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## PARTICIPATION OF AZERBAIJAN IN DIVERSIFICATION OF NATURAL GAS SUPPLY ROUTES TO EUROPE

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**Abstract.** *The article examines the conditions, conditions for the functioning and development of the gas transportation system, which make it possible to determine the parameters and directions of diversification of the European gas transportation system, its integration with the pipeline systems of the Caspian and European regions. It is stated that Azerbaijani gas is a new source of natural gas supply to the European market. The implementation of the Southern Gas Corridor, the Trans-Adriatic and Trans-Anatolian international gas pipelines is re-creating the energy map of the continent and creating powerful new infrastructures for the supply of natural gas from the Caspian region to Europe via Turkey. The existing international gas pipelines for the supply of gas to Europe, the geography of its supply and possible options for the development of new export supplies to ensure the energy security of Europe are analyzed.*

**Keywords:** *diversification, gas transportation, natural gas, European market, hydrocarbon, pipeline.*

### Introduction

In general, the capacity of main export gas pipelines from Russia, Norway, Algeria, Libya, Azerbaijan is practically enough to cover the needs of the European market for natural gas, even in the absence of domestic production in Europe. However, for various reasons, including a strategic one, most gas pipelines are not used at their maximum capacity. A typical example is the Ukrainian gas transportation corridor, which with a nominal capacity of 180 billion cubic meters on the western border is used less than half, and not only because of the difficult political situation around it, but also for purely technical reasons. In addition, the directions of flows within Europe are changing, the centers of consumption are shifting,



some regions, as part of diversification, are turning to alternative energy sources and new suppliers. As a result of a seemingly surplus capacity market, projects for the construction of new gas pipelines appear.

The large reserves of hydrocarbons (HC) in Azerbaijan are of interest to European countries, where there is a huge demand for energy, including natural gas. The geographical location and successful implementation of joint oil and gas projects have contributed to the fact that for a century Azerbaijan and European countries (including Turkey) have been interdependent partners in the field of HC resources and the main importers of Azerbaijani oil and gas [1, 2].

**Purpose of the study.** To study the role of Azerbaijan in ensuring energy security of Europe by participating in the creation of new powerful infrastructures and diversification of natural supply routes from the Caspian region to Europe. Analysis of the existing international gas pipelines for the supply of natural gas to Europe, the geography of its supply and possible options for the development of new export supplies to ensure the energy security of Europe.

In recent years, the European gas market has undergone significant changes, both in technical, organizational and regulatory spheres. Being import-dependent on the countries supplying natural gas, the EU countries strive to strengthen energy security, focusing on the diversification of primary sources of energy resources and their suppliers. Considering the real situation, the problem with Ukrainian transit in the absence of additional pipeline capacities will be problematic to ensure the full volume of Russian gas supplies to Europe. In connection with the problem that has arisen between Europe and the main gas supplier, Russia, new opportunities are being created for the development of export and transit of gas for other gas producing countries, including the countries of the Caspian region. In this context, Azerbaijan is of particular importance, given the presence of existing international gas pipelines (IGP) and the exit to the European market. Based on this, one of the key tasks for the development of the Azerbaijani-European gas partnership is to optimize the export strategy of Azerbaijan. One of the priority tasks of the socio-economic development of Azerbaijan, strengthening of economic and geopolitical positions in the world is to consolidate in the markets of the European region, including energy. A comprehensive analysis of the state, conditions for the functioning and development of the gas transportation system allows to determine the parameters and directions of diversification of the Azerbaijani gas transportation system, its integration with the pipeline systems of the Caspian and European regions [1-4].

According to Wood Mackenzie's forecasts, gas consumption in Europe by 2035 will increase from 541 billion cubic meters, and "HIS Market" predicts an increase in demand by this time to 572 billion cubic meters of gas per year [3].

It should be noted that the threat to the energy security of Europe, in particular,

is the competition for energy resources with rapidly developing countries, and since it is pipeline transport, in contrast to liquefied natural gas, that constitutes the basis for stable and long-term cooperation, and new Azerbaijani gas pipelines have advantages in European gas market. The implementation of the Southern Gas Corridor (SGC) project is a striking example of more than just successful interaction between the leading oil and gas companies of a number of countries, aimed at developing international cooperation and ensuring the reliability of supplies. This is also an example of collective strategic thinking, which once again testifies to the effectiveness of joint efforts.

In recent years, the EU has agreed on a number of new goals to strengthen Europe's position in international energy policy, including an energy roadmap to 2050, which presents different scenarios for the next 40 years. The countries of Southeastern Europe take measures and support a secure, sustainable supply of natural gas at affordable and competitive prices, based on the EU energy strategy, to complete the formation of the internal energy market, end the isolation of the member states and facilitate the diversification of routes, sources and partners, including through the development of "SGC". The EU countries emphasize the importance of facilitating access to diversified gas supplies by participating in such large projects as "SGC", gas promotion through interconnecting pipelines and construction of "FSRU". Greece hopes to become a gas "hub" for Southeastern Europe to transport gas to other countries from several points of entry and exit, in the presence of different sources of gas (Azerbaijan, Algeria, Egypt, Israel, Iran, Qatar, Russia, etc.). The EU counts on the ability of "SGC" to meet its needs, at the expense of natural gas from the countries of the Caspian region (Azerbaijan, Turkmenistan, Kazakhstan, Iran) and East Asia (Iraq, Israel, etc.). The interest of "SGC" is due to the growing demand from Europe, whose energy needs will grow by 1% annually until 2026 [1-3].

The main provisions for reforming the national gas markets in the EU, according to the Gas Directive, are: creation of a competitive gas market in Europe and diversification of supplies; lack of internal borders of the EU gas market; the need to take into account the specifics of individual countries when implementing the requirements of the Directive; ensuring equal access to the system for all gas suppliers. The intermediate results of liberalization indicate that the competition artificially created in the market, combined with a number of amendments, did not lead to a decrease in gas prices, but to an intensification of competition between gas distribution companies. Despite the fact that the share of the cellular market continues to grow, this is only a supplement to existing long-term contracts that guarantee reliability, regularity of supplies, stability of prices and conditions, as well as investments necessary for the development of new fields, the implementation of large gas projects, and the creation of transport infrastructure etc. Due to

the specifics of the European gas market, gas transportation conditions and limited suppliers, the requirements of the Gas Directive exist for the most part only de jure. The largest importers of Azerbaijani gas and their share in the total volume of natural gas consumption in European countries, etc.

To transport Azerbaijani gas within the framework of a production sharing agreement, the "Baku-Tbilisi-Erzurum" (BTE) or "SCPx" gas trunkline was built in 2006 with a throughput capacity of 20 billion cubic meters of gas per year and began transporting gas from the "Shah –Deniz" to Georgia, and since 2007 - to Turkey. Currently, "SCPx" capacities are used to supply Azerbaijani gas to Europe within the framework of SGC. The SGC project (an abbreviated version of the "Nabucco" project) through which gas from the Caspian shelf is transported to Europe, to Italy, with the prospect of the possibility of attracting new resources, including from the fields of the Caspian region and the Middle East, consists of three parts: "SCPx"- going through the territory of Azerbaijan and Georgia to the border with Turkey; Trans-Anatolian Pipeline (TANAP) - running through Turkey (initial throughput capacity of 16 billion cubic meters per year, will reach 23 billion cubic meters by 2023 and 31 billion cubic meters by 2026); Trans-Adriatic (TAP) - passing through the territory of Greece, Albania and Italy. An additional gas resource for the SGC gas pipeline (and the future of a full-fledged Nabucco) can be gas from Turkmenistan, Iran and Iraq, as well as, under certain conditions, Russia and Kazakhstan. Thanks to the oil and gas strategy, while developing the energy potential of the Caspian Sea, Azerbaijan has formed a new economic model for the development of the region, expanded political and economic ties between Europe and Asia and become a regional energy and transport hub [1, 2, 5].

The international gas pipeline "UGK" is to become the main channel for gas supplies from the Caspian and Central Asian regions, including the countries of the Middle East to Europe. TANAP's capacity will be: at the first stage 16 billion cubic meters of gas per year (will be directed to the domestic market of Turkey, and the rest of the natural gas will go to the needs of other European countries); at stage II, 24 billion cubic meters of gas per year. The "TAP - TANAP" system will connect the existing and planned gas transmission system (GTS) for gas transportation in South-Eastern Europe with the GTS in Western Europe through Greece, Albania, the Adriatic Sea and Italy, and also allow access to gas resources in the Caspian region and the future The Middle East [6, 7].

According to the EU Regulation on Measures to Ensure the Safety of Gas Supplies, the Albania-Italy offshore section of the "TAP" gas pipeline must operate in both forward and reverse modes. At the second stage, it is planned to connect the countries of the Western Balkans (Montenegro, Bosnia and Herzegovina and Croatia) through the "TAP" IGP to which the "IAP" (Ionian Adriatic Gas Pipeline) international gas pipeline, considered part of the "TAP" - TANAP system, will be

connected. IGP "TAP" was selected as a project of common interests (PIS) and as such enjoys EU support. This decision means that IGP "TAP" can ensure the supply of pipeline gas from Azerbaijan to Europe at full capacity within 25 years. The EU exempted the project from regulated tariffs at the initial stage to expand the capacity of 10 billion cubic meters of gas per year, and regulates the throughput of the reverse IGP "TAP" from Italy to Greece. EU internal market rules usually require third party access to all energy infrastructure, including gas pipelines. "TAP AG" has signed various MOUs with the developers of the "IAP" project, including Plinacro (Croatia), BHGas (Bosnia and Herzegovina), as well as the governments of Montenegro and Albania. IGP "IAP" will be linked to the existing GTS of Croatia. In addition, it can be connected to other gas infrastructure facilities, including the Adria LNG terminal in Krk, and it will be a reverse IGP with a throughput capacity of 5 billion cubic meters of gas per year [1, 2, 5, 8].

For Azerbaijan, the "UGK" (SGC) is an opportunity to supply gas to the main consumption centers in Europe for the next decades (the life of a modern gas pipeline can be up to 50 years). For Turkey, the project is an opportunity to become the largest gas transit country in Europe. In this regard, the "SGC" gas pipeline is a justified step and the first delivery to Italy has already been made. Due to the supplies of Azerbaijani gas, Bulgaria will be able to satisfy about a third of its gas consumption, Greece - a fifth and Italy - about 10%. Negotiations are underway on the possibility of expanding SGC in the future, taking into account the involvement of new participants in the project, such as Turkmenistan or Iran, potentially the participation of Russia and Kazakhstan at the later stages of the project.

Projects for the supply of Turkmen gas to the European market is considering options for supplying gas through the Caspian Sea. Trans-Caspian Gas Pipeline (TCGP) energy infrastructure, to provide a resource base for the "TAP" project (the project remains on the list of priority projects for the EU), this gas pipeline is also considered part of the "SGC" expansion and has a capacity of 30 billion cubic meters gas per year. According to some sources, it is also envisaged to connect to the "TCGP" gas pipeline from Tengiz in Kazakhstan and connect it with Turkmenbashi. This subsea gas pipeline plans to transport gas from Turkmenistan and Kazakhstan through Azerbaijan to Georgia and Turkey and further to the EU countries. In Azerbaijan, the pipeline will join "SCPx", and through "TANAP" and "TAP" to Italy. The envisaged length of the gas pipeline across the Caspian Sea is 300 km [9, 10-12].

**Conclusion.** Thus, against the background of the European energy transition, modern gas pipelines, including new Azerbaijani projects, have every chance to retain their most important strategic role in ensuring the energy security of Europe and diversification of the continent's gas transportation infrastructure. Azerbaijan, as a gas supplier, has all the capabilities not only to maintain the status of a gas

exporter in the region, but can also expand its positions in the future by becoming an energy bridge between Asia and Europe. Analysis of possible risks and new opportunities for Azerbaijan arising as a result of the ongoing changes in the EU's gas infrastructure allow us to determine the main directions for increasing the efficiency of gas exports, including more flexible marketing programs for implementation in Europe.

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## IDENTIFICATION OF THE RISKS OF THE STATE AND SOCIETY IN THE CONDITIONS OF DIGITALIZATION OF THE ECONOMY

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**Abstract.** *This article discusses an approach to organizing the identification and monitoring of risks in the context of the digitalization of the economy, discloses the concepts of "digitalization" and "digital economy". As a result of the study, the author comes to the conclusion that the digitalization of the economy, on the one hand, increases the efficiency of production and sales of products, contributes to its constant updating and quality improvement, and on the other hand, violates the stability and sustainability of the business, generates new risks, transforms existing global chains. creating value, is leading to a reformatting of relations between developed and developing countries. Overcoming these contradictions requires the development of innovative approaches to business processes, the search for new forms of international economic cooperation between developed and developing countries.*

**Keywords:** *information economy, information society, information resource, information space, digitalization, digital economy, the concept of identifying risks.*

### **Introduction**

The current stage of world economic and social development is characterized by a significant impact of digitalization. As a new direction of global social development, which replaced informatization and computerization, it is characterized by the fact that it is based on the digital presentation of information, which, on the scale of economic and social life, both in an individual country and throughout the world, leads to an increase in the efficiency of the economy and improving the quality of life.

**Purpose of the study** – to identify groups of risks caused by the emergence of challenges to the digitalization trend; possible threats caused by these challenges, negative consequences, difficulties of transition to digital technologies, problems

and practical application of technologies.

### **Materials and methods**

Currently, the term "digitalization" is used in a narrow and broad sense. Digitalization in the narrow sense means the transformation of information into a digital format, which most often leads to lower costs, the emergence of new opportunities, etc. Digitization in a broad sense means that a large number of specific conversions of information into digital form lead to significant positive consequences.

The modern understanding and analysis of this term are presented in the Strategy for the Development of the Information Society of the Russian Federation for 2017-2030 [1], where the concept is considered as an economic activity in which the key production factor is digital data processing large volumes and using the results of analysis in comparison with traditional forms of management, which can significantly increase the efficiency of various types of production, technologies, equipment, storage, sale, supply of goods and services. Ecosystem of the digital economy - the partnership of organizations is ensured by the constant interaction of their technological platforms, applied Internet services, analytical systems, information systems of public authorities, organizations and citizens.

Digital technologies are changing the very operating model of companies, especially in the banking and telecommunications sectors, increasing economic efficiency and revealing new market opportunities. Methods for analyzing large amounts of data are actively used to obtain new information and make effective and optimal management decisions. This phenomenon is called the "digital economy".

As the digital economy develops, it is changing traditional ideas about how business works, about collaboration between different companies, about the services, information and products that consumers can get. Numerous examples from the business practice of companies from different countries allow us to conclude that the digitalization of the economy is transforming the usual model of globalization.

For the Russian economy, the digitalization trend is associated with serious threats, since the issues of the formation of the digital economy become for Russia issues of its national security and competitiveness in the world market (external threats), as well as issues of the level and quality of life of the Russian population (internal threats).

The lag of Russia in the pace and scale of digitalization from developed countries can lead to the fact that it will remain on the sidelines of scientific and technological progress. This is fraught with the following threats: its role in the world economy will be catching up; ensuring Russia's national security will be called into question; it will be deprived of the prospects for innovative development, which will significantly reduce the competitiveness of both individual domestic

companies and the entire Russian economy in the world market.

Any challenges and threats associated with the manifestation of a certain trend in the economy, politics, demography, social life can manifest themselves in a combination of possible problems and negative results. Each of these undesirable outcomes can be represented as a risk, described by the parameters "size of a possible negative outcome" and "probability of a negative outcome".

The problem of the formation and development of the digital economy is relevant not only in theory, but also in practice, including at the state level, in connection with the understanding of the decisive role of digital technologies in the development of the country's strategic competitiveness.

The description of negative results in terms of risk parameters makes it possible to identify threats and concretize their consequences caused by external and internal manifestations of digitalization challenges for Russia, as well as develop appropriate risk management programs aimed at reducing possible losses from digitalization.

The difficulties and problems of Russia's transition to the digital economy can also be described in terms of risks - to describe each of them, two parameters must be used - the amount of possible damage and the likelihood of its occurrence corresponding to the respective problem.

Despite the bright prospects, the digital economy brings with it obvious challenges and threats. Significant possible negative consequences of digitalization for the Russian economy and society include:

- reduction in the total number of jobs in the country;
- the transition to new trends in the development of the economy has always been accompanied by a reduction in the number of employees, which has always actualized the retraining of personnel and leaves this problem acute at the moment;
- the emergence of unscrupulous users of new services, the emergence of which is due to digitalization;
- digital fraud;
- piracy and distribution of malicious content.

The practical application of digital technologies can lead to new risks:

- risks of imperfection, unpreparedness of the regulatory framework that accompanies and ensures the progress of digitalization processes;
- risks of misuse of technologies and new opportunities associated with digitalization, the use of someone else's information and other people's resources;
- associated risks, the occurrence of which is due to changes based on the digitalization of existing technologies, as well as the improvement of existing and the creation of new business models.

The impact of digitalization determines the groups of risks caused by the presence or emergence of challenges of the digitalization trend, possible threats caused



by these challenges, negative consequences, difficulties of transition to digital technologies, problems and practical application of technologies, etc.

It is obvious that it will take time for a deep scientific substantiation, as well as successful practical implementation of the main provisions of the new economic concept. The economy is on the eve of a digital revolution, which will lead to radical changes in labor productivity in developed countries and, as a result, to higher growth rates of national and global gross domestic product (GDP). Digital technologies should become the main factor of the new technological breakthrough, which will allow connecting all stages of production from development to marketing of products, optimizing design and production technologies, and ensuring constant product updates and high quality.

Scientific advances in digital technologies are directly related to organizational innovations aimed at improving business efficiency by optimizing the organization's management process, for example, reducing administrative costs, transaction costs, and increasing labor productivity.

For their effective functioning in this area, it is necessary to develop cloud applications; new business models and innovations in trade and services; new digital security technologies in the implementation of digital business transactions; norms, standards and special programs that integrate traditional technologies with information and communication technologies (ICT) through user-friendly interfaces.

In this regard, the training of specialists in this area of knowledge is necessary and relevant, since the new jobs created in the digital economy require high standards. These standards must be followed by qualified personnel with specific skills.

### **Results and discussion**

As a result of the study, the author comes to the conclusion that the digitalization of the economy, on the one hand, increases the efficiency of production and sales of products, contributes to its constant updating and quality improvement, and on the other hand, violates the stability and sustainability of the business, generates new risks, transforms existing global chains. creating value, is leading to a reformatting of relations between developed and developing countries. Overcoming these contradictions requires the development of innovative approaches to business processes, the search for new forms of international economic cooperation between developed and developing countries.

### **Conclusion, Recommendations**

To reduce all groups of identified risks, it is necessary to develop programs for their management. The implementation of these programs, together with other digitalization management programs at all levels of economic and social life, will make it possible to take advantage of digitalization and bring the national economy and social sphere of the country to the proper effective level.

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## IMPACT OF ENERGY EFFICIENCY FACTORS ON NATURAL GAS CONSUMPTION IN THE INDUSTRIAL SECTOR OF RUSSIA

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**Abstract.** *The paper identifies the need to create a systematic assessment for the systematization of energy efficiency factors that affect the consumption of natural gas at industrial enterprises. Factors and conditions affecting the energy efficiency of natural gas consumption by industrial enterprises are considered and grouped into a classification. The systematization of energy efficiency factors was carried out on the basis of 3 groups of industrial enterprises.*

*The interrelationships of the components of the classification of factors are determined, and the key prerequisites for improving energy efficiency at industrial enterprises are identified.*

**Keywords:** *energy efficiency, energy efficiency factors, natural gas, industrial enterprises, energy, classification.*

### Introduction

The management of natural gas consumption by industrial enterprises in the modern conditions of the development of the Russian economy requires a fundamentally new mechanism for increasing energy efficiency. To do this, it is necessary to identify the factors that in one way or another affect the energy efficiency of natural gas consumption. Establishing and maintaining sound policies requires quality, timely, comparable and detailed data that go well beyond energy balanc-

es and reflect the distinctive characteristics of economic activities and resources available in each country.

The formation of a mechanism for managing the energy consumption of an industrial enterprise involves the systematization of factors for increasing the efficiency of energy consumption. In a general sense, energy efficiency factors are the reasons that affect the specific energy consumption and a set of indicators that give rise to their economical use [5].

Factors and conditions affecting energy efficiency can be the same and differ significantly depending on the field of activity. Therefore, it is important to identify the points of view of scientists about the influence of various factors on the energy efficiency of industrial production. This will make it possible to establish the relationship between energy efficiency factors and the degree of their influence on the consumption of fuel and energy resources [2].

**Purpose of the study** – to establish the key factors and features with regards to formation of energy efficiency of natural gas consumption by industrial enterprises.

The creation of a mechanism for managing the energy consumption of an industrial enterprise involves the systematization of factors for increasing the efficiency of energy consumption.

The largest consumers of natural gas among the sectors of the Russian economy are metallurgy, power engineering and mechanical engineering, in this regard, energy efficiency factors are considered on their example. In metallurgy and mechanical engineering, natural gas is widely used in pig iron smelting and for heating rolling, forging and smelting furnaces, in the electric power industry - for generating electrical energy.

It is advisable to systematize factors by grouping them into 5 types:

- production;
- technological;
- organizational;
- socio-economic;
- climatic.

Production factors include:

- product production plan;
- production structure;
- production program of the enterprise;
- schedules of production processes;
- loading of production facilities;
- repairs and accidents;
- the level of personnel training.

Technological factors include:

- features of technological production;
- physical characteristics of the production process;
- share of equipment utilization;
- calorific value of the burnt gas;
- duration of the production cycle;
- energy efficiency class of equipment;
- level of equipment wear.

Organizational factors include:

- planning of energy consumption of production resources;
- balance of production capacities;
- energy management system;
- analysis and control of production processes;
- introduction of energy service contracts.

Production, technological and organizational factors, in turn, relate to production technology. The enterprise cannot strongly influence these factors, but it must necessarily take them into account in its activities. Organizational factors make it possible to combine all factors into a single process for an effective assessment of the degree of achievement of the goals of the organization of production, which is a necessary basis for the strategic management of natural gas consumption.

Their presence is a defining moment in the systematization of the factors of energy efficiency of natural gas consumption by industrial enterprises.

Socio-economic factors include:

- the level of gas prices;
- schedule and working hours;
- schedule of technological processes;
- material incentives for energy saving.

Climatic factors include:

- duration of the heating period;
- ambient temperature;
- daylight hours;
- air humidity and precipitation.

Socio-economic and climatic factors of energy efficiency are represented by the groups “heating needs and auxiliary production”. An enterprise can actively influence them and try to reduce the influence of these factors to a certain level.

Table 1 shows the relationship between the energy efficiency of natural gas consumption by industrial enterprises and various factors.

**Table 1 - Impact of energy efficiency factors on natural gas consumption in the industrial sector**

Level of factor influence	Economic sector		
	Metallurgy	Electrical energy industry	Machinery manufacturing
<b>High</b>	Product production plan; Loading of production capacities; Features of technological production; Equipment energy efficiency class; Energy planning for production resources	Product production plan; Loading of production capacities; Features of technological production; Calorific value of the burnt gas; Equipment energy efficiency class; Energy planning for production resources	Product production plan; The duration of the production cycle; Equipment energy efficiency class;
<b>Medium</b>	Production structure; Production program of the enterprise; Production process graphs; Schedules of work of production related processes; Physical deterioration of buildings; Physical characteristics of the processed raw materials; Technological process modes; The duration of the production cycle; Concentration, specialization and optimization of production processes; Formation of an energy saving program; Analysis and control of production processes	Production structure Production program of the enterprise Production process graphs Schedules of work of production related processes Physical deterioration of buildings; Technological process modes; Formation of an energy saving program; Analysis and control of production processes	Production capacity utilization Physical deterioration of buildings Features of technological production Physical characteristics of the processed raw materials Technological process modes; The duration of the production cycle; Energy planning of production resources; Formation of an energy saving program; Analysis and control of production processes

<b>Low</b>	Personnel training level; Share of equipment utilization; Calorific value of the burnt gas; Equipment wear rate; Production capacity balance; Energy Management System; Drawing up an energy passport; Implementation of energy service contracts	Personnel training level; Physical characteristics of the processed raw materials; Share of equipment utilization; Equipment wear rate; Production capacity balance; Concentration, specialization and optimization of production processes; Energy Management System; Drawing up an energy passport; Implementation of energy service contracts	Production structure; Production program of the enterprise; Production process graphs; Schedules of work of production related processes; Personnel training level; Share of equipment utilization; Calorific value of the burnt gas; Thermal VER output; Equipment wear rate; Production capacity balance; Concentration, specialization and optimization of production processes; Energy Management System; Drawing up an energy passport; Implementation of energy service contracts
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Source: compiled by the author on the basis of an analysis of studies of a number of works [2, 3, 4, 5, 6]

The market model for natural gas consumption includes the following indicators:

- tariffs for gas transportation;
- energy prices;
- prices for gas consumers;
- investments in the development and reconstruction of gas production and consumption;
- type of market (regional, zonal, national);
- level of gasification of the region;
- reliability of natural gas supply;
- technical level and condition of fixed assets of the gas industry;
- quality of the environment;
- prices for other fuel and energy resources;
- efficient use of natural gas and increasing the level of gasification in the region.

### **Results and discussion**

When forming a balanced system for the efficient use of natural gas in the industrial sector of Russia, the key ones are:

- indicator of gasification of production;
- indicator of the use of secondary energy resources from the use of natural gas in technological processes;

- indicator of energy intensity of production;
- reduction of the energy component in the structure of production costs.

Profitability is an important indicator of an enterprise's ability to sustainably develop. Therefore, prioritization of these two indicators turns out to be necessary in managing the decision-making process for the efficient use of natural gas.

In the formation of a sustainable strategy for the effective use of natural gas in the long term, additional investments in energy-saving innovative technologies play an important role [1, 7].

### **Conclusion**

Development of effective energy saving and energy efficiency management system is a key factor in the successful functioning of industrial enterprises and the country's economy as a whole. The degree of influence of factors on energy efficiency is expressed in three categories: high, medium, low. In this case, only those factors were taken into account that can be controlled in the production process.

The paper analyzes the main approaches to the systematization and classification of energy efficiency factors for natural gas consumption in the industrial sector. The considered approaches revealed the absence of a group of organizational factors.

The proposed classification of energy efficiency factors among industrial enterprises makes it possible to determine the relationship of the main elements that provide the prerequisites for managing the natural gas consumption system in the industrial sector of Russia. This classification reveals the main features of the formation of energy efficiency of natural gas consumption by industrial enterprises.

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## DIGITALIZATION OF THE ECONOMY AND ITS IMPACT ON THE STRATEGY OF ENTERPRISES IN THE BANKING SECTOR

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**Abstract.** *This article discusses approaches to understanding the essence and specifics of digitalization in various areas of the economy, including the banking sector. Possible directions for the implementation of the principles of digital innovation in the framework of banking in Russia have been substantiated. The practice of introducing innovations into the operating activities of a credit institution is considered on the example of one of the Russian banks. Conclusions are made about the prospects for the impact of digitalization of national currencies on the digital innovation of modern banks.*

**Keywords:** *digitalization, banking sector, innovation, digital currency, technologies, blockchain, digital asset.*

### Introduction

Nowadays, the development of digital technologies creates a serious help for the development of economic activities of enterprises of the national economy. It is impossible not to note that absolutely in all sectors of the economy, economic entities are actively introducing various innovative models, thereby trying to minimize their own costs and increase work efficiency. In modern conditions, the digitalization process comes to the rescue, which implies the widespread introduction of digital technologies in various spheres of life of the population and organizations. This newfangled trend has not bypassed the banking sector either. BigData digital technologies make it possible not only to optimize the activities of the banking institution itself, but also provide interested researchers and analysts with access to

large-scale databases, thereby forming a single database of all operations carried out by the bank's clients within the framework of banking services.

The incredible speed of development of the very concept of "digitalization" and its derivatives, such as "digitalization of the economy", "digitalization of industry", "digitalization of the social sphere", etc., is primarily due to the emergence of devices that are able to collect, analyze, evaluate and organize huge amounts of data. Since the volume of processed, analyzed and stored information in the banking sector is very large, the launch of the Digital Economy National Project allowed the Ministry of Finance of the Russian Federation to expand the fundamental principles of ensuring the processing, storage and protection of personal data of all bank users. In addition, digital technologies facilitated the transfer of this data, providing information to all interested participants and analysts of the financial market.

**Purpose of the study** - to establish the role and significance of the category of "digitalization of the economy", to determine the possibilities and directions of its implementation within the banking sector of Russia, and also to study how the innovation of Russian banks affects this process.

#### **Materials and methods**

The methodological basis of the work is based on the principles of dialectical logic, the unity of logical and historical approaches, as well as a systematic approach to the functioning of banking institutions in the new conditions. In this work, the methods of expert assessments, economic and financial analysis, structural and functional analysis, etc. were used.

#### **Results and discussion**

The digital economy as a general phenomenon lays down a statement about the key value of data presented in digital format. Such implementation of modern technologies and practices at various levels: state, corporate and private increases the competitiveness of the country and its enterprises, as well as the quality of life of the population. In addition, digitalization ensures stable economic growth not only by intensifying production and financial processes, but also by increasing the speed of informatization of the subjects, which make it possible to promptly make appropriate optimization decisions. The innovative breakthrough provided by banks in the past few years due to the digitalization of their technologies has completely changed the attitude of customers - enterprises and households - to information and the opportunities that this opens up.

The introduction of innovative technologies in the field of IT allows banks, among other things, to increase their own competitiveness, attract new customers and optimize all ongoing internal banking processes and procedures.

By banking innovations we mean the result of innovative banking, expressed in the form of a new or modernized product, service, process, organizational form or technology, created with the aim of increasing the efficiency of using the resource

potential of a commercial bank [3].

In our opinion, there are five possible directions for the implementation of the principles of digital innovation in banking:

1. Product innovations, implying the improvement of an existing product through its introduction to the online sector;
2. Process innovations that form a new method of production, technologies and operations on the Internet and with the help of modern computer technology;
3. Market innovation (this type is rarely found in the banking sector and is often used in industry. But, despite this, it implies the expansion of existing market niches using modern technologies);
4. Marketing innovation is based on the development of digital technologies in order to increase advertising coverage;
5. Management innovations are associated with changes in the organizational structure of the bank in the course of mastering digital technologies.

If in the recent past it was mainly the leading banks that resorted to identifying and implementing innovative proposals, but now, in the course of their business activities, other Russian banks are increasingly resorting to digital innovation. Indeed, thanks to the timely introduction of innovations and the improvement of the quality of the products and services provided, the bank will be able to retain the loyalty of existing customers and attract new ones, including young people who actively use digital technologies. A modern bank client expects that the search for information about a product or service will be simple, the information itself - understandable, and that bank employees will be able to promptly provide him with assistance in the design of the product/service. These expectations, in turn, stimulate the management of banks to further expand the use of digital technologies in their own activities.

In accordance with the above definition, the innovation developed by the bank must be evaluated from a cost point of view. The assessment, in turn, depends on the expected time of obtaining the actual economic effect and the degree of risk of the possibility of obtaining it. To make the right management decision in the process of introducing an innovation, it is worth calculating the costs of its implementation, evaluating business processes, and linking the innovation with the strategic goals of a commercial organization.

It is also impossible to deny that the widespread digitalization of the banking sector significantly affects the strategy of its development both within a single bank and the entire sector. This influence can be determined by the following factors:

1. The level of financial stability and solvency of the bank;
2. Target audience;
3. The main direction of the bank's product policy;
4. Technical equipment, etc.

When implementing the bank's innovative strategy, first of all, it means building a personalized organizational and economic mechanism. This is due to the dominant influence of the bank's technological base, which is often inconsistent with scientific and technological progress in small credit institutions. As a result of the optimization of this area of technology, banks are able to keep records and analytics of data on the loan portfolio in the most complete way, as well as make informed decisions on the implementation of the established policy.

At the moment, the development of product innovations in the banking sector also has a special influence on the bank's growth and development strategy. These include the analysis of big data, machine learning, in-depth analytics, artificial intelligence, roboadvising, blockchain, etc. These technologies allow the creation of fundamentally new services, thanks to which more and more banking transactions go online and do not require the physical presence of the client in branch of the bank.

Let us consider the practice of introducing innovations into the bank's operating activities using the example of "Tinkoff Bank" JSC. Within the financial structure of the bank, there are several divisions dealing with innovations:

1. Tinkoff Investments - online broker;
2. Tinkoff Development Center - a division for the development of new fin-tech services;
3. Tinkoff Mobile - online telecom operator;
4. Tinkoff Insurance - an insurance company, etc.

Tinkoff Investments, as of early 2021, is the largest broker in Russia in terms of the number of registered accounts. The number of users on the Moscow Exchange reaches 3.5 million, that is, 35% of the total amount of retail investors on the market. According to this indicator, the bank under study is ahead of even the service of "Sber", the largest in the Russian market. In terms of the number of active users, Tinkoff is the largest broker on the MOEX exchange. The presented data indicate the importance of the bank for the financial sector of the country. Such fantastic indicators have been achieved thanks to innovative solutions taken in the development of a trading terminal through which users make their transactions on the market. The terminal is a mobile application. The user experience of the authors shows that the application of the specified bank is the most intuitive and easy to learn. The bank managed to create a unique product on the Russian market that includes a number of training registers for inexperienced investors.

It should be noted that all the services provided by the bank are united by a common idea of interacting with the user exclusively online. This type of interaction allows you to significantly automate the processing of user requests through methods of big data, machine learning and neural networks. It is the factor of digitalization of innovative activities that allowed "Tinkoff Bank" JSC to take a leading

position in the rating of banks in terms of customer loyalty in 2020 with a value of 17.9 p., Significantly overtaking Raiffeisenbank, which is in second place (10.2 p.) [7].

### Conclusion

As a result of our research, we found that a modern bank is a system of services for various spheres of human and organizational life, which allows us to satisfy any client's request and leave it within the framework of the servicing bank.

In addition to the transition to online, there is another new trend in the banking sector, which is already firmly entrenched in the financial world. It's about block-chain and digital assets. These technologies have received serious development over the past 5 years and it is no longer advisable for banks to ignore them.

The central banks of 3 states, such as China, Sweden and Russia, in 2021 announced and launched the use of national digital currencies in test mode. This innovation at the macro level will make it possible to make a qualitative change in the banking sector of the countries represented. As a result of increasing the level of security of payment systems, simplifying access to funds, accelerating settlements and making settlement services cheaper for users, commercial banks in these countries will have to receive additional preferences for digital innovation.

We expect that in the future, the introduction of such digital technologies on the scale of both one state and international communities will provide significant qualitative changes in the existing banking sector, which will contribute to the national economy's emergence in leading positions in terms of servicing cash settlements and will open up prospects for creation and implementation of other digital assets.

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## ANALYSIS AND IDENTIFICATION OF DESTABILIZING FACTORS IN THE OIL AND GAS INDUSTRY

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**Abstract.** *This paper analyzes the destabilizing factors identified based on global trends.*

**Keywords:** *oil, gas, world market, energy, transformation, trends.*

### **Introduction**

Energy is fundamental to our civilization and its prosperity. This production, distribution and use are deeply rooted in the fabric of our economy and have become central to relations between states.

At this point, the situation on the energy market continues to aggravate, so there is a need to analyze both the geopolitical consequences of world energy and environmental factors.

The oil and gas industry plays one of the key roles in the global energy market, so the question arises about situations that could destabilize the position of the industry in the world.

**Purpose of the study** – identification of destabilizing factors in the oil and gas industry.

### **Materials and methods**

The work used the horizontal method of analysis and the method of graphical and tabular display of data, the method of comparing the data of various market participants. Scientific articles on this or related topics, information from open resources were used as material.

### **Results and discussion**

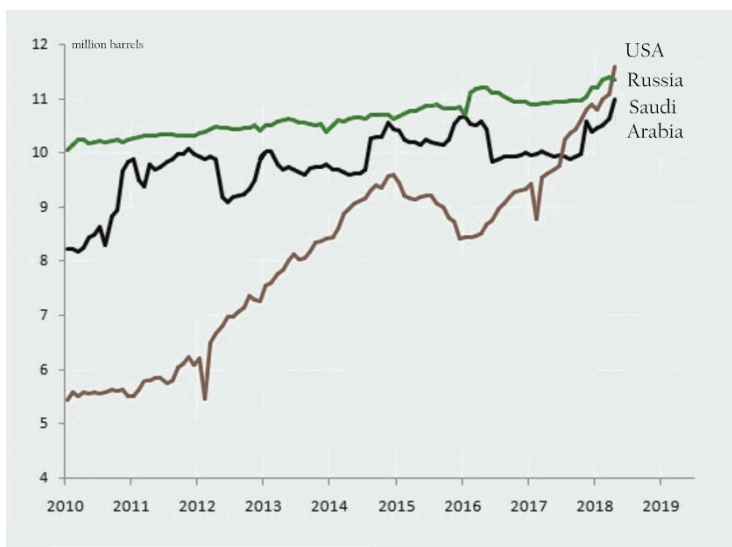
Nowadays, some of the factors affecting the oil and gas industry are very obvious and studied. The analytical centre under the government of the Russian Federation identifies two main factors, political and economic. Political risks such as sending gas through Afghanistan and imposing sanctions can be considered as an example [11].

The ability to transport oil or gas can also be considered as a separate factor.

The emergence of new branches, spreading or abandoning them, can greatly shake the position of some companies, which will lead to re-forming and changing strategies, the results of which are unpredictable. An interesting example is the former union republic of the USSR. Azerbaijan has started commercial gas supplies to Europe via the Trans Adriatic Pipeline (TAP). This was confirmed on Thursday, December 31, 2020, in the country's Ministry of Energy [12]. This is one reason why Russian gas weakened its position in the market, which affected the oil and gas sector of the country since the EU and Turkey are one of the main consumers.

We know at what speed scientific trends are changing now, which are being introduced into our everyday life faster and faster, so we can confidently say that the technological factor has a significant impact. New technologies require new energy resources - environmentally friendly, energy-intensive, easy to extract. Many leading countries are developing strategies for the next 10 years to transition to renewable energy sources.

Based on Hubert's law, one can single out the so-called resource factor. This factor can determine the end of a whole era of industrial raw materials direction.



**Figure 1. Schedule of oil production from 2010-2019.**

Having studied the data on the oil produced and its reserves in Russia and the leading countries, one can notice a tendency to an increase in producing oil and the static data on reserves in these countries, which may indicate a possible, quick, by historical standards, reaching the maximum oil production.

During the period of acute coronavirus infection, there was a sharp drop in oil prices due to a decrease in demand, as well as as a result of geopolitical restrictions imposed during this period.

In general, the following trends in the decisions made were observed in the companies:

- attempts to maintain production capacity and labour opportunities for their employees, despite breaking contracts with contractors;
- making decisions, avoiding consultation of trade unions;

A good example is the Russian companies Lukoil and Rosneft, where possible, work in them was transferred to remote work to the maximum, employees are provided with additional personal protective equipment. Back in March, they officially announced that the filling stations would continue as usual. Taking into account the fact that now the companies are actively returning to their previous level, we can assume that the chosen strategies were successful.

With this information, we can identify one more factor that has not previously had such a strong impact on the energy component in the world - this is a situational factor. This factor can, either include segments of other situations or be something completely new and unpredictable.

### **Conclusion**

The main factors identified in the work are political, economic, transport, technological, resource and situational factors. Knowing this, it is possible to determine the direction of development of the oil and gas sector of the energy industry, as well as to avoid possible shocks associated with them.

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**PROJECT-CLUSTER APPROACH AS A MECHANISM OF ECONOMIC DEVELOPMENT IN THE ARCTIC, ON THE EXAMPLE OF THE PROJECT OFFICE OF THE ARCTIC CLUSTER IN THE BULUNSKY DISTRICT OF THE REPUBLIC OF SAKHA (YAKUTIA)**

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**Abstract.** *In the modern world, the use of new mechanisms for the development of territories and infrastructure is of great importance. New times require new approaches and forms of work. The need to use new approaches is caused by changes in economic processes, optimization of budgets at all levels, complication of social ties, reassessment of the value of the quality of life of the population and social infrastructure. The article discusses the design-cluster approach and the practical elements of its implementation in the special climatic, economic, logistic and geographical conditions of the Eastern Arctic.*

**Keywords:** *Arctic, economic development, project approach, process management, clustering.*

The relevance of the study, both from a theoretical and practical point of view, is of great importance. Improving the quality of life, investment attractiveness of territories, development of infrastructure are areas of development on which the attention of authorities, non-profit organizations, and the media is focused. These areas are of particular relevance in the Arctic, which is increasingly returning to the international agenda over the past decade. Within the framework of these processes, it is necessary to assess the economic, political, geopolitical, regulatory, historical, ecological, socio-cultural process, their impact and integration into the overall picture of global and state changes. As part of the aggravation of the geopolitical struggle for the use of resources, interest in the Arctic and the Arctic region as such is again sharpening.

In the modern world, the use of new mechanisms for the development of territories and infrastructure is of great importance. The new time requires new approaches and forms of work, within the framework of the assigned tasks. The need to use new approaches is caused by changes in economic processes, optimization of budg-

ets at all levels, complication of social ties, reassessment of the value of the quality of life of the population and social infrastructure. One of such mechanisms can be considered the design-cluster approach. This approach allows, on the one hand, to strengthen projects that are being prepared at the launch stage (through complementarities and interconnections), on the other hand, it reduces risks in the event of one of the investors leaving, so that this does not affect the overall cluster system. Within the framework of the bundles, it is necessary to use the advanced experience of leading scientific schools, higher educational institutions, secondary specialized (applied) educational institutions, foundations, state and municipal bodies, the media around forward (breakthrough) projects, which become "locomotives" for the implementation of subsequent projects and diversifies the economy of the territory. In the context of subsidized budgets of most Arctic municipalities, a change in approaches is required to improve the quality of life of the population, the formation of new approaches to investment attractiveness.

Within the framework of project activities, a typical design model is used: formulation and analysis of the problem, goal setting, determination of effective implementation mechanisms, assessment of funding sources, identification of indicators, project aftereffect, etc. Depending on the specific project, its focus, mechanisms are added from other areas of project activity: social design, business design, etc. The cluster model is used to analyze the connection between partners, the resource potential to obtain maximum effects. So, within the framework of the project office, several stages were identified for conducting a preliminary analysis, the prospects and relevance of such an approach at the level of the Arctic region: an assessment of external and internal impact on initiatives, the presence of formal and hidden barriers, hidden resources and potential. So the priority measures are determined: the allocation of the levels of interaction of the project office, and the distribution into contact zones. So, according to the levels of interaction, the distribution is carried out as follows: district, regional, interregional, federal, international. In terms of the activities of the project office at the stage of the organizational period, the following support areas were identified: the formation of basic partnerships at all levels of interaction, interaction with authorities, the formation of a scientific base for the activities of the project office based on adaptive and author's models, interaction with non-commercial organizations, media, universities, secondary schools, research institutes. This distribution of interaction is linked into a number of social and economic concepts: cluster development, project management, synergistic interaction, social partnership, cooperation, "economic complexity".

After the examination of the project, an assessment is carried out by attracted experts from the relevant area of activity, an assessment of systemic and administrative barriers for their removal, based on the results of the project, if there are unique results of implementation, it is possible to "package" the project into a

boxed solution for distribution to other territories, or commercialization in the form of a franchise. Thus, within the framework of the project office, a clear working sequential structure has been formed that determines the processes and dynamics of the project at all stages of the project initiator and the project office (Office Processing). As part of defining the outline of partnerships for the project-cluster approach of the Arctic cluster, the need was identified 1. Involvement of experts of different levels (district, region, interregional level, federal level) 2. Involvement of experts from different fields (energy, project management, investment policy, innovative technologies, social technologies, scientific schools, etc.) 3. Involvement of experts from various fields of activity (State and municipal authorities, commercial companies, non-profit organizations, foundations, expert communities, higher education, research groups, mass media, etc.)

High-quality coverage of activities is important for managing the image of the territory. This is primarily due to the possibilities for successful replication, changing investment attractiveness, attracting a wide range of experts of different levels, obtaining funding to start a project, with the attraction of further co-financing or commercialization of the results. So, within the framework of the project office, a number of expert and consulting events were held for limited liability companies, public organizations, individuals, for writing and submitting grants for funding, seminars and round tables. Within the framework of these events, it is worth noting the high percentage of applications passing through, and their recognition as winners, which, on the one hand, indicates the presence of the project culture of the performers, on the other hand, the high-quality expert work of the project office for the development of the Arctic cluster. The criterion for the selection of projects and project ideas was: significance for the Arctic or, in particular, Bulunsky district, the significance of the results of the project or research, the social significance of the project, the possibility of practical application of the results obtained, the impact of projects on the infrastructure of the territory, the presence of experts in the industry leading the project.

As part of the implementation of reference projects, at the stage of conceptualization, and work to attract the necessary experts and co-financing, the following projects are considered:

1. Use of gas hydrate as an element of the gas supply system for remote Arctic settlements. Within the framework of the project, it is planned to conduct a study of gas hydrate, assess deposits in the district, analyze the efficiency and efficiency of using gas hydrate, develop a pilot model for connecting small settlements to gas, in order to obtain objective and comprehensive results, with a positive effect, economic rationality, environmental safety, the project may be considered for replication to other Arctic territories.

2. Creation and arrangement of the site "Testing ground for testing, adaptation

and certification of equipment in the Arctic". Taking into account the special climatic conditions of northern Yakutia in the Bulunsky region, the presence of different terrain, infrastructure in the form of warehouses, the possibility of creating a center where it is possible to test equipment for various purposes is being considered. On the one hand, this project is able to attract investors, create a favorable investment image of the region, create new highly qualified jobs, and attract Russian and foreign equipment for testing in the Arctic, which, after passing the test, could receive the marks of the quality system "Tested in the Arctic", "Made in the Arctic"

3. Together with the Russian University of Economics. G.V. Plekhanov (Moscow), an assessment was made of the potential for the development of coal deposits in the Bulunsky district and their potential for implementation in the real economy and energy efficiency in the village of Tiksi.

4. Creation of the International Center for the Study of Sustainable Development of the Arctic in the village of Tiksi of the Republic of Sakha (Yakutia). The creation of such a center would also be one of the "anchor" reference projects that could develop, test, apply and introduce new technologies "on the spot".

**Based on the analysis of the results, the following conclusions can be drawn:**

1. The project approach, within the framework of the cluster model, is one of the most effective mechanisms for achieving the goals of socio-economic development, including in the Arctic;

2. High-quality media support, provides an opportunity to assess and further interact with potential partners in development projects, investment in Arctic projects from non-Arctic regions of the Russian Federation;

3. The project approach forms the strategies for the development of territories, and determines the optimal partners within the framework of the cluster development model, taking into account the characteristics of the territories.

4. The design-cluster model is optimal from the point of view of the introduction of innovations, the formation of technical and technological platforms and chains of links.

5. Project management has greater mobility in comparison with traditional forms of interaction and management, increases the rate of implementation of innovations, which is important when implementing strategies for the socio-economic development of territories

6. Informal relations within the framework of project groups allows to reveal the potential of the territory, through trust between partners, forms motivational strategies for the participants to increase their efficiency and competence.

7. The project approach can create conditions for targeted clustering through the creation of new organizations and enterprises, including in non-resource sectors of the economy.

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**INTERNATIONAL, LEGAL AND ECONOMIC ASPECTS OF  
PROVIDING TRANSPORTATION ALONG THE NORTHERN SEA  
ROUTE**

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**Abstract.** *The article examines the importance of the Northern Sea Route in ensuring stable international transport for the needs of the world economy. The article considers the regulation of the Northern Sea Route in the context of national legislation and international legal norms. At the same time, international conventions and legal acts of the Russian Federation regulating the legal regime of the Northern Sea Route have been analyzed.*

**Keywords:** *Arctic, Northern Sea Route, cargo transportation, transport system, sea transport.*

In the context of the globalization of the world economy, when suppliers of various goods can be located in different parts of the world, they acquire transport communications that ensure the delivery of the required goods. The most important elements of the world transport system are international straits and artificial sea canals.

A huge role in the modern world economy is played by the Panama Canal,

which makes it possible to reduce thousands of nautical miles when crossing from the Pacific Ocean to the Atlantic Ocean, and the Suez Canal, which allows the shortest route from the Indian Ocean to the Mediterranean Sea.

So, 14,019 ships passed through the Suez Canal from January to September 2020,<sup>1</sup> approximately the same number of ships passed through the Panama Canal during this period of time.

Given the huge role of these channels in world trade, the most important indicator is ensuring the stability of the supply of goods through these channels.

The huge vulnerability of these structures was demonstrated by the accident that occurred on March 24, 2021 with the container ship "Ever Given", which ran aground in the southern part of the Suez Canal and completely blocked traffic in both directions. Losses to the global economy due to the said blockage of the Suez Canal could amount to up to 10 billion US dollars.<sup>2</sup>

In this regard, it is worth considering the prospects for using the Northern Sea Route (hereinafter referred to as the NSR) to ensure a stable supply of goods for the needs of the world economy. At present, the Russian Federation seeks to create, within the NSR, a Eurasian maritime transport artery along which navigation will be ensured through centralized government from Russia.

Currently, the operation of the NSR is influenced by the international situation, within which this northern shipping line becomes of interest to international freight carriers who seek to establish their own rules for the use of NSR, taking advantage of the fact that the problems associated with the creation of modern infrastructure for the proper operation of the NSR were previously rather slowly solved. Satisfying the requests of Russian and international shipping companies involved in the movement.

The identified problems are reflected in the strategy for the development of maritime activities of the Russian Federation until 2030, approved by the Government of the Russian Federation.<sup>3</sup> So, now in the direction of sea transport traffic management, significant success has been achieved (the volume of cargo transportation has been increased, the technical equipment of ports has been improved, etc.). Thus, in accordance with the provisions of the Maritime Doctrine of the Russian Federation, the preconditions have been created for the functioning of this highway as a national transport communication with the possibility of inter-

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1 See: [https://www.korabel.ru/news/comments/sueckiy\\_kanal\\_uvelichil\\_trafik\\_po\\_sravneniyu\\_s\\_proshlym\\_godom.html](https://www.korabel.ru/news/comments/sueckiy_kanal_uvelichil_trafik_po_sravneniyu_s_proshlym_godom.html) (appeal date: 11.03.2021).

2 See: Demidov A. Losses from blocking the Suez Canal can reach \$ 10 billion // *Gazeta.ru* – URL: [https://www.gazeta.ru/business/news/2021/03/26/n\\_15786224.shtml](https://www.gazeta.ru/business/news/2021/03/26/n_15786224.shtml) (appeal date: 27.03.2021).

3 See: Order of the Government of the Russian Federation of August 30, 2019 № 1930-r "Strategy for the development of maritime activities of the Russian Federation until 2030" // Government of the Russian Federation. – URL: <http://marine.gov.ru/upload/iblock/5f1/5f11cdf556775586360a5905054c3ec3.pdf> (appeal date: 03.03.2021).



national use, competitive in relation to traditional sea routes in terms of the quality of transport services and safety of navigation within the framework of the current national legislation.<sup>4</sup>

Since the active participation of the Russian Federation in the system of international relations, the management of NSR is determined within the framework of the formation of a new geopolitical status of the country, which has led to an increase in the volume of cargo transportation by foreign transport companies and shippers by NSR, since transportation by NSR is becoming of interest to foreign transport companies, since the considered transport highway, allows you to deliver goods to the Pacific coast in the shortest possible time.

In 1997, the Russian Federation acceded to the UN Convention on the Law of the Sea, providing that it does not accept the procedures specified in Section 2 of Part XV of the Convention leading to the adoption of binding decisions by the parties on disputes related to historical bays, the exclusive economic zone, and the delimitation of maritime boundaries<sup>5</sup>.

It is important to note that the 1982 UN Convention on the Law of the Sea has not been ratified by the United States to date, but they are trying to increase their presence in the polar space, along with Canada and the European Union.

Currently, the Russian Federation is developing NSR as a historical transport communication of the Russian Federation, however, this process is influenced by the changed geopolitical situation, which is complicated by the following factors:

- Norway's desire to oust the Russian Federation from the Svalbard archipelago or reduce the Russian presence in the archipelago and reconsider the status of the archipelago as a demilitarized zone. In particular, Norway has unilaterally established a fish protection zone of 200 nautical miles in the area of this archipelago, which is not recognized by the Russian Federation.<sup>6</sup>

- China, Japan and South Korea are considering NSR as a promising transport hub and an alternative to the Suez Canal, since the transportation of goods through the NSR is 15% more profitable than using standard Asian sea routes for this.<sup>7</sup>

- due to the ongoing climatic changes and the reduction of ice-covered territo-

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4 See: The maritime doctrine of the Russian Federation approved by the President of the Russian Federation on July 26, 2015 // President of the Russian Federation. – URL:<http://static.kremlin.ru/media/events/files/ru/uAFi5nvux2twaqjftS5yrIZUVTJan77L.pdf> (appeal date: 03.03.2021).

5 See: Federal Law of February 26, 1997 № 30-FZ "On the Ratification of the United Nations Convention on the Law of the Sea and the Agreement on the Implementation of Part XI of the United Nations Convention on the Law of the Sea" - URL: <https://base.garant.ru/2540664/> (appeal date: 03.03.2021).

6 See: Kolodkin R.A. Agreement with Norway: demarcation for cooperation // Maritime law and insurance – 2021. - № 1. – P. 105.

7 See: Kudrevich V. Arctic new challenges: how to make the Arctic Ocean not an arena for a new geopolitical confrontation, but a territory of economic cooperation // TASS. – URL: <https://tass.ru/spec/arctic> (appeal date: 03.03.2021).

ries, the volume of transported goods on the NSR is increasing.

Thus, in August 2017, the Christophe de Margerie tanker sailed along the NSR in less than 7 days, becoming the world's first merchant vessel that covered the entire route along the NSR without icebreaker assistance.<sup>8</sup>

Consequently, today the regulation of navigation according to NSR from the standpoint of Russian legislation is determined by the following structure:

- 1) ratified norms of international law;
- 2) federal legislation governing the rules for the movement of ships in the territorial sea and inland sea waters, as well as the rules for carrying out transportation by water transport;
- 3) by-laws and local regulations governing certain issues of the operation of NSR infrastructure facilities, trade transit rules, etc.

At the level of federal legislation, transportation by NSR is regulated by the Federal Law of July 31, 1998 № 155-FZ "On internal sea waters, the territorial sea and the contiguous zone of the Russian Federation."<sup>9</sup>

Considering that according to NSR the first commercial foreign vessel passed with the permission of the Russian authorities only in 2010 (bulk carrier Nordic Barents), the position of the Russian Federation, based on the doctrine of historical waters, is justified.

In addition, a sufficient basis for establishing national sovereignty in relation to NSR is the regulation by Russian legislation of transportation on this route for many decades.

At the same time, the Russian Federation does not interfere with international shipping along the NSR, since navigation along this northern route contributes to the socio-economic development of the region as a whole.

However, obtaining the economic benefit and political advantage from the ownership of the right to manage and implement the licensing system within the NSR imposes additional responsibilities on the Russian Federation. According to the UN Convention on the Law of the Sea, the Geneva Convention "On the High Seas", the Russian state is one of the Arctic states, which, having exclusive rights to own and manage part of these territories, are obliged to ensure proper control over the preservation of environmental safety in the region.<sup>10</sup>

Since transport traffic on the NSR increases annually, the Russian Federation

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8 See: Results of work of PJSC "Sovcomflot" in the 1st half of 2017. URL: [http://www.scf-group.com/press\\_office/press\\_releases/item91971.html](http://www.scf-group.com/press_office/press_releases/item91971.html) (appeal date: 11.03.2021).

9 See: Federal Law of July 31, 1998 № 155-FZ "On internal sea waters, the territorial sea and the contiguous zone of the Russian Federation" // SPS "Consultant-Plus". – URL: [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_19643/](http://www.consultant.ru/document/cons_doc_LAW_19643/) (appeal date: 03.03.2021).

10 See: 1982 United Nations Convention on the Law of the Sea // Electronic Fund of Legal and Regulatory and Technical Documentation – Consortium Codex. – URL: <http://docs.cntd.ru/document/1900747> (appeal date: 03.03.2021).

needs to pay special attention to the environmental situation in this region.<sup>11</sup>

Understanding the identified problem, the Decree of the President of the Russian Federation dated March 5, 2020 № 164 "On the foundations of the state policy of the Russian Federation in the Arctic for the period up to 2035" defines the main measures aimed at maintaining a favorable environmental situation in the Arctic.<sup>12</sup>

Considering that the Arctic and NSR are, among other things, objects of economic interest of the Russian Federation, and are also recognized as one of the main resource bases of the state, the preservation of environmental stability in the region belongs to the sphere of national interests of the Russian Federation not only within the designated period, but in the long term.

Within the framework of this article, we should pay special attention to the problems of interpretation and application of certain provisions of international normative documents and the resolution of disagreements between the Russian Federation and other subarctic countries in relation to NSR.

One of these problems is the legal interpretation of Article 234 of the UN Convention on the Law of the Sea. The Russian Federation has special rights to develop its own national interests within the NSR, in the aspect that territorial development and navigation within it was initiated by the Russian state in the XVI century and continues up to the present moment, which gives grounds to consider the NSR as a historically established national maritime transport communications.

Moreover, the above article of the UN Convention on the Law of the Sea provides for special legal regulation for states whose borders are located within the maritime regions of the Arctic.<sup>13</sup>

The content of Article 234 of the UN Convention indicates the possibility of a legislative initiative by states, whose borders lie in coastal areas, aimed at ensuring the rules of use, navigation, research and prevention of environmental pollution.

In this regard, the direct interpretation of the content of Article 234 of the UN Convention gives the Russian Federation all the grounds to ensure control over maritime navigation in the area of the Northern Sea Route. At the same time, it is obvious that due to the decrease in the areas covered with ice in the Arctic Ocean, the issue of the internationalization of the use of NSR by a number of states will be actively discussed at the international level. In particular, the United States of America views the NSR exclusively as an international strait that must be open

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11 See: Savenkov A.N. The Arctic: Legal Support for Sustainable Development and Cooperation // Proceedings of the Institute of State and Law of the Russian Academy of Sciences. - 2018. – Volume 13. - № 1. – P. 24.

12 See: Decree of the President of the Russian Federation of March 5, 2020 №-164 "On the Fundamentals of State Policy of the Russian Federation in the Arctic for the Period up to 2035" // IPO "Garant". – URL: <https://www.garant.ru/products/ipo/prime/doc/73606526/> (appeal date: 03.03.2021).

13 See: Vylegzhanin A.N., Nazarov V.P., Bunik I.V. Northern Sea Route: towards solving political and legal problems // Bulletin of the Russian Academy of Sciences. 2020. Volume 90. №12. P.1114.

for transit passage.<sup>14</sup>

In this regard, the Russian Federation needs to maintain control over the navigation of ships in the NSR area and ensure the preservation of a special legal framework for states whose borders go to ice-covered areas.

Article 234 of the UN Convention on the Law of the Sea under consideration contains a commentary on a number of characteristics that should be possessed by the territories adjacent to the Arctic state: the presence of severe climatic conditions, a strong ice shelf, which retains its stability for most of the year, is mandatory.

In this regard, it is necessary to take into account the influence of the climate on the observance by the participants of international relations of the above article of the UN Convention on the Law of the Sea.

Consequently, according to Article 31 of the Vienna Convention "On the Law of Treaties" 1969, each existing treaty is binding on its participants and must be fulfilled in good faith by them, and the interpretation of the norms of international treaties should be based on the objectives of this treaty.<sup>15</sup>

Consequently, if we take into account the intentions of the states that signed the Convention under consideration, and the meaning that was put into the concept of "ice-covered areas", it seems possible to talk about the extension of Article 234 of the UN Convention on the Law of the Sea to the Arctic areas as a whole. Therefore, the concept of "ice-covered areas" and the Arctic, in relation to the Convention under consideration, should act as synonyms, and therefore the strict observance of this article of the UN Convention on the Law of the Sea by all participants in international relations is the main task of Russia.

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14 See: Shitikov V.D., Guseinov G.M., Chirkov A.D. Comparative legal analysis of the peculiarities of the legal status of the Northern Sea Route and the North-Western Passage // Issues of Russian and International Law. 2019. Volume 9. № 4A. P. 110.

15 See: Vienna Convention on the Law of Treaties of May 23, 1969 // United Nations Organization. – URL: [https://www.un.org/ru/documents/decl\\_conv/conventions/law\\_treaties.shtml](https://www.un.org/ru/documents/decl_conv/conventions/law_treaties.shtml) (appeal date: 04.03.2021).

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**EXPRESSIVENESS AND WAYS OF ITS REALIZATION IN V.  
RASPUTIN'S FICTION: PHONETIC, LEXICAL, MORPHOLOGICAL  
AND WORD-FORMING LEVELS**

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**Abstract.** *The object of study of the article is the semantic features of expressive means belonging to phonetic, lexical and morphological-word-formation levels. The purpose of the article is to conduct a differentiated analysis of the functional potential of these tools in the texts of V. Rasputin's fiction. When considering texts, a complex methodology is used, including component, contextual and comparative types of analysis. It turns out that the expressiveness of the language of his works of art is created as a result of an unusual stylistic use of language means. The scientific and practical significance of the work is due to the fact that this phenomenon is extremely multifaceted and requires further study and coverage. The paper concludes that expressive means in the language have a systematic nature, which is represented by units of different levels. The basis of the general language system of expressiveness is determined by the lexical means that express this category as much as possible, and the syntactic means are considered as peripheral.*

**Keywords:** *vocabulary, semantic shades, expressive, feelings, emotions, artistic text.*

**Introduction**

The work of the Russian writer Valentin Rasputin is unique in nature and many linguists, critics and philosophers will turn to his works more than once.

The vocabulary of the modern Russian language has significant potential for transforming the subtlest semantic shades, and the writer's language itself absorbed the deep meaning and vivid imagery of the popular language of the masses and, in a concentrated form, appeared on the pages of his works and stories.

Presenting in his works a description of significant and everyday events, social upheavals, the characters and actions of his positive and negative heroes, his own feelings and experiences, the Russian writer V. Rasputin very accurately selects the required rhythm of the narrative, immersing the reader with the first phrase into an exciting atmosphere from which it is impossible to escape until the end of the story. In the entire manner of his writing, strict, laconic and at the same time lyrical, we note the presence of a very wide range of linguistic means.

The basis of the writer's communicative competence is knowledge and skills that allow him to build correct and expressive speech, which is characterized not only by such emotional states of the subject as approval, reverence, respect, affection, but also disapproval, disdain, contempt, irony, ridicule, condescension, etc. In his prose, expressiveness acts as a means of creating an artistic image, revealing the character's inner world, showing his feelings and emotions, covering all spheres of human activity.

The feelings and emotions of his heroes are presented in literary texts in a reflected form, which is created by the imagination of the writer himself, combines fiction and reality, forming the artistic canvas of a work or story, behind which the reader sees both the world of objects, phenomena and events, and the world of ideas, feelings and emotions. The problem of expressiveness has always been, as you know, in the center of attention of many linguists, since it is associated with the expression of the speaker's subjective attitude to the subject of speech. However, this phenomenon is so multifaceted that it cannot be exhausted by already existing research works and requires further study and coverage.

The leading place among the means of expressiveness is given to just vocabulary, which, according to V.V. Vinogradov, is the brightest and most differentiated not only by shades of meanings, but also by expressive qualities [1]. And, of course, there is nothing surprising here, since this category has a close connection with the semantics of the word, with its figurative rethinking and application in unusual conditions.

### **Purpose of the study**

The purpose of the study is to reveal and conduct a differentiated analysis of the features of expressive means belonging to different linguistic levels in the texts of the writer's fiction.

### **Materials and methods**

In the article, based on the material of fictional prose of the Russian writer V. Rasputin, a complex methodology is used that provides for component, contextual and comparative types of analysis.

### **Results and discussion**

Examples of phonetic means of expressiveness are, first of all, *sound-symbolic words*. It should be noted right away that sound-symbolism is of two types: prima-

ry, based on the synesthetic connection of sound and meaning, and secondary - on the contextual one. It includes sounding in the occasional phonosemantic structure of the text.

Unusual sound can be not only a sign of a sound symbol, but also an independent means of expressiveness, and it is achieved in different ways, for example, by onomatopoeia.

According to N.D. Lyubimova [3], onomatopoeia (*бле-блеять, буль-булькать, кря-крякать, хрю-хрюкать, хехекать*) is one of the most elementary types of contextual sound symbolism, for example:

*С того случая мальчишки нашли новую забаву: всех пойманных змей доставляли Бозодулу, а он, сидя на валуне возле своего барака и руками приподняв ногу, дразнил их, хехекая, как от щекотки, когда змея в мгновенном прыжке пыталась проколоть его твердь, и блаженно приговаривал [Farewell to Matera].*

Nevertheless, it can be carried out with the help of sound repetition - imitation, for example, *прокукарекать, гавкать, хрумкать, улюлюкать, хихихать, хохотать, шушукаться* and etc., for example:

*– Разбирайся, разбирайся, Иннокентий Иванович, – как всегда в последнее время настырничая с ним, не давая ему спуску, ответила Настена. – А я куда шепну, что ребенок-то, однако, на тебя будет походить.*

*– Тьфу, язва! – сплюнул он и пригрозил, отходя: – Нич-че, выясним, на кого он будет походить [Live and remember]*

As you can see from the above example, with the help of lexemes, there is a kind of copying of different ways of pronouncing. Words of this kind may well serve as examples of the expression of speech expressiveness.

The next phonetic means of explication of expressiveness, but not associated with sound symbolism, is the phonetic singularity of the word itself (*гуднуть, мараковать, гизнуться, болбочить*), for example:

*– Дядя Митяй, вам, наверно, три рубля надо. Я могу дать, у меня есть.*

*Митяй, всматриваясь в Саню возрождающимся взглядом, пуще прежнего поморщился и ответил:*

*– Ты корову теткой не зовешь?*

*– Зачем?*

*– То-то и оно... зачем?.. Митяй – кличка, как у быка. Кто ж кличку дядькает? Зови, как все, Митяй, чего там... Не подавлюсь [Live a century - love a century].*

The change in the duration of sounds also adds expressiveness, for example:

*– Иди-иди, голубушка, тут все узнаешь.*

*– Я больше не бу-у-ду.*

*– Иди, тебе говорят, пока я тебе не всыпал. /.../*

– Тебе сколько можно говорить, чтоб ты место знала? Ноги у тебя отвалятся, если ты добежишь куда надо?

– Я больше не **бу-у-ду** [Last date].

In V. Rasputin's fictional prose, there is also such a phonetic phenomenon as sound deformation of a word, for example:

– *Укрываться надо лучше, — со знанием дела посоветовала Варвара.*

– **Куды ишо** укрываться, когда Надя на меня и так все тряпки **постаскиват**, пошевелиться нельзя. Тяжесть лежит, а ноги **дрогнут**. Вот я и кричу Надю или Нинку за ей пошлю. Она придет, нагреет воды – будто легче. А без Нади я давно бы уж пропала – **че тут говорить**. Он трезвый-то – человек, **рази уркнет** когда, а как пьяный напьется – ой, никакого **жительства** нету. И ко мне вяжется, и к ей. Хошь на край света убегай от **его** [Last date].

Phonetic means of expressiveness are used, according to our observations, as characterizing means participating in the creation of the character's image, mainly in direct speech and in comments to it.

Linguistic analysis of the writer's literary texts indicates that the most productive and frequent are the means that can be found at the lexical level. First of all, it should be noted the expressive words that characterize the intellectual properties of a person from the side of the speaker: *болван, дурак, дуралей, идиот, простофиля* and etc.. Note right away that the lexeme *болван* –rude, stupid person (marked as *curse word*).

A touch of affection, playfulness is inherent in the expressive lexeme *дуралей* (aw. *дурашка*). *Идиот* – a person suffering from dementia, however, this word can be used as a curse word. *Простофиля* – stupid, poorly intelligent person, and in explanatory dictionaries this noun is labeled "прост", for example:

*Дарья с удовольствием подхватила:*

– *Поезжай, поезжай. Погляди, чьи избы лутче горят /.../ Че это он чужие избы жжет, ежли свои ишо не все погорели. Ох, Катерина, пошто мы с тобой такие **простофили**? Жили, жили и нисколь ума не нажили* [Farewell to Matera].

A significant corpus in the writer's literary texts is also represented by expressive words that characterize a person from the opposite point of view, positive: *голова / золотая голова* – so they say about a man of great mind.

Based on the data of the explanatory dictionaries of the Russian language, we can conclude that the groups of expressive words noted above can explicate their real stylistic shades due to the presence of additional means of expressive coloring, for example:

*Потом вернулся Михаил и подсел к ней на кровать.*

– *Ничего, мать, – после долгого молчания сказал он и вздохнул. /.../ – Ты не сердись на меня. Я, конечно, **дурак**. Ой, какой я **дурак**, – простонал он*



и поднялся. – Лежи, мать, лежи и ни о чем не думай. Не сердись на меня сильно. **Дурак** я [Last date].

In the presented context, the noun *дурак* has a meaning - just a *stupid person*, at the same time it can imply an abusive connotation. With the help of this lexism, the writer strives to evoke in the reader a negative attitude towards Mikhail - one of the main characters of the story.

The texts of V. Rasputin's fiction are intensely saturated with expressive words that characterize the personal properties of a person: *talkativeness* (*тrepнaч, советчик, тrepло* and etc.); *meanness* (*гaд, гaдюкa, мepзaвeц* and etc.); *arrogance, rudeness* (*гpyбиян, мужлaн, нaхaл* and etc.); *irresponsibility* (*гoлoвoтyпa, хaлтyрицк, aлкoгoлик* and etc.); tendency to quarrel, intrigue (*скaндaлист, склoчник* and etc.); living at someone else's expense (*нaхлeбник, пaрaзит* and etc.); insignificance (*мeлюзгa, шyшeрa* and etc.), for example:

– Дeниc Aгaпoвский, пyсть eмy нa тoм свeтe oтpыгнeтcя, пpихвaтил вaшeгo Минькy в кoлxoзнoм гoрoхe и пyстил eмy в cпину зapяд coли. Пoмнишь, Дeниc,этoт **звepюгa**, тoгдa гoрoх кapaулил – гepoй! [Last date]

Expressive words also take place. (*coбcтвeнник, aриcтoкpат, бoгaтeй, бюpoкpат, кyлaк* and etc.), which characterize the social position of a person, for example:

Гaлькa зaкpичaлa:

...пoдcкoчилa Cтeпaнидa.

– He видaлa и нe считaлa, a знaю, чтo eсть. Ты бы дaвнo уж yдaвилacь, eсли бы y тeбя их нe былo. Ты бы их yкpaлa. Ты **кyлaк**, хyжe **кyлaкa**, тeбя pаскyлaчивaть нaдo! [Money for Mary]

An insignificant number are somatisms, the role of which is to characterize a person's appearance. (*мopдa, глoткa, бpюxo, poжa, рылo, хapя* and etc.), the basic component of which is the idea of such a part of the human body as a **face** – *мopдa, poжa, рылo, хapя*. It should be noted that they all have neutral synonyms in the literary language (*мopдa, poжa, рылo, хapя* – *лицo; нacть* – *poт*), nevertheless, they all have a distinctive stylistic coloration. Lexemes *мopдa, рылo* and *хapя* are rude vernacular. *Рoжa* can be used as a swear word, and the lexeme *хapя* has a vulgar connotation, for example:

Я oтpoдaсь нe вoрoвaлa, a тyт хyжe вoрoвcтвa вышлo.

– Бeз cтыдa, cтapуня, **poжy** нe изнocишь. Хвaтит тeбe oб этoм тpaнтить – нaшлa oб чeм гoвopеть. (Last date)

Zoomorphisms - are a kind of metaphor formed on the basis of the direct name of the animal. Their specific feature is the integrity of the images they create, the ability not only to record the presence or absence of any property in a particular person, but also to qualify this personality type as a whole, expressing many different properties and qualities [4]. The presence of this category of words in the

texts contributes to a significant "revitalization" of the author's speech and giving it special expressiveness, and comparisons of heroes with any animal give the reader scope for the imagination. Therefore, the metaphor "animal-man" plays the role of one of the most expressive means in the language of his literary texts. For the most part, such names-characteristics are aimed at discrediting, a sharp decrease in the subject of speech and have a bright pejorative coloration [3], for example:

*Кузьма торопливо сказал:*

– *Наверно, в кино собралась, а на билет нету. Ухажера еще не заимела, чтоб на свои водил.*

– *Да ее, **кобылу**, все киномеханики бесплатно пускают. У ей вся деревня ухажеры [Money for Mary].*

The fact of the presence in the language of his prose of a whole series of expressive lexemes that characterize objects and phenomena surrounding a person deserves attention. In this case, nouns can be noted, the meaning of which is based on the assessment of something ridiculous, meaningless: *бред, галиматья, дребедень, ерунда, муть, сущие пустяки, чепуха, брехня*etc. It is impossible not to notice that expressive words *галиматья, дребедень, ерунда* and *чепуха* can be attributed to stylistic synonyms, since their general meaning in explanatory dictionaries is interpreted as "*absurdity, nonsense*", for example:

*Я вот сам деревенский, а в город, когда приезжаю, завсегда себе бабу найду. Говорят, деньги им надо давать, то, другое – **ерунда** это, это, может, до революции и было. Теперь у них сознательность [Money for Mary].*

Not the last place is occupied by phraseological combinations, which can also be attributed to expressive lexical means: *лезть не в свои сани, корчить из себя барыню, знает каждая собака, в три горла жрать, подвести под монастырь*, and etc., for example:

*С таким образованием только получку считать, а не казенные деньги. Я ей сколько раз говорил: **не лезь не в свои сани** [Money for Mary].*

As the above examples testify, emotions in literary texts of a writer are expressed by a combination of a wide variety of means.

The widespread use of expressive word-formation elements and models, which allow, on the basis of neutral linguistic units, to create new expressive words should also be noted: *блокнот – блокнотик, дом – домик, вода – водичка, спина – спинушка* and etc. There is also the creation of expressive words based on a ready-made expressive unit (*обжора – обжорочка*).

In V. Rasputin's fictional prose, there is also a significant number of nouns with suffixes of subjective assessment, implying such meanings as: *diminutive, petting, petting- derogatory, dismissive and magnifying*.

The presence of lexemes with diminutive suffixes is justified by the need for

an expressive representation of the sizes, volumes of an object or phenomenon:

**-ек, -ок, -к:** *бородка, книжка, кулачок, рыбка, ножка, облачко, чудок, кобылка, сынки* and etc., for example:

*Она стала считать деньги, быстро-быстро перебирая бумажки, и все-таки считала долго: деньги были только **трешками** и рублями, и она потом их еще раз пересчитывала. Кузьма стоял, без интереса и без волнения смотрел, как мелькают **бумажки** в руках Полины, ждал [Money for Mary].*

**-ик, -чик:** *солдатик, кончик, обидчик, стаканчик, разговорчик, рублик, дворик, касатик, шатерик, кустик* and etc., for example:

*Она же сама, без подсказки догадавшись, что **солдатик** не знает, куда себя пристроить, подтолкнула его наутро к немолодой уже, но чистенькой, гладенькой немой женщине по имени Таня [Live and remember].*

**-ек, -ок / -к:** *глазки, старичок, сынок, язычок, кобылка, лесочек, папироска, ветерок, речка, тучка* and etc., for example:

*Он понял это по-своему и заторопился, засуетился, как мальчишка, — тогда она осторожно, чтобы не обидеть, удержала его:*

*– Тише, Андрей, не гони, не надо. Любовь-то моя сколько без корма, как худая **кобылка**, жила. Не надорви ее, не понуждай [Live and remember].*

**-ечк, -ичк, -очк:** *минуточка, бутылочка, шуточка, полечка, книжечка, пиеничка* and etc., for example:

*Он протягивает ей деньги.*

*– **Бутылочку** коньяку, если вы ничего не имеете против. Вы там человек свой, вам дадут [Money for Mary].*

**-ушк, -ишк:** *дереушка, солнышко, камешки, матушка, дедушка, вдовушка, старушка, головушка, жenuшка* and etc., for example:

*Не надо бы мне ни перед кем тут показываться, да одному не перезимовать. **Хлебушком** ты меня заманила [Live and remember].*

**-енк, -еньк:** *песенка, работенка, бабенка, дяденька* and etc., for example:

*Жук спокойно и как будто даже привычно ждал, когда утихомярятся. Вид у него был замотанный, усталый, черное цыганское лицо посерело. Видать, **работенка** эта доставалась непросто, если представить еще, что объясняться таким образом ему приходилось с местным населением не впервые [Farewell to Matera].*

As an expressive characteristic of characters, objects and the environment, the writer also uses nouns with a magnifying suffix **-ищ:** *бородища, ручища, позорище* and etc., for example:

*Прячась, Гуськов пошел в камни, которые громоздились посреди острова, как громадный могильник, и неожиданно наткнулся за расщелиной на глубокую, уходящую далеко вбок выбоину, напоминающую пещеру, со следами старого **кострища** [Live and remember].*

A quantitative analysis of the use of special formants allows us to note the use of a significantly smaller number of expressive words with derogatory and dismissive ones, however, the degree of their expressiveness is much higher, since it is common for a person to express negative emotions more strongly than positive ones. In this case, we have highlighted nouns with suffixes:

**-ишк, -яшк:** *воришка, городишко, делишки,домишко, людишки, мыслишка* and etc., for example:

*На выходные и на праздники Роза уезжала к себе в район и не показывалась по три дня, а потом привезет с собой какую-нибудь мелочишку и говорит, что получала товар – попробуй докажи, что она гуляла. (Money for Mary)*

**-ец, -иц, -ц:** *братец, девица, дельце, книжица, пальтецо* and etc., for example:

*Хочу я спросить его, на что он такое надеется. А? Не говорил он тебе? У нас в родове всякие бывали, но чтоб до такого дойти... От стержец дак стержец. Доугрался... [Live and remember].*

**-уг, -ыг, -юг, -яг:** *ворюга, дяляга, пьянчуга* and etc., for example:

*– Помнишь, Данила-мельник пил, дак его за человека не считали. Ну. Пьянчуга, и все. Так и звали: Данила-пьянчуга. Он ить один так пил, боле никто [Last date].*

### Conclusion

Thus, the expressiveness of the language of V. Rasputin's works of art arises as a result of the unusual stylistic use of certain linguistic means, the intensification of the quantitative or qualitative aspects of what is designated, the use of associative images that cause a positive or negative emotional assessment. Despite the fact that the phonetic type of expressiveness in the Russian language is represented by a low frequency, that is why it is characterized by a high degree of expression. The use of phonetic expressions as characterizing means participating in the creation of the character's image is mainly observed in direct speech and in comments to it. At the lexical level, expressiveness is expressed either directly by the lexical meaning of a word, or it can be associated with the figurative use of linguistic units. Consideration of vocabulary with objective meaning revealed the active use of morphological and derivational means, primarily the suffixes of subjective assessment.

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## GERMAN AND RUSSIAN FAIRY TALES: CONCEPTUALIZATION OF POSITIVE AND NEGATIVE ATTITUDES TO WORK

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**Abstract.** *This article presents a linguistic analysis of the conceptualization of the positive and negative attitudes towards the work of the heroes of German and Russian fairy tales, as well as the identification of unity and differences in their perception by representatives of both linguistic and cultural communities. The main attention is paid to the consideration of linguoculturological and cognitive parameters of the implementation of the language of a fairy tale. The scientific novelty consists in a comprehensive approach to the study of the functional parameters of these concepts in the language of fairy tales. As a result, it was determined that representatives of both nationalities show a respectful, but not equal, attitude to work. The Russian perceives a negative attitude with a more positive connotation, and the German – subjects it to harsh criticism.*

**Keywords:** *linguistic and cultural concept, verbalization, fairy tale, connotative connotation, lexical unit.*

### Introduction

Cognition of the surrounding world begins by a person from the very first days of his birth, when he takes the first steps in recognizing objects, comparing them, processing information received by consciousness and its further verbal implementation. The progressive process of human development, followed by the accumulation and structuring of the information stock about the surrounding reality, contributes to the formation of a system of concepts that is unequal in complexity. Following E.S. Kubryakova, we also note the fact of using other term combinations to represent this category in general, for example, "*conceptual picture of the world*", as well as its individual parts – "*conceptual area or sphere*", etc. [7].

The totality of this kind of concepts contributes to the addition of a certain mental reality, which can be recreated both in the language and in the consciousness of the recipient. The "concept" appears in philosophy as the main idea. In cognitive linguistics, the main base of this thinking-abstract concept was developed, as you know, by the Russian philosopher S.A. Askoldov-Alekseev while working on the theory of knowledge and ethics. In his works, he considers the idea of concept as an instant and subtle flashing of "something" in consciousness, these are points of the most complex inflorescences of mental concreteness" [1]. Developing his premises, he believes that the concept is a certain semantic formation, which in the process of our thinking allows us to replace a huge set of the same kind of objects [ibid.].

It should also be noted that at present in linguistics we note the use of the terminology of related sciences to define various concepts. Moreover, some linguists tend to correlate the idea of "concept" with the philosophical category of gestalt used in gestalt psychology and denoting a visual, spatial form of perceived objects [8].

Following such linguists as S.A. Askoldov-Alekseev (1997), N.N. Boldyrev (2000), E.S. Kubryakova (2002) the idea of "concept" in our minds is represented in the form of some "education" or "construct", which can replace such terms as "concept" or "meaning".

Analysis of the works of representatives of the direction that studies theoretical knowledge [3, 7, 13], allows you to see the interpretation of the concept, which is presented in the form of an operational unit of perception, allowing you to "cleanse" and present an image without unnecessary information.

The verbalization of the "concept" in the language, as our observations indicate, is realized by a variety of means, separately taken words and phrases, such can also be sentences, phraseological units and even whole sentences.

#### **Purpose of the study**

The purpose of the study is to reveal and conduct a differentiated analysis of the features of the conceptualization of the positive and negative attitudes towards work of representatives of the German and Russian linguocultural communities.

#### **Materials and methods**

In the article, on the material of the language of German and Russian fairy tales, a complex methodology is used that provides for component, contextual and comparative types of analysis.

#### **Results and discussion**

Considering the texts, we see in them not only a mirror image of verbally fixed concepts, but also of national culture and consciousness. One of the examples of national culture in linguistics can be considered folklore texts, characterized by attractiveness, anonymity and traditional stability.

The model of the linguocultural concept "labor / laziness" in German and Russian fairy tales is of interest in our research. In the center of the conceptual model "Labor/Arbeit" the image of a person engaged in physical or intellectual work is presented. The need to carry out certain work may be due to some kind of external or internal coercion, and its implementation is associated with all sorts of efforts, patience, perseverance and other subjective qualities of a person.

It is impossible not to notice that German fairy tales abound in such lexical units as *treu dienen; fleißig sein; sich alle Mühe geben; vor Freude immer größere Stiche machen; j-m sein Leben lang treu sein; die Arbeit von Herzen tun, in großer Freude eine Arbeit tun*, with reflective positive connotative tone: *Die Frau Holle sagte: «Es gefällt mir, dass du wieder nach Haus verlangst, und weil du mir so **treu gedient** hast, so will ich dich selbst wieder hinaufbringen.» Sie nahm es darauf bei der Hand und führte es vor ein großes Tor [Brüder Grimm. Frau Holle].*

*Госпожа Метелица сказала:*

– *Мне нравится, что тебя тянет домой, и так как ты мне хорошо и прилежно служила, то я сама провожу тебя туда. – Она взяла ее за руку и привела к большим воротам [transl. G. Petnikov].*

A significant place in German fairy tales is also occupied by vocabulary with a tone, for example: *es hat sich müdgearbeitet; alle Arbeit tun; so viel Spinnen, dass ihm das Blut aus den Fingern sprang; eine immer größere Last aufbürden; schwere Arbeit auflegen; das tägliche Brot schaffen; wer Brot essen will, muss es verdienen; von Morgen bis Abend schwere Arbeit tun* and etc., for example: *Sie (Die Witwe – A. P.) hatte aber die hässliche und faule, weil sie ihre rechte Tochter war, viel lieber, und die andere musste alle **Arbeit tun**... [Brüder Grimm. Frau Holle].*

*Но мать больше любила уродливую и ленивую, а той приходилось исполнять всякую работу... [transl. G. Petnikov].*

For many Russian fairy tales, according to our observations, a wide range of vocabulary with a positive connotative tone is also inherent: *без дела не сидеть, управляться с легкостью дома, ладить с работой, у него работа горит в руках, недаром хлопотать, служить верой-правдой, работа не минует чьих-то рук, в поле возиться подпеваючи, уж как взялся за муж, на все дюж* and etc., for example: *Вот как-то говорит она (Vasilisa – A.P.) старушке:*

– *Скучно мне сидеть без дела, бабушка! [Vasilisa the Beautiful]*

The specifics of the concept of "laziness / Faulheit", its interpretation, as well as the attitude towards it worried and continues to do so up to the present time, the minds of writers, scientists, philosophers, sociologists and representatives of many other professions. In various kinds of reference sources, such interpretations of it are presented as "lack of desire to act, work, love of idleness" [11, p. 276], *«Отсутствие желания действовать, трудиться, склонность к безделью [BTSRY 2000 Comprehensive Explanatory Dictionary of the Russian Language,*



edited by S. A. Kuznetsov], *Faulheit – das Faulsein; Unlust, sich zu betätigen. Beispiel: er hat es aus reiner Faulheit nicht getan*» [15]. It is known that the image of a "lazy person" is reflected in sufficient detail in many fairy tales.

Folk wisdom in this kind of genre focuses not on magical objects, not on animals, frogs and fish that speak human language, but on sons, who, thanks to them, are able to idly lie on the stove or receive untold riches. True, it is typical for a Russian fairy tale that "laziness" in them is absolutely harmless, there is no aggression in it, and in many cases it ends with something unexpected and even useful. An example of this can be a flying carpet, a self-assembled tablecloth, a plate showing everything, an instrument that itself works, etc., have been and continue to be implemented in many modern gadgets and devices [12].

It is also noteworthy that in the concept of "laziness" one can see a lack of desire to work, enjoying idleness, and even in such a particular way as passivity and its characteristic attributes such as *loitering around, doing trifles, putting off all things for later, distracting yourself from anything, to hesitate with something, etc.* At the same time, we agree with the statements of A.A. Zaliznyak, I.B. Levontina and A.D. Shmeleva that *laziness* always acts as a kind of brake in certain situations, constantly plunges the subject into doubts about the expediency of spending efforts on the implementation of something conceived [6].

As explicators of such a concept in the domestic linguocultural community, we note lexemes of the type: *ленивый, лентяй, разлентиться, ленивец, лодырь, лоботряс, лениво* and etc. Similar can be observed in German: *Tagedieb, faul, Faulheit, faulzen, Nichtstun, Faulenzer, Faulpelz, Nichtstuer* and etc, that is, the lack of desire to act, work, a tendency to idleness [Ozhegov 1985]. The considered sets of vocabulary in both languages and the presented definitions of this lexeme indicate its negative characteristic, which creates certain obstacles for many people and interferes with their self-realization. However, one cannot fail to note a certain positive connotation, characteristic, for example, of the word *ленивец*, which is integral to this concept.

Immediately, we note that German fairy tales are characterized by the presence of such a concept as *Schlaraffenland / country of lazy monkeys*, originating from Middle High German *sluraff* – lazy person, *Affe* – monkey and *Land* – land. This motive has been known since ancient times. In Germany, this term was first used by Sebastian Brant in his satirical works "Ship of Fools / Das Narrenschiff" - a synonym for "Country of Fools" [16]. Moreover, in the content of German fairy tales, we note a number of lexical units or combinations that imply the concept of *laziness*: *Langeweile haben; du, in der Ecke, du musst auch was lernen; an dir ist Hopfen und Malz verloren; war vergnügt und spielte vor ihm herum; sie fing an zu faulzen; in Saus und Braus leben* and etc., for example: *...so ging das Königskind hinaus in den Wald und setzte sich an den Rand des kühlen Brunnens*

– und wenn sie **Langeweile hatte**, so nahm sie eine goldene Kugel... [Brüder Grimm. Der Froschkönig oder der eiserne Heinrich]. / ...и вот в жаркие дни младшая королева выходила в лес, садилась на край студёного колодца, и когда становилось ей скучно, она брала золотой мяч... [transl. G. Petnikov].

...am zweiten Tag aber fing sie (Die Faule – A.P.) schon an zu **faulenz**en [Brüder Grimm. Frau Holle]. / Но на второй день стала она [Lazy woman - A.P.] полениваться... [transl. G. Petnikov].

The texts of Russian fairy tales are also replete with similar lexical units: сидеть у ворот, прикорнуть в уголке, глядеть на улицу, спать беспробудным сном, скоро сказка сказывается, да не скоро дело делается, все время лежать на печи, перегребал сажу и спал по несколько суток непробудным сном, сидеть на печи да гложить кирпичи, как сыр кататься в масле, ничего не делал, только на печи в углу сидел да сморкался, дурак ничего не делал, все на печке сидел да мух ловил, что же ты не учишься, али целый век хочешь дураком изжить, сидит на завалинке, греется на солнышке and many others, for example: Пошла с сиротой Одноглазка в лес, пошла с нею в поле; забыла матушкино приказанье, **распеклась на солнышке, разлеглась на травушке**... [Afanasyev. Tiny-Khavroshechka]. Покуда мать закручинилась так – то, Иван сидел на завалинке и ни о чем не горевал [Afanasyev. Elena the Wise].

### Conclusion

Thus, the linguistic analysis of the concepts of "Arbeit / Faulheit" in German and Russian fairy tales allows us to note that this genre of oral folk art has been formed over a long time from many legends, tales, sagas into a special genre of epic character and refers to oral or written folk art. At its core, this genre of oral folk art is multidimensional, and reflects not only the social organization of a society distant in time from us, but also its aspirations, beliefs and customs. This can be confirmed by the fact that the motives of this genre are determined by ancient myths and rituals of folklore genres, and its multi-level content-semantic space includes matrices of cultures of different peoples. An attempt made in this work to present the concepts "Arbeit / Faulheit / Labor / Laziness" by different-level linguistic means, as well as to identify the unity and difference in their perception by representatives of the German and Russian linguocultural communities leads to a very interesting conclusion. In German and Russian fairy tales, we note a respectful attitude to work on the part of both linguocultural communities. The German, with his permanent material interest, correlates wealth and prosperity directly with conscientious work, and he severely criticizes his unwillingness to work. For the Russian fairy tale, the concept of "Laziness" is characterized by a "softer" shade, since its perception is seen as a kind of weakness, and not a terrible vice.

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## THE USE OF AUTHENTIC MULTIMEDIA VIDEO MATERIAL IN ENGLISH LESSONS AS A MEANS OF DEVELOPING STUDENTS' COMMUNICATIVE COMPETENCE

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**Abstract.** *In the modern world, trends in the development of language education occupy a very important place in the development of a person as a whole. In order to communicate freely with native speakers, avoiding possible difficulties with correct understanding, it is important not only to have a well-formed communicative competence, but also to know the cultural norms of the country, to have knowledge of the peculiarities of social life, lifestyle, and language realities, which is difficult to do outside the country of the language being studied*

*However, the actual socio-cultural processes are so dynamic that their statement, and even more detailed consideration, requires the introduction of new views on the study of socio-cultural competencies.*

**Keywords:** *multimedia authentic material, communicative competence, stages of presentation of video material, socio-cultural knowledge, socio-cultural competence.*

### Introduction

The concept of competence is relatively new and in recent years a fairly large number of works have appeared in the scientific literature that contain the definition of competence.

According to A. V. Khutorsky, competence is a complex of various personality qualities that are necessary for high-quality and productive actions aimed at them, while relating to a specific area of subjects or processes. Such qualities include skills, abilities, knowledge and methods of activity [Khutorskoy 2008: 7].

The relevance of the study is caused by the insufficient development of theoretical approaches to the organization of the process of developing socio-cultural

competence with the use of authentic video materials in teaching English to high school students.

Based on the relevance of the study, it is possible to determine the problem, namely, the need to develop a set of exercises aimed at the development of socio-cultural competence.

**Purpose of the study** to learn the methodology of working with feature films in English classes

*The object of the research* is the development of socio-cultural competence in teaching AI.

*The subject of the research* is an authentic feature film as a means of developing socio-cultural competence in teaching foreign languages.

Within the framework of the study, the following *tasks* were set::

1. To reveal the content of the concept of " socio-cultural competence»
2. Identify the potential of feature films in teaching English
3. Consider authentic video materials as a means of developing socio-cultural competence
4. Learn the methodology of working with feature films in English classes.
5. Develop a set of exercises for the development of socio-cultural competence through the use of feature films.
6. Test the set of exercises and analyze the results of testing

To achieve these objectives, the following research methods were used:

- analysis
- synthesis
- generalization
- comparison
- experiment
- testing

### **Materials and methods**

For the first time, the idea of forming key competencies was put forward by the Council of Europe experts on education in 1996 in the "European Project". This idea is reflected in the new Federal State Educational Standard of Basic General Education. I. L. Bim believes that after the adoption of the competence approach, the education system was greatly transformed, which, in turn, was necessary due to the development of the world and the shift in emphasis from the ability of graduates to adapt to modern realities to their competence [Bim 2002: 38].

Speaking about the concept of socio-cultural competence, we took as a basis the definition of E. G. Asimov and A. N. Shchukin. They believe that this is not only general information about the country of the language being studied, but also knowledge and acceptance of the national and cultural features of the social and speech behavior of native speakers and the ability to use such knowledge in

the process of communication, according to the customs, rules of etiquette, social characteristics and stereotypes of behavior of native speakers [Azimov, Shchukin: 2008].

Currently, it is not just the achievement of communicative competence, but communication with people whose English is their native language and is the actual and dominant goal of learning English. That is why students should have not only a theoretical, but also a visual understanding of the life, culture, and language realities of English-speaking countries. N. V. Baryshnikov and G. G. Zhoglina are of the opinion that authentic videos can introduce students to the cultural and social values of the native-speaking people. Taking into account the requirements of the communicative methodology, video materials quite clearly help to comprehend foreign language culture, develop motivation for communicative activity and individualize the learning process [Baryshnikov, Zhoglina: 1998]. To overcome difficulties in the process of developing communicative competence, it is recommended to use authentic videos during training

It is quite difficult to raise the level of motivation of students. By influencing the emotions of people, in particular, students, you can more accurately and in detail convey not only the author's idea, but also more effectively assimilate information. The film encourages students to communicate in a foreign language, educational, search and creative activities. The use of films in English classes offers a wide range of possible activities. This can be, for example, role-playing, thematic discussions, talking about the types of interaction-working in groups, pairs or individually. A large selection of possible activities allows you to increase the interest of students in the learning process.

As O. I. Barmenkova notes, "the use of various channels of information input (auditory, visual, motor perception) positively affects the strength of the impression of regional and linguistic material" [Barmenkova 1999: 22].

Dave Willis highlights the following advantages of using video materials in training [Willis 1983: 17]:

- the room, as a rule, does not require darkening, therefore, the teacher's contact with the students is continuous;
- when watching a movie, you can perform various exercises, for example, based on a freeze frame or watching an episode without sound;
- video materials are easy to use for different types of work: individual, pair, group, collective.

The English linguist Margaret Allan adds another fact to the list of advantages, namely, the ability to divide the video material into parts and work with each necessary fragment in isolation [Allan 1985: 32].

It is known that the effectiveness of training depends on how many human senses are involved in the process of obtaining information, respectively, the more

senses, the better and stronger the material is absorbed. These features were described by J. Komensky in his didactic principle of clarity.

When choosing video materials, you should pay attention to the following aspects:

- general or complete understanding is the purpose of showing the material;
- the screening of the film is focused on the development of oral communication or the development of written skills;
- correlation of the selected material with the curriculum, the process, the level of language of students, the ratio of sound and image;
- presentation of the material at the pre-examination, screening, and post-examination stages of training;

When using video materials, there are a number of conditions necessary for the effective use of video material:

- good quality of both image and audio track
- compliance of the video sequence with the level of training of the student;
- step-by-step, rather than a whole demonstration of video fragments (segments of no more than 10-15 minutes, divided by meaning, and not chaotically);
- excessive use of jargon in the film is not allowed, the language must meet the requirements and norms of the literary language;
- normalized amount of new vocabulary.

Like working with texts, working with videos involves three stages:

- examination room;
- viewable;
- post-inspection.

The purpose of the examination stage is the attitude and motivation of the student to work, overcoming possible difficulties and preparing for the tasks. The teacher can name the name of the film, according to which the students are asked to assume the development of the plot. It is important to prepare students lexically, in this case, a preliminary analysis of words and phrases will help, in particular, an analysis of their use in sentences, consideration of grammar and phraseology.

The purpose of the screening stage is to provide an understanding of the content of the film, the development of the student's language competence, taking into account his real capabilities.

One of the tasks of the viewing stage can be an information search. This task can be implemented by filling in gaps in the text, searching for konuret information, various lexical and grammatical exercises, right-wrong, choosing the correct option from the suggested ones

Speaking about the goals of the post-examination stage, we take into account the main one-the activation of communicative competence. The received information is analyzed, the completed tasks are checked.

Of course, an important component is the discussion of what you have viewed. Depending on the age of the students, you can specify the place and time of the action, describe the characters, and discuss problems. Role-playing is an active learning method, so you can play dialogues that will help you work out new vocabulary. When selecting tasks, it is important for the teacher to take into account the individual characteristics of the students, their age, interests and language level.

The first requirement for the results of studying a foreign language in school according to the Federal State Educational Standard - the formation of communicative foreign language competence – is impossible without the second: knowledge of the socio-cultural specifics of the country/countries of the language being studied. For the successful acquisition of the necessary knowledge in the field of social culture in a comprehensive school, it is important that the student is directly confronted with the differences of cultures and learns to isolate them. Authentic video materials, in particular, artistic ones

The films are characterized by the naturalness of the lexical content and grammatical forms, the situational adequacy of the language tools used, illustrate the cases of authentic word usage, and, of course, reflect the actual social picture of the country of the language being studied, without distortion through the prism of the alien's worldview, so it is necessary to use them as a means of forming socio-cultural competence.

In order for feature films to be effective in practice, it is important to properly conduct the process of working with them. It is very important to choose the right film, determine the educational goals and objectives, develop a system of exercises taking into account the set goals and objectives, language and country-specific features of the film and its subject matter.

In order to analyze the specifics of the level of development of students' socio-cultural competence, a study was conducted at the initial stage of the program implementation. The interview was conducted individually with each individual student. The study involved 18 people – (two groups) - class 10a, who were included in the experimental group and with whom further work was carried out. The purpose of the experimental training was to test the effectiveness of the development of socio-cultural competence based on working with authentic material.

The objectives of the pilot training were as follows:

- \* conduct a study of the development of socio-cultural competence at the initial stage of training
- \* conduct an initial survey of students;
- \* organize the training of tenth graders on the basis of working with authentic material (films)
- \* conduct a secondary measurement of students' socio-cultural knowledge



(final test),

- \* conduct a secondary survey of students;
- \* compare the results of the primary and secondary survey
- \* compare the average score for the entrance and final test;
- \* make a conclusion about the use of materials for the development of socio-cultural competence.

The research is based on conducting a questionnaire, in which attention was paid not only to the level of knowledge of students in the direction of socio-cultural competence, but also to the attitude to this knowledge, by which it was possible to judge the actual socio-cultural competence. The questionnaire is written in English and contains two sections: Sociocultural Awareness, Sociolinguistic Knowledge.

When filling out the questionnaire, students had to independently assess the level of socio-cultural knowledge and skills, as well as express their attitude to the cultural characteristics and topics that were to be studied in the course "English"

### Results and discussion

The results of the input questionnaire are presented in Table 1-2 Table 1.

Results of the input questionnaire

#### A. «Sociocultural awareness» - the answer «I know a lot»

	class 10 a (10 people)	class 10a (8 people)
1. Grade system in British and American schools	3	4
2. Gap year	5	3
3. Three levels of British school education	0	0
4. At least one modern global youth subculture	7	5
5. The meaning of the word —identity	9	4
6. Christmas traditions in English-speaking countries	10	8
7. Christmas traditions in English-speaking countries that are similar to Russian traditions	8	8
8. Social problems in western countries	0	0
9. Social problems in Russia	10	7
10. An entrepreneur who changed people's lives all over the world (one or more examples)	7	3
11. Wedding traditions in the UK	1	0
12. Family issues and lifestyle in English-speaking countries	2	1

**B. «Sociolinguistic knowledge» - the answer - «I can discuss it in English»**

	<b>class 10 a (10 people)</b>	<b>class 10a (8 people)</b>
1. Grade system in British and American schools	4	2
2. Gap year	9	8
3. Three levels of British school education	0	0
4. At least one modern global youth subculture	3	2
5. The meaning of the word —identity	7	7
6. Christmas traditions in English-speaking countries	9	5
7. Christmas traditions in English-speaking countries that are similar to Russian traditions	8	6
8. Social problems in western countries	0	1
9. Social problems in Russia	8	8
10. An entrepreneur who changed people’s lives all over the world (one or more examples)	2	1
11. Wedding traditions in the UK	3	5
12. Family issues and lifestyle in English-speaking countries	2	1

The conducted research allows us to conclude that the level of socio-cultural competence, as well as the level of socio-cultural competence, is very low in all groups. It is within the average and below the average level.

The conducted analysis of textbooks, especially the "English in Focus" curriculum, which is used for teaching at school, reveals the lack of work with socio-cultural competence.

This was the reason for the creation of the support, on the basis of which the developments for implementation were created, which contained additional "fresh" video materials, media texts and films and were used to develop the socio-cultural competence of students.

As a result of the implementation of the course, the student must know/understand the areas related to intercultural tolerance (Table 2)

**Table 2.**  
**Planned results in the development of intercultural tolerance**

Theme	Resources	Development of socio-cultural competence
Education	Video clip-School Slang from the educational portal <a href="http://engvid.com">http://engvid.com</a> ;	Know/understand: basic facts about the education system UK and USA (education levels, assessment); Be able to: compare with the Russian school and student life.
Identity	Documentary film «How to Dress Like an Indie Hipster» <a href="http://wikihow.com">http://wikihow.com</a> ;	Know/understand: an example of a global modern subculture; Be able to: express your opinion and attitude
Traditions and customs	Short film cartoon Mog’s Christmas calamity	Know/understand: examples of social problems in Western society;

The result of the work is the writing of a generalizing essay on the general characteristics of Russian and English-speaking culture and the role of tolerance in understanding the culture of another people.

After testing and questioning, the data on the intercultural tolerance of students in two groups were summarized.

The control stage focused on the analysis of data obtained as a result of the study of intercultural tolerance in students of the 10th grade after the course.

When analyzing the survey of the experimental group, the following conclusions can be drawn: during the classes, students deepened their socio-cultural knowledge and developed intercultural tolerance. The results of the experiment confirm that the students were interested in socio-cultural information, they liked to compare the features of life in English-speaking countries and in Russia, as a result of which tolerance was developed as an acceptance of a different point of view

### **Conclusion**

Based on our research, we have identified a great potential for teaching English based on authentic feature films, which is realized through the visibility of video materials, their correspondence to reality, and the creation of speech situations based on video materials that are closest to real ones. The experience of working in a secondary educational organization indicates that most students do not have the skills necessary for the implementation of socio-cultural competence. They do not have sufficient knowledge, are not able to assess the common and different in other languages.

In the course of the analysis, we found that these problems can be overcome by working in two directions-to expand cultural knowledge and background knowledge, and to teach reflection and comparison. At the same time, writing texts is implemented on the basis of systematic work, not only with the help of individual

exercises, but also with the help of specially organized classes based on the course.

The study examined the methodology of working in an English lesson based on feature films: methods and techniques of working with the film, the organization of its viewing during the lesson, exercises for the film. The given method of teaching based on feature films contributes to the effective formation of not only socio-cultural competence, but also listening skills, oral communication, and vocabulary training.

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**CELEBRATION OF THE VICTORY DAY IN THE VILLAGE OF  
DINSKAYA KRASNODAR REGION (BASED ON THE PHOTOGRAPHS  
FROM THE MIDDLE OF THE PAST CENTURY FROM THE PRIVATE  
ARCHIVES)**

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**Abstract.** *In this report, dedicated to the folklore of the war years, the author decided to illustrate photographs from the family archive and from the archives of the inhabitants of the village of Dinskaya, Krasnodar region, accompanying them with small historical comments. The Cossacks of the village of Dinskaya are the descendants of the famous Zaporozhye Cossacks, resettled by Tsarina Catherine II in the 18th century from the banks of the Dnieper to the Kuban. Cossacks by social class are military. They took the most active part in the Great Patriotic War. On the eve of the holiday - Victory Day over the fascist invaders, which is especially widely and solemnly celebrated among the Cossack population, I would like to remember with a kind word the great feat of our ancestors, who fought with the enemy without sparing their lives, and preserved with their heroism peace, happiness and freedom for us. Yes, we live because they died for us, so let us give them the honors they deserve. Blessed memory of them.*

**Keywords:** *folklore of the Great Patriotic War; photographs from personal archives.*

May 9 is coming soon! Victory Day! And the topic of our report corresponds to the red date of the calendar - one of the brightest dates in the whole world - the Victory over the fascist invaders. The residents of the Kuban region celebrate this date especially widely and solemnly. It must be said that of the entire folklore heritage, the folklore of the war years occupies one of the leading places in the research of scientists. The author was fortunate enough to record a huge amount of interesting ethnographic material about the Great Patriotic War, not only on expeditions, but also from his parents and relatives, which is periodically published in

various publications and in reports at conferences (Zaporozhets 2003; 2005 a), b), c); 2006 a), b); 2007; 2009 a), b); 2010; 2011; 2012; 2014; 2017 a), b); 2020). In our report, the author decided to publish a very interesting and little-studied part of the unique heritage - photographs from the personal archives of both her own and residents of the village. In these photographs, in some incomprehensible way, the spirit of the Cossacks has been preserved, many times rooted out and persecuted, despite the heroic service to the Fatherland with faith and truth. In these people, captured in the photographs, one can feel the spiritual simplicity, and military severity, and the readiness to stand up to defend the Motherland with arms in hand at any moment, and the ability to have fun and sing... The topic of the Cossacks is one of the least studied topics. So let's take a look at at least a small part of our vast heritage.

#### **Several historical references.**

**Cossacks** – the military estate in pre-revolutionary Russia in the 18th - early 20th centuries. In the 14th - 17th centuries, free people who worked for hire, persons who carried out military service in the border areas...; In the 15th - 16th centuries, outside the borders of Russia and the Polish-Lithuanian state (on the Dnieper, Don, Volga, Ural, Terek) self-governing communities of the so-called free Cossacks appeared ... which were the main driving force behind popular uprisings in Ukraine in the 16th - 17th centuries and peasant wars in Russia 17 - 18 centuries. The tsarist government sought to use the Cossacks to guard the borders, in wars, etc., and in the 18th century subjugated it, turning it into a privileged estate, the support of the autocracy. At the beginning of the 20th century, there were 11 Cossack troops (Donskoe, Kubanskoe, Orenburg, Zabaikalskoe, Terskoe, Siberian, Ural, Astrakhan, Semirechenskoe, Amur and Ussuriysk). ... In 1920 the Cossacks as an estate were abolished. In 1936, the Don, Kuban and Terek Caucasian Cossack formations were created, which participated in the Great Patriotic War (disbanded in the 2nd half of the 1940s). (SED, p. 529).

**Stanitsa** – ... In Russia, a large Cossack rural settlement or administrative-territorial unit that united several small Cossack families. In the USSR, the traditional name for large rural settlements on the territory of 6 Cossack troops (SED, p. 1279.).

**Don, Dnipro, Kuban** – the largest rivers of the Russian state, and later – the USSR.

**Zaporizhzhya Sich** – organization of Ukrainian Cossacks in the 16th - 18th centuries beyond the Dnieper rapids. The name comes from the name of the main fortification (Sich)... Shared on smoking .... In 1709 ... Old Sich was liquidated, in 1734 the government created ... New Sich, liquidated by tsarism in 1775 ... (SED, p. 456). The name comes from "**Sich**, which *is beyond the rapids* of the Dnieper - *Zaporozhye Sich*" - ed.

**Rapids** – a short section of a river with a relatively high level of water fall and an increased flow rate ... (SED, p. 1052)

**Kuren**– (Turkic origin of the name). ... In the Zaporizhzhya Sich - a military unit ... and its living quarters. (SED, p. 682).

**Don Cossack army**, arose in the 2nd half of the 16th century in the Lower and Middle Don from fugitive peasants. Since the end of the 16th century, it has been protecting the southern borders of Russia. Placed in the area of the Donskoy army ... In the First World War, 66 cavalry regiments, 45 batteries, 6 battalions, 110 hundred were deployed, In 1918 it was abolished. (SED, p. 411.).

**Black Sea Cossack army**, created in 1787 in southern Ukraine from the majority of the Cossacks. In the 90s of the 18th century, it was resettled to the Kuban. It defended the Caucasian fortified line from the mouth of the Kuban to the Laba River. In 1860 it became part of the Kuban Cossack army. (SED, p. 1507.)

**Kuban Cossack army**, created in 1860 in the Kuban region (the center of Yekaterinodar, now Krasnodar) from the Black Sea Cossack and part of the Caucasian line of the Cossack troops.... In the First World War, 41 cavalry regiment, 2 cavalry and foot divisions, 25 battalions, 10 batteries, 35 hundreds were deployed. Abolished in 1918. (SED, p. 672.).

**Stanitsa Dinskaya** Krasnodar region – the birthplace of my ancestors on the line of my father - the Zaporozhye Cossacks. "Dinskaya" translated into Russian from Ukrainian sounds like "Donskaya". This name of the kuren in the Zaporozhye Sich appeared in the 17th century, when an uprising broke out on the Don under the leadership of Kondrat Bulavin and the Zaporozhye Cossacks went to the aid of the Don Cossacks. And upon their return from the Don, their kuren began to be called "Dinsky", that is, "those who went to help fight in the uprising on the Don", "those who returned from the Don". And when the Cossacks were resettled to the Kuban by kurens, and villages were formed from kurens, then the villages began to be called that after kurens: Dinskaya, Plastunovskaya, etc.

*Information for photograph № 1.*

1. Zaporozhets Pyotr Nazarovich (born around 1900), local. Kuban Cossack. (The brother of my grandfather Zaporozhets Andrei Nazarovich, my grandfather died in a concentration camp in Poland in 1944).

2. Zaporozhets Praskovya Pavlovna, (born around 1903), wife of Peter Nazarovich, local. Kuban Cossack.

Photo of the early 1920s.

*Information for photograph № 2.*

1. Marakhovka Marko Vasilievich, 1917 - 1954, local, (ancestors from the village of Plastunovskaya). Kuban Cossack.

2. Marakhovka Ekaterina Pavlovna, 1922 - 1982, wife of Marko Vasilievich. (Presumably - a local, Kuban Cossack).

Photo from the late 1940s.

*Information for photograph № 3.*

1. (Left) Alexei Nikolaevich Zaporozhets (born 1926), local. Kuban Cossack. (Vasily Andreyevich's cousin).

1. (Right) Vasily Zaporozhets, 1925 - 1981, local. Kuban Cossack. (Author's father).

Photo from the late 1940s.

*Information for photographs № 4 – 9.*

The Cossacks celebrate Victory Day in the village of Dinskaya, Krasnodar region. Photos from the 1940s - 1980s.

*Information for photograph № 10.*

Kuban Cossack costume. The photo was taken by V.V. Zaporozhets in the early 2000s at the Kraivedchesky Museum of the village of Dinskaya, Krasnodar region.



**Photographs № 1.**





**Photograph № 2.**



**Photograph № 3.**



**Photograph № 4.**



**Photographs № 5.**



**Photographs № 6.**



**Photographs № 7.**



**Photographs № 8.**



**Photographs № 9.**



Photograph № 10.

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## CELLULAR AUTOMATA AS A MODEL OF REALITY

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**Abstract.** *The article examines cellular automata as a model of reality. From our point of view, cellular automata represent the most adequate ontology of the Universe, including the processes in which we participate, as well as the processes that we are.*

**Keywords:** *cellular automaton, strange attractors, Zeno's level, physical vacuum, the second law of thermodynamics, Turing's problem of undecidability.*

**Methods:** *the article uses the method of historical reconstruction of the formation of the theory of cellular automata, the conceptual apparatus of synergetics, the methodological ideas of S.Ya. Berkovich and S. Wolfram.*

In the XX century, the theory of cellular automata began to be used to describe physical reality. The cellular automaton itself is a mathematical construction that resembles a cell. Most often, a two-dimensional grid is used to analyze a cellular automaton, but a cellular automaton can also be multidimensional. Each cell of the grid is influenced by neighboring cells, so that it seems that all the cells form a simple network. John von Neumann analyzed grid cells with twenty-nine states, and proved that this number of cells is enough to create a UTM (universal Turing machine). The topic of cellular automata was also addressed by the German engineer Konrad Zuse, who wrote the book "Computational Space" in 1969, dedicated to this topic [1].

In this book, Konrad Zuse opened up the field of digital physics - explaining the behavior and laws of the universe in terms of computability.

Traditionally, it is argued that the laws of physics are continuous: it is assumed that such physical concepts as distance, speed, etc. best expressed in terms of numbers and differential equations.



Quantum theory assumes a discrete and digital nature of the universe, from this point of view, the continuous nature of the real world is an illusion. The question arises: is reality digital, analog or hybrid?

To analyze the laws of physics from the point of view of digital physics, Zuse created digital particles controlled according to the rules of cellular automata, since the development of the Universe is similar to cellular automata.

The action of cellular automata is described in terms of local dependence, the action of continuous dynamical systems is described in a similar way, which gives grounds to assert that cellular automata in informatics are analogous to the concept of "field" in physics.

A cellular automaton can also be represented as a world in which space is a uniform grid, each cell of which contains a certain number of data bits, the time is discrete, and the cells determine their own state by the states of the cells nearest to it.

The laws of the system are local and the same: local in the sense that long-range action is not allowed, the state of a cell is determined by the nearest cells; sameness means the same operation of laws regardless of place or landscape.

Given the rules, a simple mechanism is sufficient for the stable existence of structures and phenomena. Models created with cellular automata are used in natural sciences as well as in combinatorial mathematics. Cellular automata form a parallel computing paradigm, similar to Turing machines [2].

In the forties of the last century, Stanislav Ulam and John von Neumann created a modeling method known as cellular automata, with the help of which S. Ulam studied the growth of crystals, and J. von Neumann - the self-reproduction of complex systems.

John von Neumann in his work "General and logical theory of automata" put forward the idea of the existence of a threshold for the complexity of the system. Below this threshold, the system is not capable of sufficiently complex functions, and under certain conditions it only degrades, that is, it reduces its complexity. Above this threshold, the system becomes self-sustaining, capable of performing highly complex functions. In particular, the ability to reproduce itself arises here, which does not imply a simple duplication of itself. The system must become redundant compared to the simple requirement of replicating a system of similar complexity or adapting to the environment. Overcoming the threshold of complexity is associated with the production of systems of greater complexity than the original.

Von Neumann's concept also refers to the possibility of different ways of describing a system. While the system is not complicated, the description of its functions is simpler than the description of the system itself, but for more complex systems it is much more difficult to figure out what an object is capable of doing

than to build the object itself.

Cellular automata models describe a class of situations that is described by differential equations. The use of cellular automata does not require knowledge of any equations describing the situation, does not require superpowerful computers, allowing one to obtain a result, while the sought solution is presented in a graphical form.

The principle of "successive expansion of scientific interest" is characteristic of modern philosophy. It is associated with the influence of a complex of sciences, in particular, cognitive science, on the research field of a philosopher.

Modern science is characterized by a transition to the knowledge of multilevel hierarchical self-organizing systems, considered in the context of their formation, the potential multivariance of their evolution.

In the process of using cellular automata, a breakthrough occurred, which is associated with work that looked at physical theories from an algorithmic point of view. The cellular automaton approach is not an end in itself, but a means of understanding and explaining the reality that surrounds us. This is an attempt to reinterpret the picture of physical reality together with the cognizing observer included in it.

From the point of view of the cellular information approach, physical reality is a set of information structures, which is analogous to Hegel's idealism in philosophy. The informational reality created by the model of cellular automata can be demonstrated by an example with light bulbs: light bulbs that light up or go out in a certain sequence create the effect of movement, but information actually moves, creating the illusion of physical movement.

S.Ya. Berkovich called such a model the Zeno level in connection with the apparent nature of the movement [3].

A new ontology is emerging, which includes the following provisions:

1) in the traditional sense, unit cells are not physical objects; they constitute a qualitatively different level of the Universe underlying the physical level;

2) the topology of the cellular automaton network generates protospace, and the cycles of elementary counters - prototime, which then develop into physical space and time;

3) physical vacuum - a transmitting layer between elementary particles and core-like collective excitations. The level of these arousals underlies the physical layer;

4) in a physical vacuum, the cellular automaton protospace and prototime are transformed into physical space/time. Core-like collective excitations generate elementary particles, following the symmetry of a network of cellular automata that develop into the known physical symmetries of the Universe. [4]

The concept of the physical vacuum as a special form of the cellular automaton

is based on the ability of the cellular automaton to create formations with unusual behavior, which is similar to the behavior of elementary particles of matter.

The cellular automata model represents material formations as propagating wave solutions: cellular automata generate diffuse activities that can participate in information processing.

The consequence of this possibility is the possibility of the existence of a cognitive information processor outside the brain, using the cellular-automatic background of the physical world as a holographic medium.

According to Stephen Wolfram, computer experiments generate the following classes of attractors to which cellular structures tend to evolve.

Systems of class 1 after several steps reach a homogeneous equilibrium state regardless of the initial conditions. This corresponds to an attractor of the fixed point type.

A class 2 system shows a periodic pattern that is relatively independent of the initial conditions; specific parts of the structure, but not the entire structure, depend on the initial conditions.

Cellular automata of class 3 systems create configurations that seem random and scattered.

Class 4 system. Evolving configurations with random quasi-organic and locally complex structures can be observed here.

Class 3 automata are very sensitive to small changes in the initial conditions; they are characterized by a long process of information transfer. Changes of local character are transmitted globally to distant areas with a butterfly effect.

Class 4 automata transmits information over long distances, but sometimes it is limited to structures localized in space and time.

In random configurations of class 3, evolution is irreversible due to the fact that all correlations decrease; complex structures of class 4 have a chance of strange or chaotic attractors, which are complex interconnected objects.

Computational irreversibility is similar to temporal irreversibility, the inability to restore the initial position. In experiments with cellular automata, this is equivalent to the second law of thermodynamics.

Computational irreversibility is similar to temporal irreversibility, the inability to restore the initial position. In experiments with cellular automata, this is equivalent to the second law of thermodynamics.

For computational irreversibility, there is no method for predicting the behavior of a system, except for taking all the steps of actual development. According to historians of science, knowledge of laws allows predicting the future, but if we assume the possibility of chance, then there is no other way but actual evolution.

According to Stephen Wolfram, the sciences of complexity are characterized by computational irreversibility, and therefore the shortest way to find out the

state of the system under study is to consistently simulate its evolution. Even if all the laws of behavior at the micro level are known, it is impossible to predict the development of the system at the macro level.

The brain is defined at the micro-level of neurons by simple rules for synapses, but it is impossible to calculate the formation of structures in neurons.

It can be assumed that computational irreversibility and computational irreducibility support personal individuality. A person's personal life is influenced by random events. K. Mainzer believes: "The structure of our way of life is highly nonlinear, complex and random. There is no shortcut to predicting life. If we want to find out the meaning and result of our life, we must live it." [5]

Conclusions:

The theory of cellular automata is a rational interpretation of Karl Popper's "third world".

An unusual aspect of the supposed new paradigm of brain functioning is that information is processed outside the brain, in this case, the functional role of the material formations of the brain is to organize access to these processing facilities, that is, to connect to the "third world", which is materially organized in the form of a cellular -automatic background.

2. Based on this, the anthropic principle becomes more obvious, according to which the Universe is arranged in such a way that it contributes to the emergence of intelligent life.

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## PHILOSOPHY OF THE XXI CENTURY AS A PHILOSOPHY OF TECHNOLOGY

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**Abstract.** *The position of philosophy in a technogenic society is considered and, as a way out of the crisis, the priority development of the philosophy of technology is proposed. It is shown that in the modern era, the difference in philosophical approaches to technology is based on different directions of anthropology; a methodological reconstruction of these approaches is necessary because a technological turn in philosophy is inevitable in a techno-genetic society.*

**Keywords:** *engineering, technogenic society, philosophy of technology, anthropology, modernity, technology.*

### **Introduction. The crisis of modern philosophy and technogenic society**

Modern society is called technogenic by philosophers, since technology today mediates all aspects of a person's life, regulating all types of his activities - from production to communication. "The mode of existence of modern society with a significant degree of certainty can be characterized as technological," notes, in particular, B.G. Yudin. "We are getting more and more accustomed to perceiving the world around us ... and often ourselves as a field for the implementation of a wide variety of technological influences." A modern man, in his words, is obedient to "an activity, or technological, setting associated with the desire to somehow streamline, organize and even put at the service of his interests the chaos of the natural" [14, p.56]. The technogenic society is dominated by a "scientific and engineering" (according to VM Rozin) worldview, which understands everything that exists as an "object of technical action and manipulation", and any processes - as something that can be calculated and predicted, what can be controlled [12, p. 20]. The requirements of order, management, benefit, efficiency - the main ones for the technical mind [9] - have spread to all areas of culture. The hardest part is in this world of philosophy, the practical use of which raises reasonable doubts.

Technogenic society, as V.A. Lektorsky notes, "is becoming more and more

pragmatically oriented", therefore "philosophy as a specific type of abstract thinking cannot play an important cultural role" [5, p.140]. In addition to the "eternal" questions, modern philosophers pose, according to A.A. Huseynov, another one: "Why and who needs philosophy, besides the philosophers themselves"? Today, "not only the economy, but the whole society has become a market one", therefore the analysis of its position is disappointing: "Philosophy, in order to be recognized in modern society, must say what and on what basis it sells, how much is what it sells, and the main thing is who will buy her "products" and why ". Philosophy, like other forms of culture, "must offer itself as a service": today it "cannot reproduce itself otherwise than in the form of a useful (read: paid) business" [3, p.8-9]. Therefore, philosophers are increasingly forced to discuss the practical question: how to get their science "out of the crisis and intellectual backwater" [3, p.9].

But not only philosophy is in crisis in a technogenic society. Both nature and humanity are undergoing processes that cannot be called otherwise than global problems of our time. According to V.A. Lektorsky, "in our time we can talk about the crisis of civilization and man", because on the way of unlimited technical progress, "in the current stream of diverse changes, a threat to the very existence of man has arisen - it is not without reason that much is said today about the possibility of a "posthuman future"[5, p. 142-143]. Not only philosophers state that the stake "on achieving a perfect state of man and society through scientific and technical successes, rationally substantiated transformation of the external conditions of life, this venture turned out to be a mistake" [3, p. 8]. Wouldn't philosophy help at least understand why this happened: why did the creations of human thought turn against their creators and what was supposed to strengthen civilization puts it in danger of destruction? After all, it is the philosophers, according to T.I. Oizerman, who always talked about "to what extent humanity is able to understand itself, manage its own development, become the master of its own destiny, master the objective, to a large extent spontaneous consequences of its cognitive and creative activity" [7, p.200]. According to A.A. Huseynov, philosophy "must appear to society... in full consciousness of its exclusive responsibility", remembering that it "is responsible not just for the truth, but for such a truth, which is at the same time a duty, denotes a worthy path of life" [3, p. 9]. In other words, philosophy should point not only to the reasons for the current state of affairs, but also to possible ways out of the civilization crisis. But is modern philosophy capable of this? Are there any gaps in it that hinder the philosophical analysis of the modern era - technogenic and thus so unlike those that were before?

#### **Purpose of the study. Philosophy of technology as a criticism of technical reason**

There is a philosophical discipline that studies technology as a factor in social and cultural change. This is the philosophy of technology; Mikhailovsky notes

that it is that "makes it possible to develop all the main problems of modern philosophy in a systematic aspect - from ontology and anthropology (the ontological status of technical artifacts; the position of a person in the world), gnoseology (the status of know-how within knowledge) and epistemology ( the subject and methods of technical (engineering) sciences) to the philosophy of culture (design in the system of culture, the theory of cultural types) and ethics and axiology (the problem of "technical evil", the social assessment of technology)"[6, p. 226-227]. Almost all the traditional problems of philosophy require revision as applied to the conditions of a technogenic society, and the philosophy of technology sets itself this task.

Outside of philosophy, it is believed that a conscious human impact on all parameters of technical reality is possible, and the discrepancy between the technical design and the practical effect (for example, man-made disasters) is considered as human mistakes. Therefore, the conclusion is made about the need for more careful calculations of environmental risk and more persistent advocacy of the greening of industry. Unfortunately, the effect of these sermons is small; environmental problems continue to threaten the future of humanity, and a non-philosophical attitude towards technology fluctuates between two extremes - the praise of technological progress and its denunciation. Both of these extremes are not suitable to become a theoretical basis for the implemented programs of activity. The lack of reflection in the discourses used in the discussion of technogenic problems leads to contradictory conclusions regarding the current situation of mankind, as well as to opposite practical recipes for resolving global problems of our time.

The main issue of the philosophy of technology is to identify its reverse effect on a person: according to V.V. Cheshev, "the interpenetration of the technosphere and the social environment... led to the formulation of the problem of "technology-human" at a higher philosophical and sociological level, requiring an appeal to the essence of technology and essence of a person"[13, p. 110]. The philosophy of technology, therefore, should carry out a "worldview discussion of the nature of technology and its role in society" [13, p. 105], studying "functions, means, goals, interpretations, operational rules and values, as well as their relationship with national cultural traditions and features of the era "[6, p.227]. Human thinking and value orientations adapt to life and functioning in the technical world. Technical rationality connects into a single whole the practical plans for the development of the world, the analysis of their activity conditions, the creation and regulation of social practices. As a result, the "technical mind" - the result of the comprehension and algorithmization of technical activity - considers everything in the surrounding world as objects of the goal-setting human will subordinate to objective laws, the transformation of which is carried out through the planning and implementation of technological chains. It manifests itself in the unity of the practices neces-

sary for the functioning of technology [9].

Therefore, the philosophy of technology today sees in the object of its research not a human tool, but a complex, socially conditioned phenomenon: according to V.G. Gorokhov, the technical system is considered as a man-machine, connecting machine components (which are means of activity) and human (performers or subjects of activity - implementation, management, maintenance) [2, p.43-44]. The concept of "technology" in modern society is applicable to "any kind of human activity" [1, p. 123]. As a result, today for the philosophy of technology "the most promising direction is anthropological research, in the light of which an active-cultural explanation of the nature of technology and the technical knowledge accompanying its development is given" [13, p.115].

So, the traditional ideas about technology as an object generated by human activity and controlled by it cannot explain either the occurrence of negative consequences of human technological activity, or the impotence of human thought to neutralize these consequences on a global scale. The naturalistic or instrumental representation of technology based on "common sense" (as an instrument of human activity, created by him and obedient to him) is outdated. The usual methods of categorizing technology require further development, therefore, the philosophy of technology develops and offers a number of new approaches as a theoretical basis for practical programs.

**Materials and methods. Philosophical approaches to the analysis of technology: methodological reconstruction.**

The problematization of technology occurs in connection with the desire of people to control it, lowering the determinism of their lives by external forces. To explain the connection between technology and man, numerous philosophical approaches have been proposed - systems of views expressing a certain way of seeing and based on their own basic concepts (reflecting the main aspects of the subject of research). The lack of complete reducibility of a theoretical model to empirical material in any field of research makes the multiplicity of these models inevitable. Depending on the properties attributed to the technique and the goals of study, these approaches offer various forms of its comprehension and practical development. All these approaches, performing a methodological function in relation to empirical research, try to explain the facts and, by including them in the system of theoretical knowledge, to reveal the essential connections and relationships between them, predicting the directions of development of technology and technogenic society. Each approach uses its own categorical apparatus to describe (explain, predict, etc.) the technique and, with its help, logically deduce statements of different levels of generalization intended for building models and forecasts. Since all approaches have a certain area of applicability and reveal the real characteristics of technology, there can be no question of rejecting their diversity for the



sake of one, "only correct" approach. The multifactorial nature of the explanation of modern processes is inevitable, therefore the technique is analyzed using a set of philosophical approaches, which can be expanded on the basis of new ideas.

At the existing level of philosophical knowledge, these concepts are not systematized and not coordinated; implied assumptions are not formulated openly, the main problems and premises of the study, the factors taken into account, the meaning of the terms used are not always clearly stated. The lack of reflection in the discourses used in the discussion of technology leads to the fact that it occurs at an uncritical level. The correctness of the study depends not only on the detailed development of these approaches (to achieve their logical consistency and compliance with empirical data), but also on their correct use, that is, understanding what tasks can be solved based on specific assumptions, and when a change of discourse is required. Therefore, the greatest methodological benefit will be brought by the analysis of these approaches using logical reconstruction: the allocation of philosophical concepts (including the articulation of unconscious ideas), their comparison and analysis of the methodological foundations (identification of the principles underlying them).

An implicit background of traditional concepts was the idea that the basis of technical reality is the mental impulses of people, leading to the implementation of certain behavioral attitudes and setting the main parameters of their technical activity (personal or determined by mass consciousness). In accordance with the intellectual and spiritual context of the industrial era (in which the philosophy of technology was born), the main reason for its functioning was considered to be the intervention of a person seeking to harmonize his existence. But technologies tend to become autonomous: having begun to function to maintain their own ever-increasing complexity, they lose the meanings that originally gave rise to them. Therefore, researchers working on the basis of traditional approaches set the goal of restoring people's control over technology and, after trying to implement various strategies, come to the conclusion that it is impossible to achieve this goal and the inevitable degradation of nature and man. Apparently, the traditional methods of analyzing technology have been exhausted, within the framework of the discourses used in this case, its further analysis is impossible: therefore, their social projects are contradictory.

It is possible to develop other approaches to the study of technology based on different theoretical and methodological principles. These approaches - not displacing, but complementing the traditional ones - will make it possible, on the basis of new models of technology, to reveal its previously unnoticed patterns and propose new global programs. Unconventional approaches will be based on the rejection of the naturalistic interpretation of technology. It is necessary to build a new picture of the world, in which the traditional concepts of nature, technology,

and humanity are rethought. On this basis, new types of social action will be proposed.

### **Results and discussion. Anthropology of technology as a metaphilosophy of technology**

The greatest potential for research is possessed by: a socio-natural approach that analyzes nature and human society (generating technology) as steps on a single evolutionary ladder that have common laws of functioning; communicative approach, considering socio-cultural and technical practices as generated by the communication environment; an evolutionary approach that studies natural and technical systems, without taking into account the subjective factor in the development of technology, as successive stages of evolution.

The socio-natural approach considers the development of technology as the adaptation of mankind to the objective laws of the external environment (natural and social). It is argued that the technosphere, created as a result of technical mediation of an ever larger area of human life, as it becomes more complex, naturally leaves the control of mankind. Applying this approach to the analysis of technology, it is possible to solve the following tasks: identification of the complex nature of man-made impacts on the socio-cultural area; determination of the forms of the technogenic environment corresponding to different periods of socio-natural development; analysis of civilizational crises as conflicts between regularity and spontaneity of technical activity caused by their ontological duality [4].

The communicative approach considers social and technical practices on a single basis - as intersubjective communicative practices with a different ratio of material and symbolic components. This explains the property of the technogenic environment not to succumb to arbitrary change and, allowing a certain (enriching the accepted form of communication) degree of controllability, to break out of obedience when attempting to violate this form. Applying this approach to the analysis of technology, it is possible to solve the following tasks: identification of various forms of human determination - technical and non-technical; comparison of the strategies of human life in a technogenic environment - adaptation to it and its changes; consideration of the correspondence of social norms and ideals to different stages of technical development, their ability to accelerate or slow it down [10].

The evolutionary approach considers the modern era as a stage of global evolution, which consists in the concentration of evolutionary potential at the level of technical reality due to the involution of the previous levels - biological and social. The elimination of the subjective factor in the development of technology is carried out through the consideration of humanity as a subsystem of the developing Universe, and technology as the next stage of its development. Applying this approach to the analysis of technology, it is possible to solve the following tasks:

identification of the boundary parameters of technical systems by analogy with biological ones; diagnostics of the proposed social strategies against the background of global evolutionary processes; analysis of socio-cultural unification in the context of changes in the stability of the social environment [8].

Having stated various approaches in the philosophy of technology and showing the incompatibility of their basic provisions, these differences should be derived from deeper foundations - anthropological. Since technology is a creation of man, and modern man is increasingly an object of technology, their consideration is interrelated. The principles of anthropology, formulated over thousands of years of discussions, penetrating into the field of philosophy of technology, give rise to various ideas about the regularity and validity of the transformation of nature, about the goal of technical progress, about the admissibility of the transformation of man himself to adapt to the technical environment, etc. The incompatibility of philosophical approaches to the study of technology is inevitable, since there is no single idea of a person. A purely philosophical study of technology is impossible: the analysis of any problem that has a technogenic factor inevitably turns into a discussion about the essence of man, about the meaning of his activity. The formation of the anthropology of technology (as a philosophical direction that studies the relationship between man and technology, showing their mutual conditionality and creating new forms of their presentation) is a necessary stage in the development of modern philosophical knowledge. As a result, philosophers expand the concept of technology to the limits of human activity and show that with its help our society and our thinking were created. The multifactorial nature of understanding modern processes is inevitable, therefore the technique is analyzed using a set of philosophical approaches. As a result, developing a metaphilosophy of technology that unites all the diversity of these approaches and explains their mutual correspondence, we will analyze the anthropological foundations of technical activity and get an anthropology of technology that reveals man as the creator of technology.

### **Conclusion. Towards a technological turn**

So, the development of new philosophical approaches to the analysis of technology and their metaphilosophical synthesis is a promising direction of philosophy, allowing it to return public attention to its developments. But in order to carry out this research program, philosophy itself will have to change and reveal new aspects.

We see how science is technologized in a technogenic society. For the modern type of scientific rationality, the concept of "technoscience" is proposed: its goal is not to understand the object of research, but to design it. The contemplative position of classical science is replaced by a new, activity-based paradigm: technoscience is not looking for a description of an independent reality, but a means

of its recreation [11]. Shouldn't philosophy, while retaining its culture-forming features, supplement them with technological capabilities, mastering new methods and setting new goals? If by technology we mean any ways to improve human life, then philosophy is undoubtedly one of the technologies. Classical philosophy was directly viewed as a kind of logical conveyor leading from preconditions to practical conclusions: first, recipes for improving the inner world of a person, then - improving the outer world. In the XX century in non-classical philosophy there was a rejection of the activity orientation - a linguistic turn: the analysis of language becomes a means of solving philosophical problems. It was argued that all knowledge exists only when it is expressed through language; therefore, the understanding of reality depends on the language and the idea of it can be obtained only by examining the language. The abandonment of the traditional understanding of the tasks of philosophy took place gradually. At first, it was argued that traditional philosophical problems are a consequence of the misuse of language, therefore, the exact expression of our knowledge of the world is impossible without clearing the language of "pseudo-statements". Then the hypothesis of Sapir-Whorf was proclaimed that language forms a picture of the world for a person, and reality outside of language is inaccessible to us. Philosophy courses began to start not with ontology, but with semantics; the understanding of language as the ultimate ontological basis of thinking and activity led to the rejection of the concept of the truth of statements. Finally, the main function of language was recognized as a communicative one, and philosophy went into the analysis of "language games" and the subtleties of deconstruction. All these stages of the linguistic turn have further alienated philosophy from urgent modern problems and turned it into an intellectual game that is interesting and understandable to an extremely narrow circle. Shouldn't the philosophy of the XXI century take a new turn, returning to the actual problems of human life?

In this case, the general technologization of culture may turn out to be a useful counterbalance to the "weaving of words", recalling the many unsolved problems. The return to the original purpose of philosophy as a science of the right life can be called a technological turn. Instead of the skeptical smile of postmodernism, which fundamentally denies the concept of truth and personality, we have to return to simple but eternal questions listed by I. Kant: "What can I know? What can I do? What can I hope for? " These "naive" questions, from which philosophy began, have attracted the hearts and minds of people to it for centuries; the search for a worthy goal in life and morally correct means to achieve it is also a technology in the broad sense of the word that deserves attention.

The philosophy of technology here can turn out to be the forefront of the technological turn. Dealing with the analysis of ends and means, reflecting the real results of human activity and identifying the dangers standing in the way of civili-

zation, the philosophy of technology cannot get away from reality and take global problems for language games. Seriousness will replace irony, choosing the right action will replace a plurality of discourses. The infinity of dialogue can take place when the participants are alive. Awareness of the possible absence of a common future is the best way to return to the search for an answer, and the experience of technical innovation will show how choices are made in the face of uncertainty. This is not the first time that people have to act in the unknown; science has already developed rules that allow, if it is impossible to accurately predict the results of our actions, to optimize the possible consequences. We can mention at least the minimax principle proposed by game theory - "choose such an action, the worst effect of which is better than the worst consequences of other options". Not being able to know the absolute truth, a person is forced to make a choice of a civilizational path: just as a technical decision is made despite the lack of consensus, in search of the best option available, philosophy as a whole will find a way to combine the pluralism of philosophical teachings with the definition of a single plan of activity. Otherwise, philosophy may perish - together with humanity, who did not dare to take responsibility for themselves and complete the search for truth by choosing a civilizational path and serving the main goal - survival and development.

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## SYSTEM RESEARCH AS A PHILOSOPHICAL ANALYSIS OBJECT

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**Abstract.** *The article reveals the features of the philosophical analysis of the system research methodology at three levels of the functioning of science: specific scientific, general scientific and philosophical. The main problems of the philosophical analysis of system research are highlighted, which are uniquely solved at each level - these are questions of the logic and methodology of system research, actually philosophical and historical. Logical and methodological problems of the system approach consist in the description, theoretical substantiation of system principles, research methods, in the analysis of the problems of systems thinking in the context of each level. Philosophical problems are presented as problems of the philosophical substantiation of systemic research, its analysis as a methodology of cognition through the prism of the main issue of philosophy. The historical problematics of the systems approach consists in analyzing the prerequisites for the emergence, formation and development of systemic ideas, principles, methods, the very methodology of the systems approach in general, and in determining the prospects for its development in the future.*

**Keywords:** *system, systems approach, systems thinking, philosophical analysis, methodology, science, science methodology.*

### Introduction

A wide arsenal of modern cognitive means, including the achievements of the new European classical methodology and innovative approaches of non-classical science, has a pronounced analytical nature and is not suitable for analyzing the integrity, hierarchy and organization inherent in objects representing systems. Currently, systemic studies of scientific and practical human activities are widespread. Having posed many significant problems, ranging from the development of special-scientific systemic methods (for example, scenario methodology [4] and the method of expert assessments [8]) to raising questions of a general world outlook [2; 9], they have long been the object of philosophical research. The object of philosophical analysis is the entire complex of systemic studies, including such

issues as the development of philosophical problems of the systems approach [12], the formation of general worldview principles of system analysis [10]; building the logic and methodology of systems research; carrying out special scientific system developments [1; 7]; creation of a general theory of systems [11]. The range of issues analyzed in systemic studies is quite wide, especially if we consider that a complex network of specific problems corresponds to each sphere of human life. Bearing in mind the complexity of the problems of systems research, the variety of approaches to their implementation, on the one hand, and on the other, their important role and wide distribution from the sphere of private sciences to the field of ideology, worldview, it is advisable in the philosophical analysis of systems research to proceed from three levels of functioning scientific knowledge: specific scientific, general scientific and philosophical.

**Purpose of the study** – to substantiate the peculiarities of the implementation of systemic research at the specific scientific, general scientific and philosophical levels of scientific knowledge, to establish the methodological and ideological role of consistency as an interdisciplinary methodology.

#### **Materials and methods**

The methodological basis of the research is the phenomenological reduction, focused on the search for the specifics of the philosophical interpretation of the systematic approach, the identification of the specific features of the system at different levels. This methodological prerequisite is explained by the fact that, on the one hand, the systems approach is a general scientific methodology used in almost all branches of modern science as private scientific methods (for example, in technology, jurisprudence, pedagogy, management, etc. [3; 6]) and special system concepts [1; 7; 10], requiring their analysis both at the general scientific and at the particular scientific levels. On the other hand, the widespread use of the systemic approach in private sciences, its problems as a general scientific methodology, the spread of systemic research in the field of practical activity give rise to questions of a philosophical, ideological nature, which should all the more be investigated in philosophical works.

The study also implements an interdisciplinary approach based on the fact that the analysis of the problems of systems research should be, first of all, a philosophical analysis, and at the same time we are dealing with an object that belongs not so much to the field of philosophical reflection, but to the spheres of science and practice in the regulations of particular scientific and general scientific methodologies. Therefore, the philosophical study of such an object must certainly rely on these spheres, where the real, actual process of its functioning takes place. Considering the problems of systems research, proceeding from this specific process, which is the subject of analysis, first at the particular scientific, then at the general scientific levels, in the unity and difference of all levels, one can more or



less reasonably carry out a philosophical analysis.

### **Results and discussion**

The main problems of the philosophical analysis of systems research are, firstly, questions of the logic and methodology of systems research, secondly, the actual philosophical problems and, thirdly, historical ones.

Logical and methodological problems of the system approach are mainly problems that are solved in logical and methodological reflection, i.e. in works that contain, in a filmed form, the very specific process of carrying out a systemic research in any special scientific field [4; 5]. They generally consist in the description, theoretical substantiation of system principles, research methods, in the analysis of the problems of systems thinking. Already in such a general definition of the subject of these problems, one senses the ambiguity, the lack of concrete definiteness of their purpose. Therefore, it is necessary to consider each issue in relation to the indicated levels, since they, the same logical and methodological problems, at different levels have a different status. This also applies to other highlighted problems.

We will now try to define them more specifically, at each level. At the private scientific level, the logical and methodological problems of systems research consist in the analysis of specific applied system methods, social and scientific system concepts in relation to a certain class of systems, i.e. it is an analysis of systems research in private sciences, the peculiarities of the application of the systems approach, associated with the specifics of the object of these sciences [3]. At the general scientific level, we are dealing with the analysis of logical and methodological problems in relation not to any particular science, but also to all where only a systematic approach is applied [2]. At the philosophical level, problems are considered that are relatively remote from the particular features of systemic studies in special sciences, based on their results or removing them. This is an assessment of the systemic approach as a methodology of cognition in terms of the philosophical theory of cognition and logic, its capabilities and boundaries, problems of the general methodology of systems research in general, general issues of systems thinking from the point of view of logic, changes caused in the cognitive process by the application of systemic principles of thinking, methodology knowledge, etc. All issues related to the analysis of the systems approach as a (general) methodology of cognition from the point of view of philosophy, dialectics as logic and methodology of cognition are considered here.

Philosophical issues are also dealt with at different levels in different ways. They are presented as problems of the philosophical substantiation of the systemic approach, its analysis as a methodology of cognition through the prism of the main issue of philosophy. At the particular scientific level, this general problem manifests itself as general worldview issues of systemic research in a particular

science, issues of the systemic nature of an object, its study from the point of view of general philosophical problems of cognition, the philosophical and theoretical aspect of the problems of integrity, consistency, etc. Thus, through the problems of the systems approach of a certain branch of science, general philosophical issues of ontology, epistemology, and methodology are considered.

At the general scientific level, in connection with the relevant problems of systems research, one can consider, for example, such issues as the problem of integrity in modern science, theoretical aspects of general systems theory, theory of structures, the influence of system theory on the scientific picture of the world, etc. At the philosophical level, as it were, there is a crossing of two problems of a universal nature, in contrast to the previous levels, at which the universal (philosophical problems of the system approach) passed through a single and special (particular scientific and general scientific) consideration. It considers such problems as a systemic ontology or a systemic picture of the world, consistency as a method or stage of cognition, their contribution to the development of the worldview, consistency and principles of development, the unity of the world, universal communication, a systematic analysis of the categories of philosophy, the place of the systemic approach in modern science, practice etc.

The historical problematics of the systems approach consists in analyzing the prerequisites for the emergence, formation and development of systemic ideas, principles, methods, the very methodology of the systems approach in general, and in determining the prospects for its development in the future. Thus, these issues are also refracted in accordance with the specifics of each level. At the private scientific level, she is interested in all of the above, only in historical terms in relation to individual industries. At the general scientific level, the author analyzes the emergence and development of systemic ideas in science, the formation of the system approach methodology as a direction of modern science in general, general systems theory in the general scientific aspect, in the aspect of structural and functional analysis, etc. From the point of view of the philosophical level, such issues are considered, for example, as the general philosophical prerequisites for the emergence of systemicity and systemic ideas, the influence of certain philosophical teachings on their development, the problem of consistency and the study of ontological, epistemological, logical and methodological problems in the history of philosophy, etc. This also includes studies devoted to the analysis of the systemic studies themselves, criticism of those other ideas in the past. This issue can also be viewed in a similar way. At the private scientific level, we are talking about criticism of incorrect interpretations of the application of the system approach and its results in certain sciences, their refutation and the identification of the actual state of affairs. On the general scientific basis, it is shown the inconsistency of speculations around the general scientific status of the system approach,

the absolutization of the system approach or structuralism in modern science, etc. The philosophical level presupposes a struggle against the concepts of "systems philosophy", views like the recognition of the systems approach as "philosophy of modernity" or "modern science", against attempts to replace general scientific methodology with a systems approach, as well as against the dissolution of philosophy in systems theory.

### **Conclusion**

Thus, passing each of these problems through these levels of consideration, it is possible to identify its specifics at each of these levels and create a holistic picture of its development in general (after consideration at all levels). By identifying the relationship between problems and different levels of their analysis, it is possible to create a concrete and holistic picture of both the methodology of the systems approach and its philosophical analysis. It is important that the problems are considered with a gradual increase in the level of research, and philosophical analysis is more and more concretized, becomes a kind of integrity, and in the aggregate a system of philosophical analysis is formed. A specific analysis makes it possible to identify the specific scientific, general scientific and philosophical statuses of the systemic approach, more precisely, the systemic approach from the point of view of each of these levels. And then a holistic picture of the development of the systems approach is created, starting from particular scientific applications through acquiring the status of a general scientific methodology to penetrating into the space of philosophical problems proper, i.e. the ascent of philosophical knowledge of systemic research, a systemic approach from the singular through the particular to the universal.

The most essential and holistic knowledge that reflects the essence of an object can be obtained by properly examining its mature, developed state. At present, the methodology of the systemic approach as an object of philosophical analysis is not yet mature, it has become a subject, a certain holistic methodology of the general scientific status or at least an integral set of certain principles, methods, categories of systemic research on a single basis has not yet been built. As such, the systematic approach, one might say, is still in the making. And in the period of formation, deviations, inconsistencies, etc. are natural, since there is a development process that is complex and contradictory. Philosophical analysis is a reflection of this process of the formation of a systems approach as a whole. Thus, only by exploring the systemic approach as an emerging subject can one now carry out a more or less holistic analysis of it. The available works on the philosophical analysis of various problems of the systems approach show that their essence lies in the reflection of this process of formation. In theory, this means identifying and resolving the contradiction of becoming. From the point of view of the systems approach as a holistic subject, the available solutions are solutions to the problem for the

current level of development of the systems approach, and not for its developed state. Based on the idea of the formation of a systematic approach as a whole and concretizing it on the basis of its analysis, it is necessary to derive a more or less integral, unified philosophical understanding of systemicity in science.

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## EVOLUTION OF THE CONCEPT "ECONOMIC DIPLOMACY"

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**Abstract.** *The development of economic diplomacy was strongly connected with the evolution of market economy, colonial trade, industrial production and multilateral diplomacy. With the beginning of the Age of discovery commercial ties between nations started to intensify, while their policies were aimed at consolidating the positions in foreign markets. Moreover, it was trade rather than political dominance that many philosophers put emphasis on while reflecting on the factors of the flourishing of a state during the Modern Age. In the course of time trade diplomacy was established as an independent activity, promoted by central authorities and consuls with the aim of receiving the status of "most favored nations" in new lands, and free trade routes. In this sense colonies were of particular importance, since they had the resources which were necessary for the development of mother countries. Mineral exploitation opened a new stage in economic diplomacy with the states compelled to count on negotiations and treaties rather than military dominance. These processes paved the way for multilateral economic diplomacy, which continues to be essential up to now.*

**Keywords:** *Economic diplomacy, globalization, trade diplomacy*

Traditionally, the main components of diplomacy have been international political cooperation and peacekeeping. However, the most important global changes that have taken place over the past few decades have changed the very concept of diplomacy, bringing to the fore the economic component of international relations. As a result, what is now understood as economic diplomacy has become the highest priority of the foreign policy of most states, since it is economic diplomacy that is one of the central pillars that allow the country to adapt to the new reality in the context of globalization.

Currently, the need for states to conduct economic diplomacy is dictated by the impact of globalization on national economies, namely, the growing dependence of the internal reproduction process on foreign factors of production, as well as the growing involvement of national production and consumption in global pro-

duction and trade and financial networks. However, it would be a mistake to assume that economic diplomacy emerged simultaneously with the beginning of the processes of globalization and integration. It existed before, but only in the form of trade diplomacy. In this regard, before proceeding to a direct examination of the modern content of economic diplomacy, it seems appropriate to make a short historical excursion and define what trade diplomacy was.

The impetus for the development of commodity-money relations and the strengthening of world trade relations was given by the Great Geographical Discoveries. Thus, in modern times, the interests of the growing bourgeoisie, aimed at capturing new markets, acquiring colonies, and ensuring the commercial dominance of their country, began to exert a huge influence on politics<sup>1</sup>. The diplomatic activity of European states in the XVI-XVIII centuries set as its goal not only the strengthening of political influence, but also the struggle for trade dominance, in connection with which the importance of the institution of consular service grew. As you know, initially the consul was just a merchant sent abroad, but since the XVII century diplomatic functions have been assigned to the consul, he is already considered a civil servant.

An increase in the role of trade diplomacy is also evidenced by the fact that modern thinkers, citing Venice thriving thanks to effective trade activities, come to the conclusion that it is the economy, not politics, that is the guarantee of stability and peaceful coexistence of states. Of course, the further course of history dispelled the myth about the uselessness of classical diplomacy, but, nevertheless, by the end of the XIX century, diplomacy has already closely dealt with issues of a purely economic nature, such as ensuring "the security of trade routes, the conquest and retention of colonies, as well as the establishment of spheres of influence, the conclusion of trade agreements and active support for their own entrepreneurs"<sup>2</sup>. In general, according to the Russian researcher A.G. Savoy, "the prototype of primitive economic diplomacy" appeared earlier, in the XVIII century, and the prerequisites for its registration were "rapid economic development, the rapid growth of capitalist relations, the colonial confrontation of European countries, and most importantly, the merger of the interests of politics and the economy of the state".<sup>3</sup>

Let us consider in more detail the tasks that trade diplomacy performed as capitalist relations developed. Undoubtedly, at all times the states fought, first of all, for sales markets and freedom of trade routes. In this sense, initially, the trade interests of powerful countries were matched by the process of colonization, which made it possible to create zones of economic influence with all the ensuing conse-

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1 General history of diplomacy / Chief-ed. of the project M. Priz.- M.: Eksmo, 2009. - P.151.

2 Zonova T.V. Economic diplomacy // Foreign economic relations.- 2005.- №6. – P.61

3 Savoisky A.G. Economic diplomacy of modern Russia in relation to the United States in the international arena. – Pyatigorsk: RIA-KMV, 2009. - P. 38.

quences in the form of the provision of preferential terms of trade (the prototype of the modern "most favored nation regime"), and then introduce a monopoly on trade, turning the colonies into nothing more than a raw material appendage of the monopoly, while the monopoly itself acquired the exclusive right to industrial processing and maritime communication with countries that supply raw materials. This system of preferences was so strong that its echoes continued to be felt even after the establishment of their own industry in the colonies and their independence. Therefore, it becomes obvious that in the "colonial era, diplomats, who naturally had other tasks, themselves, as it were, pushed the boundaries of their duty to protect enterprises and merchants who dared to transfer their activities abroad"<sup>4</sup>.

However, initially, the task of the embassy services was limited only to the contractual registration of the results of colonial conquests made by "adventure seekers", that is, in fact, they had nothing to do with the very procedure for acquiring new lands. The very same negotiation process, the subject of which was the redistribution of territories, began to be practiced only from the XVIII century, but it is worth noting that the colonies at that time did not attach much importance, they were used only as an addition to the solution of interstate disputes and conflicts, so as the main focus was still on the possessions in Europe. So France, which handed over the West Indies and Canada to England as a result of the Seven Years War, did not consider these lands a great loss; later, at the Congress of Vienna in 1814-1815, the Netherlands also calmly reacted to the need to abandon their colonies. The situation changed only in the second half of the XIX century, when the most sophisticated diplomatic intrigues began to weave around the colonial conquests. Bismarck, a brilliant politician and diplomat, having supported the French government during the military campaign in Tunisia against the background of fierce rivalry between the French and Italian capital in the country, quarreled France with Italy, whose Francophile government also sought support in the fight against Austria-Hungary for Trentino and Trieste. Therefore, when in 1881 a French protectorate was established in Tunisia, Italy actually had no choice but to become an ally of Germany, and in 1882 an agreement was concluded on the creation of the Triple Alliance.

The fact that states put the diplomatic struggle for land at the forefront was not only a logical consequence of the impossibility of more easily seizing new lands, but also testified to the increased importance of the economic side of the issue. After establishing a protectorate over Tunisia, France, along with satisfying its great-power ambitions, defended the interests of influential domestic financial groups, which had previously bought out shares of the Tunisian state loan and other securities through a Franco-Egyptian bank.

Having exhausted the possibilities offered by the seizure of colonies, economic

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<sup>4</sup> Carron de la Carriere G. – Economic diplomacy. The diplomat and the market. / MGIMO (U) MFA of Russia.- M.: ROSSPEN, 2003. - P. 23.

diplomacy focused its efforts on acquiring rights to develop minerals, develop territories, lease lands and acquire territorial advantages.

One of the first events on an international scale in the light of new guidelines for economic diplomacy was the opening of the Suez Canal in 1869. The French diplomat Ferdinand de Lesseps in 1854 received a concession from Said Pasha for the construction of the canal, which was led by the General Company of the Suez Canal, the main shareholders of which were France (53%) and Egypt (44%), while further shareholders were entitled to 71% profits, Egypt - 15%, the founders of the company - 10%.<sup>5</sup>

The diplomatic struggle also went on for concessions for the construction of land communication routes. Serious passions flared up around the construction of the Constantino-Paul-Baghdad railway, which Germany, England and France sought to lead, realizing the huge benefits from the operation of the road in the form of obtaining territories, monetary rewards for the work performed, as well as the right to develop mines. Due to the collision of the geopolitical interests of these powers and the beginning of the First World War, the construction of the road was greatly delayed and was completed only in the early 1940s, when the British and French still achieved a revision of the German monopoly on construction, and part of the road was transferred to Turkey. The other part was given a concession to a French company, and the third part was included in the Iraqi railways under the control of England.

But special attention should be paid to the efforts of economic diplomacy in the struggle for the development of hydrocarbon deposits and oil refining. At first, oil was used mainly for lighting and directly where it was mined, mainly due to the lack of the necessary infrastructure for its transportation. However, before the First World War, with the introduction of a new model of Henry Ford's car on the assembly line, as well as with the beginning of the use of oil products instead of coal by the British fleet, the situation changed radically. The desire to control the oil fields explains the creation of the Anglo-Persian Oil Company (modern BP), in which the British government had a controlling stake. The company sold its products in the Middle East, then entered the Canadian market, and also became the first company to produce oil in the North Sea.

In the creation of zones of influence, the United States achieved particular success at the beginning of the XX century, starting to use the Monroe Doctrine of 1823 as an obstacle to the penetration of European capital (except British) into the Western Hemisphere. Using both military force (the armed invasion of Mexico in 1913, provoked by the rapid penetration of British capital into the oil industry) and diplomatic maneuvers (the deal between Jersey Standard and Royal Dutch Shell, as a result of which assets in Venezuela were transferred to an American

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<sup>5</sup> The Suez Canal is 140 years old: the story of a XIX century legend. [Electronic resource] // RIA Novosti. –URL: <http://ria.ru/society/20091117/194118343.html>



company), the United States finally and irrevocably strengthened their monopoly on trade and investment in Latin America.

However, it would be a mistake to assume that economic diplomacy in the past went hand in hand with a show of strength. With the emergence of duties used by states to regulate trade, it became necessary to negotiate, find compromises, and make mutual concessions. In this regard, a huge role was played by various types of treaties and agreements in the field of trade, which "became more and more numerous, more and more technically developed and took a place in diplomacy all the more important because customs rules have become a breeding ground for new conflicts."<sup>6</sup> Britain, the leading economically developed state of that time, fought most zealously for the reduction of customs duties, since it acutely felt the need both for new markets for its finished products and for the largest possible supply of cheap imports to the domestic market to reduce its production costs. The peak of the intensity of the conclusion of trade agreements was in the second half of the XIX century, when a clause on non-discrimination was included in European treaties, which later served as the basis for international trade regimes.

Although such agreements were still far from the full-fledged trade agreements that are concluded today, they marked an important stage in economic diplomacy: the separation of economic state interests from general political ones. Economic issues became the subject of independent negotiations, they began to be formalized into full-fledged documents, ceasing to play an insignificant role in applications.

However, despite the almost universally recognized importance of economic interests, "representatives of 'classical' diplomacy are accustomed to dealing with the problems of so-called big politics," therefore, "they viewed commercial diplomacy as a secondary task."<sup>7</sup> But time dictated its own conditions: at the end of the XIX century, industry and transport networks were actively developing, international trade grew, as never before, the struggle for markets and sources of raw materials was fiercely fought. It was necessary to support the domestic manufacturer, who expected from government departments and embassies to provide the most favorable conditions for its activities. Therefore, "from the beginning of the XX century, voices began to be heard more and more often about the close and inextricable link between political and economic problems in diplomatic work and the need for appropriate structural and other reforms of foreign affairs agencies, which would provide an integrated approach to their solution"<sup>8</sup>. Governments have heeded the demands of their entrepreneurs: departments for foreign trade, economic policy, technical advisers on financial issues appear in the central apparatus of foreign affairs departments, and the post of trade attaché is established in

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6 Carron de la Carriere G. – Economic diplomacy. The diplomat and the market. / MGIMO (U) MFA of Russia. - M.: ROSSPEN, 2003. - P. 35.

7 Zonova T.V. Economic diplomacy // Foreign economic relations. - 2005. - №6. – P. 57

8 Ornaty I.A. Economic diplomacy. - M.: International relations, 1980. - P. 10.

embassies.

The evolution of economic diplomacy is crowned by the emergence of multilateral economic diplomacy. This happened in the period between the two world wars, when, within the framework of the League of Nations created in 1920, the transformation of bilateral treaties into multilateral ones began. Such actions were dictated by the need to restore the world economy destroyed by the war, to deal with the consequences of the global economic crisis, to restore Germany's solvency, and to establish a new monetary system. Thus, "participation in the work of international institutions has become a prerequisite for successful diplomacy."<sup>9</sup>

Thus, having originated in the era of colonial conquests and playing an initially secondary role, now economic diplomacy is a full-fledged diplomacy aimed at obtaining economic gain and using a certain set of diplomatic levers for this purpose.

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## PRINCIPLES OF GENRE CLASSIFICATION OF KOMUZ MELODY

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**Abstract.** *This article attempts to investigate the problem of genre classification of komuz music (kyuu) in the context of the general theory of genres, which was developed in the works of foreign and Soviet musicologists and which served as a methodological and methodical basis for studying the genre system of Kyrgyz traditional instrumental music.*

**Keywords:** *genre, classification, methodological, kyuu for komuz, musical psychology, artistic creation, the process of multiplication.*

Kyuu should be understood in two ways - in the narrow sense of the word and in the broad. In the narrow sense, kyuu is a singular piece performed on an instrument. In a broad sense, kyuu is a collection (or combination) of pieces intended to be performed on one instrument or by instrumental ensembles. In other words, kyuu is the main genre of instrumental kyuu creativity and has been awarded a special genre status by folk musicians in Kyrgyz classical traditional music. In the national music of the oral tradition, the kyuu genre is an important independent sphere (or part) of folk art, which has its own specifics of formation and development in connection with the historical, geographical and socio-cultural circumstances in the life of the Kyrgyz. Kyu as a key word - the term of Kyrgyz traditional instrumental music means both a work and a genre at the same time.

Kyut creation is, as it were, a term that reappeared in Kyrgyz ethnomusicology. It means the author's and performing activity, which is carried out in the genres of Kyrgyz folk music of the oral tradition and which was most manifested mainly in the work of the komuzists (and kyl-kyakists), as the most developed in quantitative and qualitative relations.

From the genre point of view of kyuu in national traditional instrumental mu-

sis, in the long history of komuz art, such great komuzists as Niyazaly Boroshev, Kurenkey Belekov, Toktogul Satylganov, Shekerbek Sherkulov, Karamoldo Orozov, Atay Ogonbaev, Ybraem Tumanov and others have created outstanding classical masterpieces that demonstrate the truth of major achievements in this area and the high level of national art. This allows us to say that the best examples of Kyrgyz traditional kyuu have been awarded the status of national classical music, and deservedly call it a worthy genre of creativity of international importance. It is known that Hindus, Turks and other eastern peoples have long called their traditional instrumental works national musical classics and with such an official genre name they are popular all over the world.

Genre is a phenomenon of artistic creation associated with general concepts of spiritual culture. Art is an integral part of socio-cultural activities arising from the need to create in order to satisfy the spiritual interests that exist in the social memory of mankind and are of vital importance. The genre originally arose in the world on the basis of the spiritual production of the artistic activity of people, and was a significant folk artistic category, acting in the form of a naive creative concept. Therefore, the genre, as one of the main and systemic components of artistic creation, is a special spiritual category of artistic culture, from antiquity to our time. In the folk art of antiquity, when before the advent of writing prevailed, an exclusively oral form of thinking and the concept of a genre was very primitive and had an archaic, immature, elementary character without any scientific character.

The beginning of understanding the genre as a scientific category corresponds to antiquity, when scientists appeared for the conscious perception of the ideological and meanings and expressive means of folklore and professional creativity of oral traditions. Such genres as poetry, epic, theater, music, architecture of ancient Greece and Rome were developed, both in a practical and theoretical sense. The great thinkers of the ancient East Pythagoras, Aristotle, Al-Farabi, Abdrahman-Jami and others were the first scientists who turned their attention to folk art, in particular, to its genre issues. For example, Aristotle opened the scientific study of Greek myths and epic stories in terms of genre characteristics and categories.

Subsequent periods of history, in the eras of the Middle Ages, Renaissance, Enlightenment, when, with the development of scientific thought on art, attitudes towards the concept of the genre changed and it gradually became one of the main strategic and key problems of culture. Due to the fact that artistic creativity has received significant development in various types and kinds of artistic activity, and the science of folk and professional culture has achieved certain success with the establishment of a more differentiated research approach to issues of the genre of vocal and instrumental music of the peoples of the near and far abroad.

With the opening of universities in European countries, music departments

appear, which train young music researchers, as a result of which national schools of musicologists studying folklore and professional creativity are created. In the footsteps of ancient and European scholars, in parallel with the study of genre issues, there was a study of folk instruments, in which the German-Austrian scientists-instrumentalists S. Sachs and E. Hornbostel stood out. Based on the analysis of instruments by their sources of sound production, they established an organological system of four groups of folk instruments: 1-string group (chor-dophones), 2-brass group (aerophones), 3-percussion group (membranophones), 4-self-sounding group (idiophones). In the field of studying the genres of folk traditional instrumental music in distant foreign countries, the following works have been published in foreign languages. Vuile G. Dances, their history and development from ancient times to the present day. SPb., 1902; Guy de Maupassant. The novel "Mont-Oriol". Complete collection of works. M., 1958; Chekanovska A. Musical Ethnography: Methodology and Technique. M., 1983.

In the Soviet and post-Soviet times, social and humanitarian science, including music, progressed in breadth and depth, and against this background of general development, genre problems and aspects of artistic creativity were adequately studied and examined. Much later, almost a dozen centuries later, from the second half of the XIX century, the study of traditional musical culture (including epic) began, which took place with the acquaintance of Russian and foreign researchers with the traditional music of the Kyrgyz (mountain nomads, as they then wrote) and then collecting and publishing folk songs and kyyu performed by folk singers and musicians.

The genre is called "qenus" in Latin. It translates as "species" or "genus". In Kyrgyz it coincides with the word "tyr". Let us turn to the large explanatory dictionary of two large parts by K. Yudakhin, professor, academician of the Academy of Sciences of the Kyrgyz SSR "Kyrgyz-Russian Dictionary" and "Russian-Kyrgyz Dictionary" (old edition), where the term genre is translated in several versions: 1. In the literal sense as a kind peculiar to art and 2. In a figurative sense as a style or usually. To this it can be added that in order to continue the search for an adequate and equivalent translation of the terms "qenus", "species", "genus" into the Kyrgyz language, the word "kørynyshy" should be used, since it most closely matches the meaning of the Russian term "species". In our opinion, the terms "genre" and "type" have the most similar features and nuances. There is reason to consider them as synonyms. At the same time, there is a certain difference between these terms, since "genre" as a term of Latin origin "qenus" ("genus") is allegorical, has an allegorical meaning. Translated into the Kyrgyz language, it is also used in a figurative sense and means the species concept "kørynyshy", that is, "species". Hence, it is obvious and understandable that the "genre" entered the socio-cultural consciousness of the peoples of the world, regardless of who and

where it is accepted as an international genre term for many centuries and has become a universal character and status.

Since the genre and its theoretical understanding is an extremely important artistic concept, we will try to understand its essence and scientific significance. In artistic creation, both in oral and in writing, the genre concept is determined by a certain mysterious force that arises in the process of emotional movement and aspiration of a person through his creative thinking and feeling and which is formed by his internal energy. It is clear that the energy of his thoughts and feelings in artistic creation is born by an inner desire and willfully. Consequently, creativity is an energy source, a source of thinking and spiritual inspiration of a person. This is the energy of his creative nature and activities with a specific artistic direction. Creativity itself is a kind of sign (or code) for the manifestation of a person's spiritual talent and ability, a property of his artistic creation. And spirit and spirituality are that aesthetic phenomenon that is born as a true artistry and a high gift of nature. It will not be superfluous to say here that artistic creation is a genetically generated spiritual activity that is predetermined by nature or God. Comparing it with the biological and physiological world, one can understand that the spirituality of a person personifies the sacredness not only of his artistic gift, but also of a truly healthy state. As the folk wisdom says: "A healthy mind in a healthy body", and paraphrasing it in another way "Healthy creativity in a healthy soul", it can be argued that artistic creativity is a manifestation of spirituality and largely depends on people's health. Biological scientists have studied the spiritual abilities of a person in connection with the physiological characteristics that manifest in his body. Continuing this analogy between the genre of artistic creation and the human body, we can say that the genre directs and regulates the overall content of the work and, similarly, in the human body, hormones regulate and control its metabolism and cellular functions.<sup>1</sup>

Turning to the main objective of the article, we note that the problems of the genre are to some extent comparable with the human body in the sense that genres and genre varieties are in the aggregate one whole, consisting of "large" and "small" interconnected parts of it.

At the same time, it is natural that in the study of the structure of the species composition in the genre organization of artistic creativity, the way methodological and methodical systems are used is taken into account. Research works on this issue mainly use methodological and methodical experience developed in European and Soviet ethnomusicology and folkloristic science. This science in the USSR was sufficiently developed by musicologists to the smallest detail, headed by Academician of the Academy of Sciences of the Soviet Union B. Asafiev and professors, doctors and candidates of science in art history. Through the efforts of

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<sup>1</sup> Popular medical encyclopedia. - M.: Publishing house "Soviet Encyclopedia", 1984, P. 149

these scientists and their disciples-followers, a powerful musicological school was created, within which separate scientific divisions were formed in each republic of the country. Due to the flexibility and effectiveness of the all-Soviet ethnomusicological methodology and methods, the problems of science in musical folklore and oral-professional music of different ethnic groups have been successfully investigated in all directions, including genre issues.

On the basis of this methodological and methodical system, collectors and researchers of Kyrgyz traditional music A. Zataevich, V. Vinogradov, V. Belyaev, B. Alagushov, K. Dyushaliev, S. Subanaliev, R. Amanova, G. Baysabayeva, M. Kasey, A. Abatekova, M. Korpobaeva and others worked and are working in this direction. Methodological and methodical principles and paradigms of Soviet and post-Soviet musicological science are projected in studies of the genre structure of traditional Kyrgyz songs and kyyu and play a leading role. We can assume that work in this direction is going in the right direction. But at the same time, one circumstance should be taken into account, which needs to be known and studied. Using the existing resources and means of analyzing the genre structure of the Kyrgyz music of the oral tradition and equally applying it for the classification approach to both vocal and instrumental genre branches can cause a certain contradiction. In songwriting, music and poetry (melody and words) are interdependent and organically combined with each other due to the natural method of syncretism and synthesis, and it is not so difficult to determine the genre content of songs than in kyyu. Clarity and clearness of the ideological and thematic content of songs and such important performing components as time, season, situation, setting, condition, etc. directly influence the research process by genre. In this respect, there is a certain methodological convenience for studying songs and no delusion is allowed.

In instrumental music, however, genre research, as practice shows, the composition of genres of komuz music has its own specifics and presents a certain difficulty to the analyst. In overcoming these specific genre problems of music for the komuz, no matter what analytical principles and criteria we applied, it is all the same, attributing komuz pieces to only one genre or one kind of genres of traditional instrumental music is easy in some cases and difficult in other cases. Therefore, in such dubious and controversial cases, kyyu can be interpreted according to the principle of bi-genre and can be argued with the concept of genre variation (or variance), which does not contradict the theory of genres and the genre system in music.

It is quite natural that when studying kyyu for komuz, as well as for other folk instruments, a researcher has the right to choose a method of analysis convenient and suitable for his scientific position, which corresponds to the nature and primordial folk traditions living among the indigenous population and developed

in the work of komuzists for many centuries since the formation of the Kyrgyz people. Such multidimensionality, polyplanarity, and sometimes hidden mystery of the program content of kyuu for komuz is perceived by listeners with psychological activity and with deep faith in the truth of the reflection of images and characters in their auditory consciousness. This shows a kind of special phenomenon of instrumental music, including traditional music, in which the theoretical development of its genre structure is the factor that determines the complexity of the problem posed.

Considering the genre issue in strategic and tactical terms, one can notice its special functional quality, which informs about the presence of a guiding and regulating categorical property of the genre in the compositional structure of kyuu. This property sets it apart from other expressive means of works that participate in a holistic analysis of their content and formative components. In a comprehensive analysis of the works of instrumental music of the oral tradition, its genre components are first considered: general ideology and themes, content orientation, and then plot-figurative and program-compositional details are revealed. If a similar sequence of logic of analytical rules is observed in the research process, the genre category plays the main and leading role of the compositional construction of kyuu.

The performing life of kyuu for komuz takes place in different situations: in all kinds of spaces and conditions, in pastures, yurts, mountainous areas, houses, festive toys, concert halls and venues, abroad, traditional funerals and commemorations, etc. In centuries past, Kyrgyz kyuu were performed exclusively by ear and orally, and only in the XX century, starting from the 30s from the moment of the organization of a small orchestra of Kyrgyz folk instruments, where musical notation was gradually introduced and folk musicians tried to play by sheet music and then in music studios and technical schools introduced a new musical system for teaching Kyrgyz folk musicians with a dual methodology, when the training took place in two ways: on the one hand, they played kyuu only by ear, on the other hand, they tried to play from the notes. It turned out, as it were, a mixed system of teaching methods with double pedagogical practice. Conducting such a mixed form of kyuu teaching methodology, first in the central educational institutions of the capital, in the theater, in the philharmonic society, and then in the peripheral music schools of the regions and districts of the republic, formed a new, modern and promising musical educational system. This was an achievement that was created by combining two historically different, traditional and conditionally non-traditional (innovative) approaches to the issues of Kyrgyz national musical pedagogy of the Soviet era. It was in a way the beginning of a new progressive musical educational and pedagogical system with a double standard, in the good sense of the word, which continues with success and efficiency to this day.



With the help of technical and technological invasions that appeared in Kyrgyzstan, the komuz kyuu began to make physical and mechanical recordings on tape recorders, in cassettes, disks, pocket phones, the Internet, tablets, and were published in musical collections. All this is in the work of the komuzists in terms of the form of existence and performance of kyuu, and in terms of the figurative and typological characteristics, a wide road has opened for the formation and development of analytical interpretation work. In such conditions, on the basis of a scientific point of view, with the help of theory and practice in the field of author's composition and performance of "new" and "old" kyuu, various kinds and character of works appeared, having musical images such as "cheerful", "gentle", "comic", "solemn", "sorrowful", "sad", "tragic" and the like, which are an indicator of the diverse artistic characteristics of kyuu and demonstrate the richness of its genre types and contents.

In this mainstream, the leading figures of the researchers of the Kyrgyz ethnomusical culture A. Zataevich, V. Vinogradov, V. Belyaev worked, who laid the foundation for national musical folklore studies and B. Alagushov, K. Dyushaliev, S. Subanaliev, M. Kasey, A. Abetekova, M. Korpobaeva, S. Kochorbaev, Ch. Turumbayeva and others continued their activities, and now they work on the knowledge of the world of traditional music for the komuz. They, relying on the general theoretical position adopted in the creative, performing and pedagogical practice of professional komuzists, having analyzed kyuu in the socio-historical aspect, applied the grouping genre classification system of komuz works by clarification and approval. At the same time, their method of classification by groups and names of kyuu gave a positive result. In traditional instrumental music, the art of composing and performing kyuu, as a single creative process, as two organically interrelated and independent aspects of creativity, was established in the mass consciousness of the people under the genre names "Kambarkany", "Botoi", "Shyngyramy", "Kerbezly" and, accordingly received an adequate genre definition with the same terms.

Further, with the growth and development of social consciousness and the creative imagination of the people, these works progressed quantitatively and qualitatively in the process of collecting and gradually multiplying the same kyuu. This led to the unification of works of the same name around each specific genre type and to a steady process of genre typification. This progress was conditioned by the growth of the musical psychology of the komuzists and testified to the establishment of typical folk genre classification traditions in them. In the formation of this tradition, the main role was played by the bearers of komuz creativity. As a result, a convenient, real and effective genre classification was formed in komuz music, and against its background elements of genre forms and styles appeared. The further rise in the development of komuz music was accompanied by a differentiated

approach to its study, which set new tasks for musicologists: to continue, expand the development of the problem of genres, styles and forms of komuz creativity in theoretical, historical and aesthetic aspects.

In other words, the komuz terms "Kambarkan", "Boty", "Shyngyram", "Kerbez" by the national definition and by the definition of researchers and professional komuzists simultaneously acquired the status of a genre system. With the growth and development of the social and artistic-aesthetic consciousness of the people and the creative imagination of the komuzists, the process of genre typification of kyuu progressed quantitatively and qualitatively, as a result of which its multi-vector genre formation proceeded more intensively and purposefully, which led to the unification of traditional komuz works by the method of collecting and multiplying them around the thematic name of each of the genre species. Thanks to such not only auditory, but also mental "projecting" in the logic of musical thinking of komuzists of different generations, including amateurs and professionals, the generally accepted classification scheme has been strengthened everywhere. This socio-cultural progress was determined by the growth of musical psychology both in the field of writing and in the field of performance and testified to the establishment of the traditional genre policy of komuz music. The main and leading role in the formation of this genre classification tradition was played by professional carriers of the komuz musical culture, true masters of creators and performers of oral tradition music.

A further rise in the creative activity of komuzists and researchers of kyuu is accompanied by a more differentiated approach to its study, and as a logical way out of komuz music, it gives opportunities to set new creative tasks, the solution of which will reveal in more detail the peculiarity of each of the genre types and kinds in this iconic branch of the Kyrgyz national culture.

In the XX century, famous Soviet musicologists-theorists A. Sokhor, V. Tsukerman, L. Mazel, A. Popova, I. Zemtsovsky, A. Aranovsky, V. Nazaikinsky, E. Tsareva, Z. Alekseev, A. Sokolov and others, developing the problem of genre theory, noted the difficulty and complexity of its research. In their works devoted to this problem, the genre and genre system of musical creativity are presented as a living and dynamic socio-cultural organism, which consists of dialectically interrelated parts, united around one or more of one genre center, reflecting the general content-semantic idea of the works included in its composition. According to their theory, the genre system is presented as a set of "large" and "small" genres, which are united objectively and naturally and which are conveniently combined with each other.

Among the researchers of the genre problem in music, a more accurate description of the genre was given by the doctor of art history, professor of the Moscow Tchaikovsky Conservatory L. Mazel, who wrote that "Musical genres are genera

and types of musical works historically formed in connection with various social (in particular, the social and common, socially applied) functions of music, in connection with certain types of its content, its life purpose, the conditions for its performance and perception".<sup>2</sup> Taking into account the generalizing theoretical definition of the genre in the music of Professor L. Mazel and using it in order to study the issues of the genre system of the traditional instrumental music of our republic, it is not useless to project it in relation to *kyuu* for *komuz*.

The genre system of Kyrgyz *komuz kyuu* is a set of genre types and subspecies of music for *komuz*, created by instrumental musicians, who in their creative and performing creativity reflect the artistic and aesthetic relations between people and nature, thoughts and feelings of a person with the help of typical techniques and expressive means of *komuz* games developed in the history of Kyrgyz traditional instrumental music.

At the end of the article, based on its content, we can give some final conclusions:

1. The study of the theoretical problems of *komuz* creativity contributes to the identification of its substantive properties and a new view and approach to substantiating the ways of forming the genre system of *kyuu*.

2. Determination of the historical organizational process of the system of genre varieties of *kyuu* makes it possible to bring the genre theory of *komuz* music to a scientific level.

3. A research attempt was made to prove that the creative principle of multiplying the number of genre varieties of *kyuu* through frequent and systemic repeated-variant performances of the same genre played a large role. On the basis of this principle, a target accumulation of works in each of the genre varieties of *kyuu* was carried out, as a result of which there was a natural process of its subgenre grouping, formed by stratification and arrangement of *komuz* works according to their purpose and goal-setting.

4. The genre system of *kyuu* is such a system that was formed in the historical and artistic process, where at first the natural evolutionary accumulation of works took place, which concentrated around separate species groups having different names, traditionally established in the musical thinking of the people and professional *komuzists*. Then, with the accumulation and development of experience in playing the *komuz* for various genre types, a unified and diverse system of genres was finally established.

5. In the history of the *kyuu* genres for the *komuz* of the prefeudal, feudal and socialist eras, the evolutionary development of the genre system of *komuz* music proceeded according to the laws of dialectical formation and according to the rules of genre stabilization and the general ethnomusical method of collecting and mul-

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<sup>2</sup> Mazel L. The structure of musical works. M., 1979. P.18-19

tipling works. In our time and in the future, the state of writing and performing kyuu, including its genre component, will grow and increase due to the socio-economic support from the government and due to the activation and transformation of the creativity of the komuzists of the younger generations.

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## EXCISE TAXATION IN THE EARLY TWENTIETH CENTURY

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**Abstract.** *The article presents the main stages of excise taxation development in Russia at the beginning of the twentieth century, with attention paid to the goods subject to excise duty taxation. Historical documents used for the analysis are the following: The Order of the State Technical Committee of the People's Commissariat of Trade of the USSR No. 255 / Oper of September 15, 1927 «On the collection of excise duty on perfumes and cosmetics» and Rule No. 108 «On exemption from excise duty of exported goods». The purpose of the article is to conduct a historical analysis, which allowed us to analyze in detail the collection of excise taxes on perfumes and cosmetics, as well as the rule of exemption from excise taxes on exported goods. The source base is the State Archive of the Republic of Buryatia materials, as well as books and articles by other researchers.*

**Keywords:** *Excise tax, indirect tax, excisable goods.*

The excise tax is a type of indirect taxes on goods mainly of mass consumption (as well as services). It is included in the price of the product (or in the services payment tariffs) and is thus transferred to the final consumer.

The essence and nature of the individual excise tax is similar to the universal excise tax - VAT, turnover tax, sales tax. A distinctive feature of individual excise taxes is that they are levied only on certain goods.

According to some researchers the term «excise» comes from the Dutch «ex-ijs» (coming from the Old French «assive»), which meant «assessment for taxation». According to another opinion the word «excise» could originate from the Latin «assidege», («cut», «cut»), which meant signs on a special stick used to measure the amount of drink in a vessel for tax purposes [1].

In Russia, the so-called wine pay-offs were a kind of precursor of excise taxes. Taxation of strong drinks (honey duty, malt tax, brush duty) was mentioned al-

ready in the X-XI centuries sources.

Taxes were levied on goods that brought considerable income for centuries. In the nineteenth century, excise taxes on tobacco, matches, sugar, kerosene, salt, and a number of other goods were in use in Russia. The excise tax system was not only fiscal in nature, but it also provided state support to domestic entrepreneurs and protection from the competition with foreigners. [2]

In pre-revolutionary Russia, excise taxes were the main source of revenue for the budget; in 1901, they provided 60.8% of all state revenues. The object of taxation was both necessities (salt, sugar, matches, tea, and clothing) and consumer goods (vodka, tobacco, malt). The excise tax on vodka and alcohol was the biggest among indirect taxes. Since 1900, the amount of this excise tax has been dependent on the percentage of alcohol in the bucket of the drink, amounting to 11 kopecks per 1 degree.

The role of excise taxes changed radically after the revolution. At the end of 1918, direct charges to the prices of goods were introduced. The naturalization of economic relations with a sharp trade turnover reduction and a huge money depreciation led to a significant decrease in the financial efficiency of excise taxes. In 1917, excise taxes provided 17% of all state budget revenues, and in 1919-only 8.8%. In February 1920, the collection of excise taxes was suspended. [2]

The need for excise taxes as a revenue source for the budget arose again with the transition to a new economic policy. So, the excise tax on tobacco products was introduced in November 1921. The excise tax was levied on processed products in the form of smoking tobacco, cigarettes, cigars, cigarettes and makhorochny cigarettes, cigarette sleeves and split tissue paper when released to the market. As proof of the legal origin of the products, they had to be sold only in whole packages, sealed with parcels.

In 1922, an excise tax was introduced on ethyl alcohol (raw and rectified), vodka, cognac, beer, honey, kvass, fruit and mineral water, salt, sugar and saccharin, candles, tea of all kinds, coffee and its substitutes, chicory, pressed yeast. The list of excisable products was expanded with textiles and rubber products the following year. In 1924, there was a slight relaxation of excise taxation: the excise tax on saccharin was cancelled, the excise tax on matches was lowered, and a privilege was granted for wines sold from their own farms in wine-growing areas.

The weakening of the excise pressure continued in the following years: the excise tax was cancelled on soft drinks and tea in 1926, and on salt, natural coffee, and starch sugar in 1927.

At the same time, the excise tax on perfumes and cosmetics was introduced.

Such a different system of excise taxes existed because low incomes of the population did not allow setting excise rates at a sufficient level, and therefore, excise taxes were set in such a way as to «collect all over the place in small amounts».

As a result, the fiscal return from the use of the excise system during the 20-s was quite noticeable [6]:

Share of excise taxes in budget revenues, %							
1922/23	1923/24	1924/25	1925/26	1926/27	1927/28	1928/29	1929/30
21,8	30,5	38,4	47,2	48,6	50,4	45,1	43,5

The Order of the State Technical Committee of the People's Commissariat of Trade of the USSR No. 255/ Oper of September 15, 1927 "On the collection of excise duty on perfumes and cosmetics" came into force in 1927. [5]

In accordance with the Order of the State Technical University of the People's Commissariat of Trade of the USSR No. 255 / Oper of 15.09.1927, the excise tax imposing was based on distinguishing the four categories of perfumes and cosmetics:

- floral cologne;
- perfume;
- powder;
- other perfumes and cosmetics.

Floral cologne and perfume were to be prepared from rectified ethyl alcohol, floral cologne was to be a strength in the range of 80 to 89 degrees and contain essential oils, synthetic and other aromatic substances of at least 2%.

The perfume must have a strength of at least 90 degrees and contain essential oils, synthetic and other aromatic substances of at least 3%.

All kinds of cosmetic products in powder form were recognized as cosmetic powder, produced under the name of «powder».

Other perfumery and cosmetic products included: various products for teeth care (toothpastes, elixirs, etc.), for hair (grease, fixatoire, etc.), for skin, hands and lips (cosmetic creams, simple creams, lipsticks, emulsions), for nails (paste, nail powder, varnish, pencils), and hair coloring products.

Products that served for hygienic purposes were not subject to excise duty, namely: soap, soap powder, hygienic cologne (simple, double, triple), non-perfumed glycerin, burdock oil, simple and boric vaseline, and tooth powder of all kinds.

The excise tax on perfumes and cosmetics imported from abroad was levied when the products were released from customs as a percentage of the price of the goods declared in the invoice, waybill or other document.

In cases where the submitted documents didn't specify the price, the price was set by customs.

Rule No. 108 "On exemption from excise duty of exported goods" was issued in the same year, namely on September 19, 1927. [4]

When exporting excisable items abroad, the excise tax accrued on them was not supposed to be paid, and if the excise tax was paid, it was returned.

The following items were subject to excise tax exemption when exported:

- Grape wine;
- Alcohol, raw and rock-cured;
- Bread wine, vodka;
- Grape vodka;
- Vodka products, liqueurs, tinctures and liqueurs;
- Cognac;
- Beer;
- Yeast, pressed and dry;
- Beet sugar;
- Black and green leaf tea, tiled;
- Incendiary matches;
- Tobacco products;
- Petroleum products(gasoline, kerosene and other petroleum products);
- Rubber galoshes;
- Textile products;
- Perfumery and cosmetic products, and cologne and perfumes with the return of excise duty also for the alcohol contained in them;
- Confectionery products, with the return of excise tax for beet sugar used for their manufacture;
- Conoistent ointments, with the return of excise tax for the excisable oil products used for their manufacture.

Export abroad of excisable items under exemption from excise duty was allowed through all customs offices, and through customs posts with a special permit for each post of the People's Commissariat of Finance of the USSR, agreed with the People's Commissariat of Trade of the USSR and the Supreme Economic Council of the USSR.

The addition or refund of the excise tax for items exported abroad was made on the following grounds: [4]

A) items were released with the addition of the excise tax accrued when they were sent out from the enterprises and the warehouse – for production enterprises engaged in the manufacture of excisable items, and for the warehouses of the said enterprises which had the right to get items of these enterprises with the excise tax mentioned;

B) items were released with a refund of the excise tax paid for them for commercial enterprises, namely, commercial warehouses and other storage facilities located in the places of residence of agents, which were classified as commercial enterprises of the fifth and sixth categories according the collection of commercial



tax rules;

C) the addition and return of the excise tax was allowed only for that number of export-ready items which was certified by the final customs office.

In cases of backward import of excisable items exported with excise duty exemption, as well as, in appropriate cases, with no excise duty deductions, the amount of the added or returned excise duty, as well as the amount received under the excise duty deduction, was to be received from the consignor.

An institution or a person wishing to export an item with an excise tax addition had to submit an application to the indirect tax agency worker, under whose jurisdiction this enterprise used to function. The application should have contained the following information:

- point of goods release;
- their type, grade and quantity (gross and net);
- number of places and type of packaging;
- the customs office through which the export is supposed to take place;
  - the route of transport within the USSR, indicating the points of transshipment;
  - the day of dispatch.

After receiving the application, the indirect tax agency worker made a detailed record at the enterprise of the released items.

Thus, excise taxes are the most ancient taxes. The origin of the excise tax has to deal with the utility and quality of the good that meets special needs. Therefore, the concept of excise taxes has come into use as taxes "on sins", penalty for which is a form of taxation in the form of excise taxes, which accumulates a part of the disposable income of consumers, thereby reducing the demand for goods, the consumption of which brings negative consequences in environmental, biological and socio-economic aspects. At the same time, in the course of the entire historical path of development, it was the fiscal meaning of excise taxes that was crucial. In Russia, alcohol drinks were subject to excise taxes in the X-XI century. Excise taxes in Russia began to provide about 70% of all budget revenues by the beginning of the XX century. In the Soviet era, the taxation of excise taxes lasted until the tax reform of 1930.

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## COMPARATIVE ANALYSIS OF THE VIABILITY AND REFLECTION OF THE PERSONALITY OF SENIOR SCHOOLCHILDREN AND STUDENTS

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**Abstract.** *The article is devoted to the comparative analysis of the relationship between the phenomena of "personal life-ability" and "reflection" in senior schoolchildren and students. It is known that the period from 16 to 25 years is one of the most important stages in the formation of personal maturity. During this age period, a person acquires the basic knowledge and skills necessary for the implementation of future professional activities. A system of value orientations is formed that determine the orientation of the individual, the attitude to the world, to other people and to himself, giving meaning and direction to the social position of the young person. In addition, during this period, a person learns a wide range of options for defensive reflection, on the basis of which he forms stereotypes of defensive behavior that allows only to locally facilitate the experience, and not to radically solve the problem. The article notes that the main behavioral strategies that young people choose in unfavorable conditions are pathogenic in nature and*

*form a dependence on the experience of various emotional states. As a result, such dependence does not allow solving the problem, but only locally, in the situation here and now, facilitates negative feelings of guilt, shame, envy, resentment.*

**Keywords:** *high school age, student age, personality vitality, reflection, sanogenic reflection, protective reflection.*

## **Introduction**

The relevance of the study is dictated by the need for practice in the knowledge of new psychological mechanisms, intrapersonal resources that allow optimal organization of the educational process aimed at the professional development of senior schoolchildren and students. One of these mechanisms is reflection. The study of the peculiarities of reflection in schoolchildren and students in this context is very relevant.

Based on the analysis of experimental data on the phenomenon of personal vitality and sanogenic reflection as a factor in the development of stress resistance, emotional competence and resistance of the individual to adverse factors of the surrounding world, we put forward the assumption that sanogenic reflection can be a factor contributing to the development of personal vitality. In this regard, we set out to study the differences in the indicators of personal vitality and defensive reflection in senior schoolchildren and students.

At present, the viability of the individual is becoming more and more popular as an opportunity to ensure the individual's own psychological, social and physical well-being. Due to the vitality, the intrapersonal resources of a person are actualized in an ever-changing social environment, in difficult life circumstances. The value system, positive socio-psychological attitudes, in relation to various spheres of human life, including communication and joint activities, contribute to the choice of constructive behavioral programs that are appropriate to the social context and the values of the individual. The theme of life-ability takes on a special meaning when it comes to the developing personality, the personality of a child, a teenager, a student. In this regard, the search for factors that increase the vitality of the individual seems to us an extremely urgent problem for modern science and practice.

From our point of view, such a factor is sanogenic reflection. It contributes to the harmonization of internal mental development and external conditions of life and allows a person to maintain resistance to the adverse influences of the surrounding world. In a stressful situation, sanogenic reflection helps to reduce the suffering from the experience of the corresponding emotion (Morozuk S.H) [10; p. 67]. The function of sanogenic reflection is to recognize the stereotypes of thinking and behavior programs that trigger negative emotions that destroy human health (Orlov Yu. M., Morozuk S. N.) [12]. In other words, sanogenic reflection

is aimed at awareness of psychological defenses and regulation of the individual's emotional states.

### Materials and methods

The study was conducted on the basis of the Moscow State Pedagogical University (Moscow) and the Palace of Creativity of Children and Youth "Istoki" (Sergiev Posad). The study involved students of the historical and mathematical faculties in the number of 45 people and teenagers 17-18 years old, studying in the senior classes of MBU Secondary School No. 4, 18, 21 in the number of 41 people. A total of 86 people took part in the study.

The following research methods were used: the projective "Cognitive-emotive test" (Orlov Yu. M., Morozuk S. N.) [13] and the method "Viability of an adult person" (Makhnach A.V.) [8]. The last test is designed for use in the audience from 18 years old and up to the late age.

### Results and discussion

After conducting an empirical study using the above methods and research methods, we analyzed the results obtained. The differences in the viability indicators of the respondents of both samples are shown in Table 1.

**Table 1. Differences in indicators of viability of senior schoolchildren and students (Makhnach A.V.) (according to the student's t-criterion)**

Respondents	Indicators of viability					
	Self-efficacy	Persistence	Internal locus of control	Adaptation	Spiritual life	Social and family ties
High school students (n = 41)	51,0	54,0	46,0	72,0	30,0	46,0
Students (n = 45)	63,0	56,0	59,0	58,0	41,0	62,0
t emp.- St.	<b>0,43*</b>	0, 13	<b>0,32*</b>	<b>0,56**</b>	0,26	<b>0,48*</b>
t cr.- St.	0,41	0,62	0,27	0,48	0,51	0,37

Note: statistically significant differences\*\* - at the level of  $p \leq 0.01$ ; \* - at the level of  $p \leq 0.05$

Table 1 shows significant differences in the indicators " Self-efficacy "(0.43)," Internal locus of control "(0.32)," Adaptation "(0.56) and" Social and family ties "( $r=0.48$ ) in the samples of senior schoolchildren and students. This indicates the ability of respondents to display cognitive resources and actions in different ways to carry out a particular activity, as well as to achieve a goal. Students have a more responsible attitude to their actions. They are able to relate their interests to the peculiarities of the environment. They often seek support for coping with stress.

We also found that respondents show themselves differently in consistently performing work when achieving a goal. Students are more responsible about themselves and their lives. They feel more confident that they can cope with adverse conditions independently and successfully. They are less likely to act in accordance with their own system of spiritual and moral values than high school students.

High school students are less capable of self-regulation than students, they rely less on themselves; they solve their own problems in accordance with the moral priorities of their personality. Older students (compared to students) are focused on finding and solving problems, relying on themselves and on their own strength. They cope more effectively with the requirements of the environment, adequately assess the significance of the situation and its potential threats, the effectiveness and effectiveness of their own efforts, find meaning in actively solving the problem and positive meaning in difficult situations. They are able to establish an optimal balance of their interests in the environment, achieve socially significant goals, and effectively interact with the environment. Perhaps this is due to the usual conditions of the educational environment for older students, with the requirements imposed in general education institutions, schools: the way of life, the mode of school life, compliance with the schedule. Students are forced to adapt to alternative forms of learning and a new way of life, which requires each time from them adaptive forms of response, adjustment to changing environmental conditions.

At the same time, high school students do not consider family as a necessary factor for their viability.

The differences in the indicators of reflection in the respondents of both samples are shown in Table 2.

According to the data presented in Table 2, there are statistically significant differences in such indicators of reflection of senior schoolchildren and students, as: "the volume of defensive reflection from a sense of shame" (0.42), "aggression against oneself" (0.54), "rationalization of object depreciation (0.46)", "protection from guilt "(0.48), "protection from envy "(0.45) and "sanogenic thinking " (0.43). These differences allow us to say that students are more likely to experience feelings of shame and more often resort to discrediting the object of desire due to the existing difficult situations that require their solution. They are less envious than school children, and they are less likely to experience guilt and aggression against themselves. In turn, schoolchildren have a more pronounced indicator of "sanogenic thinking", they are less shy and, like students, tend to devalue the object of desire in difficult situations. They are more prone to envy, a tendency to experience feelings of guilt and aggression against themselves.

**Table 2. Differences in indicators of reflection of senior schoolchildren and students (Orlov Yu. M., Morozjuk S. N.) (according to the student's t-criterion)**

CET indicators (Orlov Yu. M., Morozjuk S. N.)	Respondents			
	Students	Schoolchildren	t emp. – Student	t kr. – Student
Volume of defensive reflection from the fear of failure	61,6	58,4	0,21	0,29
The amount of defensive reflection from guilt	55,6	56,0	0,33	0,37
Volume of defensive reflection from feelings of shame	64,3	61,5	<b>0,42*</b>	0,25
Volume of defensive reflection from feelings of resentment	57,4	61,0	0,36	0,41
Aggression against others	51,0	54,0	0,31	0,43
Aggression against yourself	37,0	46,0	<b>0,54*</b>	0,38
Rationalization of object depreciation	41,2	38,0	<b>0,46*</b>	0,36
Rationalization by circumstances	43,7	41,0	0,35	0,41
Projection on the other	39,0	37,3	0,39	0,46
Protection from guilt	43,0	56,0	<b>0,48*</b>	0,39
Protection from feelings of shame	51,3	49,0	0,34	0,39
Protection from the fear of failure	49,1	52,0	0,27	0,40
Protection from envy	31,0	44,0	<b>0,45*</b>	0,33
Protection from resentment	47,0	52,0	0,31	0,52
Avoiding the situation	42,6	44,8	0,34	0,54
Self-Depreciation I	43,0	46,0	0,42	0,49
The arousal of guilt in others	45,3	51,2	0,36	0,42
Sanogenic thinking	43,0	53,1	<b>0,43*</b>	0,27
Other people's behavior does not meet expectations	38,6	37,0	0,26	0,32
Appealing thinking	47,0	43,2	0,37	0,44

Note: statistically significant differences\*\* - at the level of  $p \leq 0.01$ ; \* - at the level of  $p \leq 0.05$

## Conclusion

As a result of the conducted research, it was proved that despite the main unifying feature of modern high school students and students – the focus on professional education and knowledge of the surrounding world-their personal characteristics as subjects of life activity, as well as the features of their vitality and reflection are very specific. Nevertheless, with a pronounced individualism of both, defending their interests, striving for independence and intellectual potential, neither high school students nor students can independently cope with life's difficulties, allocate time and mental resources, and plan their activities.

It was also found that students are more likely to experience feelings of shame, but unlike schoolchildren, they are less envious, they are less likely to experience guilt and aggression against themselves.

In turn, schoolchildren have a more pronounced indicator of "sanogenic thinking", they are less shy, they are more prone to envy, a tendency to experience feelings of guilt and aggression against themselves. However, like students, schoolchildren more often resort to devaluing the object of desire due to the existing difficult situations that require their solution.

We consider it expedient and promising for us to further study the problem under consideration.

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## IMPROVEMENT OF METHODS OF MICROBIOLOGICAL DIAGNOSIS OF MIXED INFECTIONS IN WOMEN OF REPRODUCTIVE AGE

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**Abstract.** *Isolation of *Listeria monocytogenes* from clinical material in obstetric-gynecological pathology is often difficult due to the presence of associate microbes. This study presents materials from the study of new domestic nutrient media for the isolation of listeria in the microbiological diagnosis of listeriosis in pregnant women. The diagnostic efficiency of the developed nutrient media in laboratory diagnostics of mixed infections in women with obstetric and gynecological pathology is shown.*

**Keywords:** *Listeria monocytogenes, listeriosis of pregnant women, isolation, culture media, microbes-associates, inhibition*

### Relevance

In recent years, more and more attention of researchers and doctors of various specialties is attracted by opportunistic infections, the problem of diagnostics of which has not yet been resolved. The causative agents of such infections fully include listeria, which cause the development of listeriosis, a disease characterized by a wide range of clinical manifestations (2, 6).

Listeria infection poses the greatest danger to pregnant women and newborns, causing miscarriages, stillbirths, and fetal malformations. In most cases, due to the

late diagnosis of listeriosis in pregnant women, transplacental infection of the fetus is observed, and, according to average data, 22% of pregnancy ends in abortion or stillbirth (6,7). Premature birth in these cases is common, as is the development of the disease in newborns. At the same time, the study of clinical material when symptoms of listeriosis appear in pregnant women would reveal its true share in the structure of abortion. For *Listeria*, as for other facultative intracellular parasites, the main role is played by cellular immunity, a decrease in which during pregnancy increases the susceptibility to listeria infection in patients of this risk group (3, 6, 7).

The polymorphism of clinical manifestations, as well as the frequent combination of *L. monocytogenes* with other microorganisms, significantly complicates the clinical diagnosis of listeria infection; therefore, the priority in this area is the bacteriological research method using selective culture media. Sowing on solid nutrient media ("Gold Standard") is still the leading research method that allows you to isolate, identify and study the causative agent of infection (1, 4, 6, 8).

The aim of this work is to study the diagnostic efficiency of domestic culture media and various laboratory research methods in the microbiological diagnosis of perinatal listeriosis.

#### **Materials and methods**

The material for the study was smears and scrapings from the cervical canal, taken in compliance with all the rules for taking material for research, which were studied by bacteriological, serological methods, as well as by PCR diagnostics (1, 4, 5).

Comprehensive examination included mandatory smear microscopy according to the generally accepted method (Gram stain) and quantitative inoculation on an expanded set of nutrient media with cultivation under aerobic conditions for (18±2) h at a temperature of (37±1)°C.

652 pregnant women who were registered in the infertility rooms of the antenatal clinics of Makhachkala were examined. All women were of active reproductive age (20-35 years). Of these, 60% of the examined were diagnosed with secondary infertility with recurrent miscarriages (58%) and stillbirth (42%). In 40% of the examined women, the following diagnoses were established: cervical erosion (46%), colpitis (19%), endometritis (15%), vaginitis (7%) and vaginal candidiasis (13%). All women in this group had an obstetric history of miscarriage.

To detect *L. monocytogenes* in clinical material, domestic culture media were used for the accumulation, isolation and identification of listeria (FSUE Microgen NPO Nutrient media, Makhachkala).

Considering that, as a rule, the accompanying microflora in obstetric and gynecological infections is represented by bacteria of the Enterobacteriaceae genus, such as *E. coli*, *Klebsiella* spp, *Proteus* spp, as well as *Candida albicans*, the

growth of which on the developed selective media for *Listeria* was completely suppressed, for the isolation of these microorganisms. In parallel, the well-known commercial media Endo, Levin, Candida-agar, amphotericin-agar (for the isolation of *Proteus*) were used, which made it possible to shorten the time of bacteriological research and accelerate the process of identifying the causative agent of the infection in the examined group of pregnant women.

### **Results and discussion**

The results of the study of the clinical material showed that in most cases a mixed microflora was found, represented by combinations of *Listeria* with microorganisms of various natures (bacteria, fungi, viruses).

In all cases of clinical manifestation of *Listeria* infection, when inoculated on a nutrient medium for accumulation, the broth was cloudy; on the medium for the isolation of *Listeria*, the growth of small colorless colonies in the S-form, shiny, bluish when examined in transmitted light, was observed. On the medium for the primary identification of *Listeria*, after  $(18 \pm 2)$  h, the growth of black colonies, shiny, moist in the S-form,  $d = 1.0 \pm 0.2$  mm was revealed.

In the examined groups of women, 24 strains of *L. monocytogenes* (21.4%) were isolated and identified to species, of which stillbirth was diagnosed in 14 cases, and miscarriage was diagnosed in 10 cases. All of them had a history of 2 or more miscarriages in the long term of pregnancy (21-25 weeks).

The results of serological studies showed that all 24 isolated pathogens belonged to *L. monocytogenes* serogroups 4b and 1/2a, and gave an agglutination reaction for "+++" or "++++".

The belonging of 24 isolates to the species *L. monocytogenes* was confirmed by polymerase chain reaction (PCR) with species-specific primers. The rest of the genus *Listeria* tested negative for PCR.

The isolated strains of *Listeria* were tested to determine their sensitivity to antibacterial drugs. Antibiotic sensitivity was determined by the disk diffusion method. We used commercial antibiotic discs (manufactured by NICF, St. Petersburg). The antibioticogram of *Listeria* was studied by inoculating the isolated cultures of *L. monocytogenes* (2.0 ml of inoculum from a standard dilution of  $10^9$ ) on AGV nutrient medium to determine sensitivity to antibiotics (produced by NPO Nutrient Media). In the experiment were taken antibiotics most often used in the treatment of listeriosis. The results of the antibiogram showed that one hundred *Listeria* was highly sensitive to linezolid (MIC was 60.0  $\mu\text{g/ml}$ ) and rifampicin; sensitive to penicillin, vancomycin, ampicillin, gentamicin and erythromycin; resistant to nalidixic acid.

Among the representatives of the accompanying bacterial flora, *E. coli* was most often detected - 41.8%, microorganisms of the genus *Klebsiella* spp. - in 28.7%, *S. faecalis* - in 4.5% and fungi of the genus *Candida* - in 5.1%. Bacteria of

other genera were found less frequently.

Most of the isolated cultures caused hemolysis of erythrocytes (on blood agar), especially often this feature was noted in *L. monocytogenes* (95%), in *E. coli* (70.0%), *P. vulgaris* (28.0%), *S. marcescens* (25.0%), *Klebsiella* spp. (50%), *Staphylococcus* spp. (25%), *P. mirabilis* (75.0%). The test for DNase in *E. coli* was positive in 50.0%, in *S. marcescens* in 100%, less often DNA-ase was found in bacteria of the genus *Klebsiella* spp. (in 10.0%).

Lecithinase activity was detected in 30.0% of *Proteus* strains. Hyaluronidase was produced by almost all isolated opportunistic representatives of the enterobacteriaceae family, for example, bacteria of the genera *Klebsiella*, *Proteus* in 100% of cases.

Clinical DNA samples isolated from scrapings of epithelial cells of the cervical canal of women with diagnoses of miscarriage and stillbirth were analyzed for the presence of specific fragments using PCR-Ureaplasma urealiticum, Mycoplasma hominis and genitalium, Chlamydia trachomatis, Trichomonas vaginalis, and 2 titles), HPV (16-18 titles).

The detection of causative agents of these infections by the PCR method was different, so in 37% of cases chlamydia, Trichomonas - 21%, human papilloma virus - 18%, gonococcus - 11%, ureaplasma - 8%, herpes simplex virus - 5% were detected. Studies have shown that of the listed viruses, the greatest etiological role in the development of mixed infections in the surveyed group of women is played by chlamydia (37%).

### **Conclusions**

Thus, it can be concluded that the developed media for the isolation and cultivation of *Listeria* had a high sensitivity and specificity in relation to the growth of these pathogens, and also ensured the stable preservation of their basic properties. *Listeria* isolated from the material under study were typical in their morphological and biological properties: gram-positive rods; catalase-positive; had mobility at 22°C; disposed of esculin; fermented with the formation of acid rhamnose and mannose and did not ferment beכון, xylose and arabinose; formed a  $\beta$ -hemolysis zone on 5% blood agar; exhibited lecithinase activity in the presence of activated carbon and yolk emulsion. The results of studies of clinical material showed that *Listeria* and opportunistic enterobacteria, isolated using the developed media, along with specific infections in obstetric and gynecological pathology in the examined groups of women, had a number of factors that determine the possibility of their participation in the pathogenesis of diseases. The data of bacteriological studies were confirmed by PCR-diagnostics methods and in the reaction of indirect immunofluorescence, the percentage of coincidences when using 3 methods was 98-100%.

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## THE FREQUENCY OF OCCURRENCE OF DIFFERENT TYPES OF HPV AND THE POSSIBLE RISK OF DEVELOPING CERVICAL CANCER IN WOMEN AGED 19-45 YEARS (ON THE EXAMPLE OF THE KIROV REGION)

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**Abstract.** *This article examines the impact of human papillomavirus types 16 and 18 on the risk and rate of development of cervical cancer in women aged 19-45 years living in the Kirov region. The effectiveness of radical treatment in women with severe cervical dysplasia was evaluated. Surgical treatment consisted of elektroconization of the cervix, followed by histological examination of the biological material.*

**Keywords:** *Human papillomavirus (HPV), elektroconization, dysceratosis, colocytes, L-SIL, H-SIL, cervical dysplasia.*

### **Introduction**

Human papillomavirus (HPV) is a DNA virus of the Papovaviridae family. They are a widespread and highly variable group of viruses with oncogenic potential.

In clinical practice, in terms of their transforming activity with respect to epithelial cells, all known papillomaviruses are divided into two main groups<sup>1</sup>: papillomaviruses of low oncogenic risk (mainly HPV 1, 2, 3, 5, 6, 11, 30, 40, 42, 43, 44, 53, 61) and papillomaviruses of high oncogenic risk (HPV 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59, 68). The list of HPV types of high oncogenic risk is expanding due to the clarification of the DNA structure and the emergence of new types of intermediate risk. The rest of the types are not included in the classification, since their explicit belonging to one of these groups is not clearly traced.

1 Dillner J., Meijer C.J., von Krogh G., Horenblas S. Epidemiology of human papillomavirus infection // Scand. J. Urol. Nephrol. Suppl. 2000; (205):194–200.

HPV is spread by close contact with infected or diseased epithelium. The target cells for HPV are epithelial cells of the skin and mucous membranes.

When it enters the body, the human papillomavirus infects the basal layer of the epithelium. The target for the impact of oncogenic HPV types is the transformation zone of the cervix, where precancerous changes in the cervix develop. In this area, cells of the basal layer of the epithelium that are sensitive to HPV infection are located closest to the surface and favorable conditions are created for HPV infection.

The HPV infection rate reflects in one way or another the incidence of HPV-related diseases. It has been shown that the incidence of cervical cancer depends on sexual behavior, and the risk of HPV infection depends on the age of sexual debut, the number of sexual partners, the method of contraception, the presence of concomitant infections and diseases of the urogenital tract. So, according to the WHO, about 600 thousand cases of cervical cancer are recorded in the world every year. Despite the ongoing therapy, 45–55% of patients have an unfavorable outcome<sup>2</sup>.

Cervical cancer is a severe, rapidly progressive and intractable disease that affects women of childbearing and working age. Despite the effective arsenal of surgical, radiation and chemotherapeutic agents for the treatment of cervical cancer, used as independent and complex methods, mortality from malignant tumors of the genital organs in women remains high. One-year mortality from the moment of diagnosis for cervical cancer is 16,3 %<sup>3</sup>.

The course of HPV infection is quite variable: it can spontaneously regress, persist and recur (progress with the development of CIN), and, accordingly, is characterized by different visual and colposcopic picture, as well as various morphological signs<sup>4</sup>.

With the references<sup>5</sup>, the most specific cells for HPV infection are koilocytes. These cells are formed due to the cytopathic action of HPV and are cells of the stratified squamous epithelium of the intermediate type with enlarged nuclei, an uneven folded membrane and hyperchromatosis. Cytoplasm is stored only in the peripheral portion of the cells, forming perinuclear halo (perinuclear bleaching zone is formed due to degenerative changes and necrosis the cytoplasmic organelles destroyed).

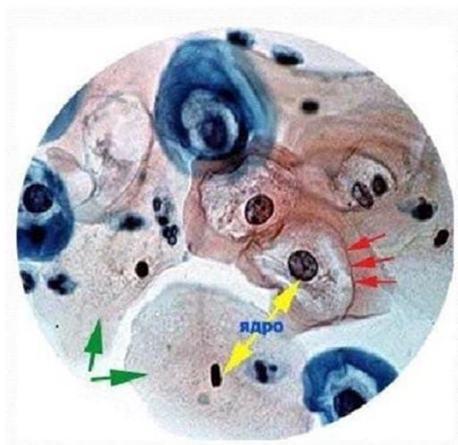
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3 Methodology of screening of precancerous diseases and tumors of the cervix, uterus and ovaries: Instructions for use, approved by the Ministry of Health of the Russian Federation. M-vom Healthcare Rep. Belarus 3.02.2005. /I. V. Zalutsky [et al.]. Minsk: Dikta, 2005. 3 p

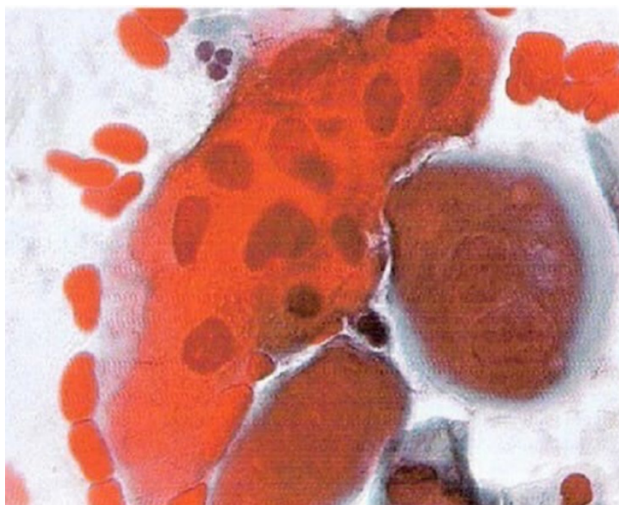
4 Semenov D. M. Clinical and pathogenetic aspects of papillomavirus infection in obstetric and gynecological practice: Sb. nauchn. tr. VSMU. Vitebsk, 2004.

5 Rogovskaya S. I. Papillomavirus infection in women and pathology of the cervix. Moscow: GEOTAR-Media 2005. pp. 48-67. 7.



**Image 1. Koilocytic atypia**

The second most specific cell in HPV infection is dyskeratocyte. Dyskeratocytes are small cells of stratified squamous epithelium with pycnotic nuclei of various shapes and sizes and intense eosinophilic cytoplasm, which are located in complexes in the surface layers of the epithelium.



**Image 2. Dyskeratosis**

Currently, there is no doubt that there is a direct link between the detection of highly oncogenic HPV types in the cervical tissues and a higher severity of CIN.



Thus, detection of HPV DNA with CIN and cervix cancer, detection coilocytes, specific cytopathic action HPV, can be attributed to a pathological condition of HPV-associated diseases.

In the diagnosis of HPV-associated diseases, various methods are used, such as:

- clinical and visual;
- colposcopic;
- cytological;
- histological;
- immunocytochemical for the detection of HPV capsid antigen;
- electron microscopic for finding mature virions in cells;
- computed resonance imaging;
- ultrasound examination (ultrasound); and others<sup>6</sup>.

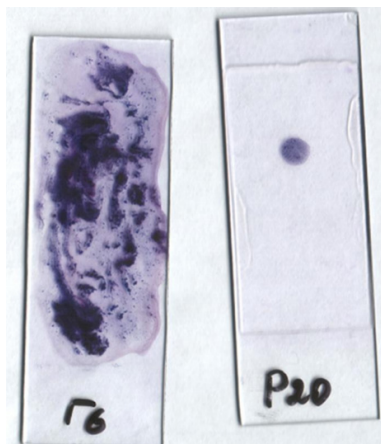
To search for prognostic signs of cell proliferation with an unfavorable prognosis even at the stage of early cellular changes, when colposcopy and cytological examination are not effective enough, ways of improving the method of cytological examination of the cervix are proposed:

1. standardized sampling of cellular material from the surface of the cervix, the transformation zone and from the cervical canal;
2. application of the liquid cytology technique for the preparation of a cytological preparation;
3. Subsequent immunocytochemical study, determination of p16ink4 $\alpha$  protein expression in dysplastic cells. The technique of liquid cytology (LC), a new technology for the preparation of cytological preparations, is increasingly used in clinical practice.

In accordance with European recommendations and the opinion of WHO 2005 experts, life cycle improves the quality of samples and is a more sensitive method with identical specificity compared to traditional cytological examination. The indisputable advantage of the technique is that the sample can be used for molecular research, for example, for the immunocytochemical determination of the p16 protein (INK4 $\alpha$ ).

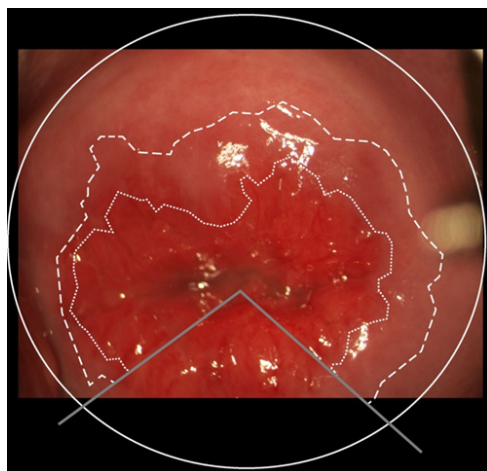
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6 Batkaev E. A., Kitsak V. Ya., Korsunskaya I. M., Lipova E. V. Viral diseases of the skin and mucous membranes: Textbook. Manual. Moscow, 2001.



**Image 3. Cytological specimen of standard cytological examination (left) monolayer specimen formed by the method of liquid cytology (right)**

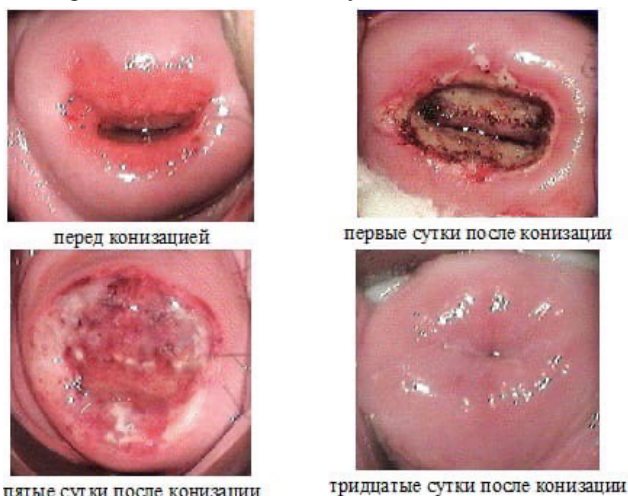
Solid line: delineates the area of the cervix. Dotted line: Original squamous junction, outer border of the transformation zone. Dotted line: Current squamous junction, represents the border between columnar epithelium and metaplastic squamous epithelium in the transformation zone.



**Image 4. Fotokolposkopic image of the ektocervix, having the features of tumor transformation**

According to the literature, modern methods of treatment are mainly aimed at removing lesions caused by HPV by physical methods, but these effects often do not provide for a systemic antiviral effect on the intracellular mechanisms of viral replication, which can cause the onset of a relapse of the disease in a short time after removal of the primary pathological focus.

Conization of the cervix includes the removal of the conical portion of the cervical tissue. The base of the cone is formed by the tissues of the exocervix (the vaginal part of the cervix), and the top is formed by the canal of the cervical canal. Zone transformation (the boundary between exo- and endocervix) is included in a conical tissue specimen. With histological confirmation of the diagnosis, the absence of tumor cells in the margins of resection and scraping from the cervical canal, the reduced volume of surgical intervention is considered adequate (I, A). Loop electroconization of the cervix or a LEEP (the Loop Electrosurgical Excision Procedure) or LLEETZ (Large the Loop Electrosurgical Excision of Transformation Zone - big loop electrosurgical loop first excision of the transformation zone). The LEEP procedure is a surgical procedure that involves the excision of a thin layer of abnormal tissue using an electric current through thin electrodes. The obtained tissue sample is sent to the laboratory for research.



**Image 5. Colposcopic picture of the cervix after electroconization**

Blocking the main mechanisms of carcinogenesis is a new approach to the prevention of recurrence of CIN associated with HPV. A chemical compound with anti-cancer properties - indole-3-carbinol (I3C), the drug Indinol, blocks the synthesis of the viral oncoprotein E7, prevents the formation of "aggressive"

16 $\alpha$ - hydroxyestrone, and causes selective apoptosis of virus-infected cells. The flavonoid epigallocatechin -3-gallate (EGCG) directionally regulates the activity of tumor suppressor genes (their reversible genetic abnormalities, the so-called epigenetic modifications, are an effective inhibitor of DNA methyltransferase). DNA methyltransferase is an enzyme, the increase of which is noted with increased tumor-forming activity of cells resulting from methylation of antitumor defense genes. The process of gene methylation is not a true mutation; it is a reversible process. The flavonoid epigallocatechin -3-gallate (EGCG), suppressing the activity of DNA methyltransferase, demethylates “silent” (transcriptionally inactive) genes involved in the process of carcinogenesis: tumor suppressor gene p16 (INK4 $\alpha$ ), gene for retinoid and other receptors (RAR). compounds I3C and EGCG, presented in the drug Promisan , is effective in preventing recurrence of CIN, since in this case not only a targeted effect on the pathogenetic mechanisms of HPV development is carried out, but also targeted activation of the expression of tumor suppressor genes that provide antitumor protection of the body<sup>7</sup>.

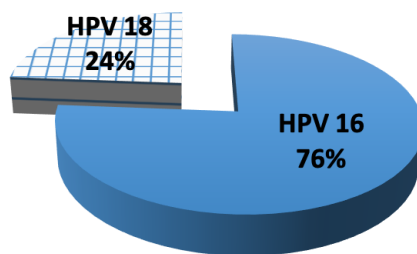
**Purpose of the study-** to establish the impact of 16 and 18 types of HPV on the severity of cervical dysplasia in women aged 19-45 years living in the Kirov region, as well as an assessment of the effectiveness of radical treatment.

#### **Materials and methods**

Using the statistical and analytical method, we analyzed 42 medical records of women living in the Kirov region for the period from 2016 to 2021.

#### **Results and discussion**

This study included an analysis of the statistics on the incidence of women with cervical dysplasia of varying severity. One of the fundamental factors in the development of cervical dysplasia is the presence of HPV of high carcinogenic risk - 16 and 18. Of the 42 medical records examined, 32 women (76%) were carriers of HPV type 16, and 10 women (24%) were carriers of HPV type 18. The data are clearly shown on the chart 1.

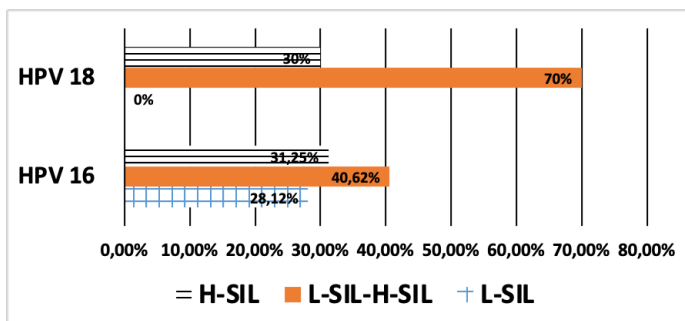


**Chart 1. Percentage of women carriers of HPV types 16 and 18**

7 Cervical dysplasia-etiopathogenesis, diagnosis, optimal treatment tactics A. E. Protasova, T. I. Dzyubiy, G. A. Raskin, N. I. Tapilskaya, I. E. Zazerskaya, E. D. Khadzhieva Textbook. - St. Petersburg: 2014. - 22 p.

There is a modern classification of the severity of the course of cervical dysplasia. L-SIL (Low grade Squamous Intraepithelial Lesions, cervical intraepithelial neoplasia I, CIN I) and H-SIL (moderate neoplasia of the cervix-High grade Squamous Intraepithelial Lesions, CIN-II) are distinguished. Based on this classification, summary charts were compiled showing the percentage of women with type 16 HPV and type 18 HPV, which include both the presence of L-SIL and the transition from L-SIL to H-SIL, and H-SIL. Among women suffering from 16 types of HPP, L-SIL was observed in 9 women (28.12%) out of 32, the transition from L-SIL to H-SIL - in 13 women (40.62%), H-SIL - in 10 women (31.25%).

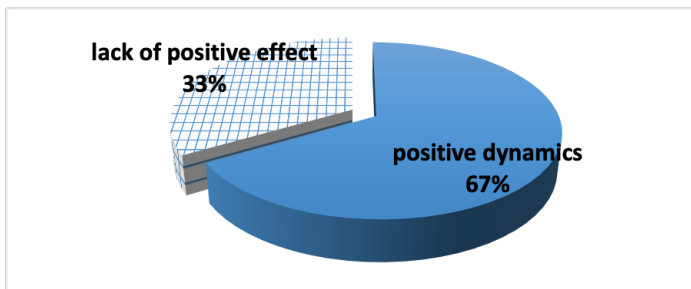
Among women with 18 types of HPV, L-SIL was 0%, the transition from L-SIL to H-SIL was observed in 7 women (70%), H-SIL - in 3 women (30%). The data is shown on the graph 2.



**Graph 2. Dynamics of the severity of cervical dysplasia in different types of HPV**

For both L-SIL and H-SIL, drug treatment was mandatory. With a severe severity of dysplasia, electrocoagulation of the cervix is strongly recommended. In total, there were 33 (78.5% of the total) women with the final H-SIL form from both groups. 30 (90%) of 33 women underwent electrocoagulation of the cervix, 3 (10%) of 33 women have not followed the recommendations at the moment, since they are on sick leave with ARVI.

Positive dynamics after electrocoagulation was observed in 20 (67%) of 30 women: the absence of HPV and pathologies according to the results of oncocytology for several months. Ten women (33%) had a minimal response to treatment. The data are presented on the chart 3.



**Chart 3. Evaluation of the effectiveness of radical treatment**

### Conclusion

During colposcopy, all 42 women had atypical transformation zones with varying degrees of severity depending on the HPV type. Based on the analysis of women's medical records, it was revealed that 76% of women had HPV the type of 16, and 24% were carriers of HPV the type of 18. In parallel, it was revealed that a mild severity of dysplasia (L-SIL) was observed with HPV the type of 16 in a percentage equivalent of 28.12%, while with HPV the type of 18 this indicator was 0%. When analyzing the data obtained in the study of the percentage of the transition of L-SIL to the H-SIL form, there was a significant increase in this indicator among HPV the type of 18. Severe dysplasia was observed in both HPV the type of 16 and HPV the type of 18 in equal measure.

According to the results of the study, the method of electroconization was chosen as a radical treatment for HPV of severe severity of cervical dysplasia. Of the people who underwent the procedure, significant improvements were observed in 67% of women.

It is worth noting that the success in the treatment of cervical dysplasia depends not only on the tactics of the specialist's management of the patient with this pathology, but also on the woman's conscious understanding of the severity and consequences that may occur with an unfair approach to the doctor's recommendations.

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## THE POSSIBILITIES OF ULTRASONIC SHEAR-WAVE ELASTOGRAPHY IN ASSESSING THE EFFECTIVENESS OF CONSERVATIVE TREATMENT OF ACHILLITIS

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**Abstract.** *The shear wave elastography (SWE) is the new ultrasound diagnostics method which makes possible to measure the tissue stiffness (elasticity). But the ability of SWE is not widely uses in cases of musculoskeletal diseases, including tendinopathy. American scientists dealing with tendinopathy found that due to degeneration and disorganization of the collagen structure, changes in the content of proteoglycan and water, fat infiltration and neovascularization, the elasticity of the Achilles tendon decreases according to ultrasound sonoelastography. However, these authors did not analyze the timing of restoring the elasticity of the tendon fiber, and did not compare the ultrasound picture of the grayscale mode and ESV indicators.*

**Keywords:** *ultrasonic shear-wave elastography, achillitis*

### Introduction

In the last decade, a new technology – elastography-has appeared in the practice of ultrasound diagnostics (ULTRASOUND) [9, 10, 15, 20, 22, 43, 47].



This term was first proposed by Ophir et al. (USA) in 1991 [9, 36] and designated a method for differentiating tissues by the elasticity of the material, the physical basis of which is the determination of the Young's modulus, which characterizes the resistance of tissues in response to their stretching / compression. To date, there are two types of elastography: compression and shear wave (shear wave).

Compression elastography – RTE) is a method for qualitative assessment of elastic properties of tissues by the equation  $E=\sigma/\epsilon$ . In the course of the study, the sensor is dosed to compress the area under study, followed by a comparison of the obtained indicators from individual sites in the field of interest. The image on the elastogram is the result of analysis, processing and "superimposition" of two echograms obtained in B-mode: before compression and after pressure on the tissue. As a result, the elasticity of the tissues is displayed on the screen in certain colors [15]. The method has been successfully implemented in practice for the detection of pathological formations in the mammary, thyroid, prostate glands, lymph nodes, and in endosonographic studies of the pancreas [2, 28, 37]. At the same time, compression elastography does not allow us to estimate the elasticity of any particular area in absolute numerical values, it is necessary to compare the area of interest with the unchanged tissue, there are difficulties with the standardization of the methodology and the reproducibility of the data. Due to the above circumstances, RTE is not used in orthopedics and traumatology [17, 37].

To eliminate the shortcomings of compression elastography, biophysicist A. P. Sarvazyan developed a method called SWE or shear wave ultrasound elastography (ESW) [17, 18, 19, 20]. The displacement of the medium particles and the accompanying deformation of the tissue occur in the transverse direction relative to the direction of wave propagation [15]. ESW is a method for quantifying the elasticity of tissues based on the calculation of the velocity of propagation of a transverse (shear) wave. The Young's modulus is determined by the equation  $E=3 \times p \times C^2$ , where  $p$  is the density of the substance in  $\text{kg} / \text{m}^3$ , and  $C$  is the shear wave velocity in  $\text{m/s}$ . It should be noted that the speed indicators are directly proportional to the indicators of the elasticity of the fabric [1, 3, 5, 17, 49, 50]. In practical health care, ESV appeared in 2008 and was initially used in gastroenterology [1, 3, 5, 9, 13, 16, 24, 28 37, 48], oncology [6, 7, 10, 14, 23, 26, 28, 37], later – in endocrinology [7, 8], urology and gynecology [4, 11, 28, 37]. However, in rheumatology, traumatology and orthopedics, studies using ESV began only in 2013. and they were devoted exclusively to determining the value of the Young's modulus of the unchanged Achilles tendon [32, 33], as the most accessible anatomical object for studying, and the presence at that time of linear ultrasound sensors with the ability to reproduce ESV with a frequency not exceeding 7.5 MHz.

As a result of active research in the framework of a pilot project in the United States, it was found that the normal elasticity of the achilles tendon is  $291.91 \pm 4.38$  kPa [31], which was later confirmed by the data of Zhang (2014) –  $289.6 \pm 23.4$  kPa and Jeong Ah Ryu, Woo Kyo Jeong (2017) - 280-400 kPa. At the same time, some authors argued that it is more correct to analyze the elasticity of the tissue, expressed not in kPa, but in m/s, proving that the wave propagation velocity in the range of 1-10 m/s corresponds to the tissue elasticity from 1 to 300 kPa (Youk et al., 2014). This version is also followed by Ahn K.-S., Kang C. H., Hong S.-J., Jeong W.-K. (2014), Xiang-Mei Chen, Li-Gang Cui, Ping He (2019). The values of the shear wave propagation velocity in the unaltered tendon presented by them were  $7.91 \text{ m/s} - 9.56 \text{ m/s} \pm 0.27-0.5 \text{ m/s}$ .

Further study of the possibilities of ESV in traumatology showed that the parameters of the elasticity of tendon fibers depend on the degree of tension of the fibrils. If in the relaxed state, the normal shear wave velocity of the unchanged tendon is 15.55 m/s in the sagittal orientation and 5.29 m/s in the transverse (axial) orientation, then when the limb is flexed, these indicators change and correspond to 7.03 m/s and 4.76 m/s [33, 42]. Thus, in order to standardize the ESV technique and ensure the reproducibility of quantitative results of assessing the elasticity of the Achilles tendon, American scientists at the University of Carolina proposed two options for its implementation: in the relaxation position (the patient lies on his stomach, the leg in the ankle joint hangs from the edge of the couch) and in the position of fixing the foot with the knee joint bent at  $90^\circ$ . At the same time, the ESV indicators in these methods differ in the range of 2-4%, which, according to Eby et al. (2013) and Aubry (2015), due to the peculiarity of the location of collagen fibers inside the tendon and do not have a significant statistical error.

Of course, the information obtained during ESV required the creation of an evidence base and reference diagnostic methods: they were MRI and histological examination. Over the next four years of development, it was shown that changes in the elasticity of tendon fibers are registered earlier than morphological changes, i.e. ESV detects violations in the structure of the tendon matrix and identifies pathology earlier than B-mode ultrasound and MRI [37, 38, 40, 46]. This is especially clearly demonstrated in the works of B. Frankewycz (2017, 2020), T. X. Haen (2017), B. K. Coombes (2018).

A certain clinical interest among traumatologists and orthopedists is caused by the possibility of diagnostic monitoring of the condition of the Achilles tendon during the treatment of achillitis. Achillitis is a disease of the achilles tendon of an inflammatory nature, accompanied by a violation of the function of the lower limb. The frequency of its occurrence in the population in the age group of 25-45 years is from 9 to 11 % [25]. In 20% of cases, the disease is bilateral in nature [25]. In the treatment of tendon disease, conservative methods are usually used.

The most common and effective measures, according to a number of Russian experts, are considered therapeutic blockades with the use of corticosteroids [20]. However, 40.9% of patients relapse at various times [25]. As a rule, if the therapy is unsuccessful, a variety of surgical interventions are used. At the same time, surgical treatment options cannot be considered ideal, since the developing scarring process in the tissues and subsequent mechanical disorders can reflexively support the secondary pain syndrome for a long time [25].

Diagnosis of achillitis is not clinically difficult. To confirm the diagnosis and detail changes in the area of Achilles tendon enthesis, ultrasound in B-mode, color-coded techniques, and MRI are used to the calcaneus. With the help of these methods, the effectiveness of the conservative treatment and the complete regression of inflammation are also evaluated. However, in this case, the question arises: if the patient with adequate therapy, initiated in the early stages of the disease, the absence of any morphological disorders in the tendon structure at the time of the pathology, professional dynamic control by specialists of traumatologists-orthopedists and ultrasound doctors, relapse occurs, then, apparently, the existing medical and diagnostic control of the treatment of achillitis is not perfect?

A partial answer to this question was obtained in the works of Arda (2011), Chen (2013), Horton (2013) and Fu (2016) dealing with tendinopathy, which found that due to degeneration and disorganization of the collagen structure, changes in the content of proteoglycan and water, fat infiltration and neovascularization, the elasticity of the Achilles tendon decreases. However, the authors did not analyze the terms of restoring the elasticity of the tendon fiber, and did not compare the ultrasound picture of the seroscale regime and ESV indicators. In this regard, the aim of our study was to compare the dynamics of regression of inflammatory changes in the Achilles tendon in the B-mode with the data of ultrasonic elastometry by the shear wave method.

**Purpose of the study** – to compare the dynamics of regression of inflammatory changes of the Achilles tendon in B-mode with the data of ultrasonic elastometry using the shear wave method.

#### **Materials and methods**

We examined 26 patients (21 men, 5 women) who were on hospital treatment, with the established diagnosis of “achillitis” at the age of 18 to 34 years. The duration of the disease did not exceed 2 weeks. All patients underwent triple ultrasound of the Achilles tendon (at the time of admission to the hospital, 1 and 2 weeks after the start of anti-inflammatory therapy) on the LG Logic S8 device with a linear sensor L9. the assessment of the elasticity of tendon fibers was performed in the area of the most pronounced inflammatory changes with the determination of the young's modulus, expressed in KPa. MRI was performed twice on a Siemens Magnetom Aera 1.5 TL machine (at the time of hospitalization

and when the achillitis clinic disappeared). CT was performed three times on the device Toshiba Prime Aguiloi 160 according to standard methods.

### **Results and discussion**

All patients with ultrasound in B-mode at the time of hospitalization showed a decrease in the echogenicity of tendon fibers with a moderate violation of their differentiation in the middle (76.9%) or distal (23.1%) parts of the Achilles tendon as a result of edema. The zone of inflammatory changes was localized in the Central parts of the tendon in 25.7%, in the peripheral parts-in 74.3%. In elastometry, the young modulus of the fibers was  $105.5 \pm 16.5$  KPa. With a decrease in the clinical activity of the inflammatory process against the background of normalization of the echographic picture of the tendon, the values of the young's modulus of fibers were preserved in the range of  $113.95 \pm 3.95$  kPa.

After 14 days from the start of conservative therapy, when the clinical manifestations of achillitis subsided and the Achilles tendon was restored to the unchanged ULTRASOUND picture, an increase in fiber elasticity to  $171.85 \pm 17.45$  kPa was observed. Ultrasound data in assessing the condition of tendon fibers were confirmed by MRI, elasticity-by CT results with densitometry. However, according to the ESV data, there was no complete recovery of unchanged parameters of tendon elasticity (in 92.4% of the examined patients).

Ultrasound in combination with ESV 21 days after hospitalization and the beginning of treatment showed that only by this time there was a complete restoration of the elasticity of the Achilles.

### **Conclusion**

Shear wave elastography is reliable (according to experimental and analytical methods) in determining the zone of inflammatory changes. The data of elastometry assess the effectiveness of conservative treatment of agilita. Residual manifestations of inflammation according to elastometry persist for 5-6 days after normalization of the echographic picture of the Achilles tendon and require an increase in the period of treatment of achillitis.

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## CIRCULATING TUMOR CELLS IN MULTIPLE MYELOMA: IMMUNOPHENOTYPIC CHARACTERISTICS IN A COMPLICATED COURSE OF THE DISEASE

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### **Abstract.**

**The purpose of the study** was to compare the immunophenotypic profile of tumor plasma cells of the bone marrow (PIC BM) and circulating tumor plasma cells (CTC MM) in patients with multiple myeloma (MM), depending on the characteristics of the course of the disease.

**Methods.** Parallel immunophenotypic study of bone marrow aspirate and peripheral blood samples from 34 patients with MM was carried out by 4-color laser flow cytometry (FACSCalibur flow cytometer (Becton Dickinson, USA). PIC gate was isolated by expression of CD38+bright/SSC, analysis of expression of CD138, CD45, CD56, CD11c, CD28, CD117, CD33, CD79b, CD19, CD20.

**Results.** Patients with newly diagnosed MM were found to have two tumor subclones - bone marrow and circulating, differing in immunophenotypic characteristics and quantitative values in uncomplicated and complicated course of the disease. A direct correlation was found between the number of PICs determined by cytological (myelogram) and cytometric methods for detecting myeloma cells in BM and PB. Immunophenotypic differences between the BM and CTC MM subclones of tumor plasma cells are most clearly presented in the groups of patients with uncomplicated MM, in MM with kidney damage, and in MM complicated by plasmacytomas, these differences are less pronounced. Associations of the expression of various immunophenotypic markers of tumor plasma cells in the BM and PB compartments with the massiveness of tumor lesions in the bone marrow, with different course of the disease were revealed, and immunophenotypic prognostic criteria for the development of local tumor growth were proposed.

**Keywords:** multiple myeloma, circulating tumor cells, flow cytometry.

Multiple myeloma (MM) is one of the most common (10% of all hematologi-

cal malignancies) and a complex pathogenic malignant disease of the blood system. Tumor plasma cells are the substrate of the disease.

MM is a unique model for studying the mechanisms that determine the transition from a pre-malignant state to a malignant tumor, from an early and benign phase (monoclonal gammopathy of undetermined significance) to an intermediate phase (smoldering multiple myeloma) and the final advanced stage (symptomatic or refractory multiple myeloma).

Despite the advances achieved in recent years in the study of the pathogenesis of MM and the improvement of methods of immunochemotherapy, answers to some key questions have not yet been found: why does the "sleeping" clone become aggressive in some patients, but remains stable in others? What are the mechanisms causing refractoriness to therapy? In the scientific literature, there are data on the existence of two subclones of tumor plasma cells in MM: bone marrow and circulating in the peripheral blood. The latter, according to some authors [1], are present in 80% of MM cases. Circulating tumor cells (CTC) in MM are able to leave the bone marrow, move through the bloodstream and cause the spread of the disease, as well as the development of extramedullary relapses of the disease. To confirm this position, it is highly relevant to study the immunophenotypic characteristics of CTC, which will reveal the biological characteristics of this subclone, its contribution to the pathogenesis and prognosis of MM. This will make it possible to more actively influence this population of tumor cells with the help of chemotherapeutic and innovative drugs, as well as optimize supportive therapy.

**Purpose of the study:** To assess the immunophenotypic profile of tumor plasma cells of the bone marrow (PIC BM) and circulating tumor cells in patients with newly diagnosed MM (CTC MM) in comparison with the characteristics of the course of the disease.

**Materials and methods.** A parallel immunophenotypic study of BM and PB tumor plasma cells by flow cytometry was performed in 34 patients (16 women, 18 men) with newly diagnosed MM. The median age of the patients was 59 years (ranging from 30 to 85 years). All patients had Durie-Salmon stage 3 disease at the time of examination. Fifteen (44.1%) patients had G $\kappa$  paraproteinemia, another 13 (38.2%) had G $\lambda$ . Paraprotein Ak in serum was detected in 2 (5.9%) patients, in 1 (2.9%) patient - paraprotein A $\lambda$ . Non-secreting MM was detected in 3 (8.9%) patients. Uncomplicated MM was diagnosed in 16 (45.7%) patients. 10 (29.4%) patients had plasmacytomas of various localization (8 patients - bone, 2 - extramedullary). In 9 (25.7%) patients, the disease was complicated by the development of CRF, of which 4 patients required renal replacement therapy. One patient had a combined lesion - CKD and plasmacytoma of the 6th thoracic vertebra. The average level of plasma cells in the bone marrow according to myelogram data was 27%.

Immunophenotypic study of bone marrow aspirate and peripheral blood samples was carried out by 4-color laser flow cytometry (2-laser flow cytometer FAC-SCalibur (Becton Dickinson, USA). The bone marrow aspirate was preliminarily filtered and washed twice with a phosphate-buffered saline (PBS) solution, then erythrocytes were lysed (PharmLyse lysis solution (Becton Dickinson, USA), then washed twice with PBS solution. The peripheral blood samples were pre-poured into several portions in volume of 500-1000  $\mu$ l, erythrocytes were lysed, washed twice with PBS solution, and the sediment was concentrated in one test tube at 1500 rpm for 5 min. Further, the bone marrow and PB samples were incubated at room temperature for 30 min in the dark with monoclonal antibodies (MABs) of a certain specificity, conjugated with fluorescent dyes in various combinations. Used the following MABs: anti-CD38-FITC, anti-CD138-PE; anti-CD45-PerCP, APC; anti-CD56-PE, APC; anti-CD11c-PE, anti-CD28-PE, anti-CD79b-PE, anti-CD117-PerCP, anti-CD19-PerCP-Cy5.5; APC; anti-CD20-APC, anti-CD33-APC (Becton Dickinson, USA). The gating strategy and the selection of immunophenotypic markers were carried out in accordance with the recommendations of the European Consortium for Flow Cytometry (Euro-Flow, 2012), adapted for a 4-color flow cytometer. CD38, CD45 were used as "framework" markers for identification and quantitative assessment of plasma cells, along with the characteristics of light scattering. The main stages of the strategy of gating plasma cells in patients with MM were the isolation of a gate of CD38-positive cells with a high expression intensity - (bright) against the lateral light scattering channel (SSC), followed by assessment of the content of positive cells within this gate for antigens of interest. The criterion for positivity was the presence of antigen expression on the surface of more than 20% of tumor cells. The analysis included at least 500,000 events. Normal plasma cells BM and PB were excluded by the CD45 + (bright) CD19 + CD56- phenotype. The quantitative assessment of PIC was carried out according to the content of CD38 + (bright) cells in terms of all nucleated cells (NC) BM and PB.

Statistical processing of the results was carried out using the Statistica v. 8.0. with the calculation of the mean and squared error of the mean ( $M=m$ ), the median, indicating the minimum and maximum values. The shape of the distribution of quantitative variables was analyzed using the Shapiro-Wilk test. To determine the statistical significance of differences in the mean values of quantitative indicators, the Student's t-test was used.

**Results.** Depending on the median level of BM tumor plasma cells (27% according to myelogram data), patients were divided into 2 groups: group 1 with a plasmacytosis level of less than 27% and group 2 with a plasmacytosis level of more than 27%. In these groups of patients, we characterized the immunophenotypic features of BM and CTC MM plasmocytes (Table 1).

**Table 1. Immunophenotypic features of PIC BM and CTC MM depending on the level of plasmacytosis in BM according to myelogram data (% of positive cells).**

Investigated parameters	PIC BM Less than 27% N=17	PIC BM More than 27% N=17	P	CTC MM Less than 27% N=17	CTC MM More than 27% N=17	P
The number of tumor cells (CD38+Bright), % of NC	7.53±1.7	18.37±5.3	0.03	0.75±0.20	2.76±1.38	0.08
Of them:						
CD138+	69.95±8.48	81.3±3.41	0.11	28.31±7.28	28.84±7.39	0.48
CD56+	65.09±7.74	59.45±8.57	0.31	38.24±4.69	41.36±7.53	0.36
CD117+	6.75±1.76	8.76±4.16	0.32	3.85±1.26	3.94±1.22	0.48
CD11c+	45.25±8.82	30.18±6.10	0.08	45.49±5.34	36.6±6.12	0.13
<b>CD33+</b>	<b>23.01±5.86</b>	<b>6.25±1.6</b>	<b>0.01</b>	16.20±3.46	11.76±3.09	0.17
CD28+	41.85±10.41	49.08±7.09	0.28	<b>19.5±4.40</b>	<b>30.12±7.78</b>	<b>0.02</b>
<b>CD19+</b>	<b>19.58±5.70</b>	<b>6.11±3.02</b>	<b>0.02</b>	<b>20.22±5.51</b>	<b>7.76±1.82</b>	<b>0.02</b>
<b>CD20+</b>	<b>3.92±1.08</b>	<b>19.97±7.27</b>	<b>0.02</b>	7.54±1.46	7.09±2.17	0.43
CD79b+	33.60±8.49	28.34±6.34	0.30	12.75±2.99	18.73±3.81	0.11

Significant (p=0.03) differences in the amount of PIC BM, determined cytometrically, were revealed: with plasmacytosis of more than 27%, according to myelogram data, the level of PIC BM was 2.5 times higher than with less (less than 27%) plasmacytosis. The same trend was observed when analyzing the content of tumor cells in PB: a more pronounced plasmacytosis according to myelogram data corresponded to a greater number of CTC MM detected cytometrically, and vice versa, a lower amount of CTC MM corresponded to a lower level of plasmacytosis.

Noteworthy is the higher expression of the adhesive molecule CD33 on PIC BM in the group of patients with plasmacytosis of less than 27%. No differences in the level of expression of this antigen on CTC MM were found in both groups. Expression of CD28 on CTC MM was detected in a significantly higher number of tumor cells in the group of patients with plasmacytosis in BM of more than 27%. There was a higher expression of CD19 on both PIC BM and CTC in the group of patients with plasmacytosis less than the median. At the same time, the expression of CD20 was significantly higher on tumor PIC BM in the group of patients with

plasmacytosis of more than 27%. On CTC MM, the expression of this marker was approximately at the same level in both groups.

Thus, firstly, we have revealed a direct correlation between the number of PICs determined by cytological (myelogram) and cytometric methods for detecting myeloma cells in BM and PB.

Second, we revealed some associations between the level of plasmacytosis and immunophenotypic features of BM and PB tumor cells: positive expression of CD33 on BM PIC was associated with a low level of plasmacytosis in BM; positive expression of CD20 on PIC BM was associated with a higher level of plasmacytosis; positive expression of CD19 on both PIC BM and CTC was associated with a low level of plasmacytosis. Positive expression of CD28 was expressed on PIC BM and did not depend on the level of plasmacytosis, while on CTC MM it was associated with a higher level.

**Table 2. Immunophenotypic features of PIC BM and CTC MM in patients with uncomplicated course (% of positive cells).**

Investigated parameters	PIC BM N=16	CTC MM N=16	P
<b>The number of tumor cells (CD38+Bright), % of NC</b> <b>Of them:</b>	<b>11.007±2.54</b>	<b>0.461±0.169</b>	<b>0.0003</b>
<b>CD138+</b>	<b>78.0 ±6.47</b>	<b>29.51±8.649</b>	<b>0.0000</b>
<b>CD56+</b>	<b>66.58±8.58</b>	<b>32.77±5.83</b>	<b>0.0012</b>
CD117+	5.21±1.71	3.982±1.349	0.282
CD11c+	40.96±7.01	40.09±5.82	0.461
CD33+	20.89±7.75	13.81±3.6	0.2006
<b>CD28+</b>	<b>49.29±7.44</b>	<b>26.38±5.9</b>	<b>0.0098</b>
CD19+	7.393±3.114	11.29±2.81	0.172
CD20+	15.41±6.39	8.44±2.3	0.151
CD79b+	34.59±7.06	22.774±4.115	0.074

It was found that in uncomplicated MM the number of BM tumor plasma cells was significantly higher (11.01±2.54%) than in PB (0.46±0.17) (P=0.0003). CTC MM was characterized by a significant decrease in the expression of CD138, CD56, CD28 compared to PIC BM.

At the time of the onset of the disease, 10 patients had plasmacytomas of

various localization (8 - bone, 2 - extramedullary). Comparative characteristics of PIC BM and CTC MM in patients with MM complicated by plasmacytomas are presented in Table 3.

**Table 3. Immunophenotypic features of PIC BM and CTC MM in patients with MM complicated by plasmacytomas (% of positive cells).**

Investigated parameters	PIC BM N=10	CTC MM N=10	p
<b>The number of tumor cells (CD38 + Bright), % of NC Of them:</b>	3.182±1.497	1.188±0.314	0.100
<b>CD138+</b>	<b>77.99±9.16</b>	<b>19.175±6.433</b>	<b>0.000</b>
CD56+	40.76±7.49	35.24±7.10	0.290
CD117+	9.73±4.6	4.608±1.49	0.144
CD11c+	45.644±12.07	43.51±8.2	0.439
CD33+	10.772±2.415	16.13±4.55	0.145
CD28+	51.99±14.45	29.33±10.22	0.09
CD19+	25.56±8.12	19.816±7.583	0.29
CD20+	4.68±1.37	7.53±2.07	0.121
<b>CD79b+</b>	<b>37.98±10.43</b>	<b>10.3±3.603</b>	<b>0.011</b>

The number of cytometrically detected tumor cells in BM in patients with plasmacytomas was approximately 3.5 times lower than in patients with uncomplicated MM. Moreover, we found that in this group of patients the total number of tumor plasma cells in BM did not differ significantly from that in PB. In general, in this group of patients, CTC MM was characterized by a significant decrease in the expression of CD138, CD79b compared to PIC BM, which may indicate the loss of the syndecan-1 molecule upon their exit from BM.

Thus, tumor PIC BM in plasmacytomas differed phenotypically from PIC BM in uncomplicated MM and were characterized by a vivid expression of CD138, a decreased level of expression of CD56, CD33, and an increase in the level of expression of CD19. CTC MM in patients with plasmacytomas were characterized by less pronounced expression of CD33, CD56, compared with bone marrow plasma cells. Probably, such immunophenotypic features as the loss of adhesion molecules and a lower level of cell differentiation predetermine the intensive release of tumor cells from BM into the bloodstream with further formation of plas-

macytes of different localization. It is worth noting the stable expression level of the CD11c integrin molecule, which carries out intercellular interactions and chemotaxis in inflammatory processes both in BM tumor cells and in PB in patients with uncomplicated MM and with plasmacytomas.

It should be noted that in patients with MM with the presence of renal pathology, the highest content of tumor plasma cells was detected in BM and PB, when compared with patients with uncomplicated MM and with the presence of plasmacytes.

When comparing the immunophenotypic features of PIC BM and CTC MM in patients with kidney damage (Table 4), we revealed a significantly higher number of tumor cells in BM compared to PB.

**Table 4. Immunophenotypic features of PIC BM and CTC MM in patients with MM complicated by kidney damage (% of positive cells).**

Investigated parameters	PIC BM N=9	CTC MM N=9	p
The number of tumor cells CD38+Bright, (% of NC) Of them:	18.876±7.282	4.083±2.353	0.034
<b>CD138+</b>	<b>72.77±9.19</b>	<b>35.7±9.51</b>	<b>0.004</b>
CD56+	77.13±9.94	57.61±8.27	0.065
CD117+	3.32±1.51	3.94±1.67	0.387
<b>CD11c+</b>	<b>17.69±5.89</b>	<b>43.20±9.07</b>	<b>0.013</b>
CD33+	15.213±6.66	11.14±3.73	0.290
CD28+	19.9±7.64	15.02±6.18	0.297
CD19+	7.040±5.729	12.91±6.51	0.127
CD20+	20.1±10.97	6.02±1.83	0.108
CD79b+	19.83±9.14	9.72±3.24	0.147

CD138 expression was significantly lower on CTC MM than on PIC BM. Integrin CD11c expression was significantly increased on CTC MM compared to PIC BM. The level of malignant myeloma cells expressing CD56 remained high in both BM and PB.

We have identified a general pattern characteristic of all compared groups of patients, which consists in a significant decrease in the expression of the syndecan-1 (CD138) molecule on CTC MM, as compared to bone marrow plasmocytes. Expression of syndecan-1 is characteristic exclusively of plasma cells, both

normal and myeloma. Taking into account such characteristic features of MM as low proliferative activity of tumor cells (less than 1%) and recurrent course of the disease, it can be assumed that myeloma cells are capable of self-reproduction (MM stem cells), tumor regrowth, and resistance to therapy. It has been proven that the role of myeloma stem cells can be played by plasma cells that lack expression of CD138 [2]. According to the results of some clinical studies, it was revealed that CD138-negative cells are characterized by a higher clonogenic activity and a higher expression of the differentiating B-cell antigens CD19 and CD20 [3]. With long-term cultivation in vitro, they are able to restore the CD138-positive population of MM cells, and are also resistant to chemotherapy. Some authors consider this population of MM cells to be less mature and possessing an increased proliferative potential [4–6].

### Conclusions

1. Immunophenotypic differences between subclones of tumor plasma cells BM and CTC MM are most clearly presented in groups of patients with uncomplicated MM and in MM with kidney damage.

2. In the group of patients with MM complicated by plasmacytomas, there were fewer significant differences between PIC BM and CTC MM, from which we can conclude about the probable biological identity of these subclones.

3. The peculiarities of clonal bone marrow PIC in plasmacytomas are significantly less pronounced expression of adhesion molecules and more pronounced expression of antigens of the less "mature" stage of differentiation, which may be additional prognostic criteria for the development of local tumor growth.

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## METABOLIC AND IMMUNOLOGICAL APPROACHES TO ASSESSING THE CHARACTERISTICS OF CHRONIC PERIODONTITIS ASSOCIATED WITH DIABETES MELLITUS TYPE 2

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**Abstract.** *Purpose: To develop a system of biomarkers for the comorbid course of chronic periodontitis and type 2 diabetes mellitus based on metabolic and immunological approaches to assessing the local pathological process. Materials and methods: a comparative analysis of indicators of molecular genetic research of 3 study groups was carried out: the main group consisted of 58 patients with an association of moderate chronic generalized parodontitis and compensated DM2; the comparison group consisted of 39 patients with moderate chronic periodontitis without concomitant somatic pathology; the control group consisted of 27 people without signs of chronic periodontitis with a sanitized mouth without clinically pronounced manifestations of somatic pathology. Results and conclusions: The lipid profile of saliva has a pronounced diagnostic value in chronic periodontitis in association with type 2 diabetes mellitus, with triglyceride levels > 6.5 mmol/l, and LDLP < 2.8 mmol/ml.*

**Keywords:** *type 2 diabetes mellitus, periodontitis, diagnosis.*

### **Introduction**

Periodontal diseases have a complex etiopathogenesis and arise as a result of a combination of a number of factors leading to the destruction of the periodontium, irreversible resorption of bone tissue and loss of teeth [1]. The prevalence of periodontitis among the adult, able-bodied population in the world reaches 75%. This nosology is considered the second most common in the world [2], while the severe form of periodontitis is the sixth most common disease [3]. Periodontitis has a great impact on the health of the population also for the reason that it is associated with a number of systemic diseases, including diabetes mellitus (DM), cardiovascular diseases, including atherosclerosis, and others [4, 5]. Today, the polymicrobial nature of periodontitis is recognized, and the inflammatory response of the human body is considered a decisive factor in the development and progression of

the disease [6, 7].

Chronic periodontitis and DM are two comorbid diseases common throughout the world [8–10]. The International Diabetes Federation (IDF) has predicted that the number of patients with DM will grow steadily and will reach over 500 million by 2030 [11, 12]. Approximately 90% of all DM patients have the so-called DM2, due to a combination of a decrease in insulin secretion by  $\beta$ -cells of the pancreas and a general increase in the resistance of human somatic cells to insulin [13]. Many researchers have shown that metabolic changes associated with DM2 are systemic in nature, affect many organs and tissues and cause chronic periodontitis, among other consequences [14, 15]. According to modern researchers, the pathogenesis of DM is based on four leading mechanisms - hyperglycemia, cell resistance to insulin, hyperlipidemia, and immune dysfunctions [16]. The same mechanisms, manifested to varying degrees at the local level, underlie the pathogenesis and chronic periodontitis [17]. The existence of a relationship between the development of DM2 and infectious and inflammatory periodontal diseases is not in doubt among modern researchers [17]. At the same time, it is emphasized that against the background of DM, chronic periodontitis, as a rule, flows much more heavily [18]. At the same time, in recent years, quite a lot of evidence has appeared that not only DM affects the development of periodontitis, but also periodontal diseases can affect the development and course of DM [19]. The mechanisms of these mutual influences are not fully disclosed, and their study on the basis of modern biotechnologies, as well as the determination of biomarkers of such an interconnection, still remain an urgent medical problem.

**Purpose of the study** – development of a system of biomarkers for the comorbid course of chronic periodontitis and type 2 diabetes mellitus based on metabolic and immunological approaches to assessing the local pathological process.

#### **Materials and methods**

To achieve this goal, 124 patients were observed, which made up 3 study groups - the main, comparison and control groups. The main group consisted of 58 patients with the association of moderate chronic generalized periodontitis and compensated DM2; the comparison group consisted of 39 patients with moderate chronic periodontitis without concomitant somatic pathology; the control group consisted of 27 people without signs of chronic periodontitis with a sanitized mouth without clinically pronounced manifestations of somatic pathology.

Molecular genetic studies were carried out using PCR and metagenomic analysis. In the latter case, the methods of 16S sequencing and whole genome sequencing were used to decipher the taxonomic and metabolic profiles of the microbiome of periodontal pockets/periodontal sulcus in the study groups.

In parallel, the lipid profile of saliva was determined spectrophotometrically, as well as the metabolism of ceramides by the level of ceramide kinase and the

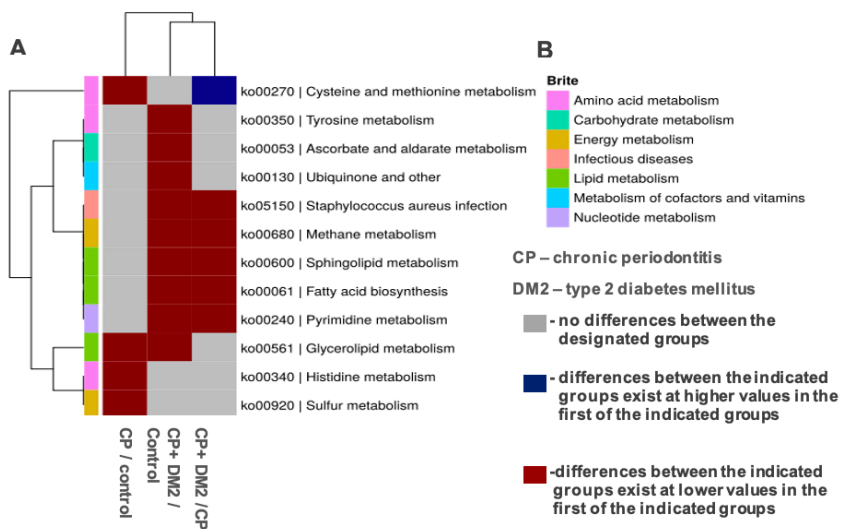
cytokine profile in saliva by enzyme immunoassay.

Statistical data processing was carried out on the basis of the statistical software package IBM SPSS, version 24.

### Results and discussion

The novelty of the conducted research is also associated with a unique phenomenon registered using 16S sequencing.

Four metabolic pathways were established, the reduction of which is characteristic of the group of chronic periodontitis in combination with DM2 and distinguishes this group from the control group and the group of chronic periodontitis only: pyrimidine metabolism (ko00240), methane metabolism (ko00680), sphingolipid metabolism (ko00600) and biosynthesis of fatty acids (ko00061). In other words, among these features, half is accounted for by lipid metabolism (figure 1).

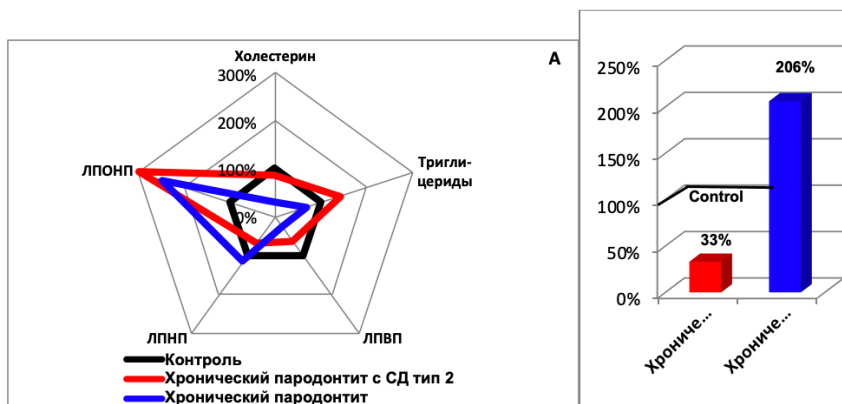


**Fig. 1. A - a graph of intergroup differences in the functional profile of the microbiome of periodontal pockets/periodontal sulcus; B - the nature of metabolic reactions**

Sources of scientific literature show that, in the oral microbiome, the most active producers of, in particular, sphingolipids/ceramides among periodontopathogens are representatives of the families Porphyromonadaceae and Prevotellaceae [20, 21]. In addition, sphingolipids in large quantities produce saprophytic microorganisms living in the oral cavity and belonging to the Sphingobacteriaceae

family. With the help of additional studies, a low content of bacteria of the Sphingobacteriaceae family in the microbiome of patients with the association of chronic periodontitis and DM2 was confirmed, however, along with this, a rather high content of other sphingolipid-producing bacteria related to periodontopathogens was noted in the biofilm of patients in this group. To find out how this is combined with metabolic disorders that are characteristic separately for chronic periodontitis and for DM2, it is necessary to determine the effect of the lipid composition of the periodontal tissues themselves, regardless of the microbiome.

When assessing the characteristics of the general state of lipid metabolism in the oral cavity of patients with chronic periodontitis associated and not associated with DM2, the lipid profile of saliva in all groups was analyzed by spectrophotometry. The lipid profile included salivary cholesterol, triglycerides, high density lipoproteins, low density lipoproteins, and the content of very low density lipoproteins in saliva was calculated (figure 2A).



**Fig. 2. Percentage of deviation from the control of lipid profile parameters (A) and ceramide kinase (B) in the saliva of patients in the study groups**

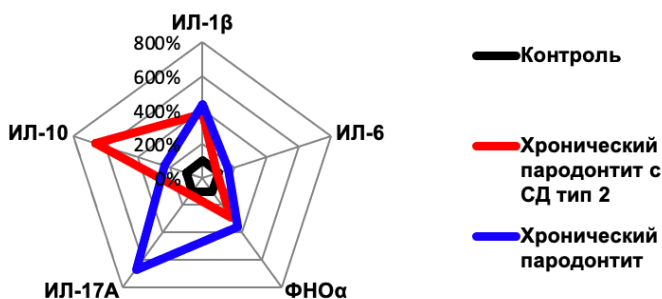
It was determined that in chronic periodontitis associated with DM2, the level of triglycerides acquires a distinct tendency to increase in comparison with the control, and the content of low density lipoproteins, on the contrary, to a decrease. In chronic periodontitis without DM, the indicated tendencies acquire the opposite character, which makes the differences between the indicators in the comparison groups reliable. At the same time, the level of triglycerides with a value above 6.5 mmol/l has a high diagnostic value (AUC = 0.758), while the diagnostic value of LDLP below 3.4 mmol/l can be characterized as close to high (AUC = 0.691). These data do not contradict the literature data with the only difference that the

authors, as a rule, determined the lipid profile according to the above parameters either only in chronic periodontitis, or only in type 2 diabetes mellitus [22].

In addition, one of the most important indicators of sphingolipid metabolism in the tissues of the oral cavity of patients with chronic periodontitis associated and not associated with DM2, as well as healthy individuals, may be the content of ceramide kinase in saliva, an enzyme that causes the breakdown of bioactive ceramides. The content of ceramide kinase in the saliva of patients with chronic periodontitis in combination with DM2 significantly decreases 3 times, while only in chronic periodontitis it increases very significantly - 2.1 times (Figure 2B). With salivary ceramidase values below 28 ng/ml, it can be argued with a very high diagnostic value (AUC = 0.9) that chronic periodontitis is pathogenetically associated with DM2. We have not found a description of this phenomenon in the available literature.

For a more substantiated conclusion about the pathogenetic role of triglycerides, very low density lipids and ceramidase, it was decided to investigate the main cytokines in saliva that regulate inflammation and create conditions for the development of oxidative stress with its leading role in lipid peroxidation. For this purpose, the levels of the pro-inflammatory cytokines IL-1 $\beta$ , IL-6, TNF $\alpha$ , IL-17A, as well as the anti-inflammatory cytokine IL-10 were determined (Figure 3).

Differences between the groups of chronic periodontitis associated and not associated with DM2 were identified by the content of 2 cytokines in saliva - IL-17A and IL-10. These cytokines have a multidirectional effect: IL-17A has a powerful pro-inflammatory effect, while IL-10, on the contrary, suppresses inflammatory reactions.



**Fig. 3. Percentage of deviation from the control of indicators of the cytokine profile of patients in the study groups**

In chronic periodontitis without concomitant disease, the level of IL-17A significantly prevailed, and in the association of chronic periodontitis with DM2, the

level of IL-10 prevailed. Both indicators demonstrate high diagnostic significance and, at values below 28 pg/ml for IL-17A and above 13 pg/ml for IL-10, against the background of the existing clinical manifestations of chronic periodontitis, they characterize the presence of comorbidities in the form of DM2.

### Conclusion

1. The lipid profile of saliva has a pronounced diagnostic significance in chronic periodontitis in association with type 2 diabetes mellitus, with triglyceride levels  $> 6.5$  mmol/l, and LDLP  $< 2.8$  mmol/ml.

2. Metagenomic analysis showed disorders of sphingolipid metabolism, which is confirmed by the results of enzyme immunoassay to determine the level of ceramidase in saliva: at values below 28 ng/ml, it can be argued with high diagnostic significance that chronic periodontitis is pathogenetically associated with type 2 diabetes mellitus.

3. The pro-inflammatory cytokine IL-17A and anti-inflammatory IL-10 demonstrate a high diagnostic value, and at values below 28 pg/ml for IL-17A and above 13 pg/ml for IL-10 against the background of the existing clinical manifestations of chronic periodontitis, they characterize the presence of concomitant pathology in the form of sugar type 2 diabetes.

4. To assess the degree of influence of dyslipidemia on the course of chronic periodontitis, it is advisable to determine the lipid profile of saliva and the metabolism of ceramides by the content of ceramide kinase in saliva with the greatest diagnostic significance of assessing the metabolism of ceramides. When assessing the state of dyslipidemia, it should be borne in mind that for chronic periodontitis of moderate severity in combination with compensated type 2 diabetes mellitus, the content in saliva is characteristic: triglycerides  $> 6.5$  mmol/l, low density lipoproteins  $< 2.8$  mmol/l, ceramide kinase  $< 28$  ng/ml.

5. To assess the degree of immune dysfunction in chronic periodontitis, it is advisable to determine the level of proinflammatory IL-17A and immunosuppressive

IL-10 in saliva. When assessing the state of immune dysfunction, it should be borne in mind that for chronic periodontitis of moderate severity in combination with compensated type 2 diabetes mellitus, saliva content is characteristic: IL-17A  $< 28$  pg/ml, IL-10  $> 13$  pg/ml.

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**MICROBIAL LANDSCAPE AND ANTIBIOTIC RESISTANCE OF THE MAIN CAUSATIVE AGENTS OF ASYMPTOMATIC BACTERIURIA OF PREGNANT WOMEN FOR THE PERIOD 2013 - 2016**

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**Abstract.** *A retrospective analysis of the microbial landscape and antibiotic resistance of the main pathogens of asymptomatic bacteriuria of pregnant women for the period 2013-2016 was carried out. It has been shown that Escherichia coli, Staphylococcus aureus, and Streptococcus agalactiae are the main causative agents of latent bacteriuria in pregnant women. In addition, during the analyzed period, there is a gradual increase in the resistance of E. coli and Streptococcus agalactiae to all groups of antibiotics, Staphylococcus aureus - to cephalosporins and fluoroquinolones.*

**Keywords:** *microbial landscape, asymptomatic bacteriuria, pregnant women, antibiotics, resistance.*

**Relevance:** Urinary tract infection during pregnancy remains one of the most important problems in obstetrics, urology and perinatology. This is due to changes in the clinical signs of urinary tract infections during pregnancy, approaches to diagnosis and treatment, as well as a high risk of urological, obstetric and neonatal complications [1, 2, 3, 4].

Asymptomatic bacteriuria occupies a special place in the structure of urinary tract infections. As a preclinical form of a number of diseases of the urinary sys-

tem, asymptomatic bacteriuria is characterized by a persistent recurrent course with a low percentage of self-healing, a high risk of complications from the mother, fetus and newborn, and a high probability of manifestation in a symptomatic form of urinary tract infection. According to literature data, asymptomatic bacteriuria occurs in 6% of pregnant women (from 2 to 13% depending on socio-economic conditions) [5, 6, 7, 8].

The standard case definition of a urinary tract infection (as recommended by the CDC) is based on clinical evidence (fever over 37.5°C, urge to urinate, urinary frequency, dysuria, suprapubic tenderness) and bacteriological data - detection in urine culture  $> 10^5$  CFU/ml (colonies in ml) no more than two types of microorganisms. The most reliable method for diagnosing nosocomial urinary tract infections, along with clinical data, remains microbiological studies. In this case, clinically significant bacteriuria should be distinguished from insignificant. If the concentration of the microorganism in the urine is more than  $10^5$  CFU/ml, the results should be considered clinically significant.

In this regard, an important task is, first of all, timely diagnosis and rational etiotropic therapy of asymptomatic bacteriuria in pregnant women as the main measure for the prevention of ascending urinary tract infection and the development of a number of complications from the mother, fetus and newborn [9, 10, 11, 12, 13].

According to the Protocol of diagnostics and treatment "Maintaining physiological pregnancy" (approved by the minutes of the meeting of the Expert Commission on the development of health care of the Republic of Kazakhstan No. 18 dated September 19, 2013), when registering, all pregnant women are prescribed a urine test for bacteriuria. Treatment of bacteriuria reduces this risk. Thus, it is recommended that pregnant women be screened for bacteriuria using a urine culture at least once in early pregnancy, and, if positive results are obtained, treat it.

Thus, the successful resolution of many problems associated with asymptomatic bacteriuria during pregnancy presents a real opportunity to improve the quality of medical care for pregnant women and reduce the number of complications from the mother, fetus and newborn [14, 15].

**Purpose of the study** – analysis of the microbial landscape of asymptomatic bacteriuria pathogens in pregnant women and the dynamics of resistance of the main pathogens to antibacterial drugs.

**Materials and methods:** a bacteriological study of biomaterial (urine) of pregnant women was carried out: in 2013 - 4572 samples, 2014 - 10857 samples, 2015 - 11451 samples, 2016 - 10490 samples. All examined women were registered for pregnancy with gynecologists of Nur-Sultan primary health care organizations, had no history of urinary system diseases. The study was carried out by the classical bacteriological method. The release of an infectious agent at a concentration of  $10^5$  CFU/ml or more was taken as true bacteriuria. The identification and determi-

nation of the sensitivity of the isolated strains of microorganisms to antibacterial drugs was carried out in accordance with the current regulatory legal acts.

**Results and discussion:** analysis of the data of bacteriological studies of urine for 2013 showed that latent bacteriuria was detected in 16.9% of 4572 pregnant women examined by the bacteriological method. In 2014, out of 10857 urine samples of pregnant women, microbial flora was isolated in 12.2%; in 2015 - latent bacteriuria was revealed in 12.3% of the surveyed, and in 2016 this indicator was 13.0%.

As can be seen from Table 1, the leading etiological agent in latent bacteriuria of pregnant women in 2013 was *E. coli*, which was isolated in almost 71% of cases, the second most important is *Staphylococcus aureus* (7.8%).

**Table 1. Microbial landscape of microorganisms isolated from urine of pregnant women for the period 2013-2016.**

№	Type of microorganism	%			
		2013	2014	2015	2016
1	<i>Escherichia coli</i>	70.9	68.2	63.1	63.3
2	<i>Klebsiella pneumoniae</i>	3	2.7	2.8	3.0
3	<i>Enterobacter aerogenes</i>	2.7	2.6	1.8	1.7
4	<i>Proteus mirabilis</i>	1.5	1.3	1.4	1.6
5	<i>Proteus vulgaris</i>	0.8	0.8	0.6	0.7
6	<i>Acinetobacter spp.</i>	0.3	0.1	0.2	0.2
7	<i>Pseudomonas aeruginosa</i>	0.5	0.5	0.4	0.4
8	<i>Staphylococcus epidermidis</i>	2	6.7	4.4	3.3
9	<i>Staphylococcus saprophyticus</i>	1.1	4.4	0.4	0.3
10	<i>Staphylococcus haemolyticus</i>	4.7	0	4.5	5.5
11	<i>Staphylococcus aureus</i>	7.8	8.7	7.4	7.0
12	<i>Enterococcus faecalis</i>	3.9	3.7	7.8	9.3
13	<i>Streptococcus agalactiae</i>	0.8	0.3	5.2	3.7

A similar situation was obtained when analyzing the data of bacteriological examination of urine for 2014 - 2016 (table 1).

Analysis of the microbial landscape of the main etiopathogens of latent bacteriuria showed that the main pathogens are Gram-negative bacilli, which belong to the *Enterobacteriaceae* family (from 79.2% in 2013 to 70.5% in 2016) and to the *Pseudomonadaceae* family (0.5% and 0.4 % respectively). Gram-positive cocci are represented by three families - *Staphylococcaceae* (15.6 - 16.0%), *Streptococcaceae* (from 0.8% in 2013 to 3.7% in 2016) and *Enterococcaceae* (3.9% in 2013, 9 in 2016, 3%). Despite the leading role of *Escherichia coli* in the pathology of the urinary tract of pregnant women, there is a significant decrease in its etiolog-

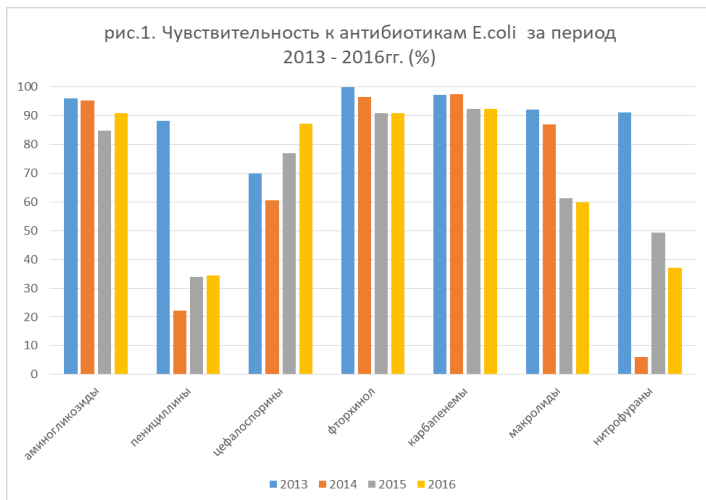
ical significance: if in 2013 *E. coli* was isolated in almost 71% of cases, then by 2016 its seeding rate was 63.3%. The sowing rate of *Enterobacter aerogenes* also decreases from 2.7% in 2013 to 1.7% in 2016. The rest of the *Enterobacteriaceae* family were sown with a stable frequency throughout the analyzed period.

Among staphylococci, the main causative agents of asymptomatic bacteriuria in pregnant women are *Staphylococcus aureus* and *Staphylococcus haemolyticus*. At the same time, the etiological significance of *Staphylococcus aureus* decreases from 7.8% in 2013 to 7.0% in 2016, against the background of an increase in the role of hemolytic staphylococcus (from 4.7% in 2013 to 5.5% in 2016) and epidermal staphylococcus (from 2.0% to 3.3%).

According to the literature, group B streptococcal infection is detected in 10-30% of pregnant women without the prior onset of symptoms. While streptococcal infection is not a threat to the mother, it can pose a serious threat to the child's health. One of the most dangerous gram-positive cocci belonging to group B streptococci is *Streptococcus agalactiae*, which can live on the mucous membrane of the digestive system, in the rectum and in the vagina. Thus, our studies have shown a 4.6-fold increase in the role of *Streptococcus agalactiae* in asymptomatic bacteriuria of pregnant women (0.8% in 2013, 3.7% in 2016) [8, 10, 11, 15].

When analyzing the sensitivity of the isolated members of the *Enterobacteriaceae* family to antibiotics, it was revealed that in 2013 98.8% of the isolated strains showed sensitivity to fluoroquinolones (ciprofloxacin). In the period 2014 - 2016, most of the isolated strains of enterobacteriaceae are sensitive to carbapenems (to imipenem - 96.7% and meropenem - 97.4% of the isolated strains).

The main etiological role in urinary tract infections is played by opportunistic microorganisms. These are *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus*, *Klebsiella*, *Serratia*, as well as staphylococci, streptococci, enterococci, *Candida* fungi and their associations. There are differences in the etiological structure of urinary tract infections depending on the gender of the patient. In women, there is a predominance of *E. coli* (up to 85%), in men, *Proteus* and *Pseudomonas aeruginosa* are more often excreted. Due to the fact that the purpose of our study is to examine the sensitivity to antibiotics of the main causative agents of latent bacteriuria in pregnant women, it was of interest to carry out a comparative analysis of the sensitivity by years of the isolated strains of *Escherichia coli* (fig. 1).



As can be seen from fig. 1, the sensitivity of *E. coli* to all groups of antibiotics gradually decreases over the entire analyzed period. There is a 2.5-fold decrease in the sensitivity of *E. coli* to penicillins and nitrofurans. At the same time, the sensitivity of the isolated *E. coli* strains to cephalosporins increases (1.3 times).

*Staphylococcus* in urine during pregnancy is a potential source of urinary tract infection. To this predispose hormones of pregnancy, causing changes in the urinary tract. As pregnancy progresses, the weight of the uterus puts pressure on the bladder, preventing it from emptying completely and increasing the risk of bacteria entering the bladder. Timely treatment is necessary to avoid complications that can lead to kidney infections. In this regard, we carried out a comparative analysis of the sensitivity of *Staphylococcus aureus* to antibacterial drugs (fig. 2).

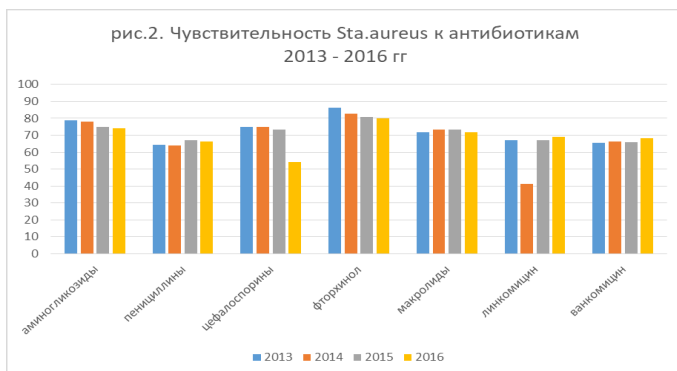
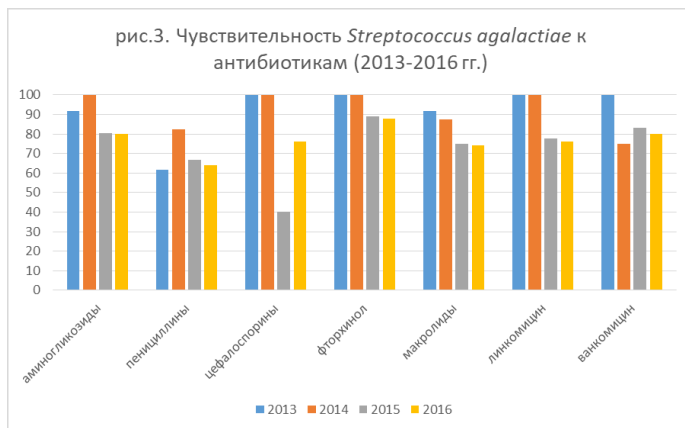


Figure 2 shows that the sensitivity of *Staphylococcus aureus* to cephalosporins for the period 2013 - 2016 decreases 1.4 times, and to fluoroquinolones - 1.1 times. At the same time, there is a slight increase in the sensitivity of this pathogen to lincomycin and vancomycin.

Group B streptococci are among the main causative agents of sepsis and meningitis in newborns. In adults, infections with group B streptococci are associated mainly with pregnancy and childbirth.



Infection with *Streptococcus agalactiae* can lead to the development of an ascending urogenital infection in the postpartum period in women, which is fraught with the development of sepsis. When analyzing the microbial landscape of urine in bacteriuria of pregnant women, a 4.6-fold increase in the etiological role of *Streptococcus agalactiae* in asymptomatic bacteriuria of pregnant women was obtained (2013 - 0.8%, 2016 - 3.7%). At the same time, the sensitivity of *Streptococcus agalactiae* to the main antibacterial drugs is gradually decreasing (fig. 3). So, in 2013 - 2014 there was 100% sensitivity to cephalosporins, and by 2016 it had decreased by 25%. A similar situation is observed with respect to lincomycin (2013 - 2014 - 100%, 2016 - 76%).

Based on the studies carried out, the following **conclusions** can be drawn:

1. The frequency of detection of latent bacteriuria of pregnant women during the analyzed period decreased by 3%.
2. The main causative agent of latent bacteriuria in pregnant women is *Escherichia coli*, *Staphylococcus aureus* and *Streptococcus agalactiae*, and the etiological significance of *Streptococcus agalactiae* increased 4.6 times during the analyzed period.
3. An analysis of the sensitivity of the isolated members of the *Enterobacte-*

*riecae* family to antibiotics showed that the vast majority of strains are sensitive to fluoroquinolones and carbapenems.

4. Gram-positive cocci showed sensitivity to fluoroquinolones and aminoglycosides.

5. Over the entire analyzed period, there is a gradual increase in the resistance of *E. coli* and *Streptococcus agalactiae* to all groups of antibiotics, *Staphylococcus aureus* - to cephalosporins and fluoroquinolones.

Thus, the main causative agents of asymptomatic bacteriuria in pregnant women are representatives of the Enterobacteriaceae family, in particular *E. coli*, which are sensitive to fluoroquinolones and carbapenems. From gram-positive cocci, staphylococci, including *St. aureus*, and streptococci (*Ente Streptococcus agalactiae*) were most often sown. Gram-positive cocci are sensitive to ciprofloxacin and penicillin. Further research is needed to assess the optimal duration of treatment for asymptomatic bacteriuria during pregnancy, taking into account the sensitivity of the isolated pathogen to antibiotics. In addition, taking into account the increased resistance of the main etiopathogens to antibacterial drugs, it is necessary to take cardinal measures to control the prescription and use of antibiotics, as well as to prohibit the over-the-counter sale of antibacterial drugs.

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**COMPARATIVE CHARACTERISTICS OF EDUCATIONAL METHODS  
OF THE PRE-UNIVERSITY MEDICAL PROGRAMS OF THE RUSSIAN  
FEDERATION AND THE REPUBLIC OF KOREA**

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**Abstract.** *This article examines and compares educational methods which are used to prepare students for admission to medical universities in South Korea and Russia, identifies and describes differences between those methods connected with the history of medical education, attitude to studying, mentality and other cultural and social characteristics. Medical universities and chemical and biological classes in both countries have something to learn from their foreign colleagues.*

**Keywords:** *pre-university medical education, South Korea, Russia, university, Seoul National University, Medical Sechenov Pre-University, medical sciences.*

Medicine is one of the most important bodies of sciences in the modern world. This system allows people to recognize, treat and prevent diseases, strengthen the health and work capacity of people and prolong lives. It is especially important that students of medical classes become qualified specialists. The pre-medical curriculum is a mandatory period for medical students to prepare before they move on to higher medical education institutions.

We reviewed the experience of South Korea, as a leading country in terms of economic growth and the level of education of the population, and Russia, because graduates of Russian medical school work in more than 100 countries around the

world and Russian universities have a rich history of training doctors.

Korean medicine has its own unique features. The legendary textbook of Korean traditional medicine "TonyiPogam" is included in the UNESCO "Memory of the World" program, which means that Korean traditional medicine is internationally recognized and functions on a par with Western medicine.

### **History of the development of medical education in Russia and South Korea**

In Korea, traditional medicine has been widespread for centuries. Western medicine began to spread around 1700, but was criticized by scientists, which made it difficult to develop. Traditional Korean medicine is now officially recognized and regulated in the same way as Western medicine. Vocational education in traditional medicine has a structure similar to vocational education in other medical programs: doctors take a six-year bachelor's program or a four-year master's program, then they take an exam.

Early medicine of Russia, despite its leaping development after the adoption of Christianity, was still based on beliefs and superstitions. Nevertheless, monastic medicine began to apply new practical methods of medicine and improved them. Only during the reign of Yaroslav the Wise did secular medicine appear, which tried to be based on reliable facts.[3]

The first hospital school was opened at a permanent land hospital in Moscow and for 26 years (1706-1733) was the only medical educational institution in Russia. More of such schools were opened in 1733. In hospital schools, future doctors showed a high general education level, knowledge of Latin, philosophy and the works of Greek and Roman writers. Hospital schools were the prototype of the Russian university, which did not yet exist at that time. [4]

In the 19th century, large scientific medical schools gained international prestige, Russian medical science and health care were flourishing, which is proved by the awarding of the Nobel Prize to I.P. Pavlov and I.I. Mechnikov, the school of S.P. Botkin and G.A. Zakharyin. [3]

At the same time, Western medicine was first introduced to Korea by the Korean government, and the first Jejungwon clinic was opened in Seoul. Since then, several private hospitals have been established, with the Severance Hospital in 2020 being the most renowned international institution. Here robotic technologies are used for operations and the clinic is provided with an artificial intelligence system Yubikont (Ubiquitous computing), which allows getting an accurate analysis of patients' anamnesis and examination results, and saves the time of medical personnel.

In contrast to Russian schools, until the 1970s, the typical Korean medical school was characterized by a clear division between preclinical and clinical education and between subject-oriented and lecture-oriented teaching exams focused

on testing theoretical knowledge. However, since the early 1980s, there have been gradual changes in the curriculum. [5]

Most Korean medical schools now combine integrated courses with conventional courses in basic medical science and clinical medicine; they can differ only in their duration. The study by E. B. Evladova proved that an integrated program is a product of the joint activities of teachers, uniting separate educational areas into a single whole. In this case, this term implies the concept of interrelation, interdependence, and interpenetration of two or more leading ideas or objects, which implies a qualitative and quantitative change in the parameters of a new idea or a new object.

One of the most important developments in medical education over the past 10 years has been the adoption of the PBL method, first tested in the Netherlands. PBL was first introduced to Korea by one of the medical schools in 1994 and is now actively practiced in all Korean medical schools. The PBL (Problem-Based Learning) method is considered a successful innovative teaching method that provides freedom to the student, which contributes to the independent search and application of information, the development of communication skills, and the ability to work independently.

In this method, the teaching emphasis shifts from a teacher to a student, who takes a more active role, trying to solve a practical problem set for them. This technique teaches students to broader and deeper comprehend everything said by a teacher during lectures and written in textbooks, it promotes original thinking and a personal approach and arouses interest to the subject. This method is most effective for seminars in the humanities, but it will also be useful in preparing, for example, for team scientific and natural works.

The OSCE method - the objective structured clinical examination, which is not widespread in Russia, is also gaining popularity in Korea. Most Korean medical schools use OSCE to test the competence of students. During the clinical objective examination (CQE), candidates are observed and evaluated and passed through the stations where the interview, examination, and treatment of standardized patients (ST) is carried out. OSKE has proven to be so effective that it is now applied not only in medicine but also in other disciplines such as dentistry, nursing, obstetrics, pharmaceuticals, engineering, and law. [6]

Medical education in Korea has changed over the past 20 years. A new medical education system has emerged, the so-called "4 + 4" system. Previously, every medical school in Korea recruited 12-year high school graduate medical students, however, since 2005, several medical schools have begun recruiting college graduate students.

The second change is that many medical schools have begun to pay more attention to the development of humanitarian and communication skills, subjects

such as medical ethics and professionalism, medicine and society, etc. have appeared in the curriculum.

### **Features of the mentality and preparation for admission to higher education**

In the process of collecting information, studying, and comparing the education systems in Russia and South Korea, we came across such a concept as "mentality", which had a great role not only in the attitude to study, but also to work, and to life itself in general. The following are some examples:

1. In South Korea, compared to Russia, there are much fewer official holidays and vacations. In Russia, the school year begins on September 1, and all schools hold a solemn line-up. In South Korea, the beginning of school is not celebrated. The academic year is divided into two semesters. Summer holidays are held from the end of July to the end of August, winter holidays -from December to February. This is due to the fact that in Korea academic competition is extremely high, a student can only cope with it by working constantly.

2. Discipline in South Korean schools is strict. School uniform, hairstyle, manicure, make-up, and hair coloring are strictly regulated. All the gadgets are stored by teachers until the end of classes. Similar practice can be observed only in a few Russian schools.

3. Exams are important for students of both countries, a failure in the exam is equated with a failure in life. Students are under enormous pressure, and in South Korea it is even higher because of the constant competition. Stress due to exams is the main cause of depression and suicidal moods in teenagers, and statistics in this regard in Korea is one of the saddest in the world. According to a 2013 Statistics Korea report, suicide was the leading cause of death for Koreans aged 9-24. Russia's situation is not comforting either. Russia occupies the fifth place in this list.

4. Teachers are respected implicitly. Teachers in Korea do not earn a lot of money, but they are absolutely respected. Education is one of the main values of Korean society, and teachers are considered its honorary guardians. [8]

Studying is the main priority in the life of Koreans until graduation. There is a saying: "If in high school you sleep for three hours, then you may get into SKY (abbreviation according to the first letters of the three most prestigious universities in South Korea: Seoul, Korea, Yonsei), if four – then in a less prestigious university, if five – then you will not be a student."

In Russia, a teacher's qualification is determined not only by their diploma, but also by the skills and abilities based on the specialist's own life experience.

### **Differences in preparation for admission to medical universities in South Korea and in Russia**

**In South Korea**, high school students are prepared for admission to medical universities in specialized programs and courses:

### **I. Seoul National University**

There is a Premedical Course. The program encourages close collaboration and integration between the medical, natural, engineering and social sciences, which helps to enhance the excellence of future doctors. The following methods are used there:

- Personalized training: individual programs are created. They match the student's abilities to optimize the amount, time, and sequence of training.
- Problem-based education: the main focus is on students' thinking process, finding ways to solve problems, and extensive analysis. This method expands the possibilities of solving problems in various situations.
- Exploring queries: Discovering and refining basic ideas and responses to them. This promotes divergent and creative thinking. Laboratory experiments, discussions, educational games, etc. increase the skills needed to solve daily tasks and to perform scientific research.
- Project-based learning: an autonomous and subjective learning method that allows students to plan and implement their projects, to develop learning activities and creativity.
- Discussion-based and presentation-based education: students exchange information and opinions and draw conclusions through interactions.
- Education using multimedia/high-tech media: using advanced devices, equipment, software, and multimedia to create live learning activities. All the sensory organs of students are used, which helps to develop their thinking abilities. [7]

### **II. Seoul National University College of Medicine**

In SNUCM, basic medical education is underpinned by personal growth, leadership skills, and altruistic principles. Students develop their clinical skills to correctly diagnose, treat patients and create research.

There are classes teaching how to use medical equipment, classrooms with simulations of various situations that the student must solve, and a 3D scanning department. A lot of sports is available to students as well.

### **III. There are 13 schools of natural science in South Korea**

The share of graduates of specialized schools who entered the university is many times higher than that of ordinary ones. Thus, in 1995 graduates of specialized schools made up 16.2% among the applicants who successfully passed the exams at Seoul State University, which is especially impressive.

**In Russia** pre-university medical education is provided at universities and in schools with medical classes.

#### **I. Pre-university education at Moscow State Medical University (Sechenov University).**

The task of the faculty is to prepare applicants for admission to Sechenov Uni-

versity at a high level and to form their professional motivation. Students of medical and biological classes have a high level of knowledge and consciously choose the direction of their future professional activity. Excursions and classes in clinics are held for students of medical and biological classes.

The program includes the course "Step into medicine". During the course, students take part in the work of the clinics of Sechenov University, as well as learn practical skills using innovative technologies in the Virtual Training Complex "Mentor Medicus" at the Center for Continuing Professional Education.

## **II. The project «Medical class in a Moscow school»**

The participants of the project "Medical class in the Moscow school" in 2020 are 71 schools in Moscow.

The main subjects of the program are chemistry and biology. The classes are organized five times a week. Students of medical classes with individual interests can choose additional courses: basic medical knowledge, practical training in microbiology, basic physiology and anatomy, first aid, etc. The practice of future doctors takes place in laboratories equipped with medical simulators, measuring devices, models of organs. Students learn to give injections or take blood from a vein on the mannequins.

The innovative direction of the project are the training programs developed by the University: "Chemistry in English" and "Biology in English". The purposes of the courses: mastering the culture of bilingual scientific thinking, the ability to build oral and written scientific speech in English.

Various subject Olympiads, pre-professional master classes, conferences and other events are held during a school year.

At the end of the 11th form, students take a pre-professional exam at the University. The results of the exam are taken into account when entering the University. In addition to the pre-professional exam, students of the 10th and 11th medical classes traditionally pass an Independent Assessment of the Quality of knowledge of chemistry and biology.

## **III. Resource Center «Medical Sechenov Pre-University»**

In 2016 First Moscow State Medical University (Sechenov University) established the Resource Center «Medical Sechenov Pre-University».

Classes are given by leading teachers of the University. Students are immersed in specialized subjects, get through some disciplines of the first year of medical school, prepare for Olympiads and conduct various scientific activities in modern biological and chemical laboratories.

Students of the Pre-university combine training in the programs of secondary general education and the university system of classes in specialized subjects with individual creative scientific and practical work. Graduates are provided with a serious preparation for admission to the best medical universities in the country.

In the spring of 2019 the rating agency RAEX performed a study of the admission of Russian schoolchildren to the best universities in the country. According to the results of the rating of schools in Russia based on the data on the admission of school graduates to 35 leading Russian universities in 99 cities of the country, Medical Sechenov Pre-University became the leader, in the field of medicine, in the number of its graduates who successfully entered the university.

### **Korean National SUNYUNG Exam**

High school students in Korea who want to enter university must pass a national test called the SUNYUNG (it is similar to the Unified State Exam in Russia) in Korean, set by the Korean Ministry of Education Quality. Depending on their preferences, students choose nine subjects to take. Korean history is a compulsory exam to pass. Some items can be selected at two different difficulty levels. The test mainly consists of tasks with multiple choice answers. Students who fail the exam or choose a different study profile can retake it.

Exam results are a key criterion for admission to many universities in Korea.

Admission to Korean universities is very difficult because of the competition. The top institutions accept only 2% of the students who passed the SUNYUNG with the highest score.

The Korean government believes that SUNYOUNG is the most objective and socially balanced criterion for admission, and seeks to increase the use of test results for university admission. But this exam has one big problem – it is almost impossible to prepare for it due to the lack of a collection of standard tasks. In South Korea, students do not have the opportunity to simulate a situation similar to the exam, and therefore there is no opportunity to come to the exam confident in their abilities, and this is one of the reasons why it is very difficult to study and pass exams in this country. Moreover, due to the lack of this opportunity – the solution of trial versions – parents hire their children tutors to increase the amount of knowledge that may be useful for the exam. However, not every family can afford to hire a tutor, thus it is obvious that SUNYOUNG is socially unbalanced.

According to research and interviews with teachers at Hagwong School, high school students in South Korea are less likely to take chemistry and tend to remove this subject from their curriculum. This is due to the fact that all the exam questions are aimed at understanding those chemical processes that are almost not considered in the curriculum. During the test, students need to apply skills and knowledge that they cannot master after completing their studies in high school. In addition, the examinees are given only thirty minutes to complete twenty tasks. Teachers themselves admit that they cannot solve so many tasks in such a short period of time. Such conditions test not the competence of the student in the field of chemistry, but rather his luck on the day of passing the exam.

**The purpose of this work** is to compare two education systems, South Korean



and Russian, in order to find possible advantages in the Korean system and offer their implementation in the domestic one.

### **Materials and methods of research**

To achieve this goal, we used systematic, documentary and structural-logical methods, monitoring and content analysis of scientific articles in periodicals, statistical reports of Statistics Korea.

We also visited exhibitions dedicated to foreign education and interviewed Korean teachers from Seoul National University.

### **Results and discussion**

Having analyzed the experience of South Korea and of the Russian Federation in the field of medical education, we see that, despite the great difference in mentality and cultural traits, there are certain features and principals in Korean system of medical education than can be implemented by medical universities and chemical and biological classes in Russia:

1. Educational principles in Korea take into account the characteristics of each student and give a degree of freedom that will strengthen responsibility and self-motivation. Students will draw on their own strengths and weaknesses to help them become independent thinkers through self-study. Emphasis is placed on the development of self-discipline. Courses in the social sciences and humanities are being expanded to lay a solid foundation for ethical principles.

2. Less strict systematization of programs in higher education institutions. Each student is offered a choice of subjects to study, depending on the chosen specialty, which makes it possible to choose interesting and necessary subjects for building a career in the future;

3. The teacher is always ready to listen to the student, to talk to him, without showing his superiority. The professorship try to be as simple and close to students as possible;

4. Grading is not based on the material that the student can reproduce after the lecture, but on the amount of what he can apply in real life. There are final and intermediate exams in theory, but the main emphasis is on grades for practice. [2]

5. The PBL method (Project Based Learning and Problem Based Learning, that is, project-based and problem-based learning).

6. Some Russian universities use this technology, but there are differences between domestic problem-based learning and PBL. PBL consists in a special organization of the educational process, where the main thing is to develop the ability of independent learning and a creative approach to solving problems, while the solution of the problem itself is secondary. This method is the closest to the real working conditions of future specialists. Universities which practice this training do not refuse classical lectures and seminars. Without knowledge of theory, critical and creative thinking will not produce results. [1]

### **Conclusions:**

1. A profound and thorough analysis of the information about the methods of pre-university education in the two countries showed that in both cases there are advantages which can be adopted from each other, and disadvantages which can be eliminated.

2. Despite the value of Korean developments in the field of medical education, many of them are either not used at all, or are implemented in an insufficient volume at present.

3. A comprehensive study of Korean educational methods promotes finding principles that might help improve the system of pre-university education in Russia.

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## TEENAGERS' HEART RATE VARIABILITY DURING INHALATION VOLATILE SOLVENTS

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**Summary.** *This publication presents results of comprehensive heart rate variability research, which achieve recent data about European Northland teenagers' cardiovascular system conditions during inhalation volatile solvents. It was registered, that vapors of solvents affect at functional conditions of 11-16 years old teenagers' cardiovascular system and heart rate variability.*

*Discovered peculiarities of alterations of teenagers' heart rate variability during inhalation volatile solvents have vital value to ecological and age physiology and this research can stand as a basement for further examinations.*

**Keywords:** *European Northland teenagers', volatile solvents, heart rate variability.*

### Materials and methods

Among the key trends that characterize the drug situation in the Russian Federation, the greatest concern is the steady rejuvenation of consumers of psychoactive substances (surfactants). Adolescents abuse drugs 7.5 times more often than people of all other ages, and non-narcotic surfactants-11.4 times more often [1].

Puberty is an important stage of growth, development of the teenager and his socialization as a person. With the formation of personality in modern adolescents-northerners is the assimilation of both positive skills and negative social stereotypes, this is manifested in an increase in the number of adolescents who use surfactants [2].

Neurotoxic period, accompanied by the use of psychoactive substances, leads to total damage in the state of health. As a result of the action of volatile solvents (VS) on the functions of the parameters of external respiration, metabolism in structures and orgVNS is disturbed, this in turn has a General toxic effect, changes the functionality and structure of cell membranes, affects the ratio of biochemical structures, enzymes and causes disturbances at the molecular and systemic levels [3]. With systematic involvement, surfactants cause powerful adaptive failures, stable desynchronization and destabilization of biochemical responses, functional processes and cellular nutrition disorders [4].

Examinations of teenagers observed at the doctor of the narcologist upon the use of VS were carried out. Of all the minors we studied, abusing VS, children 11-12 years were 30.1%, 13-14 years-35.4%, 15-16 years-34.5%.

The use of VS mainly falls on 13-14 years. The first VS test most often occurs at the age of 11 years (33%).

When studying the social status of abusers of toxic substances, a pronounced tendency of growth of consumption of VS among students of secondary schools was found-81.3%, the remaining 18.7% were not students of educational institutions. The greatest prevalence of VS abuse was found among boys (up to 80%).

In the studied children, the frequency of consumption of VS varied - from one to several times in 30 days. The largest component (91.1%) is a group of people who use VS more than once a month.

Materials and methods. The frame of the study was the results of a survey of 300 adolescents of the Arkhangelsk region aged 11 to 16 years, including 213 boys and 87 girls. The surveyed had no chronic diseases, they had an average level of physical development and were engaged in physical culture according to state programs in the main group [5].

The control group consists of adolescents who do not use VS, the main group – adolescents who use VS. According to the international classification of diseases (ICD-10: mental and behavioral disorders due to the use of volatile solvents (F18)), each subject was diagnosed by a narcologist.

The study took place in a specially equipped office with a comfortable temperature regime in the morning. Subjects were taken for examination after 10-15 minutes of rest, on an empty stomach or 2 hours after eating.

Before the beginning of the study, height and weight were measured according to the generally accepted method. Then, at rest, systolic arterial pressure (SAP)

and diastolic (DAP) were measured by the Korotkov auscultative method, as well as heart rate (HR).

The heart rate variability was determined using cardiointervalographic (CIG) study by R. M. Bayevsky (1998) using portable diagnostic complex "VARICARD 1.4" (IVNMT "Ramen", Ryazan). A standard scheme for studying the regulation of heart rate (RHR) in the supine position was used. Registration of HR was carried out within 5 minutes in the II standard lead [6].

Below are the studied HRV parameters.

Indicators characterizing the time domain-statistical: standard deviation of the dynamic series of R-R-intervals (SDNN), mode (Mo), mode amplitude (AMO), standard difference characteristic (RMSSD), the difference between the highest and lowest values of the dynamic series of R-R intervals (MxDmN), the ratio of the maximum possible to the minimum possible values of the dynamic series of R-R intervals ( $\phi_n$ ), the number of cardiointervals whose difference characteristics are more than 50 MS (PNN 50); parameters of the wave structure of the dynamic series of cardiointervals: the value of the first correlation coefficient (SS1), the number of shifts to the first zero value of the correlation coefficient (SS0); voltage indicators: the voltage index of regulatory systems (SI).

The spectral analysis of wave parameters used the following frequency ranges:

- high frequency oscillations of the HF (High Frequency) 2 to 7 sec, 0.5-0.15 Hz;
- low-frequency oscillations in the LF (Low Frequency) 7-20 h, 0,15-0,05 Hz;
- ultra-low frequency oscillations VLF (Very Low Frequency) 20-70 sec, 0.05-0.015 Hz.

Studied indicators frequency range: power spectrum (PLF) in the frequency band of short waves, power spectrum (PHF) in the frequency range of long waves spectral power (PVLF) in the frequency range of ultrashort waves, the high component of all spectra, the values of the periods of the peaks in all ranges of the power spectrum in the frequency range HF, LF and VLF as a percentage to the entire range, the average power spectrum in all bands, the average power spectrum (P), total spectral power ( $\sum P$ ), index of activation of the subcortical nerve centers (IAP), the index of centralization (IC) [7].

Statistical analysis of the obtained data array was performed using software packages Stadia 5.0, Statistica 5.0, EXCEL 2002. The reliability of the difference between the compared indicators was determined by the student's t-criterion. The differences at the significance level of 95% ( $p < 0.05$ ) were taken as significant.

### **Results and discussion**

The analysis of the data obtained in males 11-13 years of age of the control group revealed differences in time indicators compared to the control group, despite the fact that the average duration of cardiointervals (Mo) is actually equal.

The functional lag of maturation of the departments of the vegetative nervous system (VNS) in boys 11-13 years, using VS, from their peers was revealed. This is evidenced by the negative dynamics of the time parameters of HRV: the difference of the largest and smallest values of the dynamic series of RR intervals and the mean square difference characteristic. The latent periodicity of RHR, which is indicated by the value of the correlation coefficient after the first shift, increases significantly in the main group, which indicates the automation of VNS control. This fact is confirmed by frequency indicators: boys of the main group have lower characteristics of respiratory modulation (RHF, AHF) and slightly higher characteristics of the low – frequency part of the spectrum (RLF, ALF), as well as a marker of sympathetic activity – the index of centralization. In addition, boys who use VS have a more significant stress index. This reflects the prevalence of rates of maturation of brain structures in boys of the control group and the lag – in the main, as well as increased stress of the functional system in boys who use VS.

Spectral parameters have no significant differences between them, and their "weight shares" are almost the same in males of the control group of 11-13 years. The obtained results confirm the opinion that a certain balance between adrenergic and cholinergic effects on RHR is achieved in children aged 11-13. In males of the main group, at the age of 14-16 years, there is an increase in prasympathetic activity, which is accompanied by a significant increase in respiratory modulation (PHF, AHF) and a decrease in sympathetic activity, which is indicated by the dynamics of changes in non-respiratory periodicals (PLF, ALF). The ratio of the maximum possible to the minimum possible value of the dynamic series of RR intervals in the boys of the main group is lower than in the control group. Analog trends are present in the change in the values of the parameters of the standard deviation of the dynamic series of RR intervals and the coefficient of variation, which indicates a shift of vegetative homeostasis towards the predominance of the parasympathetic Department of the VNS. Discoordination of changes in the parameters of the heart rate in boys with age, namely: unidirectional changes in the mode and its amplitude indicate the instability of the mechanisms of regulation of RHR.

There were no significant differences between the control and the main groups in the temporal indices of HRV in women. The analysis of HRV spectral parameters revealed the following regularities: indicators characterizing the high-frequency component of the spectrum (PHF, THF) in girls of the main group are significantly lower than in the control group and are at the upper limit of the norm. Indicators of slow-wave components (RLF, ALF, TLF) RHR in girls using VS, significantly higher than in girls of the control group. The percentage of low-and ultra-low-frequency HRV component exceeds the proportion of high-frequency component in girls of the main group.

Individual assessment of the stress index revealed a shift in the autonomic

balance in children who use toxicants.

In boys who use VS, of all age groups, the dominant type of vegetative tone is vagotonia, the percentage of which is significantly higher than in boys of the control group. The proportion of autonav in the major groups are the same, but lower than in the control groups. Boys who use toxicants, the proportion of simpatikotonia slightly higher. The analysis of the stress index (SI) in girls revealed the following patterns: in girls who use VS, the proportion of sympathicotonics and vagotonics is higher, and eutonics is lower than in the control group. There is a tendency to increase sympathetic influences in girls of the main group, which is a statement of the fact of greater tension in their regulatory systems.

To assess the level of organization in the functional system of regulation of sinus RHR, the relationship of mode with other HRV indicators was studied.

In boys of the control group 11-13, the rhythm driver was in direct relationship with the indicators of vagal activity. In the children of the main group, there were close inverse relationships of the rhythm driver with the indicators of sympathetic activity and direct with the parameters of parasympathetic regulation of the VNS. The rhythm driver in the control group of boys 14-16 years old had similar intra-systemic relationships. In the main group, there was a significant interaction with indicators of parasympathetic activity, while compared with boys who use VS, younger age, the number of these relationships increased significantly. The relationship with the sympathetic Department of regulation of the VNS remained.

For the rhythm driver in the main group of girls is characterized by a greater number of close relationships with parasympathetic regulation. Based on the analysis of spectral characteristics of HRV can be assumed that girls between the study and control group there is a strict differentiation: the girls of the main group is dominated by sympathetic effects in the regulation of cardiac rhythm, and the girls of the control group, the proportion of vagal influences above amounts mediately modulation at the RHR [8].

There is an increase in the absolute time and spectral HRV indices with an increase in the length of VS reception. With the increase in the intake time, a shift towards the predominance of vagal activity is clearly observed, which is confirmed by an increase in the high-frequency components of spectral analysis (RHF) in children with a long history of toxicant use. The increase in the index of centralization at the initial stages of constant intake of toxicants indicates an increased activity of the Central structures of the brain. Compared with the period of initiation of VS administration, the decrease in the indices of low-frequency HRV components reflects the shift of vegetative homeostasis towards the Autonomous regulation circuit and some lag in the process of functional maturation of the VNS departments.

In General, boys who use VS are characterized by a predominance of the Au-

tonomous regulation circuit, which can be explained by two independent mechanisms: cholinergically induced decrease in the release of norepinephrine in response to sympathetic stimulation and cholinergic suppression of the response to adrenergic stimulus.

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## INFLUENCE OF CARNITINE-CONTAINING COMPLEX FOR MINERAL EXCHANGE IN QUAILS

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**Abstract.** *To stimulate metabolism and productivity, a multivitamin carnitine-containing complex was introduced into the quail's diet. The first group received the drug at a dose of 0.25 ml/l for 5 consecutive days with a 10-day interval, 2-0.5 ml/l for 5 consecutive days with a 10-day interval; 3 - 0.25 ml/l for 5 consecutive days with a 5-day interval; 4 - 0.5 ml/l for 5 consecutive days at 5-day intervals; 5 - received drinking water. The study of the trace element composition of blood serum was carried out at 13-15, 39-42 and 76-78 days of age on an automatic biochemical analyzer SMT-120 Vet with subsequent statistical data processing. As a result, regardless of the scheme, the applied complex promoted an increase in calcium, normalization of the calcium-phosphorus ratio in accordance with the physiological state of quails, and a decrease in the level of sodium and potassium-sodium ratio. It is most advisable for young animals, taking into account the critical periods of development associated with adaptation to a mixed and exogenous type of nutrition and molting, to drink the drug at a dose of 0.5 ml/l for 5 days in a row with a 10-day interval, and for layers - 0.25 ml/l in for 5 consecutive days at 5-day intervals.*

**Keywords:** *quail, macronutrients, multivitamin carnitine-containing complex, application regimen.*

## **Introduction**

Raising quails, preparing hens for egg-laying require the utmost attention and providing them with nutrients that are involved in all biochemical reactions in the body. A specific feature of the bird body is its high dependence on mineral supply [6]. Mineral substances play a major role in the formation and construction of body tissues, skeletal bones, maintain the osmotic pressure of cellular and extracellular fluids and acid-base balance, regulate water-salt metabolism, create conditions for the normal course of metabolic processes and energy, actively participate in the formation of proteins and regulate the activity of enzymes. So calcium takes part in the generation of action potential, the initiation of muscle contraction, is a necessary component of the blood coagulation system, increases the reflex excitability of the spinal cord and has a sympathicotropic effect [4]. Ossification, muscle contraction, excretion of metabolic products, and the formation of eggs in birds are carried out only in the presence of phosphoric acid compounds. Phosphorus takes part in the metabolism of carbohydrates, enhances the absorption of glucose in the intestine, enters into the structure of nucleic acids, regulates protein biosynthesis, and participates in fat metabolism [2]. Vitamins A, C, D, F and minerals have a stimulating effect on the level of calcium and phosphorus [8]. Potassium is a part of buffer systems, promotes digestion processes, participates in the synthesis of proteins and glycogen, regulates heart contractions, activates a number of enzymes, and is part of the cells of all tissues [1]. Sodium transports amino acids, sugars, inorganic and organic anions across cell membranes; participates in the transfer of carbon monoxide in the blood, hydration of proteins and dissolution of organic acids, the formation of gastric juice; activates the enzymes of saliva and pancreatic juice, enhances the excretion of various metabolic products by the kidneys. From the literature it follows that in biological objects the ratio of sodium to potassium varies in a wide range from 1:1 to 60:1 and their mutual influence on each other in the determination can be significant [3; 9].

In the poultry industry, feed additives with physiological activity are widely used, which can be considered both from the point of view of medical use and to maintain normal vital activity of the body, giving it any new properties [5]. The introduction of complexes based on vitamins and vitamin-like substances into the diet of poultry is still of great scientific interest [10].

Based on this, the **purpose** of this study was: to establish the effect of a multivitamin carnitine-containing complex on the level of macronutrients in Japanese quail.

## **Material and research methods**

The study was carried out in 2020-2021 at the Department of Obstetrics, Surgery and Non-communicable Animal Diseases. The object was Japanese quail, owned by LLC "Shepilovskaya poultry" farm (Moscow Oblast, urban district of

Serpukhov, Shepilovo). The conditions for keeping quails corresponded to zoo-hygienic standards. Feeding was carried out according to age with combined feed, drinking without restrictions from nipple drinkers.

To achieve the goal of the experiment, 5 groups of quails, 7 thousand each, were formed: the control group received a standard diet, the experimental groups received a multivitamin carnitine-containing complex (MCCC) with water from two days of age until the end of cultivation according to the experimental scheme (tab. 1). MCCC was given from 2 to 80 days of age.

**Table 1 – Experiment layout**

Group 1 – test	0.25 ml/l for 5 consecutive days at 10-day intervals
Group 2 – test	0.5 ml/l for 5 consecutive days at 10-day intervals
Group 3 – test	0.25 ml/l for 5 consecutive days at 5-day intervals
Group 4 – test	0.5 ml l for 5 consecutive days at 5-day intervals
Group 5 – control	drinking water without restrictions

Blood for the study was obtained in the morning hours before feeding from 10 heads from each group at 13-15, 39-42 and 76-78 days of age. Analysis of blood serum for the content of total calcium, inorganic phosphorus, potassium and sodium was performed on an automatic biochemical analyzer SMT-120 Vet with subsequent statistical data processing.

The choice of the drug is due to the property of L-carnitine to donate radicals inside mitochondria to oxidative enzymes, as a result of which those substances that can serve as a source of intramitochondrial acyl-CoA are included in the fatty acid chain [7].

L-carnitine is important for both young birds and during the production period of laying quails.

### **Results and interpretation**

In quails of the control group, no significant changes in the content of calcium, phosphorus, potassium and sodium were found in the blood serum throughout the entire study period (tab. 2). Only at the beginning of oviposition there was a slight tendency to an increase in calcium (42 days) and its end (76 days) to an increase in phosphorus.

In experimental group 1, at the beginning of oviposition (40 days), the concentration of calcium significantly increased by 3.90%, phosphorus - by 10.24%, sodium - by 16.23% ( $p \leq 0.05$ ). By the end of the productive period (78 days), compared with the previous date of the study, laying hens showed a decrease in calcium by 7.92% ( $p \leq 0.05$ ), as well as a tendency to a decrease in sodium and an increase in phosphorus.

In experimental group 2, at the beginning of oviposition (39 days), an increase in phosphorus by 14.29% ( $p \leq 0.01$ ) and sodium by 6.56% ( $p \leq 0.05$ ) was observed

and there was a tendency to an increase in calcium (by 2.53%).

By the end of the productive period (78 days), a significant decrease in potassium by 10.28%, calcium by 7.82% and phosphorus by 2.60% ( $p \leq 0.05$ ) occurred in layers relative to the beginning of the productive period.

In experimental group 3, at the beginning of oviposition (41 days), an increase in calcium and phosphorus by 6.14 and 6.90%, respectively ( $p \leq 0.05$ ), was revealed. By the end of the productive period (78 days), there was a decrease in calcium by 5.37% and an increase in sodium by 31.47% ( $p \leq 0.05$ ) relative to the previous indicator.

In the 4th experimental group, at the beginning of oviposition (40 days), a significant increase in phosphorus by 8.98% ( $p \leq 0.05$ ), a tendency to an increase in calcium and a decrease in sodium by 7.75% ( $p \leq 0.05$ ) were found. Compared with these data, by the end of the productive period (77 days), the hens showed a decrease in calcium and sodium by 5.04% and 8.57%, respectively ( $p \leq 0.05$ ).

**Table 2 – Dynamics of mineral metabolism in quails participating in the experiment, n=10, M±m, mmol/l**

Indicator	Test				Control
	Group 1	Group 2	Group 3	Group 4	Group 5
<b>age 13-15 days</b>					
Total calcium	2.31±0.03	2.37±0.02	2.28±0.01	2.32±0.02	2.06±0.06
Inorganic phosphorus	1.66±0.01	1.68±0.02	1.74±0.02	1.67±0.03	2.03±0.05
Potassium	4.72±0.14	4.58±0.18	5.50±0.16	5.58±0.12	4.87±0.21
Sodium	123.20±12.8	120.40±10.8	125.60±14.3	127.70±13.9	173.50±24.6
<b>age 39-42 days</b>					
Total calcium	2.40±0.02	2.43±0.03	2.42±0.03	2.38±0.01	2.11±0.02
Inorganic phosphorus	1.83±0.01	1.92±0.03	1.86±0.01	1.82±0.01	2.02±0.02
Potassium	4.74±0.07	4.57±0.06	5.60±0.07	5.55±0.03	4.82±0.16
Sodium	143.20±10.4	128.30±11.30	127.10±12.50	117.80±14.70	173.80±16.35
<b>age 76-78 days</b>					
Total calcium	2.21±0.01	2.24±0.02	2.29±0.01	2.26±0.02	2.06±0.03
Inorganic phosphorus	1.86±0.01	1.87±0.02	1.86±0.01	1.84±0.01	2.12±0.02
Potassium	4.70±0.01	4.10±0.04	5.62±0.03	5.50±0.06	4.80±0.06
Sodium	139.5±13.60	128.70±10.50	167.10±7.80	107.7±8.00	173.00±17.30

Having analyzed the ratio in blood serum between the level of total calcium and inorganic phosphorus by 13-15; 39-42 and 76-78 days in 1-4 experimental groups found that the dependence changed from 1.4:1.0 to 1.3:1.0 and 1.2:1.0. In the 5th group (control) throughout the entire period, the ratio did not fundamen-

tally change, and was at the level of 1.0:1.0.

Naturally, with high productivity in laying quails, there is a decrease in the concentration of calcium in the blood serum, since a significant part of it is spent on the formation of the shell.

Comparing the content of calcium in separate age periods, it was found that in the 2nd group of birds of 13-15 days and 39-42 days of age, its concentration was higher than the same indicator in the other groups by 2.60-15.05% and 0.41-14.70%. 76-78-day-old quails of the 3rd group in terms of calcium content exceeded their analogs from the 1st, 2nd, 4th and 5th groups by 1.33-11.17%.

In terms of phosphorus content, the control group exceeded the analogs by 5.21-22.29% throughout the entire study period.

Having considered the dependence of potassium and sodium in the blood serum of quails in the control group, it was found that the proportion was 1.0:36.0 and did not change throughout the experiment. In 1 experimental group for 13-15; 39-42 and 76-78 days, the ratio of ions corresponded to 1.0:26.0; 1.0:30.0 and 1.0:29.0 in group 2 - 1.0:26.0; 1.0:28.0 and 1.0:31.0; in group 3 - 1.0:23.0; 1.0:23.0 and 1.0:30.0; in group 4 - 1.0:23.0; 1.0:21.0 and 1.0:20.0.

The highest content of potassium ions at 13-15 days of age of quails was noted in group 4, the indicator was higher than that of analogues by 1.45-21.83%. At 39-42 and 76-78 days of age, in terms of potassium content, quail 3 groups exceeded the rest by 0.90-22.54% and 2.18-37.07%, respectively.

A high concentration of sodium ions was recorded in quails of the control, group 5. Throughout the entire research period, the sodium level in quails of this group was 3.53-60.63% higher than in the experimental groups.

### **Conclusion**

Regardless of the regimen of application, the multivitamin carnitine-containing complex promoted an increase in serum calcium, normalization of the calcium-phosphorus ratio in accordance with the physiological state of quails, and a decrease in sodium and potassium-sodium ratio.

Nevertheless, it is most advisable for young animals, taking into account the critical periods of development associated with adaptation to a mixed and exogenous type of feeding, to give MCCC at a dose of 0.5 ml/l for 5 days in a row with a 10-day interval, and for layers - 0.25 ml/l for 5 consecutive days at 5-day intervals.

The multivitamin carnitine-containing complex promotes a more complete assimilation of feed macronutrients, their deposition in bones, muscles and internal organs, stimulates earlier egg-laying and the duration of the productive period.

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## IONIC NITRIDING OF R6M5 STEEL WITH ULTRAFINE-GRAINED STRUCTURE IN A PULSE GLOW DISCHARGE

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**Abstract.** *The article presents comparative data on the hardness of steel R6M5, rolled in helical rolls (BB) with different number of passes and smooth rolls (HS). It is shown that severe plastic deformation (SPD) in HR with different passes and hardening of the surface of steel samples by nitriding in a glow discharge makes it possible to increase the hardness and length of the nitrided layer of tool steel. The effect of nitriding in a glow discharge on the structure and mechanical properties of steel R6M5 obtained by quenching at 1200°C and single tempering at 560°C with preliminary SPD in HR and SR has been investigated. It was found that for a specimen rolled with twelve passes in HR and one pass in SR, the increase in microhardness to the surface is comparatively small (1.5-1.8) than for specimens deformed with four or eight passes in HR and one pass in SR (2 - 2.2 times). It is shown that the microhardness along the depth of the diffusion zone for samples deformed with twelve passes in HR is distributed smoothly, and the thickness of the diffusion layer for these samples is 2.6 times greater than the thickness of the diffusion layer of samples previously deformed by a small number of passes in HR.*

**Keywords:** *glow discharge nitriding, temperature, nitrides, hardness, structure, helical rolls.*

Today, steel nitriding is used in various industries to increase the operational durability of a wide range of products: discs, crankshafts and camshafts, spindles of metal-cutting machines, stamping and cutting tools, etc. [1].

The search for sources of active nitrogen led to the development of a nitriding process in a glow discharge [1-3]. At present, a series of units with a capacity of up to 150 kW have been developed, which can process large-sized parts up to 12

m long. The use of ion nitriding made it possible to reduce the duration of the technological cycle by 2-5 times, optimize the composition of the diffusion layer, provide a technologically simple process automation scheme, improve the quality of nitrided coatings.

Various types of electrical discharges are used to activate the gas phase: arc, glow, spark and corona; magnetic and electrostatic fields; irradiation with ultraviolet and  $\gamma$ -rays [4–7].

The most widespread at present is the process of nitriding with ionized nitrogen in the plasma of a glow discharge (ion nitriding) [1]. In a rarefied nitrogen-containing atmosphere between the cathode (part) and the anode, a glow discharge is initiated, gas ions, bombarding the cathode surface, heat it to the saturation temperature. The nitriding temperature is 470–580°C, the vacuum is 1–10 mm Hg, the operating voltage ranges from 400 to 1100 V, the process duration is from several minutes to 24 hours.

The intensification of the process during ion nitriding is explained by the effect of a glow discharge on all elementary processes responsible for the formation of a diffusion layer: activation of the gas phase, adsorption and diffusion [1, 2]. At present, installations for nitriding, operating on a glow discharge, have almost completely replaced installations for gas and liquid nitriding. This is primarily due to the fact that the process of ionic nitriding in them is the fastest and most efficient.

Thus, at present, one of the popular technological methods for changing the performance characteristics of steels and alloys is the diffusion saturation of the surface layers with nitrogen. Nitriding increases fatigue resistance, corrosion resistance, heat resistance, hardness and wear resistance. However, the properties of the nitrided layer in most cases depend on the chemical composition and the initial structure of the material. In particular, this concerns such parameters as hardness and length of the hardened area.

Analysis of existing nitriding methods shows a rather noticeable efficiency of this method for hardening steels containing alloying nitride-forming elements, such as titanium, chromium, vanadium, aluminum, etc. [3-5, 8]. Alloyed steels after nitriding have a surface hardness of HV 850 - 1200 kg/mm<sup>2</sup>, while the hardness of the nitrided surface of parts made of carbon and low-alloy steels does not exceed HV 350 - 500 kg/mm<sup>2</sup>. The presence of alloying materials increases the solubility of nitrogen in iron and contributes to a significant increase in hardness and strength due to the formation of ultradispersed nitrides of these elements in the saturable layer. However, high-alloy steels used for the manufacture of parts for nitriding have a complex smelting technology and contain expensive and scarce alloying materials. Most often, for the structural strength of the mating units of various parts, alloying of their base throughout the entire volume is not required;



it is enough to introduce alloying elements into the surface layer.

It is known [9] that the rate of nitrogen diffusion in steels depends on the area of grain boundaries. It can be noted here that transcrystalline processes undergo significantly slower in coarse-grained steels at temperatures below 600°C. Therefore, to intensify the formation of the nitrated layer, it is necessary to choose materials with a finer structure, or to bring their initial coarse-grained state to a submicrocrystalline one as a result of preliminary treatment. In particular, the refinement of the average grain size of steels of the ferrite-pearlite class can be achieved as a result of quenching with the formation of a martensitic structure [10]. Quenching itself also leads to an increase in the hardness of the steel, and not only on the surface, but throughout the entire volume of the part. However, quenched structures are prone to softening as a result of tempering at elevated operating temperatures, have low corrosion resistance even in normal environments, and also tend to diffusely set in contact with the surfaces of many materials in tribological processes.

In our opinion, severe plastic deformation (SPD) can be used to improve the performance properties of the surface layers of tool steel. It is known that in recent years it is SPDs that are increasingly used to improve the structural homogeneity and quality of metallic materials [11].

The aim of the work is to experimentally confirm the feasibility of using SPD of the surface zones of tool steel to intensify the nitriding process of tool steel.

### **Equipment, materials and technique of the experiment**

In work [12], a tool was developed with rolls with helical working surfaces. In these rolls, the helical protrusions and valleys of the upper and lower rolls are located oppositely. Helical rolls (HR) are designed to produce semi-finished products with a fine-grained structure. The developed tool implements SPD without significant changes in the original shape and dimensions of the workpiece. It should be noted that smooth rolls (SR) installed on any laboratory mill can be used to level the undulating surface of semi-finished products with a fine-grained structure and obtain strips of the required size.

A series of experiments were carried out in laboratory conditions. Steel R6M5 with a size of 6×150×400 mm was chosen as the workpiece material. Rolling of this billet on a mill with HR and SR was carried out in the following modes:

- heating to a temperature of 850 °C, holding for 2 h, rolling in two passes in HR to a thickness of 5.8 mm, heating at a temperature of 850 °C, holding for 30 minutes, rolling in two passes in HR to a thickness of 5.5 mm, heating at a temperature of 850 °C, exposure 30 min, rolling in SR to a thickness of 4.0 mm;
- heating to a temperature of 850 °C, holding for 2 h, rolling in four passes in HR to a thickness of 5.8 mm, heating at a temperature of 850 °C, holding for 30 minutes, rolling in four passes in HR to a thickness of 5.5 mm, heating at a temper-

ature of 850 °C, exposure 30 min, rolling in SR to a thickness of 4.0 mm.

- heating to a temperature of 850 °C, holding for 2 h, rolling in six passes in HR to a thickness of 5.8 mm, heating at a temperature of 850 °C, holding for 30 minutes, rolling in six passes in HR to a thickness of 5.5 mm, heating at a temperature of 850 °C, exposure 30 min, rolling in SR to a thickness of 4.0 mm.

To study the effects of ion nitriding on the structural-phase composition and hardness of strips from R6M5 high-speed tool steel, rolled according to the above-described technology, model specimens 50×20×4 mm in size were cut out. The test samples were first ground and then polished with diamond pastes to a mirror finish. Before loading into the nitriding chamber, the model samples were washed in gasoline, then in acetone, and dried in air. Glow discharge nitriding was carried out in a JON-600 device. The following process parameters were used: temperature  $T = 520$  °C, vacuum pressure (reactive atmosphere)  $p = 150$  Pa, time  $t = 15$  hours, the composition of the reaction atmosphere was a mixture consisting of 90%  $N_2$ , 5% Ar and 5%  $H_2$ , the flow rate of gaseous media was as follows: 900 ml/min  $N_2$  + 50 ml/min Ar + 50 ml/min  $H_2$ . After nitriding, the samples were subjected to heat treatment, which consisted of quenching at 1200 °C and a single high tempering at 560 °C.

Measurements of the microhardness along the depth of the diffusion zone were carried out on a Struers Duramin-1/-2 microhardness tester. The static load applied to the indenter for 10 s was 980.7 mN (100 g).

Metallographic analysis was carried out using an energy-dispersive spectrometer JNCAENERGY (England) installed on an electron probe microanalyzer JEOL (Jeol) at an accelerating voltage of 25 kV. The magnification range of the JEOL device is from 40 to 40,000 times. The structural features of the samples were also studied using a JEM-2100CX transmission electron microscope (TEM) at accelerating voltages of 200 kV. To reveal the structure of the steel, the section was etched in a solution of 5%  $HNO_3$  and 95%  $C_2H_5OH$ .

### **Research results and their discussion**

Analysis of the photograph of the initial structure of the material showed that in the cross section of the sample there are coarse lines and carbide banding. The structure contains inclusions of both large and medium and small carbides. This orientation of the carbide phases in the cross section leads to anisotropy of volumetric changes during quenching and an increase in the level of thermal stresses caused by the phenomenon of phase hardening. In our opinion, this structural heterogeneity affects the performance of the tool. It should be noted that the surface hardness of the initial samples was 60 ... 62 HRC.

The study of the structural state of steel R6M5 after rolling in HR with four and eight passes shows that a relatively fine-grained structure is formed in the surface zone of the section. In this case, the density of intragranular dislocations increases,

and a strip structure is formed.

It should be noted that an increase in the number of passes leads to a decrease in the width of the microbands, while thinner shear bands are formed at the boundaries of the original wide microbands. An increase in the number of passes to eight leads to the formation of a fine-grained grain-subgrain structure in steel R6M5. The sizes of individual grains in the peripheral zone of the workpiece reach 12-19 microns.

Deformation by twelve passes in HR of billets heated at a temperature of 850 °C led to the formation of a homogeneous and equiaxial structure in the peripheral zone of the longitudinal and cross-section of the billet. It can be seen that further refinement of the grain-subgrain structure occurs. As a result of softening processes in the metal of the workpiece, a recrystallization structure is formed in the surface zone of the rolled strips with an average grain size of about 6 - 9  $\mu\text{m}$ .

It can be assumed that with an increase in the degree of deformation in subsequent rolling passes in HR, structure refinement occurs not only by twinning, but also by the formation of cellular substructures as a result of the development of dislocation slip processes. At high degrees of accumulated deformation, the boundaries of former twins and subgrains transform into high-angle boundaries.

Thus, during rolling in HR, the action of alternating deformation mechanisms provides fragmentation and reorientation of the crystal lattice. At the same time, high-angle boundaries are formed in the peripheral zones of the workpiece with a high density.

Analysis of the data obtained shows that rolling at the last stage in SR at a temperature of 850 °C significantly affects the microstructure of the alloy. The microstructure of the surface zones of the R6M5 steel strips, after rolling on HR with eight passes and one pass in SR, is characterized by the presence of subgrains formed inside the former deformation bands. The average subgrain size is 1 - 4  $\mu\text{m}$ .

SR rolling of billets deformed with twelve passes in HR results in the formation of an ultrafine-grained (UFG) structure on the surface of the strips. As a result of softening processes, a structure with a size of 0.6 to 0.9  $\mu\text{m}$  is formed on the surface of the rolled strips. In the images of the microstructure after rolling in SR, a clear image of grain boundaries was observed. The type of microstructure indicated the formation of grains with predominantly high-angle boundaries.

The experiments have shown that the main parameters of the nitrided layers treated in a glow discharge are the hardness of the surface layer and the depth of nitrogen penetration. It should be noted that the depth of the nitrided layer is 0.03–0.8 mm.

The study of the results of measuring the microhardness showed that samples deformed with twelve passes in HR and subsequently processed by nitriding in

a glow discharge have a comparatively small increase in microhardness on the surface (1.5-1.8) than samples deformed with four or eight passes in HR (2 - 2.2 times). This increase in microhardness is due to the formation of nitride phases with a high nitrogen content in the near-surface layer. The high nitrogen content in the near-surface layers is due to the low nitrogen diffusion coefficient in steel that has undergone SPD with a small number of passes in HR.

Evaluation of the microhardness over the cross section of the sample showed that the strip deformed with twelve passes in HR and then nitrided in a glow discharge has a smoother distribution of microhardness over the depth of the diffusion zone. In our opinion, this is due to the formation of the UFG structure in these samples and the appearance of crystal lattice defects in the material structure as a result of such SPD. All this creates more favorable conditions for the diffusion of nitrogen deep into the material. It should be noted that the thickness of the diffusion layer in specimens deformed with twelve passes in HR is 2.6 times greater than the thickness of the diffusion layer in specimens deformed with four or eight passes in HR. It can be seen from the results obtained that nitriding in a glow discharge at a given temperature does not lead to a decrease in the mechanical properties of the base material.

Studies have found that the rate of increase in microhardness is maximum at the beginning of the nitriding process. In our opinion, during ion nitriding, a high concentration gradient, which is the driving force of the process, is established in the initial stages of the nitriding process in a glow discharge.

The creation of a UFG structure at SPD and a limiting concentration gradient at the early stages of ion nitriding, activation of the UFG surface and the escalation of defects in the surface zone are accompanied by intense absorption of nitrogen and the completion of the formation of a relatively thick layer in terms of hardness during the first hour of the nitriding process.

A coarser-grained structure accelerates the nitriding process of the surface layers of the samples, while a nitrided layer, small in size, is formed. This is manifested in higher values of microhardness in these layers in comparison with nitrided layers obtained in samples with a fine-grained structure.

The thickness of the diffusion layer, in the samples rolled with eight and twelve passes in HR, reaches an almost maximum value during 7 and 4 hours of nitriding, respectively. An increase in the nitriding time over 7 hours has a relatively weak effect on the depth of the diffusion layer. At the same time, the size of the diffusion layer obtained in the samples with a fine-grained structure on the surface increases even more in comparison with the samples with a coarse-grained structure on the surface.

With a nitriding time of the order of 10 h, the maximum values of the microhardness and the depth of penetration of the nitrided layer in the samples obtained,

rolled with eight and twelve passes in HR, practically do not differ. However, it should be noted that when nitriding samples deformed with twelve passes in HR and nitrided in a glow discharge, the limiting values of hardness are reached at a nitriding time of 3-4 hours. The same parameters in the samples deformed with eight passes in HR and nitrided in a glow discharge are realized during the nitriding time of 6-7 hours.

### Conclusions

1. It was found that for the specimen after SPD, rolled by twelve passes in HR, the increase in microhardness to the surface is comparatively small (1.5-1.8) than for specimens deformed with four or eight passes in HR (2-2.2 times).
2. The distribution of microhardness over the depth of the diffusion zone in deformed specimens with developed SPD is smoother, and the thickness of the diffusion layer is 2.6 times greater than the thickness of the diffusion layer in specimens deformed with a small SPD.

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