupiter's moons) and why-discovery (Newton explains the motion of the planets).

On the basis of the Kuhn model of science, a distinction is sometimes made between revolutionary discoveries (the discovery of the quantum), leading to the creation of a new paradigm, and conservative discoveries that develop this paradigm (the discovery of Neptune).

Many researchers of scientific creativity (Whewell, Reichenbach, Popper) believe that creativity is an intuitive act, interesting from the point of view of psychology, and the methodology of science, its logic, its history cannot help much, since the specificity of the new is that it is not deduced from the old one, and only in retrospect can the desired connection be established, but not always.

However, for a certain class of creative tasks, there is a formal theory of creativity: heuristic programming, heuristics, the logic of scientific discovery, that is, useful rules based on experience, techniques that limit the search for solutions, but that do not guarantee an optimal result.

The theory of creativity is based on the assumption that scientific creativity is a choice from a fixed set of possibilities. This is a simplification, but often (far from always) fully justified. Research on creativity at the junction of the methodology of science and the psychology of scientific creativity is effective, when various abilities, age characteristics, professional training, cultural and historical conditions are taken into account and connected with a certain methodological model. For example, it is shown that in normal science the originality of the mind rather hinders the scientist, and in the period of scientific revolutions, on the contrary, sometimes scientists are hindered by their encyclopedic awareness.

The specifics of scientific and technical creativity:

I. Great proximity to the needs of production, which is the goal of creativity, in contrast to fundamental science, where scientific creativity is not oriented toward production (in any case, directly).

2. The relative fragility of the products of creativity, especially in connection with the acceleration of the pace of scientific, technical and technological progress.

3. The continuity of the results of creativity is more noticeable, while for great science this is rare, and for revolutionary science it is not characteristic at all.

4. Simultaneity of creative results, which acquires an almost regular character not only due to the filiation of ideas, but also due to similar methods, technologies, etc.

5. Less dependence on the abilities of the researcher due to greater manufacturability of the process of technical creativity.

6. More pronounced collectivism in creative activity, which is manifested both in the number of participants in creative groups and in the depth of the division of labor between them.

7. Special criteria for the value of a scientific result: economy, stability, reliability, etc.

12.2. Rationality as a philosophical and methodological problem.

The concept of rationality. Rationality (from the Latin ratio - intelligence) is a key term of philosophy in general and the methodology of science in particular. In a simplified form, it means the reasonableness of being, actions, relationships, goals, etc. But the fundamentality of the problem lies precisely in clarifying the meaning of reasonableness. Solving the problem is determined by the general content of one or another philosophical and methodological concept, which asks the following questions: what are the essential characteristics of reasonableness, are they variable or relative, or are different types of rationality possible?

In classical rationalism, a paradigm has developed that comes from antiquity. It is based on the belief in the absoluteness and immutability of the laws of Universal Reason, which are understood by man and inherent in all things, including the human spiritual ability. The most obvious laws of this kind are the laws of logic, which, according to, for example, Aristotle, are the fundamental principles of being and thinking. That is why it is sometimes believed that everything that conforms to the laws of logic is rational, that which does not conform to these laws is not rational, and that which contradicts logic is irrational.

But, firstly, completely nonsensical "conclusions" can be logically correct, and, secondly, the reasonableness of objects, considerations or actions can be determined by expediency, efficiency, harmony, systematicity, clarity, predictability. The ideal of rationality in this respect coincides with the Absolute Mind.

However, human activity is far from such an ideal, so it is considered rational if it meets certain criteria that are historically and culturally determined. Hence the distinction between the rationality of antiquity, the Middle Ages, the New Age, non-classical and post-non-classical rationality as its historical types arise. This is where the distinction between prudent and reasonable rationality comes from (like the distinction between prudence and reason, for example, in I. Kant). Reasonable rationality includes sufficiently strict criteria: laws of logic and mathematics, rules and patterns of action, causal schemes of explanation, fundamental scientific laws, systematicity, etc. Reasonable rationality implies the evaluation and selection of criteria, their discussion and criticism, it is necessarily connected with intellectual intuition and creative imagination.

If rationality is completely determined by its criteria, then the very choice of these criteria cannot be substantiated rationally and is carried out from some other, for example, value considerations. In addition, it is necessary to periodically update the criteria of rationality. Thus, in order to reconcile supporters of "physical determinism" with indeterministic descriptions of microcosm objects, it was necessary to add a broader, in particular, probabilistic, meaning to determinism. Therefore, the choice of rationality criteria is often conventional and pragmatic in nature.

Another way of determining rationality is through its standard. Since the New Age, science, especially mathematical natural science, has been considered such a standard. Disputes about the problem of demarcation, that is, the distinction between science and non-science, which formed the main content of the philosophy of science of the 20th century, showed that attempts to define the boundaries of science and scientific activity with the help of unambiguous criteria of rationality constantly encounter contradictions. They try to define rationality through scientificity, and scientificity – through rationality.

The third way of defining rationality is to present it as a special construct that does not have a universally objective referent, but performs an important methodological role. This role is determined by one or another "partial" model of rationality. Thus, M. Weber proposed the concept of "formal rationality", with the help of which M. Weber's economic sociology describes the relations of production, exchange, accounting of money and capital, professional activity - that is, the most important elements of the market economy and the corresponding organization of society. By analogy with Weber's formal rationality, epistemological and methodological models of rationality were built, in which the cognitive goals were not traditional goals, such as truth, but "partial" ones: consistency, empirical adequacy, simplicity, growth of empirical content, and other similar properties of conceptual systems. Each of these models gave a certain idea of how these goals could be achieved and, therefore, formed a specific image of rationality. In this case, the concept of rationality is interpreted in the spirit of pluralism, bordering on relativism, which is highly undesirable in science.

The fourth approach proposes to consider rational theories or conceptual systems, as well as ways of behavior and activity that could ensure productive intellectual and practical communication. Rationality in such cases is provided by intersubjectivity, the varieties of which were developed by D. Huebner. Intersubjectivity includes: clarity and general agreement regarding concepts and statements (semantic intersubjectivity), the substantiation of statements by observations or facts (empirical intersubjectivity), logical coherence, consistency and sequence (logical intersubjectivity), reproducibility of samples actions or considerations (operational intersubjectivity), general acceptability of norms and rules of behavior or its assessment (normative intersubjectivity). The general meaning of rationality as intersubjectivity depends on the explicitly or implicitly accepted conventions of a given culture. In this case, rationality is interpreted so expansively that none of the forms of intersubjectivity is dominant or paradigmatic. If rationality is represented as a variety of forms of intersubjectivity, then the myth will be no less rational than science, as the well-known "methodological anarchist" P. Feyerabend has been insisting for a long time.

The fifth approach is based on the distinction between "criterion" and "critical-reflexive" rationality as "lower" and "higher" types. However, there is a hidden contradiction here. For example, subjecting one's intellectual or practical activity to a rigid system of criteria, a person loses the rationality that makes critical reflection and revision of this system possible. If it dares to improve it or replace it with another, then it acts irrationally.

Overcoming the conflict is possible if we proceed from the principle of complementarity of both approaches (in the spirit of the methodological ideas of N. Bohr). "Criterial" and "critical-reflexive" approaches jointly describe rationality as an object of philosophical and methodological analysis. The applicability of the idea of additionality as a basic principle of the theory of rationality is the subject of modern philosophical and methodological research. The theme of rationality is heard in modern cultural, socio-philosophical, philosophical and anthropological studies. Thus, there is a tendency to evaluate the development of a culture based on the increase or decrease of elements of rationality in it; the processes of democratization of society, the level of civilization, and the effectiveness of social institutions are connected with the development of rationality. At the same time, excessive rationalization of social existence is seen as a threat to a person's personal existence. Rationality is often taken as a limiter of subjective freedom and creativity. Related to this are calls to return to rationality the role of the most important cultural value, largely lost in the "technogenic civilization", that is, to turn to the mind as the highest human ability that allows understanding - to understand the semantic connection not only of human actions and mental movements, but also natural phenomena.

Rational and irrational. Difficulties in determining the criteria of rationality. If rationality is determined by a set of criteria or a list of features, then the very choice of these criteria cannot be justified rationally and is carried out based on some other considerations, for example, based on values, at the level, so to speak, of meta-rationality. In this sense, we can talk about levels of rationality.

They distinguish prudent and reasonable rationality according to the principle of distinguishing prudence and reason, for example, in I. Kant. Then reasonable rationality includes sufficiently strict criteria: laws of logic and mathematics, rules and patterns of action, causal schemes of explanation, fundamental scientific laws, systematicity, etc. In other words, it will be identical to the classical paradigm of scientific rationality. And reasonable rationality implies evaluation and selection of criteria, their discussion and criticism, and most importantly, it correlates with intellectual intuition and creative imagination and other para-rational factors, and often has, in fact, a conventional and pragmatic, that is, non-rational character. But still, since the choice of rationality criteria is usually argued, it has a rational component. If this combination of rational and non-rational is typical for scientific classics, then what can we say about non-classical or humanitarian rationality?

To rationalize the non-rational selection of criteria, it is declared a higher level of rationalization. Such a dialectic of two levels of rationality, when the contradiction between them is removed, is often used and can really clarify to a dialectically trained individual (if it does not obscure the situation for a researcher unfamiliar with dialectics) some problems, for example, the problem of choosing the criteria of rationality and the problem of transitioning to a situation of choice, which just seems irrational. Another option for solving this problem can be the distinction between "criterion" and "critical-reflexive" rationalities also as "lower" and "higher" types (which was discussed above). Thus, subjecting his intellectual or practical activity to a rigid "criterion" system, the scientist loses the possibility of critical reflection and revision of this system within these frameworks. The review assumes other criteria, irrational from the point of view of the former. Here, a transition to "critical-reflexive" rationality with a different system of criteria is necessary. But the transition itself does not look rational. Therefore, it is sometimes suggested not to oppose rationality, but to proceed from the principle of additionality in the spirit of methodological ideas of N. Bohr. Thus, "criterion" and "critical-reflexive" approaches can jointly describe rationality as an object of philosophical and methodological analysis.

The concept of non-rationality and even irrationality is often included in the context of methodological studies and does not frighten modern researchers. Indeed, not only a number of manifestations of the human spirit have a non-rational nature, but also rational formations sometimes lose their rationality.

Many attitudes, assessments, requirements, prohibitions and so on, expressed in the form of norms and acting as guidelines and criteria for activity, in particular even scientific, have both rational and non-rational ontology. They were formed as rational requirements and norms and became established as traditions. At the same time, they are not always the subject of individual reflection or scientific and philosophical analysis, they are not always realized, they do not always appear in the form of knowledge, but, let's say, in the form of incentives or appeals. In this respect, they are non-rational factors of activity. Subject values, evaluated from the point of view of good and evil, truth and error, beautiful and ugly, just and unjust, even received an epistemological development in the form of philosophical or axiological knowledge, that is, they have the form of an explicit rational existence in culture, in real activity they often function implicitly, on levels of intuitions and insights, sensory-emotional and other non-rational presence.

It is necessary to distinguish, at least, four meanings **of the word "irrational"** ("irrational"), essential in the context of scientific rationality. **In the first sense, the irrational** is a self-sufficient and self-valued extra-rational form of human spiritual activity that exists alongside and simultaneously with the mind as a non-reflective sphere of the spirit that preserves itself in this capacity regardless of the latter's development. Such irrationality has its own means of understanding the world, for example, faith, mystical intuition, inner contemplation. The sensory-emotional sphere of the spirit is sometimes referred to here as opposed to the mind. It is obvious that in such a context, it is possible to identify scientific values and scientific faith, which, although they have a rational origin, often function as non-rational factors.

In the second meaning, the irrational as the sphere of the spirit is not self-sufficient and self-valuable, it undergoes changes in accordance with the changes of the mind and the sphere of the spiritual in general. There is, for example, a point of view according to which, in the course of the development of mankind, the sphere of the irrational narrows to its complete disappearance due to the expansion of the rational sphere, in contrast to another hypothesis about the infinity of the irrational, which performs the function of eternal nourishment of the rational. In any case, here the irrational looks like still-irrational. In this capacity, it is a possible object of science.

The third meaning of the term "irrational" is related to that sphere of the human spirit, which functions relatively independently of the mind, at the level of sensations, emotions, and the rational pushed into the subconscious. Many norms of morality or evaluations of the type fair-unfair, beautiful-ugly, and the like are carried out without prior rational processing, as habitual, emotional reactions. In philosophy and humanities, these norms and values have long been rationalized, which may have been once learned by individuals in the process of socialization, but forgotten or taken for granted or learned by imitation. Such phenomena have become post-rational, non-rational.

The fourth meaning of the term "irrational" is related to the assessment, usually negative, of the world in general or its fragment, some practical action or spiritual phenomenon, as irrational, although they are not necessarily so. Reasoning within the framework of another model of rationality, taking into account other criteria, is perceived as irrational. The same applies to the definition of rationality criteria. They may come across as irrational.

The irrational is not a qualitatively lower or, on the contrary, a higher form of relation to the world in relation to the rational. This is a different form of implementation mechanism. Irrational and rational are not always antipodes, they may well act as complementary aspects of the human spirit as a single whole.

The ideal of humanitarian knowledge can be not only rational, but also irrational. The question of the place and meaning of the mind is resolved positively or negatively. It is possible to observe in science and culture alternating periods in which the irrational organically interacts with the rational, and periods in which the irrational opposes the rational. Apparently, now we are going through a period of some rehabilitation of the irrational under the general trend of expansion of the rational, at least in humanitarianism.

Models of scientific rationality. Having despaired of rationally justifying and formulating general criteria of rationality, many authors emphasize the cultural-historical framework of rationality, placing the responsibility for rationality on the standards of rationality inherent in each epoch, inscribed in culture. In this way, the objectivity of the criteria is preserved, they do not turn into subjective arbitrariness, but the problem of the relativity of the criteria of rationality remains. Only classical science, above all natural science, remained an unchanging stronghold.

However, in the second half of the 20th century the historical character of scientific rationality itself was revealed. This problem was especially acutely posed in the works of representatives of post-positivist philosophy and methodology of science T. Kuhn, I. Lakatosh, S. Toulmin, J. Agassa, M. Vartofsky, P. Feyerabend, and others. Feyerabend exacerbated the problem of scientific rationality to the limit, accusing scientific rationality of aggressiveness and dogmatism. "Separation of the state from the church," suggests Feyerabend, "must be complemented by the separation of the state from science - this most modern, most aggressive and most dogmatic religious institute. Such separation is our only chance to achieve the humanism we are capable of, but which we have never achieved."

Despite the fact that in the second half of the 20th century many norms of rationality have been questioned, a huge army of their defenders proves the ineradicability of rationality as the most important component of culture and science.

Some researchers distinguish rationality, and above all scientific rationality, from one or another model of rationality. That is, it is important to distinguish between the ideal of scientific rationality and its methodological models. One model differs from another by some set of features and rules, and the transition from one model to another looks irrational, since the transition rules are not formulated in advance. But this supposedly irrational transition is declared rational from the point of view of universal rationality. This is a peculiar paradox of rationality.

The idea of distinguishing models of rationality is promising in light of the complementarity of theories, paradigms, and worldviews in the humanities. After all, moving from one method to another (from quantitative to qualitative and vice versa), from one theory or paradigm to another, moving from one picture of the world to another, the researcher actually simultaneously changes the model of rationality. How rational is this transition and the change of rationality itself is another question. It can be resolved in the spirit described above. It may not be realized by the researcher and only then receive a rational illumination, as often happens in the history of science. Perhaps the transition is not always rational, or always non-rational, being carried out by inspiration, assumptions, intuition, enlightenment, special research sensibility, which can always be rationalized in retrospect. But after the transition, work in another model will be no less rational than in the first. It's just that another model is rational on other grounds. It will be more adequate to the research task: to use rigid or flexible requirements, causal or narrative schemes of explanation, quantitative or qualitative methods and theories, to be determined by one or another values and advantages - to formulate a typical, general regularity, or on the contrary, to show the individual and singular. But in both cases, the basic classical standards of rationality remain intact: the laws of logic cannot be violated, thinking must be clear and consistent, not confused, the organization of knowledge must be systematic, not a chaos of impressions.

The concept of models of rationality corresponds to modern ideas about less stringent requirements for scientific rationality. Sometimes the terms "soft", "non-rigid", "flexible" rationality are used. In general, this implies a departure from the so-called rigid rationality, that is, from the standards of classical science as absolute criteria of rationality. In other words, this is not a rejection of the principles of rationality, but taking into account the sociocultural and individual contexts of scientific research. Flexible criteria are connected taking into account the choice of the research path, evaluation of the result, etc. They depend on the purpose of the research, on the composition of the scientific community, especially its leaders, which adds a fair touch of subjectivism and relativism to flexible rationality, but, at the same time, largely corresponds to the actual practice of scientific research.

In fact, flexible criteria are already offered by critics of neopositivism, building a historical model of science. Thus, for T. Kuhn, the scientific community is responsible for adherence to the paradigm and, accordingly, for this model of rationality. In I. Lakatos, positive heuristics as the development of a hard core and especially negative heuristics as a criticism of auxiliary hypotheses of the protective belt create the impression of different models of rationality, and the protection of one's own advantages of the hard core is very similar to subjective scientific advantages. In S. Toulmin's matrix of understanding, which is rooted in the psychological and sociocultural structures of consciousness of scientists, also softens the requirements of strict rationality. All this is a clear departure from the idea of inviolable classical rationality.

The term "flexible rationality" is becoming widespread in modern literature. Such flexible rationality complements "classical" rationality, as it demonstrates the correspondence of the individual standards of reasoning of the cognizing subject to certain psychological, worldview, methodological "matrices" that are not reducible to each other, but make the process of cognition multidimensional.

The idea of models of rationality correspond to four types of scientific rationality distinguished by M. Weber - "rationality as a means of progressive scientific logical thinking; rationality as the expediency of human activity; rationality as a correlation of activity with some system of values; rationality as a normative and methodological model of scientific research". Indeed, while preserving the main features of scientific rationality, the practice of scientific research varies them according to specific research tasks.

The idea of models of rationality is largely consistent with the forms of intersubjectivity identified by K. Huebner as indicators and constants of rationality that are realized in the course of communications. Hubner proposes to consider theories or conceptual systems as rational, as well as ways of behavior and activity that could ensure productive intellectual and practical communication (which was discussed above).

Models of rationality, mitigating the strict requirements of classical rationality in general, preserve the invariance of many norms and rules, so it can be argued that they do not contradict scientific rationality.

12.3. Rationality and creativity.

Creativity and rationality are the two most important components of human spiritual and practical activity. They have always accompanied people, interacting with each other, contradicting and complementing each other, but in any case embodying those essential features of the human spirit, which humanity has always been proud of. Their connection was especially close at the beginning of the formation of modern scientific and technical civilization, which marked a special active-transformative, creative attitude of man to the world, a concomitant factor of which was scientific rationality, which still remains at the center of philosophical analysis.

Ever since creativity has been recognized as the prerogative of free individuality, it presupposes, first of all, the realization of artistic, scientific, inventive and other human potentials. This leads to the creation of new objects not given by nature. However, creativity is not an act of arbitrariness, although it includes impulsive, intuitive, unconscious and irrational moments, which do not always coincide with prudent-rational sequence, logic and other requirements of the mind. All creativity is carried out within the framework of a certain system of values, which determines the model of behavior of the subject of creativity in a certain historical period. On the one hand, the value system includes implicit, unreflected and even irrational attitudes, which to some extent are clarified only by subsequent generations of researchers. On the other hand, this system of values includes clearly realized ideals, as value guidelines pushed to the limit, and norms that became such when value requirements acquired a sufficiently stable character, having received a rational expression.

The fact that much less is known about the technical work of ancient Greek mechanics than about the work of philosophers and scientists is explained precisely by the value attitudes of antiquity, some of which were revealed by philosophy: technical inventions that relate to the fleeting sensory world are less significant than the knowledge of things that are included in the eternal ideal world of real existence. Distrust of human creativity in the Middle Ages was explained by the fact that, within the framework of the Christian value system, creativity was attributed to God, and imitating him could be regarded as devilish imitation with all the consequences that follow. This, in particular, explains the long period of mistrust of innovations in the mass consciousness, the ethical condemnation of creativity carried out by man, if one does not consider the creation of the Christian value system itself as creativity, which, naturally, was not the subject of analysis.

Only in the Renaissance period, when man began to consider himself the creator, supplanting God in his value picture of the world and dissolving him in nature, human creativity rises to an unprecedented height and receives a rational justification. Later, creativity begins to give significant practical results and spreads to all types of activity from art to technology, when a technician (master artist) becomes an engineer (creator), and from politics to science, when all types of creativity are taught, and scientific and technical creativity becomes the leader with a consumer attitude towards nature, society and man. Therefore, scientific creativity itself becomes a value reference point, sets aesthetic and ethical standards, is fetishized, and turns from a means of achieving a goal into a goal. Because of this, technical and scientific-technical creativity was practically beyond ethical criticism for a long time, obeying its own value criteria, among which economy, stability, productivity dominated, and sometimes political, bureaucratic, and corporate ambitious motives were connected here, blurring the line between creativity and arbitrariness. A creative attitude to work and to life in general is still considered to be the most important characteristic of a specialist and a person, but few people think about the shortcomings and dangers of unbridled creativity and the need to be aware of its limits.

With the emergence of scientific understanding of the world, rationality appeared not only as a value of science, but also as a cultural value that determined many norms of human thinking and behavior. Rationality turned out to be one of the main value orientations of human creative activity, especially in science. However, the 20th century made people afraid and sometimes ashamed of a number of manifestations of creativity and rationalism, raising questions about the limits of creativity and rationality and exposing the problem of their relationship.

The problem of rationality, not departing from the philosophical horizon, was usually actualized in crisis and turning points in history. It is no coincidence that the interest in reason and social creativity is sharpening among French educators - ideologues of the bourgeois revolution, among Russian revolutionary democrats and Marxists who were preparing a revolution in Russia, as well as in modern conditions due to the need to solve global problems as a way to overcome the crisis of civilization and the preservation of humanity.

As already indicated, there is no complete unity among researchers regarding the definition of rationality, its interpretations and assessments. Rationality is often understood as certain principles, forms and ways of thinking, since the epistemological direction of the study of the mind prevailed in the history of thought. As a result of the fact that the rational beginning in human consciousness has a number of possibilities, the fixation of some of them made it possible to distinguish two forms of rational thinking: prudence and reason. They were already distinguished by Nicholas of Cusa, but were developed by Kant and Hegel.

For Kant, reason means the ability to think by forming concepts or thoughts according to certain rules and finding them in phenomena. Hegel pointed to the function of reason that systematizes, organizes, and is characterized by certainty, clarity, and consistency of reasoning. Mind, according to Kant, unlike prudence, creates principles and unites the multifaceted in an object with the help of ideas. Hegel understood reason as the ability to go beyond existing "definitions of thought", to rebuild the very system of initial attitudes of a cognitive attitude to the world, to develop and improve their system, while prudence is thinking that always operates in a given system of initial coordinates. Reason, according to Hegel, is a higher form of rationality, associated with the possibility of constant creative revision of initial attitudes. Pointing to the possibility of creative development of initial attitudes is fundamentally important here. It is important that the activity of the mind is inextricably linked with the work of ethical and aesthetic consciousness, which are also carriers of creativity. Emphasizing the creative function of the mind, the classics did not do this with regard to prudence, but at the same time they did not deny its creative nature, just the scope of this creativity was clearly limited.

In the wide range of modern meanings of the concept of rationality, an invariant can be identified, which includes: the rules of understanding objects, the principles of their explanation, interpretation, systematization, methods of evidence, derivation, organization of knowledge, principles and norms of theory construction, and the like. sounds paradoxical, typical samples of scientific creativity, for example, ways of building theories, although the result of creativity should be unique. And attempts to build a theory of creativity, in particular, a theory of solving inventive tasks, which is based on an algorithm for solving such tasks, it would seem, not only deprive creativity of the aura of mysteriousness incomprehensible to the mind, but also turn it into a prudent and rational activity. The same can be heard about the procedure of modern technical creativity due to its great technological ability.

It is not difficult to see here the closeness with the Kantian-Hegelian understanding of the rational form of thinking. In the minds of a number of researchers, this gave rise to the idea of limited creative potential or even their absence in a rational way of relating to the world, which in turn gave reason to oppose rationalism and creativity. For example, Mykola Berdyaev saw in Kantian rationality a serious symptom of the disease of creativity, its tragedy. Diverting from Berdyaev's understanding of creativity, we note that if rationality tends to limit creativity and "dogmatization", then only in the era of "normal" science, expressed in Thomas Kuhn's terms, when the established ideals and norms of science are not questioned and are not subject to criticism by the scientific community, and the authority of luminaries can interfere with the freedom of scientific research. However, one should not exaggerate the losses of such a limitation of creativity. Any organization of science, scientific and generally professional thinking, which, by the way, can and should be improved, will have costs, but it is better than chaos. Only mastering the technique of professional thinking can create a basis for true creativity.

In the history of philosophical thought, in addition to the epistemological study of the mind, there was also a socio-practical direction that considered the role of the mind in human history. In this regard, rationality can also be understood as the principles of intelligent human activity, understanding of the world, attitude towards nature, society and the person himself.

Already early bourgeois philosophers analyzed its socio-practical functions along with the study of epistemological aspects of the mind. It was a peculiar way of criticizing feudal orders and justifying new social relations. Therefore, the mind was presented as an active creative force, which not only frees humanity from mistakes, but also contributes to the rearrangement of reality. Reason was attributed the role of the supreme critic of everything that exists. The mind has an absolute criterion for evaluating the past, present and future. Thus, the enlighteners who declared the feudal system and its spiritual values unreasonable came from the ideas of reason, as well as the entire previous history. Enlighteners saw the source of unreasonableness in an unreasonable social environment, first of all in the despotic government and the church. The conclusion followed from this: social changes are necessary for the realization of reasonableness, which must be carried out by the bearer of reason - a ruler who issues wise laws. In Mykola Chernyshevsky's concept of reasonable egoism, the functions of the mind consist in the awareness and adoption of a certain ideal of national happiness and its implementation through active participation in the struggle for a change in the social order.

Kant saw the socio-practical function of the mind in the formulation of a universal ethical ideal and the setting of the ultimate guiding goal, thereby implicitly preferring the socio-creative function of the mind to the epistemological one: the priority of the practical mind over the theoretical one expresses the determining role of human creativity in the creation of ethical values. Hegel clearly and consciously puts human creativity above natural, noting that tools invented by man as a product of the spirit "should be placed higher than the object of nature." Marxism declared the proletariat to be the bearer of reason, which embodies social reason through revolutionary creativity.

Thus, in the socio-practical functions of the mind, rationality and creativity are bound together. Moreover, the Marxist approach received a practical embodiment in socialist revolutions and communist construction, which in practice turned out to be associated with huge sacrifices, violence, totalitarianism, violation of human rights and other manifestations of inhumanity. Awareness of the danger of limitless social creativity also raises questions about the limits of the socio-practical functions of the mind.

Meanwhile, the development of philosophical studies of the mind revealed not only different aspects of the relationship between creativity and rationality, but also the different role of creativity in different types of rationality, for example, in philosophical and scientific.

Until modern times, the pursuit of science did not differ from philosophical research, which, in turn, was considered a type of art, so the nature of creativity in these areas did not differ much. But the distinction between active and objective causes in modern times clearly separated philosophy and science. Although active and purposeful causes were familiar to Aristotle and other ancient and medieval authors, they were not given such worldview significance. However, in modern times, this is exactly what divided rationality into two types: scientific, engaged in the search for effective causes, and philosophical, metaphysical, engaged in target ones. Having narrowed the understanding of rationality, science sought to expand the scope of its application, spreading the scientific approach not only to nature, but also to society, culture, and man, demanding to transform both the relevant systems of knowledge and methods of creative search. Although philosophical rationality successfully competed with scientific rationality and, according to the classics, in particular, Hegel and Schelling, in the nature of its creativity approached a model, that is, art, this lasted only until the 19th century. Positivism and neopositivism, as well as the clear successes of science itself, showed the world a "sinless" and self-sufficient image of science and determined the identity of science and rationality. But the development of alternative philosophical concepts, and then the formation of historical models of science within the framework of the so-called post-positivism, ultimately led to the problem of other types of rationality and their relationship with creativity.

The limit of scientific rationality in some cases was determined by the ability of the subject to apply some general ideals and principles of reason, in particular, to find reasons, laws and the like, and in others - by the object that determines the appropriate research methods. Thus, "rational shackles" were imposed on creativity, but its importance increased with the growth of the authority of science. At the same time, the emphasis on distinguishing research methods stimulated the juxtaposition of the humanities and natural sciences, which allegedly studied fundamentally different objects using opposite methods: explanation and understanding, which justified the search for new types of rationality with characteristic features of creativity.

By the end of the 20th century, many more types of rationality were highlighted, for example, due to its detection in everyday consciousness or myth. In the pre-scientific exploration of the world, the instinctive, subconscious, emotional, and rational intersected. This was partly manifested in language, the schemes, meanings and images of which provided description, explanation, forecast, which later became almost the absolute prerogative of science. Modern studies of the procedures and functions of science, such as explanation, rarely look into the background, so it seems as if the procedure of explanation arose together with science.

Meanwhile, explanation as a thinking procedure exists and existed outside of science both in the modern era, for example, every day, everyday explanation, and in the pre-scientific period. Different types of cultures, by setting appropriate models of rationality through value systems, provided satisfactory explanations. Mythological creativity, which connected emotional and rational, natural and supernatural, subjective and objective, gave the first example of rationality, although it was not aware of it. Mythological gods can be considered as the majestic result of human creativity and as the first attempt to rationalize human forces, qualities, experiences, ideas, states: fear - Phobos, reason - Athena, belligerence - Ares, inevitability - Themis, Erinyes. The myths themselves can be considered not only as a result of literary creativity, but also as a rationalization of means of transmission of professional habits, and generally socially significant actions. Although the logic of the myth does not fulfill the law of contradiction, ignores the idea of causality and the like, nevertheless, the effect of explanation and understanding is achieved by retelling the myth or pointing to the relevant symbols. The onset of darkness, for example, is explained by a reference to Helios, who went to sleep, or to Zeus, who covered the Earth with a cloak. In the formal sense or in the sense of adequacy to the corresponding cultural forms, above all to value attitudes, these explanations are no worse than the modern reference to the rotation of the Earth around the Sun.

In addition, **the historicity of rationality itself**, particularly scientific, was recognized. Only in modern European science is a distinction made between classical, non-classical and post-classical rationality, and if science is derived from the cultural and civilizational context, then even more so. Methodological studies of scientific and theoretical thinking allow, for example, to distinguish between the rationality of description methods and the rationality of the theoretical system in the situation of choosing a theory. Moreover, in the second case, the concept of value is used to justify the theory, not necessarily in the epistemological sense, and the choice between competing scientific theories is sometimes non-rational. A serious problem is the methodological description of subjectivity and, in particular, the creative "surge" of a scientist-theoretician. The fragmentation of rationality into many types, types and interpretations, on the one hand, makes it possible to clarify a number of problems, on the other hand, it threatens to turn into absolute subjectivism and relativism. Modern hermeneutics, justifying its type of rationality, has done a lot to reveal the limitations of scientific rationality, and its penetration into the methodology of science has both exacerbated the problem of rationality and at the same time given hope for its solution. The conceptual apparatus of hermeneutics makes it possible to enter the broad cultural and psychological context of scientific knowledge, to shed additional light on scientific creativity, to hope for the establishment of dialogical relations not only between cultures, but also with nature, which gives reason to many authors to almost crown hermeneutics as the modern queen of sciences.

Meanwhile, the 20th century - the century of scientific, technical and technological progress - increased scientific and scientific and technical creativity, giving it the status of worldview value. It began its limitless embodiment, spreading to all spheres of activity, largely determining the very nature of human civilization.

The problem of limits of creativity. Creativity as a valuable attitude assumed the mastery of the object of creativity in at least three aspects.

First, creativity meant the mastery of natural objects and processes, and ideally, the whole of nature in order to adapt it to the evolving needs of man. In this regard, nature is viewed as unorganized, wasteful, spontaneous, requiring improvement, correction, and rationalization. Starting from the 17th century, the rapid development of technology and its effect on nature laid mechanism and technocratism as a worldview and activity in the body of culture.

However, the idea of mastery over nature was rooted in the system of Christian values, but man has become its transformer and even rapist since the 18th century, when the idea that the purpose of man is creativity, his task is to change, to transform the world, is confirmed.

Secondly, creativity assumed the mastery of the social organism with the aim of rearranging it for the sake of justice, happiness, and human development. Society was viewed as spontaneously developing, generating evil, antagonisms, alienation. Therefore, it, like nature, required a rational understanding and transformation through an evolutionary or revolutionary path on rational grounds. These rational grounds are widely represented in various socio-political doctrines, for example, utopian, enlightened, anarchist, Marxist, neo-Marxist and others. Control over the social organism for the sake of its creative and rational rearrangement was one of the natural, albeit unexpected, consequences of totalitarianism. Totalitarianism in all its varieties has brought countless troubles to peoples, but it should hardly be considered an accidental or irrational deviation from the main historical path.

Thirdly, creativity presupposed the mastery of the person himself, first of all, his thinking in order to make it correct and organized. Thus, in modern times, rationalism is established as a philosophical and cultural current, along which the idea of method develops. Subordinating thinking to the correct method did not contradict the idea of creativity and was considered a priority task. As a result, it turned out, in particular, that technocratism and totalitarianism were complemented by the "only correct" method of learning and transforming the world. From his standpoint, other methods were rejected and persecuted as erroneous or harmful, as a result of which both creativity and rationalism were driven into such narrow frameworks that they turned into their opposites. Although the last investigation was not carried out everywhere, it is not legitimate to talk about its random nature.

In general, creativity and rationalism were inseparable from the idea of activity, progress, the fundamental importance of technology, the priority of science. Activity, activity sometimes turned into violence, but she rejected passivity and contemplation, which acquired a negative value color. The cult of historicism, development, progress, sometimes progress at any cost, rejected completeness, stability. The idea of the fundamental importance of technology and production in general in relation to the sphere of the spirit gave rise to the phenomenon of spirituality. The priority of science and scientific rationality rejects other forms of understanding the world as insufficient or incorrect. It should be noted that this is hardly the fault of science itself and its rationality, rather it is the image of scientific rationality, inadequate to its true essence, which has been promoted to the rank of worldview value. Therefore, many authors emphasize the importance of humane initial values as an obstacle to the absolutization of rationalism and the prevention of "valuable dangerous novelty" of creativity, fraught with disasters.

Thus, the ideas of creativity and rationalism reveal not only positive, but also negative value coloring. It is wrong to attribute violence, lack of spirituality, totalitarianism, technocratism only to special accidental circumstances, socio-political conditions, incompetence and other manifestations of "unreasonableness". They have a deeper basis, and most importantly, they require a new understanding in modern conditions.

In particular, relations of ownership, control, and priority should be replaced by relations of partnership, mutual understanding, interchangeability of people, social structures, and cultures.

Questions to repeat:

1. What are the features of scientific creativity?
2. What are the specifics of scientific and technical creativity?
3. Name the philosophical and methodological problems of scientific creativity.
4. What is the meaning of the term "rationality"?
5. What are the approaches to determining rationality?
6. How do rational and irrational differ?
7. What are the models of scientific rationality?
8. How are rationality and creativity related?
9. What is the problem of limits of creativity?

13. Philosophical and methodological problems of historical models of science.

13.1. Karl Popper's concept of the growth of scientific knowledge.

Karl Popper (1902-1994), an outstanding Austro-British philosopher, started a new tradition in the methodology of science: the analysis of the development of scientific knowledge, and from the end of the 40s of the XX century exerted a growing influence on philosophers of science. The sphere of the philosophy of science gradually begins to shift from the problems of analyzing the structure and language of science, as it was in neopositivism, to the problems of the development of science. This caused the awakening of a wide interest in the history of science. In turn, methodologists' turn to history immediately revealed the limitations of the hypothetico-deductive model of science and the formal methodological ideals of both logical positivists and, soon, some of Popper's own ideas.

According to Popper, theories are the basis of developed scientific knowledge. He calls a certain conceptual scheme, a kind of net, which we throw over the world in order to "catch" and rationalize it, a scientific theory. And we are working on making the cells of the network as small as possible. Everything positive in scientific knowledge, notes Popper, is positive only insofar as, at the moment, some theories are better compared to others. The best are those that:

- first, they explain more, and they explain with greater accuracy, and as a result, they allow us to get better forecasts;
- secondly, verified in the shortest way.

At the same time, Popper does not equate the verifiability of the theory with its logical validity and, even more so, with empirical confirmation. He insists that the theory in general cannot be exhaustively confirmed or substantiated; it can only be successfully refuted. After all, the theory involved in the real cognitive process is permanently tested by empirical and logical tests, so its evidentiary justification ideally requires an infinite number of practical and imaginary experiments, which is impossible. On the other hand, to put an end to it, one experiment that disproves this theory is enough, and this is quite possible.

Neo-positivists, according to their principle of verification, considered it possible to comprehensively check hypotheses and theories for truth: a theory is true if it is verified by the facts of experience. Instead, Popper shows that things are not so simple. The changeability of theories that occurs in the development of science indicates that there are no absolutely true theories; what yesterday seemed credible, tomorrow may turn out to be questionable and even vicious. Therefore, verification procedures not only do not guarantee truth, but also mislead researchers; because even terminologically "verification" seems to provide an opportunity to reach the truth, however, in reality, there is no such opportunity. Popper abandons the strategy of verification and develops the opposite one - **the strategy of falsification** (from the English to falsify - to refute, to prove false), the strategy of refutation. He emphasized: the empirical system should allow refutation by experience. If successful verification only adds confidence to researchers in their own rightness, but does not guarantee against errors, then falsification reveals errors. In general, science always tries to obtain knowledge that is richer in information. These attempts are realized, according to Popper, by proposing more and more profound (compared to previous) theories. However, advanced theories are forced to withstand a collision with a much larger number of facts, and even more different ones. Therefore, at the same time, the probability of their refutation increases. Therefore, irrefutability is not the merit of the theory, as is often thought, but its vice. For example, astrology has accumulated a huge theoretical arsenal; but it is not subject to scientific refutation, therefore it is outside the boundaries of science.

Theories are tested and refuted in scientific discussions based on **criticism**. K. Popper puts forward the following decisive criteria for checking and refuting theories: meaningfulness, logic and simplicity. The initial condition of scientific (as opposed to any other) criticism, he notes, is a clear definition of the problem. Hypotheses put forward to solve problems become the main object of scientific criticism. This or that hypothesis, which has withstood the test of criticism, is recognized as a theory; although this does not protect her from further criticism. The refutation of a hypothesis means the elimination of a scientific error and the ascertainment of the need for a new, deeper hypothesis. Criticism, refutation and deepening of theories and hypotheses ensures the growth of scientific knowledge. He considers the principle "everything is open to criticism" to be the greatest achievement of science.

Popper's principle of criticism has as its source the idea of **fallibilism**, which was developed by the American philosopher, logician, mathematician, the founder of pragmatism and semiotics Charles Peirce (1839-1914) and the English logician and philosopher John Stuart Mill (1806-1873). Fallibilism (from the Latin. Fallibilis - prone to errors, or containing fallibility) claims that any scientific knowledge is fundamentally not final, but is only an intermediate interpretation of truths, which implies a subsequent replacement for a better interpretation. From here follows a purely non-classical view of scientific research, the content of which is assumptions and refutations.

Criticism, combined with the principle of fallibilism, is understood by Popper as a fundamental methodological component of science, which ensures its development. The driving force of this development is not a priori ideas, but really scientific knowledge, its really scientific language, approaching the truth by critically eliminating vicious versions and errors and by constituting more and more plausible theories. This circumstance not only brings scientific knowledge closer to the truth, but also brings the varieties of scientific knowledge closer together. So, according to K. Popper, the disciplinary convergence of sciences takes place on the basis of their methodological unity. Such unity is stimulated by the implementation of various principles of critical rationalism.

Critical rationalism provides:
a) separation of the latest scientific methodology from neopositivism,
b) uncompromising internal scientific criticism as a decisive factor in the growth of scientific knowledge.

In addition, critical rationalism acts not only as a toolkit of scientific knowledge, but also as a program of scientists' activities, requiring them to develop the most unexpected and daring theoretical assumptions, open, however, to strict criticism. Finally, critical rationalism separates the proper sphere of rationality (science) from pseudoscience, philosophy, ideology and similar spheres.

From what has been said, it follows that **the problem of demarcation** (from the French demarcation - separation) is another main factor of Popper's concept. The essence of this problem is to find criteria for distinguishing between science and non-science, science and philosophy, science and ideology, empirical science and formalized science (mathematics, logic), heuristic methodology and dogmatic. Note that unlike the neo-positivists, who tried to separate science from philosophy in every possible way, K. Popper recognizes the necessity of philosophy for science (although he points out the differences between them). He considers it much more important to differentiate heuristic methodology from dogmatic one.

The growth of knowledge occurs due to the progress of theories, which is associated with the process of "shifting the problem", which causes the need for new theories. The driving mechanism is the scientific method, which consists of trial and error: boldly proposing theories, striving to do everything possible to show those theories to be wrong, and temporarily accepting them if criticism proves unsuccessful. The method of trial and error is characteristic not only for scientific, but also for any knowledge in general and is generally a method of any development. Nature, creating and improving biological species, works by trial and error.

There is another important point in Popper's works: the evolution from methodological to ontological and epistemological issues. The already developed concepts of falsification and critical rationalism have a sufficiently convincing philosophical basis - **the concept of three worlds**. According to Popper, our entire external and internal reality is covered by three worlds:

- the first is the world of physical objects or physical states;
- the second is the world of subjective (mental and psychic) states of consciousness;
- the third is the world of the objective content of thinking (confirmed and unconfirmed hypotheses, theoretical systems and problems, objectified and unobjectified projects, read and unread books, etc.).

The first and third worlds interact only through the second world. The third world is not localized anywhere, and yet it is autonomous, as it exists regardless of whether people are aware of it or not. Therefore, Popper believes, we may not even understand, partially or completely, the objective content of certain theories and ideas of the third world. In turn, theories and ideas can develop consequences not predicted by their authors. Scientific thinking is an element of the third world. Although the third world is quite autonomous, we are constantly acting on it and experiencing action from it; thanks to such interaction, the growth of scientific knowledge occurs.

13.2. Scientific paradigm and scientific community. Scientific revolutions and normal science.

T. Kuhn's model of normal and revolutionary science. In the philosophy and methodology of science, largely thanks to Karl Popper, science is studied not only as a structure, but also in dynamics as a system of knowledge that develops historically, depending on both intra-scientific and socio-cultural factors. Here the philosophy and methodology of science is connected with the history of science. In the second half of the 20th century historical models of science appeared. The most famous models are those of Thomas Kuhn, Imre Lakatos, Paul Feyerabend, and others, who belong to the post-positivist stage of the philosophy of science. These models were an attempt to solve many questions, in particular, about the ratio of rationality and creativity in science, the demarcation of science and non-science, the verification of theories, the truth of scientific knowledge, the stability and changeability of scientific knowledge, etc. It would seem that scientists work within the framework of established rational norms. The fact that assumptions, insights, intuition and other non-rational factors are involved in scientific discovery does not negate the fact that only rationally verified and rationally presented knowledge makes sense in science. At the same time, the attitude towards it is critical, and the meaning of scientific creativity is to create new knowledge. How is the logic of science preserved in creative acts? How do the rational norms of science change, how to describe this dynamic?

The model of normal and revolutionary science was developed by the American historian of science Thomas Kuhn (1922-1996) in the 60s and 70s of the 20th century as a sequence of evolutionary, "normal" periods interrupted by leaps and revolutions. T. Kuhn rejects both the reduction of scientific rationality to a sum of unambiguous rules, and the other extreme — recognition of the irrational character of science. The concepts of normal science, paradigm, scientific community, successfully applied by T. Kuhn, have taken root in the philosophy and methodology of science and are used to this day.

The carrier of scientific knowledge is **the scientific community** - scientists of a certain field of science who have received a similar education and who work within the framework of the same paradigm.

A paradigm is a model, a set of fundamental ideas, values that determine the general understanding, the principles of explanation and forecast, and in general the scientific activity of a given scientific community. An example of a paradigm: the Aristotelian picture of the world, which determined science in antiquity and the Middle Ages, or Newtonian mechanics, which determined the understanding and explanation of the world until the 20th century. The paradigm sets the schemes for solving specific tasks - puzzles. T. Kuhn called them puzzles in order to, on the one hand, show the difficulty of their solution, although knowledge known in science is used there, and on the other hand, to distinguish them from scientific problems, for the solution of which it is necessary to invent new knowledge. The paradigm determines scientific research activity over a long period, while the paradigm works successfully. Kuhn called this period normal science.

Normal science is the activity of scientists to solve paradigm-based puzzles within the scientific community.

Kuhn described in his model a really functioning science, not its ideal, but it is impossible to take into account all the features of scientific realities in the model. Thus, Kuhn does not explain or analyze the disagreements among scientists that arise within one paradigm. And they are of great importance, stimulating the development of science. But other phenomena are grasped very successfully by the Kuhn model of normal science.

In normal science, **anomalies gradually accumulate** - facts that do not receive an explanation, and tasks that do not have a solution in this paradigm. This was the case, for example, in the case of the discovery of oxygen or X-ray radiation, which at first did not find an explanation. A crisis of the paradigm is coming, when it was not questioned before, but now it begins to be criticized, alternative theories and concepts appear, philosophical studies of the foundations of the paradigm are activated. As a result, a **scientific revolution** takes place - complete or partial displacement of the old paradigm by a new one.

In the course of the scientific revolution, there are qualitative transformations in science associated with a change in the scientific picture of the world, the fundamental scientific theory, or the most characteristic ways of explaining and describing reality for this era. Many consider the first scientific revolution to be the approval of the heliocentric system of Copernicus and the formation of the first truly scientific theory - Galileo-Newton mechanics, which later acquired a paradigmatic character, becoming the core of the mechanistic picture of the world.

A classic example of a scientific revolution is the displacement of Newtonian mechanics by Einstein's theory and quantum mechanics, which caused the restructuring of all branches of natural science. After the scientific revolution, the period of normal science begins again, based on a new paradigm.

The value of Kuhn's concept also lies in the fact that it overcomes naive cumulativeism and more or less adequately describes the course of the development of science. However, Kuhn's model does not overcome all the difficulties of describing science.

Cumulativism and the principle of incommensurability of theories are two opposite methodological attitudes. According to cumulativism, the development of scientific knowledge occurs due to the gradual addition of new provisions to the accumulated amount of knowledge. This simplified idea arose in the practice of descriptive natural science and explained errors exclusively by subjective factors. A type of cumulativeism is the correspondence principle introduced by Niels Bohr. According to him, the development of knowledge is presented as a sequence of principles and theories, where each subsequent one includes the previous one. Bohr thereby defends the continuity of scientific knowledge. Indeed, continuity is the most important feature of science. But one should not think that new knowledge flows from the old. Often it is just the opposite: new knowledge contradicts the old, which is captured by Kuhn's understanding of paradigm shifts. But this is where an insurmountable difficulty arises: how does continuity arise if the paradigms are incompatible, incommensurable?

The principle of incommensurability of theories states that fundamental theories that replace each other are not logically connected, use different concepts, methods, ways of seeing the world. Even if they are compatible, they cannot be rationally compared, so choosing one of them is irrational. With such an approach, the history of science is deprived of continuity, which is not entirely consistent with real scientific reality. Famous supporters of the principle of incommensurability are T. Kuhn, P. Feyerabend. Admittedly, Kuhn is more cautious than Feyerabend, and when he was accused of denying the norms of scientific rationality due to the incommensurability of paradigms, he vehemently denied it.

13.3. Methodological evolutionism and anarchism. Cultural and historical models.

The evolutionary model of science was developed by the American philosopher of science Stephen Toulmin (1922-1997) shortly after Kuhn's concept. According to S. Toulmin, the basis of a scientific theory is a standard, a matrix of understanding accepted by a given scientific community. What does not fit into the matrix of understanding is considered an anomaly. The elimination of anomalies does not occur as a result of revolutions, as in Kuhn's concept, but during the evolution of scientific theories, which assimilate various innovations under the influence of not only scientific factors, but also economic, ideological, etc. This concept overcomes the principle of incommensurability, but does not explain where scientific revolutions come from.

The concept of research programs - a special model of science - was proposed by the British philosopher, methodologist and historian of science Imre Lakatos (1922-1974).

A research program is a chain of theories united by the main idea that replace each other. The program consists of: 1. The hard core of the program - a set of scientific and philosophical assumptions, which are not subject to change or criticism while the program exists; 2.3 protective belt - auxiliary theories that protect the core from criticism, take a blow on themselves, and new scientific data that change under the influence of new scientific data; 3. Methodological rules contributing to the development of the program. For example, when perturbations in the movement of Uranus were discovered in the 19th century, scientists did not question Newtonian mechanics (the hard core of the scientific research program), although the facts contradicted it. On the contrary, they proposed an auxiliary hypothesis about the existence of an unknown planet that causes outrage in the movement of Uranus. With this, they modified the protective belt, preserving the rigid core - Newton's theory - from criticism. A new planet was soon discovered and named Neptune. The concept of the scientific research program corresponds to the attitude of common sense: you cannot doubt everything at once, you must be sure of something. So it is in science: despite the mandatory criticality of scientific thinking, it is pointless to criticize everything at once. Lakatos' model is more adequate to research reality in its dynamics, but it also does not explain how the transition from one hard core to another can be rationally described. Perhaps, the rational description of the scientific revolution is the greatest difficulty of any models of science.

But the Lakatos model overcomes many difficulties in the description of science. First, it provides a picture of the evolving theoretical frameworks. Indeed, we can evaluate any research program only on the basis of its dynamic characteristics: observing the ratio of its theoretical and empirical growth, we evaluate it as progressive or degenerate. Here, by the way, is an important point against empiricists. Lakatos specifically emphasizes the most important fact: for a program to progress, its theoretical growth must precede empirical growth. It is also important that Lakatos not only recognizes the idea of scientific progress, but also looks for ways to measure it. In addition, his model of research programs is a kind of response to Thomas Kuhn. After all, Kuhn's concept does not deny the possibility of arbitrariness in the choice of paradigms. Lakatos, while recognizing Kuhn's thesis about the mutual misunderstanding of supporters of different paradigms, claims that, nevertheless, there is an objective criterion for evaluating competing theories. Such a criterion is the ability of programs to solve problems and effectively manage empirical material. If one of the programs overtakes the other, then this is an objective fact, and not the result of the subjective passions of the scientist.

Lakatos has sometimes been accused that his methodology does not allow the scientist to apply it to his practice. But Lakatos did not propose such a methodology; he was developing a model for the rational evaluation of existing research currents.

The idea of rational reconstruction is fundamentally important. If in the history of science there are facts that have a seemingly irrational character, then the task of the rationalist is to retell the same facts in a rationalist version. The complete reproduction of real history is an unattainable ideal, therefore it is not fundamental that some discrepancy between the reconstruction of scientific knowledge and some historical realities will always remain. However, it is still an important goal of the rationalist historian to constantly adjust and improve his models in order to find the best possible reconstructions.

And one more important point. Ideally, a scientist is looking for a true theory. But in real research practice, he works in comparison mode, choosing the optimal one from the spectrum of those available. In other words, Lakatos aims to dispense with the use of truth parameters to evaluate theories. Instead, I. Lakatos analyzes the theory's ability to solve scientific problems.

The concept of methodological pluralism ("plural" - many) of the American philosopher of science Paul Feyerabend (1924-1995) states that there are many equal types of knowledge, for example, theories, each of which gives its own vision of the world, and the task of science is to multiply the number of such alternative theories P.Feyerabend calls such a task or requirement the principle of proliferation. Although this violates a number of scientific requirements: systematicity, derivability, continuity, etc., Feyerabend's concept is quite popular, especially taking into account the criticism of rationality in the modern philosophy of postmodernism. But Feyerabend also has opponents who believe that the principle of proliferation destroys science.

Historical models of science represent scientific knowledge in development and in rational models correctly fix many characteristics of science, however, none of them answers all emerging questions.

An alternative to postpositivism as a methodological concept is the **cultural-historical approach** discussed in the first chapter.

The general meaning of the cultural-historical approach in the study of science is as follows: science depends not only on the studied objects and the tools used, but also on the culture of which this science is a part. For a generalized characterization of the role of social and cultural factors in the development of science, the term "socio-cultural background of science" is sometimes used.

Such concepts are worthy of attention, but focusing on non-scientific phenomena that determine science, they cannot describe in a general way the interrelationship of intra-scientific and extra-scientific factors of the development of science, and this is the main problem.

Another alternative post-positivism version of the philosophy of science, which arose in the 60s and 70s of the 20th century, was such a direction as case-studies. This direction in the modern philosophy of science is a kind of synthesis of sociological, sociocultural and microhistorical research of science. We are talking about the study of the entire complex of conditions in which a fact, hypothesis, theory, research program or any other scientific knowledge arises. At the same time, in the context of the entire complex of conditions, separate motives that lead specific scientists to adopt or reject certain scientific concepts must be analyzed. Great importance is given here to the study of the life path of individual scientists as a factor in their cognitive choice and behavior, which is connected with the biographical method in the history of science. Basically, representatives of cognitive sociology of science, cultural science of science, and anthropology of science (Michael Mulkey, Karin Knorr-Cetina, Steve Walgar, etc.) are engaged in "case study" research.

13.4. Paradigms in humanities.

Humanitarian paradigms and paradigms of humanitarian sciences. T. Kuhn added a clearly defined methodological character to the concept of paradigm, and it was used at one time mainly in methodological literature, and it was mostly devoted to natural science. However, even in physics, a paradigm is not only theories, methods and purely scientific standards, although they are decisive, but also a certain picture of the world, philosophical attitudes, worldview value orientations, etc. This already gives reason to use the concept of paradigm outside natural science and even outside science, for example, in theology, which, by the way, is sometimes included in the category of humanitarian knowledge. For example, the Thomistic idea of the harmony of faith and reason and Tertullian's formula "I believe because it is absurd" can be considered as two opposite paradigms. The widespread use of the term "paradigm" led to numerous studies of paradigmatic phenomena and even raised the question of the creation of a paradigm theory.

Currently, the concept of "paradigm" is used both in the original linguistic sense as a tabular pattern, for example, the conjugation of a verb, and in a broader sense. This is both a conscious example of the application of the method, and an unconscious mechanism of unification in culture as a model for solving practical and intellectual problems, and a model of behavior that is broadcast in a narrative form in the form of a myth or a parable, and simply a way of thinking, and an unattainable example, a masterpiece in art, and some kind of job description, and a certain mindset. The peculiarity of such paradigms is the combination of formalized, described rules of activity and informalized, unconscious or conscious, but unwritten rules.

The term "paradigm" turned out to be so successful that it was widely used not only in scientific, but also in educational, journalistic and even fiction literature, especially since the mid-70s of the 20th century and, above all, in those cases when the corresponding text pretended to be scientific or at least professional adequacy. This concept is used in various variations in linguistics, where the linguistic paradigm is considered to be the system of meanings revealed in linguistic units, in literary studies, where the paradigm is the structure of artistic language in a specific era, and "paradigmatic texts" perform the function of cultural integrity, in art history as cultural or stylistic paradigm, which implies a synchronous unity of culture or a single style in art, which define different aspects of socio-cultural life, in history and political science as a set of meaningful landmarks in a specific historical era, and in historical research as a set of philosophical approaches that guide the historian.

It is obvious that the term "paradigm" is used here in at least **two senses**. First, as a truly existing intersubjective system of models, ideals, and norms that directs the activities of social and professional groups and individuals. It can be called a cultural paradigm. Secondly, as a subjective system of samples, ideals and norms, which determines individual research or artistic creativity, which allows division into research, scientific paradigms and creative paradigms, where there can also be a kind of research, different, however, from a scientific one. Gaining supporters, they become intersubjective within the given community of scientists, writers, etc. It may or may not coincide with the intersubjective. In this sense, cultural paradigms determine the behavior of people, for example, their everyday adaptation to the fact of the existence of ranks and their acquisition, as well as the corresponding evaluations, for example, honoring uniforms, ranks, public positions and awards. In real life, these cultural paradigms are usually not analyzed or understood. Therefore, their ethical evaluation does not pose a problem for some time, until they are understood in literature or art, as those that create the corresponding paradigms of official respect or official compliance. They, in turn, will be analyzed by literary theory or art history through their own paradigms.

Coexistence of paradigms. The functioning of a large number of paradigms in culture raises **the question of their coexistence**, in particular, commensurability, mutual influence, compatibility, predominance, struggle, displacement, fragmentation, unification, and the like. The coexistence of paradigms determines their diverse influence, which goes beyond the area of knowledge and activity where the paradigm was formed. It can be assumed that there is a cultural mechanism that transfers paradigms from one sphere to another. Otherwise, many discoveries look like a miracle.

Paradigms can be distinguished by the degree of commonality and, accordingly, predominance, depending, for example, on the nature of intellectual or practical activity. The general mythological assessment of the orderliness of the world, the state, and the family by the ancient Greeks was essentially a paradigm of the cosmos established by the Olympian gods who defeated the Titans, who embodied chaos. If the ancients' conception of the cosmos is a projection of man onto the world, then can they not be considered the first humanitarian paradigm, with which all conceptions of order, harmony, and beauty were correlated? Perhaps that is why in ancient Greece, technique (techne) was associated not only with craftsmanship, but also with high art. Both the craft and the artistic work were considered products of techne. Here you can see the influence of the same paradigm of cosmic harmony, which continues in the Renaissance period, although medieval Christianity rearranged many accents. Of course, this was not the only paradigm of cultural activity, but the desire for orderly universalization prevailed, despite the specialization of activities and the multiplication of their samples. In the Renaissance, inventions in everyday life, crafts, and painting were phenomena of the same order. Only in modern times is the former general cultural paradigm overcome. Philosophy, science, art, technology find their own niches with their own paradigms. Recurrences of the "techne" paradigm are found until now, when we use the term "technique" to characterize a high level of skill in art, sports and other creative activities, but to a lesser extent where standards prevail over creativity. The specialization of science also gave birth to various specialized scientific paradigms along with general natural scientific paradigms. Apparently, they can be classified according to the classification of sciences: both in natural sciences and in humanities. Apparently, only in classical natural science, based on rigid rationality, paradigms are incompatible and supplant each other. It seems that this is not a general cultural norm, since in other areas of science and culture, paradigms interact differently.

Thus, it can be stated that there are a large number of paradigms in culture, which differ in both the level and the sphere of functioning. This raises the question of their coexistence. The incompatibility of paradigms that supersede each other is characteristic of classical natural science, based on rigid canons, and is not a general cultural norm. Paradigms mainly have their own cultural and cognitive niches.

Different meanings of the concept of "humanitarian paradigms". Four main meanings can be identified in the use of the term "humanitarian paradigms". First, this term is applied to paradigms of activity in the field of culture. Man, not being able to live in nature, processes it, creating a cultural place of his existence. One of the mechanisms of cultural activity are paradigms as examples of cultural creativity. They are studied by, say, cultural studies as a humanitarian discipline, which is why they are considered humanitarian paradigms. In principle, the natural scientific paradigm can be considered a similar cultural paradigm. Therefore, calling all cultural paradigms humanitarian may be true in essence, but meaningless in terms of terminology, because the actual problem of the relationship between humanitarian and natural science paradigms as intra-scientific formations is lost. Secondly, paradigms of high creativity in the field of art and literature are called humanitarian paradigms. The use of the term is fully justified, but with caveats, because research, knowledge, and the acquisition of knowledge are not the main tasks of literature and art. Thirdly, in relation to technical practical and scientific activities, as well as to natural scientific research, the requirement of human dimension is put forward, and above all, taking into account possible risks and dangers for humanity. Similar humanistic axiological imperatives are also called humanitarian paradigms, but they are not actually paradigms of the humanities or research activities in general. Fourthly, the paradigms of scientific research activity in the sphere of the spirit, in contrast to the studies of natural objects, which include man as a natural object, are paradigms of humanities and in this context humanitarian paradigms. What has been said also applies to the study of natural science texts and natural science thinking itself. Therefore, if a natural scientist reflects on his mental activity and his science, he enters the field of humanitarian knowledge ("goes a floor higher") and must be included in existing humanitarian paradigms or create new ones. It is not by chance that the methodology of science is included in the humanitarian disciplines, although it was created not only by humanitarians. This applies to the history of science and other disciplines that study science.

Questions to repeat:

1. What is the meaning of Karl Popper's concept of the growth of scientific knowledge?
2. What is the essence of the principle of fallibilism?
3. Describe the concept of "scientific paradigm".
4. What role does the concept of "scientific community" play in T. Kuhn's model?
5. What is normal science?
5. How are scientific revolutions and normal science related?
6. What are the main features of I. Lakatos' model?
7. What is the essence of methodological anarchism?
8. Give examples of paradigms in various fields of scientific knowledge and describe them.

14. Functions of science and scientific research.

14.1. Scientific description and its philosophical and methodological significance.

Science performs various functions: systematization, classification, proof. Of particular importance are description, explanation, forecast, understanding, which are actively discussed in the modern methodology of science.

Scientific description is a presentation in the language of a given science of some subject area. Usually, this is the fixation of empirical data using symbols, graphs and other elements of language that make up empirical descriptions. Most often, the representation of empirical data is carried out in qualitative terms. Theoretical description means the use of idealizations, principles and other elements of the theoretical level of science.

In the humanities, narrative description is studied, when the sequence of events is fixed in the form of a completed story, as if in the plot of an artistic work, which is coming to an end as some goal, to the realization of meaning. This is characteristic of many historical studies, biographies and autobiographies, ecological and sociological texts, etc. However, narrative descriptions are also common in natural sciences and technical disciplines.

Most often, descriptions provide a primary representation of empirical content in the form of affirmative factual judgments. Sentences of this kind, fixing the presence or absence of any characteristic of a given object, are called attributive in logic, and terms that express certain properties of a given object are called predicates. Concepts that function as qualitative generally characterize the subject under study in a natural way, for example, when a chemist describes a gas as having no smell, no color, etc. But they can be used in a different way: to correlate a subject with a certain class, as in taxonomic descriptions, when a certain classification of the concept is given, for example, in metallurgy, zoology, botany, microbiology, in technical sciences. This means that already at the stage of qualitative description there is a conceptual arrangement of empirical material.

Descriptive procedures are also called descriptive. During the formation of natural science and up to the 18th century. scientists wrote natural history, compiling multi-volume descriptions of all kinds of properties of plants, minerals, substances and the like. And now the description as a means of representing empirical data has not lost its importance. Although modern science is theorized, and empirical description is subject to explanation, nevertheless, in many sciences, entire sections are represented by descriptions, as, for example, in zoology, and some sciences, such as, for example, geology, cannot be other than descriptive. However, in modern descriptive procedures, standards of accuracy and unambiguity of descriptions are of great importance. After all, a scientific description must have the same meaning for all scientists, that is, it must be universal, constant in its content, intersubjective. Special methods are used for this: comparison of data from independent sources of information, standardization of descriptions, clarification of criteria for one or another assessment, control by more objective, quantitative, instrumental research methods, agreement of terminology, etc.

Description is considered both as an independent function of science and as a component of other scientific procedures, for example, explanation.

The prevalence and importance of scientific description even gave birth to a philosophical movement called descriptivism.

Descriptivism is a methodological position popular at the turn of the XIX-XX centuries, represented by empirio-criticism and neopositivism (A. Mach, P. Duhem, L. Wittgenstein, U. Stace). The essence of the concept boils down to the idea that science cannot answer the question "why?", but only the question "how?", that is, the function of science is not to explain, but to describe phenomena.

The reason for the spread of descriptivism is the development of science at the end of the 19th century, which showed the weakness of mechanistic explanations, provoked the idea of the relativity of knowledge, and brought phenomenalism to life. Currently, the popularity of Descriptivism has fallen, but its supporters exist.

The concept of description is often used in a slightly expanded sense, when not only empirical data, but also a wide range of theoretical ideas are used to describe some objects. An example can be quantum mechanics, the purpose of which is to describe certain objects of the microcosm, but almost all functions of science are used for such a description. When formulating many provisions of this kind of theory, the term "description" simply cannot be dispensed with, as in the case of the principle of additionality.

The principle of additionality is one of the most important philosophical and methodological principles of science, which also has heuristic significance. It was formulated in 1927 by Niels Bohr. According to this principle, for a full description of quantum mechanical phenomena, it is necessary to use two mutually exclusive, or rather complementary, additional sets of classical concepts, when their totality provides comprehensive information about these phenomena as a whole. For example, space-time and energy-momentum pictures are additional in quantum mechanics.

The principle of complementarity in modern science has become a concept widely used in many disciplines: in biology, psychology, cultural studies, when it is necessary to describe an object that has mutually exclusive characteristics. For the first time, the concept of complementarity was used by the American psychologist William James, who referred to them as mutually exclusive. It was the psychological works of James, along with the philosophical ideas of the famous Danish philosopher Seren Kierkegaard, that pushed Bohr to create the concept of additionality.

14.2. Philosophical and methodological problems of scientific explanation and prediction.

Explanation is the function of science, which consists in establishing the essence of the object being studied. Procedurally, this is expressed in establishing the connection of the studied object with certain laws and theories.

The simplest scheme of **scientific explanation**: from the statements expressing a certain law and the initial conditions in which the object is located, a statement describing this object is derived using the rules of deduction. In special terminology, it looks like this: the explanandum is derived from the explanance. An explanation is impossible if the specified conclusion does not come out or the corresponding law or theory cannot be formulated.

The explanation is fundamentally ambiguous, since the phenomenon to be explained can be deduced from various laws and theories. Therefore, there is no single correct theory. This poses important methodological problems: which theory to choose for explanation, which explanation can be considered reliable and correct. For example, the death of dinosaurs can be explained by several dozens of theories that are not consistent with each other in terms of reliability.

Many types of explanations were developed by the famous German-American logician and methodologist of science Karl Hempel (1905-1997) in the middle of the 20th century.

Types of explanation. Explanations can be classified on different grounds. Most often, this is done according to explanance, that is, according to explanatory provisions. It is taken into account what exactly is used as an explanance: 1) the law; 2) reason; 3) structure; 4) function; 5) origin and features of development.

<u>1. Nomological explanation</u>. A nomological (from nomo - law) explanation is one when a law or a law-like statement acts as an explanance (explanatory provisions). The structure of nomological explanations was developed by Karl Hempel, who became a recognized classic in this matter.

<u>2. Causal explanation</u>. In this case, the explanation comes down to finding the cause or set of causes that caused this phenomenon. Such an explanation is also called causal

(causa - reason). The reason can determine both a single-valued effect and a statistical one. It can appear as a tendency, a certain tendency, a correlational relationship that is manifested in mass phenomena. Accordingly, statistical and correlational explanations are distinguished.

The causal concept of explanation was developed by the famous American specialist in logic and philosophy of science Wesley Selmon (1925-2001). It is sometimes considered as an alternative to Hempel's theory. Basic concepts related to the causal concept of explanation: statistical relevance, causal processes, causal interactions. U. Selmon insists that the explanation is not just a deduction from the laws, but something more meaningful. With this, he immediately drew attention to himself, since Hempel's formal-logical scheme lacks content, which caused the dissatisfaction of many authors. According to Selman, an explanation is a collection of statistically relevant information about the causal history of events. In other words, in the explanation, we should not so much present the formula or scheme of the law as reveal in the context of the theory the entire set of reasons that determine this or that event.

3. Structural explanation. This explanation reveals the structure of the object that determines the explicable properties or behavior of the system. For example, certain chemical properties of a substance can be explained by the structure of its crystal lattice; in biology, the explanation of the peculiarities of certain life processes is based on the disclosure of the structure of protein molecules, cell membranes, etc.

4. Functional explanation. It consists in revealing the functions performed by this object in the system in which it is included. Functional explanation can be used in cases where the object being explained is a part, element or function of a wider system. This type includes the explanation of the meaning of some social institution through its function within the framework of the general social system or, for example, in physiology, the explanation of the special biconcave shape of erythrocytes due to their transport function and the related need to maximize the surface of erythrocytes. Functional explanations have been used for a long time, mainly in biological sciences and humanities. Explanations of this kind have received the traditional name of teleological, since their essence consists in indicating the goal that must be achieved by this system. In Aristotelian philosophy and physics, the teleological approach was considered quite reasonable and natural. However, in modern times, the teleological explanation was criticized, as science began to replace the concept of purpose with the concept of mechanism in order to avoid anthropomorphism. Therefore, the law becomes the main explainer, that is, to explain the behavior of the object, it is necessary to know the general law and the initial conditions, but not the final state to which the given object aspires.

The development of cybernetics revived this type of explanation. The study of self-regulation schemes, maintaining the stability of systems, which was carried out in cybernetics, showed that complexly organized objects are indeed teleological in a certain sense, that is, they strive for stable states, so-called. homeostasis However, this does not mean the recognition of animacy, consciousness of such systems. The purposefulness of their behavior can be analyzed and described in terms of negative feedback, that is, in causal and structural categories. For example, if there are two systems, the first of which heats the room, and the second adjusts its operation, then the second can be marked as a goal in relation to the first. Sometimes this type of explanation, to avoid unnecessary associations, is called teleonomic.

Synergetics studies even more complex self-organizing systems: the importance of positive feedback, which gives the system the direction of development and self-organization, was realized. The study of the processes of form formation and the birth of order from chaos led to a new understanding of the possibilities of teleological categories and showed in what context it is possible to talk about the target settings of certain complex, unbalanced processes.

5. Genetic explanation. Here the explanation is achieved by indicating the origin and features of the development of the object, when it is necessary to understand the history of the object, the stages of its development, especially the events of the past that affected its current state. It is especially widely used in medical, biological and social sciences.

Specific types of explanation can be found in individual sciences. For example, social sciences use intentional explanations. It is an explanation through the indication of the intention, the purpose, the intention of the people. True, it should be borne in mind that they do not exhaust the explanation of human activity. In addition, goals and results of actions do not always coincide. Therefore, referring to people's intentions when explaining the results can lead to a misrepresentation of the essence of the case.

Prediction (forecast, prophecy) is a function of science, which consists in deriving from some knowledge information about the future state of an object or an as-yet-unknown phenomenon. Examples: forecast of solar and lunar eclipses, weather, results of political campaigns. A big problem is the accuracy of forecasts, especially for multifactorial phenomena.

Scientific predictions, in contrast to non-scientific (everyday) or non-scientific prophecies (astrological, palmistry), are based on laws, theories and other components of science. Non-scientific, non-scientific and anti-scientific prophecies-explanations are often based on random regularities, concomitant signs, and dubious analogies.

The prediction of unknown phenomena in the past or the reconstruction of a historical event is called **retrovision**.

The logical scheme of prediction (retrospection) is the same as that of explanation: the predicted phenomenon is deduced from laws or theories. That is why they talk about the symmetry of explanation and prediction. The difference can be traced in reasoning according to the scheme. In the explanation, the reasoning proceeds, as it were, from the bottom to the top: from the known phenomenon to the search for an explanatory law. And in prediction, reasoning proceeds, on the contrary, from top to bottom: from known laws to unknown empirical phenomena that are predicted. And in methodological terms, these procedures are different: if the explanation is ambiguous, because the same conclusion can come from opposite premises, then the prediction is unambiguous, because the conclusions derived from the premise are compatible, and their conjunction can be taken as a single prediction. In addition, prediction is possible not only on the basis of laws, but also on the basis of accompanying signs: Babylonian priests correctly predicted solar eclipses without being able to explain them.

14.3. Narrative and scientific explanation.

Modern problems of scientific explanation. Currently, methodological literature is well aware of the limitations of the subject's position as a disinterested observer, which has become a significant cause of the crisis of universalist-rationalist scientific ideas. Modern methodological and scientific theories include the values and goals of the subject in the scientific picture of the world and theoretical descriptions. On the other hand, the narrative and linguistic turn that took place at the turn of the century in humanitarian disciplines dissolves the subject in narrative structures that, as it were, speak for themselves instead of the subject. Postmodern theorists regard the subject's determination by linguistic and generally sociocultural factors, as well as the existence of the text independent of the author and its diverse interpretations, as the death of the subject. However, the revision of the principles and the blurring of the boundaries of scientific rationality, the penetration of the concepts and methods of the humanities into the social and natural sciences and vice versa, does not negate the fact that an important, if not the main, function of science remains explanation, but the emphasis in its research has shifted significantly precisely in side of the subjective component and narrative components.

The analysis of explanation began with studies of natural scientific explanation, and the first approaches related to the XIX century are associated with attempts to present it as an independent formal-logical procedure. Despite all the diversity of later proposed models of explanation - phenomenological, reductionist, deductive-nomological, historical, etc. - they were united by the desire to formalize the explanatory process. As a result, especially under the influence of neopositivism, the explanation was reduced to the logical derivation of explanatory provisions (explanandum) from those that explain (explanance). Although this approach made it possible to clarify the structure of the explanation, reveal its specificity, develop criteria of correctness and solve a number of other problems, its one-sidedness was revealed quite quickly. Therefore, later both scientific and non-scientific explanations are no longer considered as self-sufficient, but as included in the socio-cultural context. In particular, ideas about the structure of the explanatory procedure have significantly expanded, especially in connection with the successes of the humanities, in particular, literary studies. In addition to the traditional explanance and explanandum, the context and subtext of the explanation, ideals and norms of the explanatory procedure, initial conditions of explanation, semantic framework, preunderstanding and understanding, etc., began to be distinguished there. If we take into account that during the explanatory process there are necessarily participants who give and receive explanations, explicitly or implicitly use various initial conditions, ideals and norms, especially different linguistic constructions, in particular narratives, bring subtext and context to the explanatory activity, then actualization the problem of the subject of explanation, which is reproduced by the explanatory procedure itself, included in the relevant socio-cultural, in particular, linguistic, structures.

The subject of the explanation. The subject of the explanation can be understood as an individual as a representative of some community in the broad or narrow sense of the word with historically and socially determined different norms and traditions, linguistic and psychological features. The subject of a scientific explanation can be considered a scientist as a representative of a scientific community or a specific scientific school, who uses scientific language, professes certain ideals of science, a "normal" scientist who works within certain scientific norms, does not think of going beyond the boundaries of a given scientific tradition, or, on the contrary, a "revolutionary" striving to go beyond existing ideas.

In addition, scientists, or other individuals as subjects of explanation, live everyday life, the structures of which cannot help but reflect on their imaginative system of seeing the world, on their thinking and activities, in particular scientific ones. In the course of the explanation, various linguistic structures are explicitly and implicitly used, for example, narrative structures, learned by individuals in the process of socialization. With all socio-cultural, linguistic, scientific norms that determine an individual, the explanatory procedure itself requires someone who will "digest" them, apply and even change them in relation to a specific case. Thus, the subject of explanation, in particular, a scientific one, accumulates practically all the channels of entry of personal, social, mental, linguistic, and cultural factors into the explanatory procedure, being an indelible element of the explanatory process. The concept of the subject of explanation allows not only to go beyond narrow logicism or methodology when studying the process of explanation, but also to present it as a personal-subjective process that implements, implements, and changes intersubjective norms and ideals.

Explanation-process and explanation-result. The subject of the explanation is usually included in one of two typical situations: the first is the formation of the explanation, when the explanation-process takes place, and the second is its translation, which gives the explanation-result. Because of this, the subject of the explanation splits, as it were. The one who conducts the explanation is the subject of the explanation-process. The one to whom the explanation is addressed is the subject of the explanation-result.

In the first situation, the formation of an explanation takes place, when the subject explains something to himself, bringing it to an acceptable level. Two options are typical here. In one of them, the subject gives an explanation without going beyond the existing vision, general ideas, beliefs and scientific concepts. In this case, the cultural context, for example, ideals and norms of explanation, a figurative picture of the world, or other premises are used implicitly, since they do not require special understanding, they are familiar, self-evident. New knowledge does not contradict existing ideas. Here the explanation is easily formalized and the subject's role is reduced to the accumulation of knowledge and skillful selection of explanatory provisions, which T. Kuhn called solving puzzles. In another option, when the existing arsenal of explanatory tools is not enough, the subject formulates a fundamentally new concept, an original vision that lays the foundations of a new understanding. Here, the question inevitably arises about implicit prerequisite, most often "personal", knowledge, while in the first case - about the prejudices of the given era, which largely determine individual ideas.

A kind of knowledge called foreknowledge means that which precedes reason. The tradition of the European Enlightenment gave the term "prejudice" a negative meaning, almost equating it with everyday superstition. However, if the explanation, like any cognitive act, is carried out with the mandatory use of implicit prior knowledge, such that not so much causes errors and misunderstandings as sets certain directions for intellectual activity, and sometimes results, then the concept of prejudice acquires a positive meaning. Prejudice is responsible for a certain semantic background, context and subtext of the explanation. Preconceived notions can also be called preconceptions, if we mean understanding as a mental procedure of the subject of the explanation, which consists in attributing meaning to some object. An example of prejudice can be analogy as the ideal of explanation in the Middle Ages or objective-causal explanation as the ideal of modern science. Each of them predicted the corresponding meanings of the used terms and their connection into a certain integrity, which provides one or another understanding, within the framework of which an explanation was given to some separate phenomenon: the eclipse of the moon as a divine providence or as a natural process of the movement of heavenly bodies. In this regard, prejudice implicitly determines the choice of an explanatory model. That is why it is so important to make it clear.

But when the context of the era is understood, the prejudice is determined, the responsibility for choosing the model of explanation lies with the subject explanation. Objective sociocultural determinants cannot fully describe this process, if only because the new principles of understanding the problem do not logically flow from previous knowledge, and even contradict it.

In the second typical situation, in which the subject of the explanation is included, the explanation is broadcast either in "his" tradition, when the subject explains something to his own community, or in "another" one, when the explanation is reproduced or studied in another cultural situation. Depending on who the explanation is intended for, various narrative structures are used, metaphors, various linguistic analogies, and other figurative means of language are used. Thanks to, for example, metaphors, a visual picture of a phenomenon is created or associations are generated that allow us to capture new meanings. Thus, modern ideas about the megaworld include strange at first glance terms: "throat", "hole", etc. The context of the explanation and the prejudices of the era are connected in language, mental norms, images of the world, existence, knowledge, and ordinary life. It is enough to mention Darwin's metaphorical term "struggle for existence", unnecessary in his concept, since the concept of "natural selection" appeared there. But in the everyday life of the Victorian era, in the situation of political clashes, the term "struggle" was more understandable to the subject of the explanation-result.

Narrative and explanation. Specific narrative structures included in descriptive and explanatory procedures, for example, narratives, are of special importance, in particular, for explanatory models in humanitarian knowledge. Even if one does not agree with J. F. Lyotard's idea of replacing explanatory theories with narratives, one should recognize the presence of narrative structures not only in literature, but also in history, philosophy, and science, which is sometimes understood as a manifestation of narrative rationality and perceived as a narrative turn in epistemology.

As already emphasized above, among the distinguishing features of the narrative are usually recorded the presence of the final goal of the story, from which all the mentioned events receive an explanation, the selection of the most important events that are directly related to the final goal and the arrangement of events in a certain time sequence - plotting. In addition, various forms of narrative are determined by the storyline, for example, progressive or regressive. Both the setting of the goal, and the selection of events, and plotting, and the nature of the narrative cannot be completely dissolved in sociocultural norms, because they depend on the subject of the explanation.

Narratives participate in explanatory processes in at least three cases: 1) when the narrative itself acts as an explanation; 2) when the narrative as a linguistic structure is implicitly present in the explanation; 3) when the explanatory theory is broadcast (narrated) in culture.

In general, in a narrative explanation, an event or phenomenon is characterized by indicating its role and meaning in connection with a certain goal, project or some integrity, in other words, its meaning is clarified, which flows from those other events, results, consequences that followed it.

Narratives have a good explanatory power in areas that usually use different stories, for example, in the theory of literature and cinema, in historical disciplines, in philosophy, ethnography, theology, psychoanalysis. They connect the unknown with the known in various ways, in particular, by indicating a certain rule, scheme, scenario, simile, metaphor, allegory, and so on, in particular, when creating a historical narrative. For example, a historian tries to build a story so that the events presented in the story, as well as the actions of the characters, are understandable, regardless of the time interval that separates the reader from the events taking place in the story. Moreover, the longer this interval is, the more incomprehensible ancient events seem. They look strange, mysterious, mysterious mainly because of their rootedness in ancient ways of life, different from ours. The historian adds meaning to ancient events, describing them in categorical forms of culture, such as philosophical concepts, religious beliefs, ethical norms, forms of stories. As a result, the past is presented as a reality, the continuation of which is the present. It is important that the most important events are highlighted and "unnecessary" events are excluded, based on the purpose of the story, a certain style and point of view is chosen, as if the plot of a work of art is being formed, the author of which and the subject of the explanation are the historian at the same time.

In humanitarian disciplines, narrative explanations are the most important way of transitioning to the theoretical level of knowledge organization, ensuring the integrity, consistency, systematicity and other characteristics of the theory. For example, they add meaning to human actions, presenting them as regular connections and relationships. Concepts serve this, creating a narrative scheme: goals, motives, intentions, obstacles, unforeseen circumstances, and the like. Thanks to them, unrelated and independent objects, phenomena and events are considered as connected elements of the whole. In explaining the activities of social groups and peoples, narratives demonstrate the interrelationship, regularity, and significance of various unrelated, random, minor matters and events, linking them into integral formations. Individual life as a single and integral phenomenon does not disintegrate into an infinite number of independent events and phenomena, but is explained with the help of an autobiographical or biographical narrative that builds a clear plot line. Apparently, the narrative forms the fundamental psychological, linguistic and sociocultural basis of our explanation of the world.

In the natural sciences, the locality of the production and transmission of knowledge with the use of various rhetorical techniques and narrative schemes by scientists in order to give their scientific results the appearance of objective, transcendental, timeless and universal truths is also quite obvious. Thus, Newton's "Optics" used the construction principles and terminology of Euclid's works, borrowing their rhetorical power, although it contained only descriptions of experiments and their results.

Not only scientific concepts and principles have explanatory power, but also the very structure of scientific texts used by the subject. The illusion is created that the texts speak, as it were, on behalf of nature, thanks to the conventional rhetoric and patterns of scientific language, for example, the omission of pronouns, the use of the passive voice, an impartial tone and other obligatory linguistic structures that make scientific texts convincing. In this plan, the subject is split again, but already into the author and the one who explains. The author of the explanation, as an ordinary individual with his own biography, emotions, mistakes, differs from the "explainer", who speaks, as it were, on behalf of the truth, although in reality it is the same person. R. Barth justly notes: "he who speaks is not the one who writes, and he who writes is not the one who exists."

In the explanatory text, everything that can indicate the author is usually removed. Only a special study, for example, biographical or methodological, can restore the author's trace, which is sometimes of significant importance for the subject of the explanation-result. And in the very structural organization of scientific theory, especially natural science theory, and when constructing consequences, non-narrative forms of knowledge representation come to the fore. For example, a scientific theory predicts phenomena or events that are not yet known, therefore, they cannot serve as a factor in the selection of phenomena or events that cause them.

This phenomenon is sometimes used to distinguish between logical-scientific, or paradigmatic, and narrative rationality. In this case, a narrative explanation of events is built by clarifying their meaning, which follows from those events that followed them, and a "paradigmatic" explanation demonstrates the connection of this statement with others based on formal logic.

There is a contrast between traditional explanatory schemes and narrative schemes, as well as their convergence. For example, K. Huebner, referring to A. Danto and in solidarity with him, believes that a strict deductive explanation and a story are two different forms of explanation, and one can be translated into the other.

Despite all the popularity of the narrative approach, especially in the historical sciences, it is here that you can meet many objections to narrative explanations:

sometimes they are accused of being unscientific, sometimes of literaryness, sometimes of a linguistic attachment that does not allow entering into real history, sometimes of sub objectivism. The last remark is particularly reasoned. Indeed, in the narrative there is often such an arrangement of facts that only this historian considers important. Quite often, the historian inserts even fictional facts into the narrative in order to fill the original material with emotional, vital saturation, which ensures the effect of the reader's presence in the historical situation. Such a text seems very convincing due to the sequence of the story, the convincing narrative connection of various data. Often this is more evident than the logic of the behavior of historical agents or the laws of the functioning of the social system, or a set of statistical causal relationships precisely at the expense of imagery, "living life". Something similar within certain limits has the right to exist, because even Hegel called such stories pragmatic history, but from the point of view of classical science, this is unacceptable. If history is to remain on the ground of rigorous science, narrative explanations, at a minimum, must be neither deterministic nor unified. The narrative strategy of historical disciplines and humanitarianism in general should not replace scientific objectivity.

Apparently, in the case of the involvement of texts from the field of humanitarian disciplines in science, it is possible to get rid of narrativeness, as a decisive feature of humanitarianism, if it is usually considered a disadvantage, which is not at all obvious, in the way of applying mathematical or systematic methods due to the use of formal language, free from corresponding tropological figures. However, this is not an alternative, rather a good addition to the narrative of humanitarian knowledge.

In both cases, a certain role belongs to the subject's explanation, and in narrative explanations this role is decisive. In a paradigmatic explanation, individual talent and professionalism often determine the success of the choice of explanation and the persuasiveness of the explanation both in the case of an existing paradigm in normal science and in the case of creating a new paradigm in revolutionary science. When reproducing such explanations, the role of the subject is very insignificant. In the narrative explanation, the subject determines the goal, that is, the event to which the sequence he has built leads, selects the main events from his point of view, building them into a plot that corresponds to his understanding. Such plotting is the main feature of a narrative explanation and a demonstration of its subjectivity, although the latter is hidden by various linguistic techniques. At the same time, such an explanation should not be considered completely arbitrary. The order of the story is in some sense given: there are various but defined cultural norms in which the subject was formed and in which real life, scientific and cultural creativity, and the narrative itself can unfold.

Dissemination of theories, scientific publications, communications within the scientific community also include different narrative structures. The transmission, as well as the creation, of scientific texts even in the natural sciences, and even more so in the humanities, is largely determined by the discursive practices adopted in certain scientific communities. Examples can be prevailing social ideas, ideological, moral, political preferences, which are given the appearance of objective and dispassionate descriptions of the world. Racist narratives, historical descriptions, rehabilitative values of modernity and diverse ideological preferences of the subject of explanation are hidden in a number of cultural texts.

In other words, the subject of the explanation accumulates practically all channels of entry of personal, social, mental, linguistic, and cultural factors into the explanatory procedure. The structure of explanation, in particular, narrative constructions in explanatory processes, constantly reproduces the need for subject explanation as an indelible component of it, which implements, implements, and changes intersubjective norms and ideals. The subject of the explanation determines both the formation of the explanation and its translation, both in the case of paradigmatic and narrative explanation, both with the preservation of classical explanatory schemes and with the narrative explanatory strategy, choosing the appropriate narrative and sociocultural forms, and, therefore, fully bearing responsibility for constructing an explanation.

Considering the subject of the explanation as the most important component of the structure of the explanatory process, and together with the subject and the narrative strategy as its inevitable companion, allows to expand the framework of the analysis of the explanatory procedure and helps to more adequately present the model of explanation.

14.4. Understanding as a function of science.

Understanding is a function of science, which consists in attributing meaning (or discovering meaning, if one examines, for example, a historical document) to what is understood. Meanings are given by the concepts of this theory. For example, in theoretical physics, meanings are given by constructs (ideal objects) of physical theories. To know these meanings means to understand the theory.

The problem of understanding in science is exacerbated when theories arise with their semantic field, which does not coincide with the previous one. Then scientists often do not understand each other. For example, Hertz, one of the founders of electromagnetic theory, did not understand Maxwell's electromagnetic explanations. Lorenz, who discovered the most important properties of the theory of relativity, did not understand Einstein and for more than twenty years tried to interpret them in the spirit of old ideas, as well as the quantum hypothesis. Einstein did not understand Bohr and until the end of his days considered it possible to understand quantum phenomena within the framework of electromagnetic ideas. The general reason for this can be seen in the fact that the context of drafting the explanation and the context of its reading do not completely coincide, for example, due to different interpretations of the meaning of certain terms of scientific language.

In principle, meaning-making processes take place in the sphere of traditions, which ensure the continuity of cultural inheritance, as well as in customs, rituals, symbols and find their reflection in language, and in science - in the language of the relevant discipline or theory.

In addition to internal, there are also external reasons for meaning-making. In general, this is the interaction and communication of distinctive cultures, the practical and spiritual comparison of their semantic funds, and in the scientific field, this is the interaction of science with all aspects of human activity. Therefore, understanding is always a connection to the meanings of human activity, it acts as a form of interaction between the objective task of the text being understood and the interpreter. The result of such interaction is understanding, and often the formation of new meanings.

The concept of text is also important, as is the concept of meaning. The text is considered universally. It refers to all the results of a person's spiritual activity, as well as the processing and objectification of the historical reality of human existence in the form of certain information. In this sense, the text will be artistic canvases, and sculptural forms of art, and material and technical means of expressing human thoughts, starting from drawings, and ending with machines or buildings, and the person himself. Accordingly, the "read" human creations of the past, from strange artifacts to clay or birch tablets, will also be texts with their own meanings. If we can decipher the meanings embedded in these objects, we read and understand these texts, if not, they remain as we have not understood. Nature can also be presented in the form of a text with certain meanings. It is enough to recall what a huge role the image of the book of nature, written in the language of mathematics, played at the time.

In understanding there are irrational components in the form of insights, intuitive understanding of meaning, imagination, empathy and other psychological factors. This is the first level of understanding. The second level of understanding requires the involvement of other means and methods of research: logical-methodological, axiological, cultural. That is, in general, understanding is a rational procedure for identifying or attributing meaning. Understanding is related to cognition, but in general it is broader than cognitive activity, since operations with meaning are present in all spheres of activity, although they are not always carried out adequately.

Since understanding is connected with the discovery of meaning, then only that which has meaning can be understood. This process takes place in the conditions of communication, communication and dialogue. Understanding is inseparable from self-understanding and takes place within the framework of a certain language. Thus, meaning is what we appeal to when we assume the adequacy of the interlocutor's or reader's understanding of the information communicated to him.

An important methodological problem of science is that, based on the understanding of the text as a materialized expression of spiritual culture, to objectify the subjective meanings that were objectified in the texts, to hear human voices through them and with their help to penetrate into the spiritual world of past eras, foreign cultures

Understanding is subjective, as it assumes meanings given by a person. Therefore, understanding was sometimes contrasted with explanation as a formal conclusion. The German philosopher Wilhelm Dilthey (1833-1911) even contrasted humanitarian knowledge as that which "understands" with natural science as that which "explains." There are supporters of this approach even today.

In fact, explanation and understanding are interconnected. Any explanation is carried out in a certain semantic context, which determines both the construction of the explanation and its understanding by those to whom it is addressed. Understanding in science is determined by the semantic field of this scientific discipline. For example, in theoretical physics, the meanings are given by the constructs of physical theory. To know these meanings means to understand the theory. Explanations made by scientists primarily depend on the semantic field. First, it limits the plurality of explanations of the same fact, preventing the regression of the explanation into infinity. Secondly, it requires semantic unity of explanatory provisions and generally recognized scientific ideals and norms. Therefore, the clarity of the explanation sometimes plays a greater role than the truth. That is why they are in no hurry to reject false explanations in science, as well as outside of it.

Types of understanding:

1) Understanding that occurs in the process of language communication that occurs in dialogue. The result of understanding or misunderstanding here depends on what meanings the interlocutors attach to their words.

2) Understanding related to translation from one language to another. Here they are dealing with the transfer and preservation of the meaning expressed in a foreign language with the help of words and sentences of the native language.

3) Understanding related to the interpretation of texts, works of fiction and art, as well as actions and actions of people in different situations.

Scientific understanding can be present in any of these types.

The circle of hermeneutics. The cornerstone of the problem of understanding is the principle of the circle of hermeneutics, which expresses the cyclic nature of understanding, which is expressed as a circle of whole and part: to understand the whole, it is necessary to understand its individual parts, and to understand individual parts, it is necessary to have an idea of the meaning of the whole. For example, a word is a part of a sentence, a sentence is a part of a text, a text is an element of culture, and so on. To understand the whole work, you need to understand each chapter, but you can understand each chapter only by understanding the whole work. To understand a work, one must understand the era in which it was created. But to understand the era, you need to understand its works.

The circle of hermeneutics is partially broken due to preunderstanding. The beginning of the process of understanding is preunderstanding, which is often associated with the intuitive understanding of the whole, with the pre-reflective content of consciousness. Preunderstanding is usually given by tradition, spiritual experience of the relevant era, personal characteristics of the individual and, in general, the level of his education and intelligence. According to many authors, it is impossible to overcome the circle of hermeneutics, and it is not necessary. Being in it, we move from one interpretation to another, more acceptable or adequate, or more interesting, etc. Some researchers believe that the main problem is not how to get out of the circle of hermeneutics, but how to enter it. Indeed, if there is no more or less acceptable pre-understanding, it is impossible to enter the circle of hermeneutics and there will be no understanding of this text or this problem at all.

Understanding the text and the person implies different approaches. In principle, any text is the source of many of its understandings and interpretations. And the author's understanding of it is only one of them. Any work, literary or scientific, contains several meanings at the same time. This is precisely its symbolism: a symbol is not an image, it is the very multiplicity of meanings. Therefore, the understanding of the text cannot be limited only to the meaning that the author put into it.

It should be borne in mind that the meaning of the text changes in the process of historical development. That's why each epoch discovers something new and unique in the works of the past. The new understanding rethinks, reevaluates the old meaning. Understanding the text is not a finished result, but a long process, so it is said that interpretation is always finite, because it always gives a certain result, and understanding is infinite, because interpretations can change each other in search of new meanings.

Understanding as intuition, enlightenment, voice from above and the like has no rational expression, therefore it is not considered in the methodology of science. One of the first researchers of comprehension, F. Schleiermacher (1768-1834), considered comprehension as the reconstruction of the meaning of the text in order to understand the author better than the author himself. V. Dilthey (1833-1911) interpreted penetration into someone else's subjectivity as a higher type of understanding: "transferring oneself to the place of another", that is, empathy. E. Husserl (1859-1938) and the followers of analytical philosophy believed that the meaning of the text has, in addition to personal, an intersubjective character, therefore it is amenable to logical analysis. V. Windelband (1848-1915) and G. Rickert (1863-1936) linked understanding with the ideographic nature of the sciences of the spirit as a means of understanding the individual. M. Heidegger (1889-1976) presented understanding as the essence of human existence. H.G. Gadamer (1900-2001) considered understanding as a means of self-understanding of the reader in the course of numerous interpretations of the text. Modern authors basically agree with R. Ricker (1913-2005) that understanding is not penetration into the author's intention and that there is no transparency of the meaning of the text for the reader (that is, it is not necessary that the author wrote what he wanted to write, and the reader read exactly what the author wrote), and the text lives its own life, and the reader's understanding of it is not related to the author.

Interpretation is a kind of understanding, which consists in the fact that elements of some theory (symbols, formulas, constructs and sign systems in general) are given some meanings (values) or meanings are replaced. In logical-mathematical and natural science disciplines, interpretation means establishing the subject area on which the corresponding elements, symbols, and formulas are performed. The theory, its elements, laws, concepts, etc. can be interpreted. Interpretations can be different. A chain of interpretations is possible, when each subsequent theory (symbol, law) interprets the previous one. Mathematics and logic provide many examples of how theories interpret each other.

In humanitarian disciplines, interpretation means the interpretation of texts, for example, as a search for the author's intention or its socio-cultural conditioning, or as the identification of special meanings seen by the reader, or as a study of special structures of the text, etc.

In the 17th-19th centuries theories and methods of interpretation were actively developed, as a result of which hermeneutics emerged as a doctrine of understanding, especially thanks to F. Schleiermacher (1768-1834), V. Dilthey (1833-1911), M. Heidegger (1889-1976), H-G. Gadamer (1900-2001), to Paul Ricker (1913-2005).

The functions of science are interrelated, especially description, explanation, prediction and understanding, and serve ever deeper knowledge of reality.

Questions to repeat:

1. What is the essence of scientific description?
2. What is descriptivism?
3. Describe the principle of additionality.
4. What is the essence of scientific explanation?
5. What are the types of scientific explanations?
6. What is the structure of a scientific explanation?
7. How are explanations and predictions related?
8. What is a narrative explanation?
9. Describe understanding as a function of science.
10. What is the circle of hermeneutics?

15. Philosophy of technology.

15.1. Concept of philosophy of technology. Evolution of the concept of "technique".

The philosophy of technology is a philosophical discipline, the subject and task of which is philosophical reflection on technology, the identification of its nature and patterns of development, as well as the evaluation of technology in its relation to man. The term "philosophy of technology" was introduced by the German philosopher Ernst Kapp (1808 - 1896).

Technology as a field of human activity always attracts the attention of researchers. Thinkers of the era of antiquity, the Renaissance, and modern times to one degree or another turned to consideration of theoretical and philosophical problems of technology. In the 20th century the problems of the philosophical analysis of technology were dealt with by researchers of various specialties: a German biophysicist, a radiologist, a neo-Thomist philosopher, one of the founders of quantum biology Friedrich Dessauer, who became the founder of a religious direction in the philosophy of technology, philosophers of an existentialist sense, but such different in their views, as Martin Heidegger. But only since the 1960s have philosophical studies of technology acquired the status of an independent philosophical discipline.

Technocratic worldview and technocratic thinking. The influence of technology in the world has grown and continues to grow at an accelerating pace. This significantly changed the social status of technology, turning it into a factor that determines the future of humanity. Until recently, the attitude towards technology in the public consciousness was more than positive. Awareness of the huge successes of technology, unstoppable technical progress even led to the emergence of technicism as a special worldview, according to which technology is declared to be the driving force of the historical process. Technicism was organically connected with such phenomena as technophilia, technocratism, technocratic worldview and technocratic thinking. For a long time, respect, almost love (technophilia) for technology bordering on unrestrained faith in its miraculous power was formed, especially among young people, through educational programs of various ranks. Technology was interpreted as the material basis of society, the basis of its existence and future prosperity, and also as a consequence of science, which, in turn, was surrounded by a halo of infallibility and connected with the limitless possibilities of the human mind. The resolution of the then-fashionable dispute between "physicists" and "lyricists" was unequivocally in favor of the "physicists". In the same context, issues of management, politics, and power were considered, in particular, the question of who should make decisions about the introduction of new equipment, new technologies, and who should manage society. The answer was meant to be unequivocal: technical specialists, perceived at the everyday level as magicians, who control mysterious forces in the form of machines, energies, and technologies. This is how the worldview position of technocratism was formed, according to which political power should belong to technical specialists. The basis of technocratism is absolute trust in scientific and technical creativity, technique and technology, their creators and users, what can be called technophilia. The technocratic worldview was brought up in every way of life, upbringing and education. In technical universities, for example, the programs were built so that technical and engineering knowledge and concepts such as productivity, efficiency, and economy were transformed into worldview values. This was ensured by the attitude according to which all general education and humanitarian subjects should be subordinated to the acquisition of special knowledge. But in this case, ethical and aesthetic ideals were displaced from the worldview, an effect of spiritlessness arose, an inhuman model of creativity was formed, when the interests of man and humanity were not taken into account, everything was justified by an unstoppable technical race. It is significant that humanitarian education, which, it would seem, should form a high spirituality, was built according to the same scheme, aiming at the mastery of special knowledge and the technique of operating with it, i.e., not automatically providing either spirituality, high morality, or humanity. There is only one reason for this: technocratism was and in many respects remains a general civilizational phenomenon, and its roots grow everywhere, including on the ground of humanitarian education. Therefore, technocratism, technocratic worldview and technocratic thinking can be the same property of a humanitarian as a technologist.

Here it is necessary to clarify the concept of **"technocratic thinking**", distinguishing it from the technocratic worldview. In contrast to the technocratic worldview, technocratic thinking can be attributed a positive meaning. After all, the concept of technique implies not only artifacts, but also a certain level of skill that characterizes a specialist, a professional in any field of activity. Accordingly, technocratic or technical thinking, as well as his actions, will be the thinking of a specialist of any profile, functioning within the framework of that categorical structure, which is set by the basic meanings of his profession. And the higher the level of special education, the narrower, the more specialized and, in this sense, the more technical his thinking. It has undeniable merits associated with mastery of a skill, method, means, that is, technique. In sports, it is rightly called technicality: a technical football player, a technical boxer. Such technicality is characteristic of a good professional in any field: in religion, in art, in science, in particular in humanitarian knowledge. It follows from this that it is not technocratic thinking that is dangerous, but a technocratic worldview, that is, such a valuable orientation in which technology is transformed from a means into a goal, subordinates the entire inner world of an individual to itself, becomes a life position that is rightly associated with spiritlessness, immorality, inhumanity, the end in the end, with the destruction of culture.

The above-mentioned thinkers to one degree or another felt the danger of technocratism, but tried to give a balanced assessment of technology. They did not see in it insurmountable dangers, on the contrary, they connected the development of technology with the further evolution of man. Thus, for Dessauer, technology acts as a tool for man's continuation of God's creativity. Ortega y Gasset sees technology as a means of human liberation. According to Jaspers, technology is a means of shaping and facilitating human existence. Berdyaev poetically defined technology as the last love of a person who is ready to change his image under the influence of the object of his love.

However, the further development of the scientific, technical and technological revolution put humanity in front of the threat of global problems. It would be a tragedy for world civilization to continue further spontaneous, thoughtless, uncontrolled development of technology. That is why it is so important to create a new field of knowledge, focused on the study of the phenomenon of technology. A critical philosophical analysis of the existing situation, assessment of the results of technical activity, possible prospects for its development is necessary. In short, technological progress must be brought under the control of society, but first this phenomenon must be understood.

The concept of technology. In a broad sense, technology usually refers to the world of artifacts, that is, the world of artificiality, the second nature created by man, as opposed to the first, pre-human nature. The concept of "technique" is associated with the corresponding activity, which refers not only to the production of artifacts, but also forms specific technical and technological knowledge about them. The famous German philosopher Martin Heidegger (1889-1976) gave technology another meaning: a special attitude to the world as a material, a source of matter and energy. It is true that this meaning was laid down in many ways by science in modern times, but it was really embodied in technology.

In a narrow sense, technology is the world of artefacts, primarily machines and mechanisms that facilitate and improve the life of man and society. True, recently there have been technological factors that complicate and complicate life for man and humanity. The philosophy of science is precisely designed to deal with this contradictory situation. The activity corresponding to the world of artifacts is called engineering, design, construction and is associated with technical sciences.

The development of the concept of technology implies answers to several questions:

- what is the essence of the technique,

- what is the history and prospects of the technique,
- how does technical knowledge, in particular, technical theory, differ from other types of scientific knowledge,
- how technology affects humanity,
- what technology gives to a person and what it takes away from him,
- how philosophical-methodological, worldview, ethical, etc. arise in technical knowledge. problems

The list of questions can be continued, because for each question there are many more. But it is obvious that two relatively independent approaches to technology are synthesized here, coming, on the one hand, from the traditional philosophy and methodology of science, which, in particular, analyzes technical knowledge, and, on the other hand, from philosophical anthropology, which focuses on moral -ethical, culturological and generally anthropometric, human-sized issues of technology, humanistic and valuable aspects of technology. As a result, the problematic field of the concept of technology and, accordingly, the philosophy of technology is extremely wide: from a brief definition of the very concept of technology to the study of its historical development, from consideration of the specifics of technical knowledge to its relationships with fundamental sciences, art, politics, economics, from the search from a new concept of the interaction of man and nature to new behavior in the modern technosphere, from ethical issues to logical problems, from rationalism and orderliness to irrationalism and chaos in the complex industrial and informational world.

Evolution of the concept of technology. The concept of "technique" goes back to the ancient Greek word "techne", which is related to some orderliness of rules, actions, results. "Techne" gave rise to a whole group of terms: "technique", "technicality", etc., as well as a huge semantic block, where almost all manifestations of man-made civilization are tied into one knot: from humble craftsmanship to the transforming role of science and technology. The transition from techne to modern civilization has a large number of nuances, the study of which produces many approaches, where Heidegger's analysis of the transformation of techne into technicism with an indication of the possible danger of the latter is of particular importance and where the question of the essence of technology is not so much resolved as raised. In search of an answer, modern research combines a sharp critique of technocratism with a respectful attitude towards craftsmanship. Technology and science are considered not only from the point of view of possible dangers, but also in aspects capable of harmonizing human creative presence in the world at the expense of updated methods. One gets the impression that at one time technology as a skill was reborn as a technique, displacing art as creativity, thanks to the implementation of the scientific and technical method.

In antiquity, techne, at first glance, was understood very broadly. Techne is, firstly, a craft, secondly, an art and, thirdly, a science. Since science in ancient Greece was understood practically, and not speculatively, it is not surprising that scientific techne is similar to craft and artistic techne. According to Aristotle, the whole difference between science and technology boils down to the fact that the former do not serve any benefit to society, while the latter do. But there is no significant difference between them: they know the general through reasons. Sophists understand technology as a craft and value it very highly: it needs to be learned, and for such learning it is not a shame to take money. For the first time, sophists began to take money for education, it was not accepted before. Heidegger notices that even the philosophy of that era, such as that of Plato and Aristotle, is also techne, albeit of a special kind.

At the same time, techne was understood by the ancient Greeks quite precisely and definitely, despite the attribution of such diverse types of activities to techne. The unequivocal understanding of techne was determined by the ancient paradigm of the cosmos, with which all ideas about harmony, beauty, and especially order were correlated. Actually, cosmos in Greek means order, regularity. Therefore, craftsmanship and high art, for which the muses of history, astronomy, dance, tragedy, comedy, various types of poetry, etc., were responsible, were considered mastery and differed from inspiration and obsession, which broke out of order, for example, in the same poetry. Socrates declares on this occasion that all good epic poets compose their beautiful poems not thanks to techne, but only in a state of inspiration or mania. Plato puts poetry above techne, equating the former with obsession, madness, compares poets with prophets and believes that poets need divine inspiration and enlightenment. However, as Aristotle shows, this type of activity can be brought to mastery, to technology. Strictly speaking, the craftsman does not create the object that is made by him, but the latter, as it were, reveals itself through the mediation of the master craftsman, who only reveals the ideal forms potentially inherent in things. In other words, the difference between techne and non-techne follows the line of distinguishing the Apollonian, i.e., rational, harmonious, and the Dionysian, i.e., irrational, intuitive, inspired beginning in activity in general and creativity, in particular. However, mythology did not record the quarrels between Apollo and Dionysus, except for the not entirely clear massacre of the Bacchantes with Orpheus. This gave reason to hope for the cooperation of the rational skill of techne and inspired sensual mania.

Craftsmanship, especially as reproduction, continues to be valued in the Middle Ages, and the work of masters is viewed with suspicion, as it belongs only to the Creator. Renaissance rehabilitates creativity in many respects at the level of philosophy due to the pantheistic dissolution of God in nature, when creative talent can be regarded as a divine spark. And creativity is truly separated from technology only in the era of romanticism (18th century), when a fundamentally new concept of the subject of activity emerges, which turns into a sovereign creator of his work, and he, in turn, into a means of manifesting the personality of this creator. It is significant, however, that Leonardo da Vinci's canvas and technical invention were of the same order as techne in antiquity. Only starting with Galileo, the universalism of the Renaissance is gradually overcome. In modern times, technology as an activity is divided into engineering and art and is mainly connected with the first. Here the method begins to prevail as a rational sequence of actions, and a close connection is established with science, cognitive activity and methods of scientific research. Science, according to Heidegger's expression, turns into a theoretical technique. Already Galileo gave the scientific method a decisive importance, in fact, opening observation and experiment to science.

Thus, the universalism of the ancient techne and the techne Renaissance thanks to the actualization of the method, which was only potentially contained in the techne and was not theoretically realized, turns into a technique, and later a science related to it, the embodiment of which is the method as a conscious and justified sequence of actions directed to obtain a certain result. This methodicality had a somewhat humiliating character for techne, as it was associated with mechanical repetitiveness, mindlessness and nonsense, which since antiquity has been associated with slave labor or, in general, with activities unworthy of a free person. Such an image will soon be realized in the work of workers in factory production, and even the activities of production organizers and engineers will not soon become respected.

In art, the method began to be interpreted differently: not as a sequence of actions, but as a system of principles that governs the process of creating works of art and literature that acquire independence. The understanding of the method as a well-thought-out, rational sequence of operations, such that leads to the successful implementation of the goal, did not gain widespread use, since it was not possible to clearly describe such a method, with the exception of auxiliary technical operations. Therefore, as a rudiment of techne remained a qualitative characteristic in the sense of technicality, mastery in art and literature, since it is difficult to express mastery quantitatively. In this qualitative sense, the "technique" paradigm still works: we admire the technique of a painter, musician, writer, lecturer, scientist, football player and other representatives of creative specialties, for whom "technicality" should not, it would seem, prevail over the "divine spark".

The idea of mastery in art played a peculiar role in a totalitarian society, since the understanding of education as the processing of natural human material brought art and engineering closer together. For example, the method of socialist realism assumed to describe reality, on the one hand, accurately, scientifically, skillfully, and on the other - in accordance with the ideals of socialism, from the point of view of the desired future, which was determined by ideology and specific tasks of ideological action and also required skill. Stalin directly declared that the writer is an "engineer of human souls", therefore, with his skill, he should educate the reader in the spirit of devotion to the party and its communist ideals. It was not by chance that the leader constantly referred to writers as masters, emphasizing their transforming influence on human material. The method of socialist realism was, in a certain sense, a fusion of engineering and art, a kind of socialist techne. As in technology, literature set standards and examples of works of art that had to be followed. This was done in official statements about art and literature, in addresses to congresses of creative workers, where lists of exemplary works were constantly present, which were supposed to guide artists in their further work. For writers, these were mainly "Mothers" and "Life of Klim Samgin" by M. Gorky, "Chapaev" by D. Furmanov, "Iron Stream" by O. Serafimovich, "Cement" by F. Gladkov, "The Quiet Don" and "The Raised Virgin" by M. . Although the lists could change depending on the political situation, the specified works were a constant of socialist realism. In this way, a certain ritual of writing, reading and analyzing works of art, especially monumental ones, such as a novel, was set. The ritual form of permitted Soviet novels contains symbols and signs for positive and negative heroes, a kind of catalog of plot functions performed by the characters, a unified plot, etc. That is why you can see so much in common in O. Tolstoy's "Peter the First" and M. Sholokhov's "The Raised Virgin", despite the inconsistency of the eras, events, and historical figures described.

Literary activity turned into production, became "a matter of technology", was likened to the work of a craftsman or an apprentice in a medieval workshop. As the icon painter painted, constantly checking with the model in order to maintain the given arrangement of figures or colors, so the Soviet novelist copied the gestures, emotional reactions, actions of the heroes, symbols used in the model texts.

In fairness, we note that literary work "according to models" is not an invention of socialist realism, it has always taken place to one degree or another. The well-known literary critic Academician Mykhailo Gasparov, characterizing modernism as a small part of literature of the end of the 19th century, noted that the mass press was filled with mass poetry, which was entirely produced according to the civil models of the 1870s and the lyrical models of the 1880s. Another thing is that adherence to literary models, as well as rejection of them, should be a free choice, which the Soviet era did not allow. Although craft sometimes provides an opportunity for talent to manifest itself, and Soviet craftsmen of the pen could publish masterpieces such as Sholokhov's "Silent Don", worthy of the Nobel Prize, but in general, such unification and "methodology" of creativity was a brake on the development of art and literature.

On the other hand, much of art has been preserved in technology and technical knowledge. For example, knowledge about something that did not exist before and cannot exist by itself, that arises as a result of human activity, is born by the consciousness of a person, his work and serves his goals, refers to both the field of technical knowledge and the field of art. This is roughly how artists and thinkers reasoned in the initial period of the Renaissance, when painting was introduced into the sphere of art, which until then, due to its allegedly imitative character, was considered to be the so-called mechanical arts, associated with slavish imitative mindless work. The justification that in painting or in sculpture there is that idea that glorifies man, which distinguishes liberal arts from mechanical arts, had the result of elevating painting to a respectable occupation.

But the actual technical knowledge will for a long time be correlated not so much with knowledge as with skill, not so much with intelligence as with cunning, not so much with the sublime as with the low. And indeed, for a long time, the technical task was not to study the processes occurring in nature in order to use them more effectively, but to outwit nature, to deceive it with the help of various "machine tricks", including wonderful effects, foreign to the natural, reasonable order of things in nature.

The philosophy of technology has shown that technical knowledge is a type of rational knowledge, in particular, due to well-founded, rational considerations, the rigor of formulations, and the clarity of tasks. The rational character of technical knowledge increased when science (theory), and then fundamental sciences, took a decisive place in the attitude to technology.

In the 17th century, during the era of scientific revolutions and changes in production in the countries of Western Europe, the Latin technica ars (the art of skillful production) passed into French as the term technique, and then into German as technik. The term is becoming more and more special. In modern times, it means the totality of all means, procedures and actions related to skilled production of any kind, but, above all, to the production of work tools, especially machines. Thus, with the development of technology, the very meaning of this concept changes significantly. This is especially felt at the end of the 18th century. It was then that a leap took place, covering the entire technical side of human life as a whole, which is now called the industrial revolution. Then machines that automatically produce consumer products were discovered, such mechanisms were invented that powered machines that produce products. The turning point was the discovery of the steam engine (1776), followed by the universal engine - the electric motor (the dynamo in 1867). The energy obtained from coal and water power went wherever it was needed. Ancient technology is now opposed by modern energy. Former mechanics had only limited power at their disposal in the form of human or animal muscle power, wind or water power, driving the mill. What was new was now that a thousand times greater power was at a man's disposal, which, as it seemed at first, could be increased to infinity.

A similar development of technology became possible only on the basis of natural sciences at their current level. They gave the necessary knowledge and opened up possibilities that were unthinkable within the framework of the previous technology. That which is hidden from human view and is revealed only to the researcher, gave almost unlimited energy at the disposal of man.

The modern perception of the term "technique" is largely related to its classical understanding, however, scientific and technological progress has made serious changes and expanded the scope of this concept. Today, the influence of technology extends to organic and inorganic nature. In the field of organic nature, this is agricultural technology, as well as biotechnology, which allows to include all biology in the subject field of technology. In the field of inorganic matter, this includes construction engineering, electrical engineering, heat engineering, physical and chemical engineering, and energy engineering. At the same time, there is a "technique" of thinking, discussion, study, memory (mnemonics), the technique of painting, drawing, playing musical instruments, as well as the technique of managing people, production, the state, etc.

Therefore, the modern understanding of technology in the broadest sense of the word is, in addition to artifacts and related activities, also a set of abilities and skills, components of the professional characteristics of one or another type of human activity, the art and skill of a person engaged in this activity, a field of knowledge acting as a connecting link between empirical and theoretical knowledge.

15.2. Science, engineering, technology. Nanoscience and nanotechnology.

The relationship between technology and science in history. If science arose relatively recently, then technology appeared and began to improve almost simultaneously with the emergence of man, initially in the form of tools of objective activity, and in the course of the development of the latter turned into means of changing the world, which are increasingly complicated. Knowledge, which can be called technical, corresponded to these tools and means. Although technology and related knowledge developed independently of science, nevertheless, scientific knowledge was somehow used in technology in one way or another. But that knowledge, which according to some features can be classified as scientific, was not aimed at conscious application in the technical field. Technical knowledge, like often scientific knowledge, had a prescriptive appearance and was opposed to scientific knowledge for a long time, so there could be no question of special scientific and technical knowledge at all. In the early period of the formation of civilization, technical knowledge was syncretically merged with the mythological worldview and was not yet separated from practical everyday activities.

The technical knowledge of ancient people was closely related to magical rituals and mythological worldview, so it can be isolated in its pure form only in retrospect with a large amount of abstraction. But gradually, technical knowledge is separated from myth and magic, and although it is based on everyday consciousness and everyday practice, and not on scientific considerations, it nevertheless acquires independence. This is clearly visible from the technical recipes that have come down to us in manuals for craftsmen. They no longer have anything ritualistic-mystical-mythological, although there is still no scientific description or special technical terminology.

In ancient times, science and technology were considered as fundamentally different activities, and technology was similar to art. In the Middle Ages, craftsmen used mainly traditional knowledge, which changed only a little, in many respects also because it was kept in strict secrecy. The question of practical choice when using technical knowledge was resolved in a theological way, for example, which stylistic approach in architecture has more advantages from the point of view of Divine harmony.

In the Renaissance, those theories that have a practical sense become more and more important. The social status of craftsmen, engineers, artists, who in their activities reached the highest levels of Renaissance culture, increased. At this time, a trend is developing towards a comprehensive consideration of the subject, which is connected, in particular, with the formation of the ideal of an encyclopedically developed personality of a scientist and engineer, who possesses equally good knowledge and skills in various fields of science, art and technology.

In modern science, another trend is developing - fascination with specialization, when certain aspects of the subject are studied using experimental and mathematical means. At the same time, the ideal of a new science, capable of solving various engineering tasks by scientific and theoretical means, as well as the ideal of a new technology based on science, is put forward. A disciplinary organization of both science and technology is being formed. In socio-cultural terms, this meant the formation of the professions of both scientist and engineer, and a certain increase in their status in society, especially the status of a scientist. At first, science took a lot from the master engineers of the Renaissance, then in the 19th and 20th centuries, the professional organization of engineering activity began to be built on the models of the scientific community.

In modern times, there is an urgent need for special educational institutions for the training of engineers, where it was impossible to do without science. A fixed and socially established system of transfer of technical knowledge and experience is emerging through the structures of professional education, which has replaced the simple transfer of accumulated skills from a master to a student. The specialization and professionalization of technology with the simultaneous mechanization of science and the "teaching" of technology resulted in the emergence of many technical disciplines, which formed a fairly coherent system of disciplinary organized technical knowledge in the 19th and 20th centuries. This process was also closely related to the formation and development of special scientific education and science-based engineering education.

Stages of relationship between science and technology. The evolution of the relationship between technology and science, starting with the modern era, allows us to distinguish three stages.

1) Leading role of technology. The first stage (around 1660-1750) begins mainly in England, during the Restoration and the spread of absolute monarchy in Europe. Science and technology in this period are in close connection. The technical principle of knowledge in the form of a mechanical picture of the world acts as a universal model and a model of scientific explanation. The image of the world as a mechanical clock took shape, according to which the Creator created the world and set it in motion, like a watchmaker who assembled a clock from its parts and set it in motion, after which the intervention of the Creator is no longer necessary as a result of a natural process corresponding to an intelligent design. Such an image generally corresponded to both scientific and theological understanding. The orientation of the inherently empirical science to technology is manifested not only in the application through technology of scientific knowledge in production and the answers of science to the demands of production, but also in the significant development of the technique of scientific instrumentation.

2) Separation of science and technology. The next stage, from the middle of the 18th century. to the beginning of the 20th century, is a period of institutional differentiation of science and technology, their relatively independent, independent development as social institutions. Within the framework of science, the importance of theoretical consideration and substantiation of scientific propositions is growing. Science turns from empirical to theoretical, although the value of empirical knowledge does not decrease, but the specific weight of theoretical knowledge increases many times. The technical field is dominated by the creativity of brilliant self-taught inventors: from James Watt, a Scottish engineer, mechanical inventor, to Thomas Edison, an American inventor who received more than four thousand patents. True, it should be noted that invention is often much closer to science than it seems. Yes, James Watt was considered and is now considered a mechanic, that is, not a scientist. At that time, the mechanic was much lower in social status than the scientist. But Watt's level of knowledge corresponded to the professors-scientists with whom he collaborated and who noted it. It's just that at that time technology and science were separated institutionally, which did not allow to properly assess Watt's achievements and raise his social status.

3) Leading role of science. The unfolding industrialization turns technical innovation into a defining element of production. Technical knowledge can no longer be limited

to generalization and improvement. In addition, the dynamic nature of technology creates a demand for science, gives rise to the process of the so-called scientization of technology, which embodies the next, third stage of the development of relations between science and technology. In the 20th century science reaches a stage where it can be oriented towards practical goals, creating new technologies that individual inventors are unable to develop. In turn, technical innovations are the result of applying the scientific method to solving technical problems. Thus, in the XX century. integration, interpenetration of scientific and technical knowledge is carried out with the leading role of science. This was especially evident at the beginning of the second half of the 20th century, when scientific discoveries quickly became branches of production, as happened, for example, with chemical synthesis.

Since the relationship between science and technology is very complex and contradictory, examples can be given indicating the primacy of technical devices and tools in relation to science, the analysis of which encourages the development of science. As an example, we can consider the theory of the magnet, which was based on the use of the compass, or the emergence of thermodynamics based on the technical development of the steam engine, or the science of Galileo, as a product of the work of a craftsman or engineer. Such examples gave rise to the concept of the leading role of technology, particularly everyday technology, in the emergence and development of science. Although it can be substantiated with individual examples, in general this point of view is untenable: the examples are selected tendentially, and the determining factors in the development of science are simply ignored. As the methodology of science has shown for a long time, nothing can be conclusively proven by individual examples, the concept must cover all the facts.

In fact, the technology of science, that is, tools and devices for measurement, observation and experiment, at all times overtakes the technology of everyday life. This point of view was well substantiated, for example, by the famous French historian and philosopher of science Alexander Koire (1892-1964). He emphasized that Galileo and Descartes were never men of handicrafts or mechanical arts and created nothing but mental constructions. Galileo was the first to create the first truly accurate scientific instruments - the telescope and the pendulum, which were the result of physical theory. When creating his own telescope, Galileo did not just improve the Dutch spyglass, but proceeded from optical theory. He wanted to make the invisible observable, using mathematical calculation, trying to achieve precision in observations and measurements. Cartesian and Galilean science was of great importance for technicians and engineers. The fact that the world of approximation in the creation of various technical structures and machines by craftsmen is replaced by the world of new science, the world of precision and calculation, is due not so much to engineers and technicians as to theorists and philosophers.

Relationship of science and technology in modern conditions. The noted differences between science and technology are not absolute. The processes of scientization of technology and mechanization of science determine each other, erasing the boundaries that separate science and technology, which is especially noticeable at the turn of the XX-XXI centuries. The influence of modern technology on society is manifested not only in the sphere of material production and science, although the latter remain the main spheres of technology. For example, the development of military equipment, and especially means of strategic purpose, determines important aspects of international politics, relations between countries, and affects the state of their economy. The education system, art, everyday life and culture in general are being transformed to a great extent under the influence of technical means. Cinema, radio, television, the Internet and their technical and technological possibilities brought to life a new form of art and literature, produced a new type of activity, and had a great impact on the entire human culture. The appearance and distribution of technical means of education, especially controlling and teaching machines and devices, simulators, etc., made it possible to increase the effectiveness of the educational process in secondary and higher schools, to implement the principles of programmed learning. Home appliances, which are used to facilitate many household chores and create comfort in everyday life, are developing more and more. Vending machines and household machines became widespread. In many countries, special household services have been formed, which deal with the introduction of household machines, their maintenance and repair. Modern technology stimulates the development of physical culture, sports, and medicine. So, for example, the use of a laser as a surgical tool during operations determined the development of several sections of medicine. Technology also affects a person's psychology and outlook.

Due to their complexity, the development of many types of modern technology turns into a high cost, which is often beyond the power of individual corporations and countries. There is a need to unite the efforts of scientific institutions of many countries to obtain new scientific and technical results, which conditions international technical cooperation. Thus, cooperation in the field of television made it possible to create the Intervision and Eurovision systems, scientific and technical cooperation in atomic energy is coordinated by the International Atomic Energy Agency. Many countries carry out technical cooperation in space exploration. International cooperation in the field of science and technology is an effective means of implementing large target programs aimed at solving the most important problems of scientific and technical progress.

The question of the determining factors of technological progress, both in the question of what determines it, and in the question of what it determines, causes many discussions. For example, supporters of technological determinism believe that the main determinant of socio-economic and other changes in society are major shifts in technology and production technology, and the development of technology itself is guided by universal criteria (efficiency, economy, systematicity, reliability, etc.), which determine the nature technical innovations. It is difficult to object to this. It is only necessary to take into account that the concept of technological determinism takes into account only one side of such a multifactorial phenomenon as technology. Meanwhile, the development of technology is influenced not only by production, but also by science itself in the course of its own development. In addition, it is necessary to take into account a huge number of social determinants, starting from the level and structure of technical education, and ending with the specifics of social ties and relationships. Therefore, the philosophy of technology faces very difficult tasks.

Technique and technology. Technology is usually understood as a collection, and most often clearly defined, of actions for the production of some artifact. In this regard, technique is sometimes defined through technology. Thus, the famous French philosopher and cultural scientist Jacques Ellul (1912-1994) defined technology as "a set of rationally developed methods that have unconditional effectiveness." As an independent, specific concept, "technology" was formed much later than the concepts of "technique" and "mechanics", although this does not mean at all that man did not have any technologies at his disposal already in the early stages of primitive society. For example, we have evidence of primitive man's ability to lift heavy objects of considerable size, such as large statues.

When moving from technique to technology, the Greek concept "techne" is somewhat narrowed: for example, from technique as a skill, mastery in creating some unique product to its serial production, and production according to stable standard rules, which can be correlated with the concept of "algorithm". In this regard, we can say that true art and technology standards are incompatible. Technological activity is algorithmic in the sense that each of its steps is strictly determined by previous steps in a certain way.

Historically, primary technology can represent some transformative activity, for example, the activity of creating the first tools and hunting tools. Technology becomes full-fledged specific knowledge later. But, of course, it does not lose its active component. However, the modern understanding of technology presupposes a special activity characterized by preconceived thinking on the basis of some theory, which is prepared with the help of appropriate technical means, stable sequential steps-actions and is aimed at the creation of artifacts or a significant change in their state.

The phenomenon of technoscience. Nanoscience and nanotechnology. When assessing the level of modern technologies, the word "high" or "high-tech" is usually used. Technological "height" is associated with a high degree of knowledge-intensiveness of such technologies, and among them, more often than others, nanotechnologies are talked about. In addition to the scientization of modern technologies, there is a process of mechanization and technologization of science. In particular, the phenomenon of technoscience is emerging. The term "technoscience" was coined by the French philosopher Gaston Bachelard in 1953, and it came into widespread use already in the 21st century. Technoscience means the social, in particular, technological context of science, which must be taken into account in scientific research.

Nanotechnology is an interdisciplinary field of fundamental and applied science and technology that deals with a set of theoretical justifications, theoretical and practical research methods, in particular, analysis and synthesis, as well as methods of production and application of products with a given atomic structure through controlled manipulation of individual atoms and molecules. The term "nanotechnology" is associated with the name of the famous American engineer Eric Drexler (b. 1955) and with the corresponding unit of measurement: a nanometer is one billionth of a meter or one hundred thousandth of the thickness of a human hair. Nanotechnology is one of the most dynamically developing fields of knowledge in our time. Many researchers associate the breakthrough in this area with the new scientific and technical revolution of the XXI century. Nanotechnology is a product of interaction, synthesis of such scientific disciplines as physics, biology, computer science, cognitive sciences (psychology, epistemology, etc.). Nanoscience is also associated with nanotechnology. However, there is a difference between them. Nanoscience is the fundamental research of phenomena and interactions at the atomic, molecular, and supramolecular levels, where matter exhibits new properties. Nanotechnology involves the description, production, and application of structures that have new physical, chemical, and biological properties through control over shape and size at the nanometric level. Nanoscience forms the basis for nanotechnological research. The leadership of leading industrialized countries considers research in the field of nanotechnology as an important factor in economic and technological competition in the 21st century. Representatives of nanotechnology set themselves many socially significant goals, in particular:

- in general, a deeper understanding of nature, which will ensure a revolutionary breakthrough in all areas of science and activity.
- increasing the productivity of almost all types of work due to the optical nanostructure for high-speed communications.
- improvement of medical care methods, in particular, the production of special drugs that have significantly reduced side effects due to the formation of nanoparticles, the creation of new biologically compatible materials for implants, etc., which will completely revolutionize medicine.

With the development of nanotechnology, the relationship between the sciences is becoming more symmetrical, whereas previously a hierarchical or reductionist approach dominated. Within the framework of reductionism, physics, for example, was considered as the basis on which chemistry was built, and biology, in turn, was based on physics and chemistry. In the era of nanotechnology, the relationship between sciences is built a little differently: biology and medicine, together with physics and chemistry, are in search of a "molecular approach". Scientists even set themselves the goal of integrating humanitarian and social sciences within the framework of a single interdisciplinary approach based on nanotechnology.

The peculiarity of nanoscience is that ultra-small particles obey different laws than ordinary macro-objects. First, if the movement of macro-objects occurs according to the laws of classical mechanics, then the movement of these particles is carried out according to the laws of quantum mechanics. Secondly, at the scale of nanoparticles, almost all atoms and molecules of matter are not in a "free floating" or "cluster state", but near the surface, which allows them to be used relatively easily. For example, nanoscale particles can absorb certain colors, turning, say, white into red. Biologists are well-known for the blue butterfly, which is so bright that the color of its wings can be seen at a distance of hundreds of meters. However, blue pigment is not found in butterfly wings. As studies at the micro level have shown, the butterfly's wings are covered with close rows of transparent scales that form layers that reflect blue light.

The thickness of each layer is 62 nanometers, and the distance between the layers is 207 nanometers. These spatial ratios allow the reflection of shimmering blue light, while other ratios would produce reflections of other colors. This effect is used in their work by scientists who have signed a contract with the famous cosmetic company L'Oreal. They are working on creating cosmetics that can generate different bright colors just like the wings of a butterfly.

The prospects that the development of nanotechnology opens up for humanity are unprecedented. However, both nanotechnology and nanoscience are in the initial stage of their development. The main problem in the nanoindustry today is controlled mechanosynthesis, that is, the assembly of molecules from atoms using mechanical approximation until the appropriate chemical bonds come into play. To ensure mechanosynthesis, a nanomanipulator is needed, which must be controlled either by a macrocomputer, or by a nanocomputer built into the assembly robot (assembler), which controls the manipulator. The nanomanipulator must be able to capture individual atoms and molecules and manipulate them within a radius of up to 100 nanometers. If the task of nanotechnology consists in the formation of nanocomponents and their subsequent inclusion in the structure of macroobjects, then the goal of molecular nanotechnology is the creation of macroobjects from the initial to the final stage with the help of nanotechnology.

Unlike microtechnology, in which billions of atoms are an "unruly herd", molecular nanotechnology is molecular engineering with a high degree of precision, where each atom or molecule has a specific place. Thanks to this precision, nanomaterials combine such qualities as strength and lightness. For example, unlike a simple steel beam, which is the basis of a building structure, a stronger and lighter nanobeam can also be equipped with special sensors that signal the degree of stability of a given structure.

Molecular nanotechnology is associated with the threat of the so-called "sticky gray mass", with which self-creating "nanomachines" can fill the Earth and absorb all life on it. First formulated by Drexler in 1986, this scenario describes the emergence of artificial bacteria that greedily devour everything around and are able to displace all living organisms. Such a scenario caused a certain mistrust of the scientific community in the development of molecular nanotechnology. However, supporters of the development of molecular nanotechnology point to the fact that the processes of molecular assembly in nature occur continuously: cheap resources (water and soil) and cheap energy (sunlight) are transformed into useful building materials (forest).

(MIT) Massachusetts Institute of Technology`s scientist Neil Gershenfeld, who was named one of the 50 leaders in science and technology by Scientific American, develops the idea of "custom manufacturing." It is about the creation of machines that would allow us to realize any project created on a computer with a simple keystroke, just as we can now print a project written in words on a printer. With the help of computers, employees of his laboratory not only design, but also create objects of their own choice: motherboards, diesel engine sensors and even works of art. Gershenfeld stated that he and his collaborators were close to creating a machine that would do any other machine. The creation of individual production based on molecular nanotechnology will bring about a fusion of the industrial and information technology revolution, the result of which will be the ability to instantly and inexpensively move data to any point on the planet and turn virtual projects into real objects in the right place. Moreover, the cost of these objects would consist only of the sum of the cost of raw materials and energy costs.

15. 3. Technology in a philosophical and anthropological context.

Philosophical study of technology. Technical activity is directed not so much to the understanding of reality as to its transformation in accordance with human needs. The motto of technical activity is to know to do! Therefore, technology seems to be called to master nature and subjugate it, to make it available for the realization of human goals and desires. And this requires knowledge and understanding of the processes that occur in nature, which makes technology dependent on science. The last circumstance repeatedly strengthens the influence of technology on nature, society, and man. Many researchers in the field of philosophy of technology are seriously interested in such problems as the distinction and social consequences of modern scientific and technical development, ethical problems of modern technology and technology, the formation of a system of values in an industrial and post-industrial society, technical education, upbringing, etc. These problems affect the interests of all mankind. Moreover, the danger lies not only in irreversible changes in the natural environment. A direct consequence of these processes are changes in the person himself, his consciousness, his perception of the world, his value orientations. Sometimes discussions on this topic have the character of a dilemma - technicism or humanism. Naturally, lately humanism is winning. Humanization of technical activity, technical education, submission of technical values to humanitarian values becomes an important task.

The humanitarian component in the modern philosophy of technology is represented by the thinkers mentioned at the beginning of this chapter: Lewis Mamford, José Ortega y Gasset, Martin Heidegger, Jacques Ellul. Although they noted the positive value of technology, they warned about its possible dangers. This last circumstance is now receiving special attention, as their worst fears are coming true.

Lewis Mumford (1895-1990) is an American philosopher and sociologist, whose numerous works are devoted to the social problems of technology, the history of cities, and the processes of urbanization. He acts as one of the extreme representatives of negative technological determinism.

Mamford sees the main cause of all the social troubles and upheavals of the modern era in the growing gap between the levels of technology and morality. This, in his opinion, already in the near future threatens humanity with enslavement by a faceless megamachine, that is, an extremely rationalized, technocratic organization of society. Scientific progress since the time of F. Bacon and Galileo, according to Mumford, is increasingly turning into "intellectual imperialism", the victim of which is humanism and social justice. Science becomes a surrogate for religion, and scientists become a society of new priests. Therefore, Mumford expresses a utopian hope to stop scientific and technological progress and revive the social values of the Middle Ages, which he describes as the "golden age" of mankind. Mumford nevertheless pays tribute to the progressive phenomena of technology, its beneficial effect on man. If all the technical inventions of the past millennia were to suddenly disappear, Mumford asserts, it would be a catastrophic loss of life. But, he emphasizes, a person would still remain a human being, and in the case of subordination to a megamachine, the human essence remains in question. Standard examples of megamachines are large armies, groupings of workers, such as, for example, those who built the Egyptian pyramids or the Great Wall of China. Megamachines often lead to an impressive increase in the number of material goods, but at the cost of limiting the opportunities and spheres of purely human activity, which leads to dehumanization.

At approximately the same time as Mamford, José Ortega y Gasset (1883-1955), a famous Spanish philosopher, publicist and public figure, was engaged in the problems of technology in the context of philosophical anthropology. He gave a generalized picture of the evolution of technology, dividing its history into three main periods: the technology of a particular case; craftsman's technique; technology created by technology and engineers. The differences between these three types of techniques lie in the method that a person discovers and chooses to implement the project he created of what he would like to become, to "make himself". In the first period, technology is invented by chance, due to circumstances. In the second period, some technical achievements are recognized as such, preserved and passed on from generation to generation by craftsmen. But even in this period, there is still no conscious study of technology, what is called technology today. Technique is only skill and skill, but not science. And only in the third period, with the development of an analytical way of thinking, historically connected with the emergence of modern science, the technique of technicians and engineers, scientific technique, "technology" in its literal sense appears. The technicism of modern technology is radically different from all that was provided by all previous types of technology. According to Ortega, modern technology gives a person the possibility of independent activity, which is manifested both in the technology itself and in pure (or scientific) theory. People now know well how to implement any project. The improvement of scientific technology leads, according to Ortega, to the emergence of a unique modern problem: the dying of any ability to desire this or that goal and strive for it. Technology is unable to determine the content and meaning of life. Ortega y Gasset had in mind the basic human meaning of life. He did not live to the society of mass consumption, when the production of goods turned into the production of human needs, through the satisfaction of which a new meaning of life is formed - unrestrained consumption. Ortega would most likely call him inhuman, dehumanizing. Philosophers of later generations, for example, Erich Fromm, see in this consumer society both the danger of the degeneration of the person himself and the danger to the environment, which, unable to withstand the burdens of the consumer society, degrades earlier and will destroy man before he has time to degrade in his essence.

The problems of technical development are considered by the German philosopher Martin Heidegger in the book "Questions about Technology" (1954). He questions the traditional view that technology is a neutral tool in the hands of man. Thinking about the essence of technology, the philosopher believes that it is not limited by narrow technical frameworks, and tries to include modern technology in a wider context. Technology is not only a means to achieve goals. In the worst captivity of technology, - writes Heidegger, - we find ourselves when we see something neutral in it. Meanwhile, the instrumental understanding of the technique has become a habit. And, according to Heidegger, the concept of technique presupposes a much deeper understanding: technique is not just a means, but a way of revealing the hidden. By revealing this hidden, i.e. previously unknown, extracting, processing, accumulating, distributing, transforming, technology changes the appearance of the surrounding nature. Along with how the method of revealing the truth, the method of understanding, technology changes the very perception of nature by man, changes the picture of the world as a whole. Technological progress can have a detrimental effect not only on the environment, but also on human perception of the world. Moreover, technology itself becomes the place of human existence.

The French philosopher Jacques Ellul (1912-1994) studied the problem of the influence of technology on human life in the work "Another Revolution" (1969).

Ellul believed that social progress in the New Age is the inexorable enslavement of man by technology and the absorption of the individual by a mass consumer, increasingly regulated society; for the sake of material benefits brought by science and technology, people sacrifice individual freedom and spiritual values. At the same time, the development of technology is accompanied by the displacement of humanistic goals by technical means of achieving ephemeral domination over the surrounding nature. After all, technical means are increasingly becoming an end in themselves of an impersonal "technological society" in which people are reduced to the role of appendages of the machine. Defining technology as a set of methods, rationally processed and effective in any area of human activity, Ellul connects technology with the general rationalization of the world and puts forward a demand for control over technical development. Technology is capable of turning means into ends, standardizing human behavior and, as a result, making a person an object of "calculations and manipulations."

The presented considerations made up the set of ideas that became the starting point of the philosophical study of technology. Of course, changes in technology are intensifying, which requires new research, but a radical revision of negative technological determinism is not yet foreseen. With all the positive aspects of technical progress, its lack of control is really deadly for a person.

Therefore, the role of the above philosophical ideas regarding technology is that they have fulfilled their philosophical functions:

- value, justifying the need to revise the value attitude towards technology, showing that technicism should be replaced by humanism;
- interpretive and communicative, demonstrating the need for discussion of the raised problems by all specialists, from scientists to politicians, and showing the possibility of an unfavorable social scenario;
- guiding, literally pushing scientists to deal with the problem of the consequences of scientific and technological progress;

- prerequisite, creating the prerequisite knowledge that scientists used, determining the scientific directions of studying the social context of scientific, technical and technological processes on a global scale, which was specified, for example, in the studies of the Club of Rome.

It is absolutely obvious that without the philosophical study of technology, the informational, valuable, problematic, conceptual space in which detailed scientific research began using scientific means of mathematical modeling, accurate calculations and forecasts of the economic, energy, and raw material state of the planet would not have arisen.

Scientific studies of technology in the context of global problems. The development of technology in the modern world more and more acutely manifests the dual character of its achievements. On the one hand, it is impossible to imagine the development of humanity without technology, and on the other hand, technology is a powerful force capable of causing the most negative, even tragic, consequences. The ill-conceived development of technology leads to the fact that the successes of technical progress turn into complex social problems. Replacing human labor in production, thus leading to an increase in labor productivity, technology exacerbates the problems of employment and unemployment; living comfort nowadays leads to unwanted separation of people; mobility achieved with the help of personal transport is bought at the price of noise pollution, uncomfortable, impersonal cities, lost and damaged nature.

At the beginning of the XXI century. humanity was faced with the need to solve the problems of the planetary order: environmental pollution with industrial production waste, exhaustion of irreparable natural resources, imbalance in demographic processes, danger of radioactive disaster, and so on. All this forces us to think about the goals and prospects of technical development, about measures for its possible limitation.

Uncontrolled technological expansion, the ambiguity of which was noted by the philosophers of technology and their predecessors, who raised this issue for a wide public discussion, caused a wide controversy in the West in the 1960s. It became a milestone in understanding the growing crisis consciousness of the era. This time was replaced by a general fascination with technology, worship before the successes of the scientific and technological revolution, and it was marked by a change in the relationship in the "society-technology-nature" system, the growth of public unrest, mass demonstrations by young people, and the "green" movement to protect the environment. And finally, the scientists had their say.

In 1972, the sensational publication of "The Limits to Growth" - the first report of the Club of Rome, now a world-famous international public organization. This report was prepared based on the results of a study conducted by a group of scientists at the Massachusetts Institute of Technology under the leadership of Dennis Meadows as part of the Global Threats to Humanity project. The conclusions reached by the scientists overturned all the usual ideas about the trends of world development, stability and prosperity, about the goals and prospects of human existence. According to the forecast of Meadows and his colleagues, humanity is surely heading towards a global catastrophe, which can be avoided only by taking appropriate measures aimed primarily at limiting, regulating the growth of production, and spoiling natural resources. But it's not just about that.

Of particular value is the fundamentally new approach proposed by scientists to the concept of the very criteria of social progress, which until now have traditionally been seen in the continuous increase of productive capacities aimed at the constant increase in production with their help of material goods. The Limits to Growth showed that growth cannot continue indefinitely. The time has come when humanity must abandon quantity in favor of quality.

The conclusions reached by the researchers caused a lot of critical comments, disputes, and discussions. But what is happening on the planet now only confirms the fears.

For almost half a century, scientists from different countries have prepared 50 reports on the initiative of the Club of Rome. They are based on large-scale studies of global problems of our time. When the Club of Rome was created, the scope of tasks of this organization was determined, in particular, to help the people of the planet to realize the importance and complexity of the problems facing humanity at the turn of the XXI century, to promote the establishment of new relations, which are necessary to prevent a global catastrophe, for the survival of humanity.

One of the most important areas of activity of the Club of Rome, which was previously not accepted in scientific structures, is to inform the general public about the problems facing humanity, about the results of research conducted at the initiative of the Club of Rome, about the prospects and social consequences of scientific, technical, industrial, economic development in the world. The fate of the world community depends on understanding the seriousness of global problems and the involvement of each person in their solution. Only by uniting in the face of imminent and general danger, humanity is able to show the political will to carry out joint actions aimed at ensuring its survival. The Club of Rome in its anniversary report "Some on!" (2017) called for a new Enlightenment, a holistic worldview, a planetary civilization, an alternative economy, that is, for those steps that need to be taken immediately.

Perspectives of the philosophy of technology. Today, only the formation of the philosophy of technology as a separate area of philosophical knowledge is being carried out. Until recently, it was believed that technology in theoretical and philosophical relations did not deserve special consideration. Since antiquity, consideration and solution of theoretical questions was really valued as a higher form of activity, which surpasses in its significance purely practical activities, which also included technology. Perhaps that is also why, to this day, a theoretical concept of technology has not yet been created, a system of basic concepts, explanatory models, argumentation schemes has not been developed, as it has historically developed in other branches of philosophy, such as philosophical ontology and epistemology, philosophy of history and social philosophy, philosophy man and the philosophy of science. This task is faced by modern scientists and philosophers who are creating a new philosophical discipline.

The development of the philosophy of technology is determined by the achievements of the technology itself, the expansion of the technical capabilities of mankind. Scientific and technological progress creates more and more new problems, the solution of which requires the coordinated interaction of representatives of science, public figures, philosophers and even certain forecasting. Technical sciences should, first of all, turn to forecasting the results of their development. However, the broad economic, social and cultural consequences of the achievements of scientific and technical progress cannot always be predicted clearly enough. Scientists are faced with many alternatives. Broad perspectives for the philosophy of technology are revealed here: methodological, theoretical, cultural, ethical, etc.

The philosophy of technology is a young philosophical discipline aimed at the study of technical knowledge, the analysis and evaluation of the results of technical activity, as well as the forecasting of possible social perspectives of technical development.

However, another option is also possible. The fact is that modern technology is so widespread, and modern technologies are so comprehensive that it becomes increasingly difficult to separate them into a separate independent complex. Engineering and technology are literally merged with economy, politics, education, art, and technical sciences are increasingly becoming a continuation and supplement of fundamental and general scientific complex and transdisciplinary programs and projects. Taking this into account, it is quite possible that the philosophy of technology will dissolve in the traditional sections of philosophy, enriching them with its problems.

But be that as it may, the tasks set by the philosophy of technology are vitally important for humanity. Therefore, it is the intellectual duty of philosophers, thinkers, engineers and simply educated people to respond to the challenges posed by modern civilization.

Questions to repeat:

1. How are the technocratic worldview and technocratic thinking related?
2. Explain the concept of technology.
3. How did the concept of technology evolve?
4. How did science and technology interact in history?
5. What is nanoscience and nanotechnology?
6. Which thinkers dealt with philosophical and methodological problems of technology?
7. What are the results of technology research in the context of global problems?
8. What are the prospects for the philosophy of technology?

Conclusion.

The previous presentation, among other things, shows that science develops quite consistently and regularly. This allows us to determine some trends in its evolution, which actualize philosophical and methodological research, their significance and prospects.

First, there is a dynamic renewal of the subject area of science, ultra-complex objects such as self-organized, self-developing, non-linear, fractal, etc. are involved in the field of research. This requires the production of new research methods, new methodological ideas, and new philosophical ideas.

Secondly, research acquires an interdisciplinary and transdisciplinary character, which, on the one hand, is combined with the continuing differentiation of scientific knowledge, and on the other hand, requires an understanding of the unity of science, its ideals and norms, which requires philosophical and methodological reflection on science.

Thirdly, the tendency to increase various, in particular alternative, theories, and the urgent need for new scientific knowledge, as well as sharp criticism of the negative consequences of scientific and technological progress, produce a large number of all kinds of non-scientific concepts, pseudo-theories, pseudo-scientific and anti-scientific constructions, many of which are difficult refute without philosophical and methodological training.

Fourthly, in connection with intensive changes in science, there is an evolution of traditional criteria and ideals of scientific rationality towards their liberalization and consideration of value aspects, as well as noticeable changes in the interpretation of scientific truth and a departure from the traditional correspondence concept to a more pragmatic understanding.

Fifth, the social and humanitarian sciences are developing at a faster pace, the methodological basis of which clearly lags behind their development, which requires the activation of the philosophical and methodological understanding of social and humanitarian knowledge.

Sixth, non-institutional science is spreading, which requires a philosophical and methodological understanding of its perspectives and the relationship with traditional institutional research.

Seventh, there is a convergence of fundamental developments with engineering and high technologies, which is accompanied by accelerated implementation of scientific results in production, which requires careful study, in particular of philosophical and methodological, possible social and humanitarian consequences.

Eighth, scientific research is increasingly subject to action
axiologising, humanizing, environmentalizing, which also requires philosophical and methodological understanding.

The list can be continued, but the indicated trends are enough to see the growing importance of philosophy and methodology in scientific research and the need for further philosophical and methodological understanding of science.

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