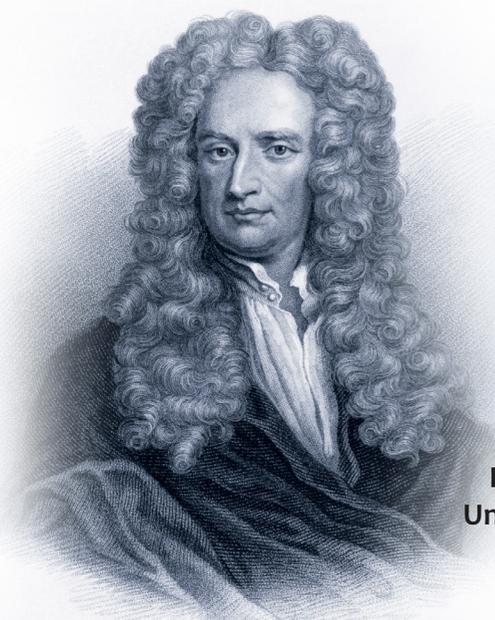




INTERNATIONAL CONFERENCE

**PROCESS  
MANAGEMENT AND  
SCIENTIFIC  
DEVELOPMENTS**



Birmingham  
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## FOREIGN EXPERIENCE IN THE DEVELOPMENT OF SOCIAL ENTREPRENEURSHIP

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**Annotation.** The article presents the results of the analysis, systematization and generalization of the best practices of countries with developed economies in the field of social entrepreneurship development. The features of the models of social entrepreneurship development in the countries of North America and the British Commonwealth, the European Union, as well as the experience of participation of international organizations, development institutions and private foundations in the development of social entrepreneurial initiatives in African, Asian and Latin American countries with developing economies are determined. The advantages of the Italian model of social entrepreneurship based on the cooperative movement are substantiated. It is determined that the positive experience of Italy is actively used by other European countries, in particular Spain and France.

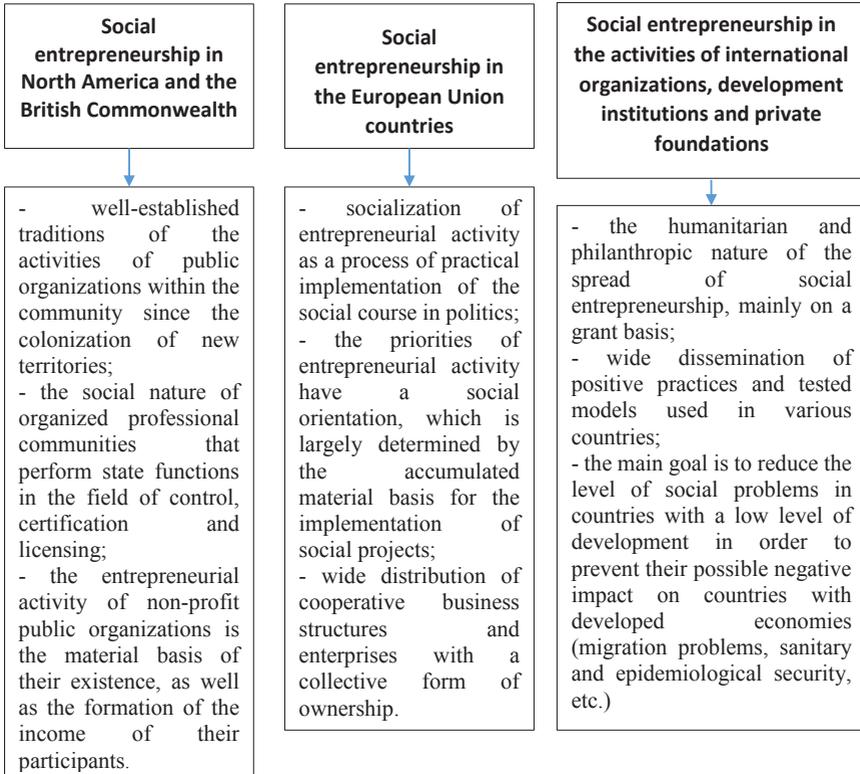
**Keywords:** social entrepreneurship, adaptation, best practices, development

We have analyzed, systematized and summarized the experience of countries with developed economies in the field of social entrepreneurship development. The analysis also took into account models and positive practices used in the activities of international organizations, development institutions and private foundations. The information base of this stage of the study was the works of Russian and foreign authors [1-14], as well as primary information from the methodological literature and open information materials of free access of national institutes for the development of social entrepreneurship and specialized international organizations [15; 16].

## Process Management and Scientific Developments

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In various macro-regions of the world, as well as at the level of international organizations and development institutions, various models of social entrepreneurship have developed, characterized by certain features (Figure 1.). These features are primarily determined by fundamental differences in the organization of commercial entrepreneurial activity, as well as traditional forms of self-organization of the population, social processes and their dynamics.



**Figure 1. Models of social entrepreneurship in the countries of North America and the British Commonwealth, the European Union, international organizations, development institutions and private foundations**

The USA and Canada are countries with liberal economies and strong traditions of self-organization of the population. In these countries, a num-

ber of public administration functions (in the field of education, healthcare, pensions, law enforcement, etc.) were initially performed by public organizations and other types of citizens' associations. Under these conditions, social entrepreneurship is more an evolved form of social activity than a stage in the development of commercial activity.

As an example, the situation with the investment fund of the American Marmon Church should be cited. In February 2020, this situation in the United States received a significant public response due to the fact that this investment fund accumulated \$ 100 billion, which was used to implement a number of business projects, including in the real estate and real economy sectors. While these funds were withdrawn from the tax base as assets of the charitable foundation of the church NGO. In this case, we are not trying to analyze this case from the point of view of American tax legislation. In our opinion, this example is successful from the point of view of the potential of asset mobilization for the organization of entrepreneurial activities of a social orientation in the United States.

The strong traditions of private property and private business, as well as the corporate organizational and legal form of doing business with a strict separation of ownership and management (taking into account all the positive and negative aspects of the agency theory) do not allow us to fully talk about the possibilities of further evolution of American business beyond the implementation of the concept of social responsibility.

The European structures of social business are to a greater extent a reception of the cooperative movement, as well as a form of evolution of the established entrepreneurial community with a high level of income. This is a form of implementation of social initiatives, which has moved from the political plane to the practical one. In other words, this is an evolved left-wing socialist idea, which is implemented in practice not through elections and the victory of progressive left parties, but through the direct participation of social entrepreneurs in solving public problems by directing their business activity to the most acute social issues on the regional or national agenda.

The practice of national enterprises in European countries should be noted separately. Social entrepreneurship should also be defined as the evolution of this form of production activities organization. At the stage when the needs for jobs, working conditions and the level of remuneration were met, social entrepreneurship went further and moved on to solving social problems that cannot be the object of the activities of enterprises, trade unions, municipal or state bodies.

At the international level, social entrepreneurship is largely based on

the patronage and philanthropy of the largest multinational corporations. The most famous representative of international institutions for the development of social entrepreneurship is the Ashoka Foundation, established in 1980 by Bill Drayton, a former business management consultant at McKinsey & Company. This foundation provides scholarship and grant support to social entrepreneurship initiatives around the world. In addition, training programs and methodological support for social entrepreneurs are being implemented. In 2018, the fund's assets amounted to \$ 80 billion. Since 2020, Microsoft Corporation has become a strategic partner and financial donor of this fund. This corporation has chosen social entrepreneurship as one of the new directions of its philanthropic activity, indicating its high potential for simultaneously solving a number of global problems of humanity. It should be noted that the attention of global structures to initiatives in the field of social entrepreneurship largely concerns developing countries in Africa, Asia and Latin America.

In our opinion, the issue of comparative research of state policy in the field of support and development of social entrepreneurship is also relevant. For this purpose, we conducted a review and analysis of foreign literature [1-14]. The analysis, generalization and systematization of the main provisions of these studies allowed us to identify a number of well-established national models of state policy in the field of support and development of social entrepreneurship, which can be further taken into account and adapted for use in our country.

Italy is one of the world leaders in the development of social entrepreneurship. The accumulated experience and achievements in this area have allowed Italy to institutionalize its position in the international cooperative movement and in the development of social entrepreneurship.

Entrepreneurial initiatives of a social orientation in Italy are implemented in the organizational and legal form of cooperatives. This form of economic activity (social cooperative) was legally regulated in 1991. All social cooperatives were divided into two categories. Category A includes enterprises engaged in activities in the field of social services (care for children, the sick, people with disabilities and addictions, as well as elderly people). Social enterprises of category B were represented by production (agriculture, furniture and joinery production, craft workshops) and service (information technology, laundries, cleaning, etc.) cooperatives. The main goal of Group A cooperatives was to provide socially significant services. In turn, social cooperatives of category B performed the functions of reducing unemployment and overcoming its negative consequences. According to the regulatory requirements, volunteers could not exceed 50% of the

staff of social cooperatives.

The rapid growth of the social cooperative movement was institutionalized in the creation of the European Research Institute of Cooperative and Social Enterprises (EURICSE) [15], which is located in Trento (Trentino region), which is the European center for the development of the social cooperative movement. This organization carries out research in the field of development of social entrepreneurship and cooperation, as well as carries out systematization, analytical processing and dissemination of the most promising positive experience in the field under study.

It should be noted that the Italian model of social entrepreneurship based on the activities of cooperatives has been significantly developed in Spain, Portugal, France, Greece, Belgium and Poland. As an example, we should mention the Mandragona Corporation of Cooperatives [16] in Spain, which, being established in 1956, by 2017 united more than 90 thousand people who are owners of enterprises-subjects of the corporation. The turnover of the Mandragona Cooperative Corporation in 2015 was 12.1 billion rubles. the assets amounted to 34 billion euros. euro. The corporation was formed by 256 cooperatives that worked in the financial sector, trade, industry, services and other economic activities.

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## INTERNATIONAL INFRASTRUCTURE AGENDA. IS RUSSIA IN TREND?

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**Annotation.** Key trends in the global infrastructure practices in the context of the sustainable development paradigm are analyzed. Special attention is paid to the conceptual and doctrinal design of new approaches to infrastructure development - the concepts of “sustainable infrastructure” and “quality infrastructure investments”, as well as new approaches to the development of the infrastructure complex announced by leading international organizations.

Through the prism of the main trends that have formed the international infrastructure agenda, the efforts made by the Russian Federation on the infrastructure track are considered. The main barriers hindering the full-fledged development of the infrastructure complex are identified, and recommendations on ways to improve the effectiveness of infrastructure development in Russia to achieve the sustainable development goals are made.

**Keywords:** infrastructure, sustainable development, quality infrastructure investments, ESG-approach, green financing

### Introduction

In the last decade, infrastructure issues have come to the forefront of the international socio-economic agenda. The importance of infrastructure and its diverse impact on economic activity and people's lives are reflected in the “The 2030 Agenda for Sustainable Development” adopted at the UN Summit in 2015 and UN Sustainable Development Goals aimed at solving global problems facing humanity. One of the goals explicitly provides for “creating a sustainable infrastructure”, in addition, many of the goals of the agenda are directly related to infrastructure development and investment (1).

For Russia, a country with a huge territory located in the center of the Eurasian continent, the importance of the development of the infrastructure complex goes beyond the purely economic framework. The political leadership of the country noted that “The infrastructure for our country is a matter of its existence. ... the scale of the country is such that in the XXI century the lack of investment in infrastructure means the degradation of the entire space of the state” (2).

Despite the recent positive developments, the state of the domestic infrastructure continues to be much to be desired. According to the World Economic Forum, Russia has significantly moved up in terms of infrastructure quality in recent years and took the 50th place in the world ranking, although five years ago it was only 100th. Nevertheless, for many important components - quality of road infrastructure, density of railway infrastructure, efficiency of air transport infrastructure, quality of electricity supplies, etc. it is much inferior to the leading countries of the world (3). Assessments of the infrastructure by domestic researchers are even more stringent: the unsatisfactory state of infrastructure in Russia covers all industries and all regions. The provision of infrastructure in Russia is insufficient and is at the level of developing countries (4).

### **Conceptual and doctrinal design of new approaches to the development of infrastructure in the world**

In the last decade, there has been a gradual change of worldview in the world – the idea of continuous improvement of well-being and increasing consumption of natural resources has been replaced by a more balanced view, according to which the needs of humanity should be met “without harm to the ecosystem and future generations”. A number of new concepts and approaches to infrastructure development have become widespread in economic policy, including the concepts of “sustainable infrastructure”, “quality infrastructure investments”, “responsible investment in infrastructure”, etc.

The concept of “sustainable infrastructure” is closely related to the problems of sustainable development. Infrastructure plays a key role in achieving sustainable development and has a direct or indirect impact on the achievement of all 17 Sustainable Development Goals (SDGs) included in the 2030 Agenda for Sustainable Development and more than 90% of the 169 individual goals (5). Sustainable infrastructure refers to “infrastructure projects that are planned, designed, built, operated and decommissioned in such a way as to ensure economic and financial, social, environmental (including climate change resilience) and institutional sustainability throughout the project life cycle” (6).

G7 and G20 play an active role in promoting the concept of sustain-

able infrastructure. In 2019, at the G20 summit in Osaka, the "Principles of Quality Infrastructure Investment" (QII) were agreed and adopted, taking into account the environmental, social and economic aspects of infrastructure to achieve the quality and sustainability of facilities (7). The transition from traditional infrastructure to sustainable infrastructure based on quality investments is becoming one of the most relevant topics in the international community.

The concept of responsible sustainable investment, or investment based on ESG-factors (ESG - Environmental, Social and Governance), is based on the same principle as the concept of sustainable development, but with an emphasis on the activities of companies and corporations. Investing in infrastructure taking into account ESG factors allows to manage environmental and social risks, improve the quality of infrastructure investments, enhance management efficiency and ensure long-term profit for investors.

At the beginning of 2021, the World Bank announced a new approach to infrastructure investment, which was called Green, Sustainable and Inclusive Development (GRID). The priority of environmentally "clean" products, "clean" jobs, low-carbon technologies and intelligent risk management systems, overcoming inequality in opportunities and results through inclusiveness at all levels, is becoming increasingly important for infrastructure projects (8).

New conceptual approaches to the development and modernization of infrastructure have been implemented in a number of areas of practical activities, which, taking into account its global scale, can be considered key trends in global infrastructure practices. Let's look at some of the most significant ones.

### **Long-term planning of infrastructure development**

In recent years, the number of countries applying long-term infrastructure development planning has been growing markedly. This phenomenon reflects the growing desire of governments, taking into account bitter lessons of the global economic and financial crises, to form a clearer vision of the vector of infrastructure development, calculate the quantitative and qualitative parameters of this development, and create guidelines for funding sources. Examples of systematic long-term planning of infrastructure development are given by the United Kingdom, Australia, Canada, etc.

Strategic goal-setting and long-term planning of infrastructure development is gradually becoming one of the important tools of the authorities in Russia. In 2019 The Government of the Russian Federation has approved the "Strategy of Spatial development of the Russian Federation up

to 2025”, defining the priorities, goals and objectives of regional development of Russia (9). Very important is the “Comprehensive Plan of modernization and expansion of the core infrastructure until 2024” adopted by the Government of the Russian Federation in 2018. The plan provides for implementation of projects for construction of high-speed highways, reconstruction of more than 60 airports, development of transport hubs, ports of the Azov-Black Sea basin, reconstruction of major highways, transport bypasses of a large number of large cities, creation of hub transport and logistics centers, etc. (10).

### **Improving the quality of infrastructure projects**

In recent years, the global infrastructure policy has taken a line not just to reduce infrastructure gaps, but also to radically improve the quality of infrastructure. The Principles of Quality Infrastructure Investment (QII) adopted by the G20 cover various aspects of the preparation and implementation of infrastructure projects — economic, managerial, social and environmental. Projects that meet these requirements are most resistant to shocks, including those that the world has faced for the last two years.

At the corporate level, the concept of quality sustainable investments is expressed in the “ESG-approach” which indicates a serious transformation of the paradigm of modern business. According to the Global Alliance for Sustainable Investment (GSIA), the share of investments that take into account ESG factors, or sustainable investments, in total assets under management in various regions is steadily growing and in 2020 was 41.6% in Europe, 33.2% in the United States, 61.8% in Canada, 37.9% in Australia and 24.3% in Japan (11).

In Russia, the “ESG-transformation” is still at the very beginning. As of March 2021, there were only 81 companies and 19 banks in Russia that had implemented the principles of sustainable development (12). The position of leading corporations and banks, unfortunately, does not yet “make the weather” on a national scale. A recent study on the opinion of infrastructure market participants towards sustainable infrastructure in Russia shows that the ideas of sustainable development and quality infrastructure investments have yet to take hold of the minds of Russian business. Almost all companies (92%) agree that most of the infrastructure projects implemented in Russia cannot be classified as sustainable investment. According to more than half of the respondents, now the Russian infrastructure market is dominated by the focus on economic efficiency of projects (54%), in second place is the quality of life of people and the convenience of using an infrastructure facility (32%). Environmental aspects and environmental protection are considered a priority by only 6% of respondents (13).

### **Development of tools and mechanisms for assessing sustainability of infrastructure projects**

To facilitate the implementation of the QII principles in practice, many countries have created and successfully operate systems for evaluating and certifying the quality of infrastructure projects, which provide investors and financing organizations with comprehensive information for making investment decisions on the project. Today, more than 50 tools have been developed in the world aimed at implementing sustainable development approaches and helping investors evaluate financial, economic, environmental, social, managerial and other aspects of infrastructure projects. Among these tools, CEEQUAL, Envision, Infrastructure Sustainability and Greenroads have become the most widespread in the world practices.

Russia has also started moving along this path. In 2021 the State Development Corporation VEB.RF and the National PPP Center developed IRIIS (Impact and Responsible Investing for Infrastructure Sustainability) - the national system for assessing quality and sustainability of infrastructure projects. The system is designed to help investors, national and international banks correctly calculate the risks of entering into infrastructure projects in Russia. The specificity of this tool is an integrated approach that includes an assessment of all the risks of an infrastructure project, including economic, social and environmental aspects (14). The IRIIS system is currently running in test mode. Based on the results of testing, edits and clarifications will be made to the methodology in order to prepare for scaling the system to the whole country.

### **Development of digital and platform solutions in the field of infrastructure investments**

One of the notable trends in infrastructure market is the active development of digital and platform solutions to support the implementation of infrastructure projects at both the international and national levels.

The largest global digital platforms - Global Infrastructure Hub (GIH), World Bank's PPP Project Database, IJ Global, InfraPPPnet, etc. - provide data on global infrastructure and investment needs, country risk profiles and guidelines that help investors improve the quality of preparation of investment projects, their launch and implementation.

National products, as a rule, offer data adapted to the rules and practices of a particular country. Their main task is to promote the growth of the market and attract investment. At least a third of the G20 countries have and actively use databases of infrastructure projects, and some have already switched to the introduction of full-featured infrastructure platforms, which also include state support measures, expert platforms, "Facebook"

of market participants, interactive analytical and other tools.

Since 2019, the ROSINFRA Infrastructure Project Support Platform has been operating in Russia, which is a unique digital solution for the preparation and implementation of infrastructure projects (15). The core of ROSINFRA is the database of infrastructure projects and organizations involved in their implementation, which currently contains information about more than 3,900 ongoing projects and 1,400 project initiatives. Since 2020 The “Digital Project Office” service operates on the ROSINFRA platform, which allows regional and municipal authorities to conduct joint online work on launching investment projects, including involvement of external experts, investors and financing organizations. More than 5,700 market participants are already working with the platform as registered users. More than 70 industry experts provide support for ongoing projects and project initiatives.

### **Introduction of new infrastructure financing mechanisms**

The relevance of sustainable development and interest in sustainable investments have led to the emergence of new financial instruments - transitional, green, social, blue bonds, which allow investors to direct capital into projects to solve environmental and social problems.

Green bonds are one of the tools for attracting investment in projects of clean production, renewable energy and introduction of circular economy solutions. The largest issuers today are the USA, China and the EU countries, and among interstate associations - IBRD, WB, IFC, EBRD, African Development Bank and Asian Development Bank There are also other types of “green” instruments - for example, climate bonds which are designed to achieve a certain environmental or energy result (16). One of the most relevant topics is the reduction of greenhouse gas emissions and the achievement of the goals of the Paris Agreement. In this regard, transitional bonds have emerged, which allow to step up efforts to transition to a low-carbon economy. Recently, blue bonds have been gaining popularity in the financial market, which are aimed at implementing projects to protect oceans, coastal areas and support the blue economy.

Green finance appeared in Russia in 2018, when the country's first issue of green bonds of the company “Resource Saving of Khanty-Mansi Autonomous Okrug” was placed on the Moscow Stock Exchange. Over the past three years, the system of green finance in Russia has made some progress: as of the end of 2020, the Register of Green and Social Bonds of Russian Issuers (INFRAGREEN) includes 20 issues of green and social bonds of seven Russian issuers worth more than 216 billion rubles (17).

Nevertheless, a stable framework of the domestic system of green finance has not yet been formed in Russia. To solve this problem, the order

of the Prime Minister on the creation of system of financing green projects and initiatives in the field of sustainable development was signed in July 2021. The financing will be carried out by “green” financial instruments. With their help, businesses will be able to attract extra-budgetary funds on favorable terms. The document also defines the directions of green financing - in particular, energy, construction, industry, waste management, transport, agriculture, water supply and sanitation (18).

### **Conclusion**

The analysis of the main trends of infrastructure development in the world, as well as its projection on Russian realities, show that Russia is undergoing a serious reconsideration of infrastructure issues, its content and direction. This is reflected not only in general intensification of efforts on infrastructure track, but also in the development of new approaches to infrastructure development that increasingly correspond to key international trends.

Russia's turn to infrastructure issues is becoming more systematic, planning is being strengthened in this work, the regulatory and legal framework is being improved, the organizational and institutional framework is being modernized, Russia is opening up new directions for moving towards sustainable development.

At the same time, serious barriers still remain on this path, the key of which are:

- problems with strategic planning, the ambiguity of the authorities' plans for projects with the expected financial participation of private sector;
- regulatory instability, introduction of new regulatory barriers;
- lack of the flow of “long money” into the infrastructure, insufficient use of the potential of pension and insurance funds;
- the need to improve the speed and quality of project preparation;
- inertia of officials in the regions;
- low activity of Russia's participation in multilateral infrastructure projects and the use of the potential of international financial institutions.

The removal of these barriers could give a significant impetus to infrastructure development in the country, improve its quality and efficiency, which would fully correspond to the objectives of achieving the Sustainable Development Goals.

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**MODERN PROBLEMS OF YOUTH EMPLOYMENT AND THEIR  
ENTREPRENEURIAL SOLUTION**

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**Abstract.** The analysis of youth employment and unemployment in Russia and the North Caucasus Federal District is carried out according to statistical data. The specificity of youth employment in different age periods is revealed: 15-19, 20-24 and 25-29 years. The problem of youth unemployment is especially acute in the South of the Russian Federation. It is shown that for the timely solution of the problem of unemployment, it is necessary to develop youth entrepreneurship. The COVID-19 pandemic has complicated this task, but has also opened up new forms of entrepreneurship and employment in general, which is revealed in the article.

**Keywords:** youth, employment, unemployment, entrepreneurship, COVID-19, digitalization

The current economic turbulence caused by the restrictions of the pandemic period, sanctions and other reasons, inevitably affects the labor market and youth employment.

Analyzing the employment of young people, namely young people of working age from 15 to 30 years old, it is possible to clearly distinguish three periods of maturity of young people and the corresponding specificity of employment, determined by the share of students in various educational institutions, which, in accordance with the "methodology of the ILO, are classified as persons outside into the labor force".

According to statistics, the share of students aged 15 to 19 is the most significant (from 85 to 90 percent in different regions) (The number and composition ..., 2020).

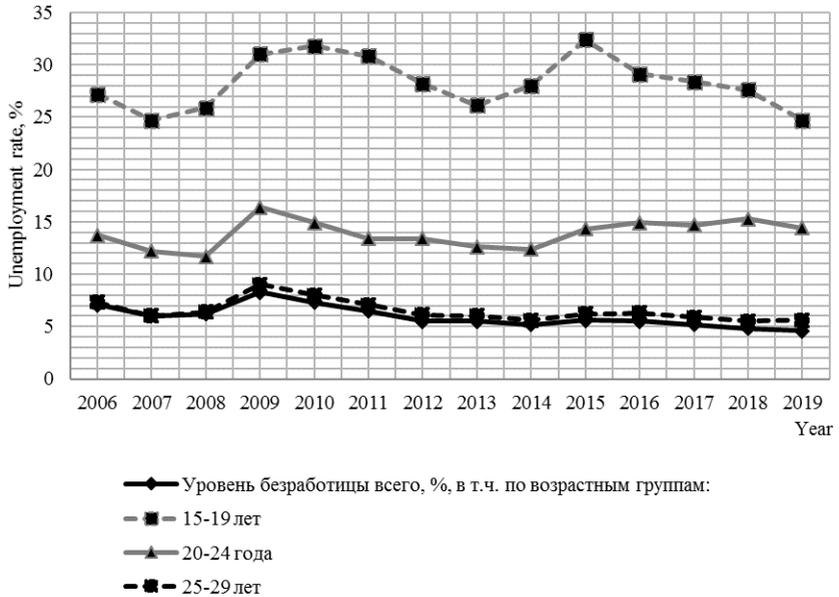
In the age period from 20 to 24 years old, this share is less: from 40 to 44%, and the issue of employment of graduates is actualized. During this period, the number of employed (35-40%) and unemployed (20% and more) will grow. Crossing the 25-year mark, young people 'move from the category of persons outside the labor force to the category of employed people", the share of students is less than 2%, and the share of the employed increases to 70% and more.

According to the data of the Office of the Federal State Statistics Service for the North Caucasus Federal District, in 2018, enterprises of various forms of ownership dominate in the employment of employed youth (62.4%) in the region (Policy brief "Youth in the labor market of the Stavropol Territory", 2020).

Less than 2% of young people are engaged in entrepreneurial activity without forming a legal entity (IE).

Among young people, the share of unemployed is high, especially among the working-age population under the age of 24 (in 2019, the average for the Russian Federation was 4.6%, for youth groups 15-19 years old - 24.7%, 20-24 years old - 14.4 %). For the 25-29 age group, the unemployment rate is approaching the average (figure 1).

In the Russian Federation, the most unfavorable situation with unemployment is in the North Caucasus Federal District, where it is more than 2.5 times higher than the national average. This also determines significant differences in the scale of youth unemployment, primarily among graduates, which in the North Caucasus Federal District is almost 3 times higher than the national average (Labor force, employment and unemployment in Russia, 2020).



**Figure 1 - Dynamics of the youth unemployment rate in Russia**

The problem is of global concern, especially for developing countries and countries with economies in transition, where there are more than 200 million unemployed or underemployed young people. These economies are not creating new paid jobs fast enough to absorb the growing labor force (Flegontov, 2020; Ivashina, Kaznina, & Kalinina, 2020).

As a result, young people develop a passive and expectant (all of a sudden, everything will change for the better) position as in work and forcing them to look for work in the shadow sector (Merkulov, 2017).

In order to reduce employment problems, it is important that young people have a pool of self-management skills during the period of study: self-esteem, self-presentation, self-motivation, self-development, etc. (Parakhina et al, 2012).

At the same time, young people have a high level of activity and a high (often overestimated) level of expectations. This can create an "explosive social situation".

To solve the problem of unemployment in a timely manner (so as not to bring young people to the level of "desperate to find a job"), it is necessary to develop a system of youth entrepreneurship. It is necessary to begin to create an entrepreneurial spirit and a corresponding "pool" of those

wishing to have their own business in the student environment, for which purpose, in educational organizations, practice-oriented entrepreneurship training should be formed on the basis of their own university or regional innovation infrastructure (technoparks, incubators).

The COVID-19 pandemic has made this task more difficult, but at the same time has opened up an opportunity to rethink the forms of entrepreneurship and forms of employment in general. As the McKinsey group researchers note, "a dramatic change that happens less than once a generation and can change society in countless ways is happening." It is noted that managers and employees are trying to learn new experiences, but now we need to "admit that no one has the answers to all the questions" (Kartajaya, 2021).

There is a transformation of human activities based on digitalization. Experts mention at least "four benefits of digitalization: lower costs, increased accuracy, increased speed and efficiency" (Fitzgerald, et al, 2013; Kaur & Bath, 2019). At the same time, the positive results of digitalization, which were realized by organizations long before the coronavirus pandemic, did not lead to their mass development by all employees and widespread use in technological processes (This also applies to the field of higher education, in which the authors of the article work.

The outbreak of COVID-19 has forced people to quickly master new communication technologies and digitally transform business processes. A 2020 survey by McKinsey & Company found that digitalization took a quantum leap during the COVID-19 pandemic in both

organizational and sectoral levels (LaBerge et al., 2020; Kartajaya, 2021). At the same time, "digital transformation" concerns transformations in goods, interaction with customers, business management models, including the creation of a new business, as well as structural and functional structures.

It is based on human transformation, which affects organizational culture, systems thinking of employees and a model of work behavior (Parakhina, 2009; Schwertner, 2017).

These changes relate to expectations of post-pandemic worker behavior. So, at the end of the pandemic, employers want to return workers to their workplaces in the office, and employees want to work more remotely. There is a need to develop a hybrid work model that includes teleworking from home and direct work in the office.

Research from more than 500 senior executives across eight industries has helped McKinsey identify the key positions companies must take to shape and operate a hybrid business model. Having analyzed these posi-

tions and compared them with the Russian experience (LaBerge, 2020; Parakhina, Boris, & Timoshenko, 2017), we consider it necessary to propose the following principles for the formation of a hybrid model of work in new conditions: 1) set clear goals and clarify the relationship with the strategies and priority values of the company; 2) delegate decision-making authority to the localities, especially with regard to the implementation of innovations, in order to accelerate their implementation; 3) expand the use of mentoring and recognition of achievements, supporting employee initiative; 4) use new communication technologies for collaboration and mutual understanding, taking care of the mental health of workers; 5) automate work operations, without accompanying it with staff reductions, directing the time and energy of employees to the tasks of business development.

Most of these recommendations are especially important in relation to new, young employees, since they have not yet developed a relationship of mutual understanding and support in the team, and remote work contributes to this weakly.

### Conclusions.

So, the problems of youth employment are of global importance and are being addressed, both by enhancing the participation of young people in entrepreneurship, and by attracting easily trained young people to new areas of business.

Digitalization and restrictions in the communication of people in connection with the COVID-19 pandemic led to a reduction in the number of jobs in many sectors of the economy, especially in the service sector (tourism, hospitality, retail), but contributed to the development of e-commerce, delivery, transportation, logistics and warehousing.

At the same time, the current conditions of pandemic restrictions and the development of digitalization create the need and opportunity for the development and widespread use of a hybrid model of work, which will partially solve the problem of conflicting priorities in the actions of government and business: to limit communication between citizens in order to protect them from a life-threatening infection, and to save the economy.

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**APPLICATION OF ASSESSMENT CENTER TOOLS FOR  
THE EVALUATION OF THE EFFICIENCY OF PERSONNEL  
COMPETENCIES AND FOR THE DEVELOPMENT OF THE  
INTELLECTUAL POTENTIAL OF ENTERPRISES**

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**Lead.** This article offers a new approach to assessing the existing level of professional competencies of enterprise personnel on the example of middle management managers of one of the enterprises of the most dynamically developing sphere of the digital economy – the creation and implementation of digital economy products. The results obtained made it possible to conduct a brief analysis and develop recommendations for the transformation of the structure of professional competencies of middle management managers. The strengths and areas of competence development are identified, proposals for the development of individual development programs for middle management managers are formed.

**Keywords:** enterprise, personnel, intellectual potential, competencies, tools, assessment center.

**Foreword**

Today, many Russian enterprises carry out its production activities under the conditions of the negative impact of sanctions restrictions. This circumstance highlights the presence and development of the intellectual potential in determining promising areas and opportunities for its progressive development. At the same time, the intellectual potential of each enterprise is individual, depending on its industry affiliation, type of production activ-

ity, organizational and legal structure and a number of other factors that have a greater or lesser influence on its formation.

In the most general sense, the intellectual potential is usually understood as the personnel of an enterprise that has a certain level of professional competencies, capable of building them up and transforming them to ensure the development of the enterprise's production activities. The harmonious development of the intellectual potential of enterprises is becoming more relevant than ever in order to ensure the successful counteraction to sanctions restrictions, since it minimizes the costs of financial, material, information-technological and other types of resources necessary for the organization of production. This circumstance is particularly evident in the example of medium-sized and small modern enterprises engaged in the creation, production and sale of digital economy products. The intellectual potential and development prospects of such enterprises are largely determined by the level of professional competencies possessed by their personnel in general and middle management managers in particular.

### **Research purpose**

The main purpose of this study is to substantiate the possibility of using the assessment center's tools to assess the effectiveness of existing professional competencies of enterprise personnel and develop their intellectual potential on this basis. For its implementation, a contingent of middle – level managers of one of the enterprises of the most dynamically developing sphere of the digital economy was selected- the creation and implementation of digital economy products.

### **Materials and methods**

The novelty of the proposed approach to the management of the formation of the intellectual potential of the enterprise lies not only in determining the level of professional competencies of managers of the middle management level, but also in creating conditions for their development (an internal determinant of the formation of the intellectual potential of the enterprise). At the same time, the company's management must create all the necessary conditions for the development of professional competencies for all personnel contingents (an external determinant of the formation of the intellectual potential of the enterprise). Thus, the essence of the proposed approach is to combine these determinants and use a dynamic approach for the continuous development and professional competencies of the company's personnel.

The most significant indicators from the point of view of their impact on the performance of each manager and the enterprise as a whole were selected as criteria for evaluating the professional competencies of manag-

ers of the average management level of the studied enterprise. It includes:

1) result orientation-implies the desire and ability of the manager to focus his attention on achieving the set goals and its resource support through quantitatively and qualitatively measurable indicators of the implementation of business processes;

2) leadership-implies the ability to lead subordinates, inspire and motivate them to achieve the set goal in such a way that they can achieve the desired result, while demonstrating standards and quality of work above their usual level;

3) performance management-implies the ability to effectively delegate their powers and organize a cycle of managing them, starting with setting tasks and organizing control over their implementation and ending with receiving feedback and making adjustments if necessary;

4) ability to work in a team-implies the ability to establish relationships with colleagues at work, create a comfortable working atmosphere in the team, the desire to contribute to the achievement of goals;

5) stress resistance-implies the ability to control emotions, remain calm in pressure situations, cope with long loads or a large amount of information, work effectively in non-standard situations, quickly restore their performance, maintain it at a high level;

6) self-organization-implies the ability to plan your actions in time, rationally prioritize, effectively use time and achieve set goals within the planned time frame.

The tools of the assessment center (AC) were chosen for conducting an empirical study. Its advantages and disadvantages are well studied and described both in fundamental works [3, 7] and in the works of the authors of this article [5, 6]. In our country, the AC tools have been used for more than 30 years. During this time, it has established itself as one of the most popular methods for assessing the professional competencies of personnel of enterprises in various sectors of the economy. According to the Federation of Personnel Assessment, more than half of the 150 largest companies on the Russian market have used AC tools in the last 10 years [9]. Standards have been adopted that prescribe the principles and procedures for its implementation [2]. Practical manuals have been published, in which the methodology, technology and ethical issues of using the AC tools are disclosed in detail [4, 8]. An analysis of the practice of its application in our country and abroad gives every reason to believe that its use helps to obtain comprehensive and objective information about the professional competencies of the company's personnel [2, pp. 51-52].

In comparison with other methods of personnel assessment, the main

advantages of using the AC tools are as follows:

- makes it possible to obtain more balanced and reliable assessments of the professional competencies of the staff in comparison with the assessments obtained using other methods [4];

Stipulating key moments:

- 1) the cases within the AC toolkit are modeled on the basis of real working situations that the specialist will face;

- 2) each professional competence is identified on the basis of the application of at least 2 methodological techniques;

- 3) each specialist is monitored by several experts, which significantly reduces the subjectivity of assessing his professional competencies.

- ensures an "honest" and correct procedure for evaluating the professional competencies of personnel by the organization, even if as a result of it, applicants did not receive an invitation to work or were not offered a new position;

- allows you to get a comprehensive assessment of a particular specialist, which simultaneously provides information on the entire composition of the competencies that he has;

- provides a multifunctional use of the results, on the basis of which you can simultaneously make several decisions for a group of specialists;

- provides time savings, since as a result of using the AC tools, you can get estimates for several groups of specialists;

- provides visibility of the results, which are presented in the most detailed and accessible way, which makes it easy to determine the current level and features of the development of certain professional competencies in any specialist;

- allows you to assess not only the current level of professional competencies of a specialist, but also the availability of potential opportunities and abilities for the successful development of new competencies [4].

To assess the managerial competencies of middle management managers of the studied enterprise, a three-point scale was selected with a step equal to "0.25" points, where:

- the rating "3 points" corresponds to the level of skill and implies a particularly high degree of development of this competence;

Middle managers of an enterprise who have reached this level are able to apply their competence in non-standard situations or situations of increased complexity. They can take initiatives related to expanding the scope of this competence.

- the rating "2 points" corresponds to the level of experience and assumes that the head of the middle management level has fully mastered

this competence;

This means that in standard situations, he/she does not make mistakes, and the manifestation of competence skills occurs automatically.

- the "1 point" rating corresponds to the level of development and means that the head of the middle management level understands the importance of this competence and is in the process of mastering it;

However, the skills of competence are unstable, mistakes are possible in standard situations, it is necessary to make conscious efforts to manifest skills.

- the score "0 points" corresponds to the level of incompetence and means that the head of the middle management level does not possess competence, does not try to apply and develop it.

The study sample consisted of 12 middle rank managers (heads of departments), whose age ranged from 23 to 49 years. There were 7 men and 5 women among them.

When conducting an empirical study using the AC tools, all middle rank managers were randomly divided into 3 subgroups, for each of which the competence assessment took place on a separate day. The process of assessing competencies using the AC tools corresponded to the standard technology and contained the following stages [1]:

1. Specialists within the framework of the AC toolkit pass cases, and observers record behavioral manifestations and statements of participants in the observation form. In each case, a specific observer was assigned to a certain specialist. In the corresponding cases, the observer also acts as a role player at the same time (usually at the managerial AC this is the role of a subordinate with whom the AC participant needs to talk as a manager under the terms of the case). At the interview stage, the assessor conducts an interview and records the candidate's answers. Thus, the tasks of the assessor within the framework of using the AC tools were as follows: monitoring the behavior of specialists and recording information; conducting role-playing games within the framework of cases; conducting interviews.

2. The observer processed all the collected information individually using classification technology ("classification of behavior units relative to competence indicators" [1, p. 141]). To do this, the assessor attributes each unit of behavior from the observation form to a certain indicator of a certain competence in a checklist specially prepared for this case. Then, in each checklist, the observer sets an assessment for a particular competence of the manager according to the accepted measurement scale. The result of this stage is a completed checklist for each case for each participant from each observer attached to this participant in this case.

3. After using the AC tools, an integration session is held, at which assessors discuss their assessments and conclusions, and each participant is given a final assessment for each competence.

4. Then a written report is compiled for each participant with conclusions about his "strengths" and "growth zones". It includes recommendations for development - for a specialist and recommendations for managing a specialist-for his head.

AC tools comprise 6 assessment instruments:

- 1) simulation group case "Additional opportunity";
- 2) simulation group case "Preparation for the exhibition";
- 3) individual simulation case with role-playing game "Time trouble";
- 4) "Probation period" individual simulation written case;
- 5) written testing;
- 6) talk show.

This set of tools was selected on the basis that each competency should be assessed using at least two tools. [1, p. 31].

All the simulation cases were combined by one "legend". Each middle-level management manager was asked to imagine himself as an employee of another fictional enterprise. At the same time, each specialist was given brief information about the activities of the fictional enterprise, its history, results and plans. This approach (a single legend) allows each specialist to immerse himself as much as possible in simulated situations and behave as naturally as possible in them (similar to how he behaves in real activity).

In the "Additional opportunity" case, all specialists acted as managers of one of the divisions of a fictional enterprise. Their task was to promote their unit and convince others of this decision. At the same time, the common goal facing all specialists (in the context of this case, the heads of departments of a fictional enterprise) was to choose a finite number of promoted departments, which will be obviously smaller (in our case – 2). Thus, in this case, there was a certain conflict between the personal interests of each specialist and the general interests of the company's management, as well as between the interests of individual specialists. In this case, such competencies were observed as: result orientation, leadership, ability to work in a team, resistance to stress and self-organization.

In the individual case "Probation period", the specialist was asked to solve a problem related to the adaptation of a new employee at the workplace. To do this, the specialist had to study the information about the position that the employee entered, his/her biography and prescribe for him: goals and a work plan, ways to control him and his motivation, as well as prepare a welcome letter for the employee. This case was used

to assess the competencies: leadership, performance management, self-organization.

The case “Preparation for the exhibition” is also a group task. It has been repeatedly used in different variations of the use of the AC tools [6].

The individual case “Time trouble” was a task in which the specialist had to sort out the to-do list and make a written plan of the day, and then talk to one of the subordinates (an observer acted as a subordinate) in order to delegate some of the work powers to him. The following competencies were evaluated using the case: result orientation, leadership, performance management, stress resistance and self-organization.

The essence of the “Competence talk show” method is that the interviewee is asked questions about his past with a request to give an example of his actions in a certain situation (it is asked by the interviewer) and describe his behavior in it. For example, “Give an example when you needed to complete a task that you had not previously encountered”. This method is based on the following relationship: as the competence was manifested in the specialist in the past, so it is highly likely to manifest itself in the future. Thus, the “Competence talk show” method allows you to supplement the idea of a specialist's competencies by analyzing his behavior in a situation that may actually arise in practice.

**Results and discussion**

A summary table with the final assessment points for each competence and the assessment of the set of competencies for each of the 12 middle management managers is shown below.

In general, the absence of the highest values for all competencies (3 points) is noteworthy in the sample, which indicates the degree of availability of competencies at the level of experience when they are manifested in standard situations. The manifestation of competencies in non-standard, creative situations that require initiative is uncharacteristic for managers of this sample.

**Table**  
**Final points for each manager competencies and its points by the totality of competencies**

№ i/o	Assessment criteria (competency)	Participants											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Result-orientation	1,25	2,25	2,0	1,75	2,0	1,75	2,0	2,0	1,5	1,75	0,5	2,0

## Process Management and Scientific Developments

2	Leadership	0,75	1,5	1,5	2,0	1,5	1,5	1,5	1,75	1,0	1,25	1,0	1,25
3	Performance management	1,0	2,0	1,25	1,75	1,5	1,75	1,5	2,0	1,5	1,25	1,75	1,25
4	Ability to work in a team	1,5	1,0	1,75	1,75	1,5	1,25	1,75	1,75	1,5	2,0	2,25	1,75
5	Stress resistance	1,75	1,5	1,75	2,0	1,75	1,75	1,5	1,5	1,5	2,0	1,0	2,0
6	Self-organization	1,5	1,5	1,5	2,0	1,5	1,5	1,5	2,0	2,0	1,75	1,75	1,75
Final point by competencies		1,3	1,6	1,6	1,9	1,6	1,6	1,6	1,8	1,5	1,6	1,4	1,7

Personally developed for each middle manager:

- 1) individual report on all competencies, indicating strengths and development zones;
- 2) detailed recommendations as to the training and development of competencies.

Due to the rather huge volume of such documents, as well as to its individual & personal orientation, it has not been included in the article hereunder.

### **Opinions**

Results, obtained in the course of research, allowed to formulate following opinions.

1. To solve the tasks set and conduct an empirical study, it is advisable to use the tools of the assessment center. Its advantages in comparison with other methods are presented, the main stages of its implementation are described, as well as the tools used, namely: group simulation cases; individual simulation cases with role-playing games; individual simulation written cases; interviews.

2. The composition of the most relevant competencies for middle rank managers from the point of view of the enterprise management is determined, which include: result orientation; leadership; performance management; ability to work in a team; stress resistance; self-organization.

3. The use of the AC tools allowed us to obtain data that allowed us to identify the structure of managerial competencies of middle rank managers of the enterprise. On the basis of a dynamic approach to competencies and the capabilities of the AC tools, strengths are identified and areas

of competence development are identified. These results can be used in the development of programs for the individual development of managers' competencies.

4. The absence of competence ratings higher than 2.25 points for any of the studied competencies indicates the presence of competencies at the level of experience, when they are manifested in standard situations. The manifestation of competencies in non-standard, creative situations that require initiative is uncharacteristic for middle-rank managers of this enterprise.

5. Among the priority tasks facing the management of the enterprise in the field of managing the formation of its intellectual capital, training of middle management managers and improving the level of their professional competencies are identified.

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## MECHANISMS FOR ENSURING ECONOMIC SECURITY OF THE PIPE-ROLLING INDUSTRY

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**Abstract.** Today, the Russian economy faces new long-term systemic challenges, internal and external threats in the economic sphere, reflecting both global trends and internal development barriers. In the scientific work, an attempt is made to identify and consider the main external and internal threats and their consequences for the economic security of pipe-rolling enterprises in the Russian Federation, which need operational regulation or consistent strategic neutralization. The main mechanisms of ensuring the economic security of the industry, which is a strategically important system-forming link of the country's economy as a whole, are revealed.

**Keywords:** economic security, pipe companies, external threats, internal threats, sanctions, COVID-19

### Introduction

The industrial complex of Russia includes pipe-rolling enterprises as the foundation of the entire fuel and energy complex. They are strategic enterprises, and their financial and economic activities are reflected in the level of sustainability of state economic development as a whole. After all, the efficient operation of the fuel and energy complex is the key to the foundation of economic stability and independence of the entire industrial complex of the Russian Federation.

It follows from this that ensuring the economic security of pipe-rolling enterprises is one of the priority tasks for the state, which requires the inclusion of a number of mechanisms aimed at the balanced and uninterrupted operation of the industry.

The state strategy of economic security of the Russian Federation [1] defines the key issues of state policy in the modern global world: assessment of current and potential threats to economic security, development of adequate countermeasures, identification of competitive advantages and

opportunities, implementation of competitive potential.

Today, the Russian economy faces new long-term systemic challenges, internal and external threats in the economic sphere, reflecting both global trends and internal development barriers.

The first challenge is the strengthening of global competition, accompanied by an increase in geopolitical rivalry, including for control over raw materials and energy resources. This competition extends both to traditional markets for goods, capital, technology and labor, and to systems of national governance, innovation support and human development. It should be noted that for Russia, the transformation of the world economy creates new opportunities for the development of foreign economic integration, strengthening and expanding positions in world markets, and importing technologies and capital.

The second challenge is the expected new wave of technological change, which will enhance the role of innovation in socio-economic development and reduce the impact of many traditional growth factors. That is, the transition of the world economy to a high-tech structure, which leads to an increase in the role of human capital as the main factor in economic development and state security.

In this regard, it is necessary to take adequate measures of state policy aimed at overcoming the third challenge - the existing negative trends in the development of human potential, including:

- declining population and employment in the economy;
- growing competition with European and Asian markets for qualified personnel;
- decrease in the availability of social services in the field of health care and education, low quality of these services.

The fourth challenge is the depletion of the potential of the raw material export model of economic development. Energy export yields are declining due to the transition to efficient technologies and the trend towards renewable sources. Modernization of the fuel and energy complex, development of the resource base and infrastructure requires significant resources, which can lead to an increase in the level of economic costs.

An extremely negative factor is the policy of the United States and the EU to change the strategic foreign and domestic policy of the Russian Federation, which is expressed in the use of technologies against our state for creating crisis situations in the financial, economic and socio-political spheres [2, 3].

To build an effective system of external economic security of pipe rolling enterprises, it is necessary to identify the most dangerous external threats

that need operational regulation or consistent strategic neutralization.

### **Mechanisms for ensuring foreign economic security**

So, let us consider the main external economic threats and mechanisms to prevent their consequences for pipe-rolling enterprises.

The first threat is negative changes in the structure of foreign trade associated with the sanctions regime and lockdowns from COVID-19, which lead to the destruction of foreign economic partnerships between the states that export pipe products, as well as the breakdown of the external supply chain, which there is nothing to replace in the domestic market. As a mechanism to prevent an increase in negative changes in the structure of foreign trade, the state, together with business, should adopt an effective and efficient policy of regulation in relation to foreign economic activity aimed at creating favorable conditions for the favorable economic functioning of the Russian pipe-rolling industry [4, 5].

Urgent measures must be taken to prevent the spread of the pandemic:

- Organizational and medical measures, including the growth of scientific research and technologies related to health, the availability of services, the provision of universal vaccination, additional government funding in the field of medical facilities, equipment, pharmaceuticals, online health consultations in the fight against COVID-19, an increase in strict the mobilization capabilities of the system as a whole and ensuring the highest level of safety for physicians involved in the fight against the pandemic.

- Exchange of knowledge, determination of priorities for joint coordinated work of international health organizations with domestic research centers and medical authorities.

- Strict sanitary and epidemiological control with the countries affected by the pandemic, but especially with the countries in which the research centers of biolaboratories associated with the Pentagon are located.

Sanctions always "hit the sick": dependence on imported equipment, technologies, etc. Therefore, it is necessary to introduce counter-sanctions, agreed with the leading pipe-rolling enterprises, where the emphasis is placed on the development of their own production (import substitution).

The second external threat is a decrease in prices and energy consumption in the world market, which leads to a decrease in the flow of investments in the pipe-rolling industry, and this negatively affects the financial activities of enterprises and, as a result, leads to losses in tax payments to the budgetary funds of the Russian Federation.

As a safety mechanism, it is necessary to effectively develop the oil and gas chemical industry in Russia, aimed at achieving a high level of com-

petitiveness of production through the synchronization of production, delivery and processing of raw materials while stimulating domestic demand for oil and gas chemical products with high added value. Construction of new enterprises (clusters) that will be able to ensure the transition from the export-raw-material model of the development of the petrochemical industry to the resource-innovative one, which involves the production of high value added products along the entire technological chain from raw materials to finished products. Without these products, it is impossible to ensure not only energy, economic, but also defense security of the country [6].

The third threat is an increase in the dynamics of the movement of factors of production abroad, which means the "flight" of capital to more developed economies.

A mechanism for overcoming this severe systemic threat can only be the implementation of a targeted set of measures in all spheres of the state and society, which is possible only if citizens have a high level of trust in government bodies and authorities.

Today, state bodies have a tool in their hands to combat these negative phenomena - Federal Law of November 24, 2014 N 376-FZ "On Amendments to Parts One and Two of the Tax Code of the Russian Federation (in terms of taxation of profits of controlled foreign companies and income of foreign organizations)" (as amended by Federal Laws dated 06.04.2015 N 85-FZ, dated 08.06.2015 N 150-FZ, dated 15.02.2016 N 32-FZ, dated 28.12.2017 N 436-FZ, dated 19.02.2018 N 34-FZ, dated 12.11.2018 N 412-FZ). The authorities need to conduct constant financial monitoring of the observance of currency and customs legislation and strengthen the responsibility of the inspection authorities [7].

The fourth external threat to the economic security of pipe rolling enterprises is the protectionist policy of the states of the Anglo-Saxon world, which leads to unfair competition, expressed in the absence of the possibility of selling pipe products in countries with protectionist policies [8].

The mechanism to ensure the prevention of this threat is to resist the economists who allegedly found a solution to the threat of protectionism - unfair competition, in the form of the creation of transnational companies, the formation of which "successfully" came to Russia from the West. It turns out that the policy of the Anglo-Saxon coalition negatively affects only enterprises operating on the territory of the state and not included in such companies. This is probably why the threat from the protectionist policy of the states of the Anglo-Saxon world does not seem so significant in comparison with the growing power of transnational companies, which, like an octopus, have spread their tentacles all over the world [9].

The fifth foreign economic threat is the negative impact of international economic organizations and transnational companies, leading to the conquest of the domestic market by foreign firms and, as a result, the growth of the industry's dependence on imports (equipment, technology, etc.), the elimination of pipe-rolling enterprises (bankruptcy) in favor of competitors abroad [10].

The mechanism for countering this threat is the need for the State to pay close attention to the growing influence of transnational companies that have a negative impact on the country's economy, gradually absorbing small and medium-sized companies, buying up their assets and property [11]. Transnational corporations seek to control all sectors of the economy, including the pipe-rolling industry, leaving little room for small businesses that cannot compete with large companies.

### **Internal economic security mechanisms**

The main internal economic threat to the pipe rolling industry is the orientation of the economy towards the export of raw materials, although the world situation is rapidly changing and the sale of pipe products in the direction of Nord Stream 2, Power of Siberia is no longer accounted for, since the construction of these facilities is almost completed [12]. In this regard, it is necessary to look for new directions for the sale of pipe products in the domestic market. Such areas can be the housing and communal services sector, according to the draft "Strategy for the development of housing and communal services in the Russian Federation until 2035", the project of turning Siberian rivers to the south, by building a water pipeline from Russia to China through the territory of Kazakhstan, as well as trunk pipelines to Crimea, on North Caucasus and Lower Volga region [13]. Restoration of the irrigation complex, associated with the technical re-equipment of existing and complete replacement of failed resource systems in accordance with the Draft Decree of the Government of the Russian Federation "On approval of the state program for the effective involvement of agricultural land in the turnover and development of the reclamation complex of the Russian Federation", calculated until 2030 [14].

The industrial complex of Russia today faces an acute economic problem of import substitution in the field of modernization of production and wear and tear of the transport system (oil pipelines, gas pipelines, water pipelines, etc.). To solve it, it is necessary to launch a mechanism for the innovative development of pipe-rolling production with the use of high technologies. The state should pay close attention to the rational distribution of investments, not only for the introduction and development of domestic specials. equipment that is not inferior to Western counterparts, but

also for the production of pipeline transport technological systems, which should ensure the reliability of all those. processes of the modernized enterprise and be carried out taking into account the possibility of their high-quality management and maintenance.

### Conclusions

The pipe-rolling industry is a strategically important backbone link for ensuring the economic independence of our state as a whole, since the production of pipe products manufactured with the intensive use of the latest technologies has two-way interaction with the successful development of not only the fuel and energy complex, but also mechanical engineering, construction - offices and other branches of the national economy of the Russian Federation. To ensure an effective system of economic security for pipe rolling enterprises, it is necessary to launch a number of mechanisms to consistently neutralize the identified external and internal threats and their consequences.

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**SCIENTIFIC AND APPLIED APPROACH TO THE FUNCTIONS OF  
CIVIL LAW IN THE REGULATION OF RELATED SUBJECTS OF  
LEGAL PROTECTION**

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**Abstract.** In the lawmaking activity, which is the basis of Russian legislation, key functions are laid that determine the types of protective legal relations. The latter are provided through their legislative consolidation and, thereby, the regulatory function of law is carried out. General legal and intersectoral areas of regulation and protection are reflected in the material and procedural legislation of the Russian Federation. Our work is based on understanding the scientific and research nature of the legal regulation of related legal relations, protected by the norms of civil law and the criminal law cycle. The purpose of our study is to determine the specific types of functions of civil law in the regulation of related subjects of legal protection, to outline the scientific, applied and conceptual components.

**Keywords:** functions of law, civil law, convicts, penal law, legal regulation.

The theoretical significance of the institution of functions of civil law of the Russian Federation at the present stage is traced in its universality as a means of increasing the efficiency of legal regulation of related subjects of legal protection. Accordingly, the applied value of the study is determined on the basis of generalization of the functions of the civil law industry in Russia, the limits of correlation with the subject of legal protection of other goods regulated by criminal law. In particular, the criminal-executive legislation of the Russian Federation provides a significant range of personal property and non-property relations of persons who are isolated from society.

In the lawmaking activity, which is the basis of Russian legislation, key functions are laid that determine the types of protective legal relations.

The latter are provided through their legislative consolidation and, thereby, the regulatory function of law is carried out. General legal and intersectoral areas of regulation and protection are reflected in the material and procedural legislation of the Russian Federation. Our work is based on understanding the scientific and research nature of the legal regulation of related legal relations, protected by the norms of civil law and the criminal law cycle.

The issues of process management within the definition of the sphere that is subject to legal protection, the presence of problems of its law enforcement and gaps in legislative regulation is an actual scientific research. This is primarily due to the fact that, according to the authors, it is necessary to define the role of civil law as the regulation of normal relations in modern society. Secondly, modern approaches to considering the functions of civil law as an integral part of a unified legal system, including, reflect other related subjects of legal protection.

The classical approach to the differentiation of basic functions includes their division into regulatory, protective, preventive and educational, preventive and stimulating. Summarizing the scientific material in this area, the opinions of scientists, practical implementers of civil law norms, we highlight the key aspects of the institution of functions of civil law in the Russian Federation at this stage of the development of the Russian state. So, the main functions of Russian civil law are such as regulatory, economic, protective, human rights, political, cultural, historical, socio-educational, compensatory and legal restorative. Note that the scientific and cognitive directions in the field of recent decades on the classification of the functions of law are associated with the statements of various views by such scientists as S.S. Alekseev, I.E. Farber, T.N. Radko, V.G. Smirnov, etc. And the problems of legal integration were touched upon in the works of prominent legal scholars of the late XIX - early XX centuries G.F. Shershenevich and A. Yashchenko. It seems necessary to at least briefly generalize this problem, taking into account the current level of development of legal science.

It seems to us that along with the indicated functions of civil law, which directly follow from the provisions of the domestic civil legislation of the Russian Federation or from its dogmatic and other interpretation, another function should be noted - integration. In its legal essence and legal content, such a function reflects the simultaneous legal regulation, legal protection of the same good by several branches of Russian law. Accordingly, a single subject of legal regulation is covered simultaneously by at least two laws. At the same time, this subject of legal protection is not in all of

them the highest, in fact the only, interest of legal relations regulation by the norms of law.

Consider an example from the criminal executive branch that regulates the rights, freedoms and other general civil benefits and interests of persons isolated from society in connection with the commission of a crime. So, Civil law regulates public relations on the basis of discretion, equality and mutual assessment of participants in civil turnover, inviolability of property, freedom of contract and the inadmissibility of arbitrary interference by anyone in private affairs. Convicted citizens serving sentences in places of isolation from society are participants in civil turnover and other relations arising from domestic legislation. This, in fact, is due to the fact that they are citizens of Russia and enjoy the corresponding rights, and a number of legal restrictions provided for by Russian laws for convicts, for the most part, are not related to the civil law of the Russian Federation. Confirmation of this is the provisions of the norms of chapters 2, 13 and 23 of the current criminal-executive legislation of the Russian Federation. In the first case, the law determines the legal status of convicts, where in Art. 12 of the Penal Code lists the rights of convicted citizens. In the second situation, the legislator reflects the conditions for serving the sentence in correctional institutions, along with which, in Art. 102 of Chapter 13, the limits of the material liability of persons serving imprisonment and the types of Russian legislation regulating these provisions are determined. Chapter 23 of the Criminal Executive Code of the Russian Federation reflects the procedure and conditions, other requirements and procedures for the execution of the death penalty.

Historical background regarding the death penalty. It is one-act and the most severe type of criminal punishment in the Russian Federation for committing a crime with increased public danger. Since 1997, the courts have not prescribed this measure as an exceptional measure that deprives a convicted person of life, but at the same time it is not excluded from the criminal legislation. It is currently a type of criminal punishment included in the system of measures of state coercion for a crime. Accordingly, the current criminal-executive legislation regulates the issues of the death penalty, such as the procedure for its execution and the legal status of a person sentenced to death. The latter is reflected in the current civil law of Russia.

Note that the functions of the Russian penal law are considered in the context of two groups. One of them is the main functions, which include regulatory and protective, and the second function is an additional one, that is, its clarification can be traced through a logical, comparative legal interpretation of the norms of legislation regulating the execution of criminal

punishments. Additional functions include: corrective, educational, social, incentive. It is the corrective function that is of applied importance for the implementation of criminal law norms, due to the fact that the domestic legislation in force in the sphere of exercising the rights of convicts is focused on the execution of criminal punishment imposed on a person by a court for a committed criminal act. If the imposed punishment isolates the convicted person from society, then the correction of the person becomes an important task and function for the bodies ensuring isolation from society. According to Art. 9 of the Criminal Executive Code of the Russian Federation, the means of correcting him are applied to the convicted person, which are determined by the administration of the correctional institution.

The unambiguous conclusion of our study reflects the provision that the functions of civil law are implemented not only in the emergence of civil law relations, but in the implementation of other social relations that have arisen, protected by other types of Russian legislation. In the situation under consideration, it is relevant to talk about the allocation of such an independent function of law as integration.

The integration function is considered by us as the direction of legal impact in the form of legal methods and means, taking into account the peculiarities of the most significant social and legal relations regulated by other branches of Russian legislation.

Its direct meaning, which we put in the basis of our proposal - the allocation of an independent integration function of civil domestic law - is included in the scientific and applied rationale. First of all, the theoretical basis is determined by the explanatory and explanatory content of the function in question. So, in the opinion of the authors of the scientific editorial council of the publishing house "Soviet Encyclopedia": "Integration is the process of convergence and connection of sciences, which occurs along with the processes of their differentiation"<sup>1</sup>. Integration (from Lat. Integratio - "connection") - the process of combining parts into a whole<sup>2</sup>. Social integration is the process of establishing optimal connections between relatively independent social objects<sup>3</sup>. Along with this, in his dissertation research, E. G. Potapenko notes: "The complexity and increased social significance of economic, political, cultural integration predetermines the need to formal-

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<sup>1</sup>Soviet encyclopedic dictionary / Ch. ed. A.M. Prokhorov. – 4th ed. - M.: Sov. Encyclopedia, 1986. P. 495. – 1600 P., ill.

<sup>2</sup>Dictionary of the Russian language: In 4 volumes / RAS, Institute of Linguistic Research; Ed. A.P. Evgenieva. - 4th ed., Ster. - M.: Rus. lang.; Polygraph resources, 1999. P. 303. - 791 P.

<sup>3</sup>Social integration. [Electronic resource] – Access <https://ru.wikipedia.org/wiki/%D0%A1%D0>. (Appeal date 26.08. 2021).

ize and coordinate these processes using various legal means..."<sup>4</sup>. The author defines that integration in law is a kind of intrasystem legal integration and is defined as the integration of elements of the legal system into a structurally ordered integral unity, which has relative independence, stability and autonomy of functioning, which maintains the integrity and unity of law, the consistency and interconnection of its structural parts. These judgments confirm the integration legal function we are considering.

The foregoing confirms the possibility of separating an independent integration function of the civilian industry for the regulation of protected goods. Secondly, one should turn to the applied meaning of the function under consideration, which makes it possible to make it relevant for modern domestic law and legal implementation. It is understood that the integration function of civil law, reflected in the current Civil Code of the Russian Federation, is reflected in the implementation of other Russian legislation. In particular, civil legal relations are the subject of ensuring the civil benefits of convicts serving sentences in correctional institutions. Thus, the indicated interests of persons serving a sentence are regulated by the norms of substantive law and have significant applied significance. Especially when ensuring the personal constitutional rights of citizens of the Russian state.

Taking into account the foregoing, we note the integral component of the functions of civil law in the regulation of related subjects of legal protection through a scientific explanation of the meaningful meaning and applied confirmation by applying certain provisions of Russian legislation.

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**ON THE SUBJECTS OF RULE-MAKING IN THE FIELD OF  
REGULATION OF RELATIONS IN THE ELECTRONIC SPACE  
AND THE PLACE OF INTERNET NORMS IN THE SYSTEMS OF  
INTERNATIONAL AND DOMESTIC LAW**

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**Abstract.** an attempt is made to differentiate (identify the potential of opportunities) of domestic and international legal regulation of the rules of behavior on the Internet, corporate and individual normative regulation of relations in the field of the Internet space, to determine the specifics of subjects and objects of regulation of the Internet sphere by means of international and state law. Criteria for the institutionalization of the law of Internet norms in the legal system of the state are formulated (based on the author's interpretation of the Russian experience).

**Keywords:** Internet, Internet relations, the state as a subject of legal regulation of relations in the electronic space, subjects of rule-making in the field of regulation of relations on the Internet.

In the Russian scientific literature, various points of view are expressed regarding the range of subjects and methods of effective regulation of Internet relations. According to a study by the Russian scientist I.M. Rassolov, a specialist in information law, in the foreign scientific literature express "quite polar positions on the mechanism of rule-making and the range of subjects of rule-making in the field of regulating relations in the electronic space. Thus, some researchers believe that market self-regulation should operate in the Internet system; it is necessary to abandon any "external" interference in the Internet, since "cyberspace is a new territory that is qualitatively different from physical space; regulators and judges of the "real world" are doomed to be ineffective in this "fluid" and elusive world, existing without formalism of documents and without physical boundaries".<sup>1</sup>

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<sup>1</sup>Rassolov I.M. Law and the Internet / Theoretical problems / 2nd edition, supplemented, 2009. P. 19

According to the position of other authors, the regulation of relations in the virtual space is necessary, but this should be, as a general rule, corporate and individual regulation: this should be done not by the state, but by Internet users - first of all - economic participants in Internet relations. According to the definition of the supporters of this position: "states, their institutions and institutions are too slow, do little for the technical and commercial development of the Network and have powers only within their borders"; therefore, the best subjects of regulation of relations on the Internet are enterprises, practitioners, specialists, "interested in ensuring that their profitability is based on consumer confidence. It is they who should propose, develop, even oblige to introduce moral and ethical codes into the Internet sphere and introduce ideas of self-regulation, which the law and jurisprudence can then legislate"<sup>2</sup>. Finally, another opinion is expressed that: "the existing democratic institutions and legislative processes fully reveal their consistency in regulating the information environment. And only they alone are legitimate to discuss and resolve legal issues facing the theory and practice of the Internet"<sup>3</sup>.

Regarding the participation of such subjects as enterprises and practices in the regulation of relations on the Internet, Russian researchers give such an argument that it is relevant for the proper identification of the subjects of relations that interact in the electronic information space. For example, V.B. Naumov (a researcher from the Russian Academy of Sciences) writes that: "for an initial assessment of the composition and boundaries of new institutions, legal science should use those interdisciplinary knowledge and solutions that are offered by economic sciences and are enshrined in strategic documents of the state. So, the need to establish the institution of identification found a response in the indication in the Action Plan in the direction of "Normative regulation" to the need to develop a draft federal law aimed at unifying the requirements for identification, expanding opportunities and methods of identification"<sup>4</sup>. It is also noted that: "in the field of information technology, one should take into account the impact on legal norms of technical norms ... the peculiarities of technical standards and protocols determine the presence of different identifiers for users, information itself, technical devices. This affects the conditions for the use and processing of information when identifying subjects of information legal relations"<sup>5</sup>.

<sup>2</sup>Rassolov I.M. Spec. work. P. 20

<sup>3</sup>Rassolov I.M. Spec. work. P. 20

<sup>4</sup>Naumov V. B. Naumov V. B. Law in the era of digital transformation: in search of solutions.

// Russian law. Education, practice, science. 2018. №6 (108P. 6-7). P 6

<sup>5</sup>Naumov V.B.) Spec. work. P 7

In the study by M.B. Kasenova (from the Moscow Institute of International Relations) also speaks about the existence of grounds for the recognition and legitimation of corporate and individual regulatory regulation. The author writes that: "The Internet is not a kind of "single" object of regulation, since it is a multi-level technological network, the global technological infrastructure of which ensures its cross-border operation and use, which must be taken into account in the legal regulation of relations in the studied area. The technologically complex global multi-level structure of the Internet encompasses several infrastructural levels, ranging from the lowest "physical" level (fiber-optic communication channels, satellite channels, radio frequency spectrum, etc.) to the "highest" level of Internet applications (websites, social networks, postal services, etc.). At each of the technological infrastructural levels of the Internet, there are relationships that arise about various and rather specific objects of regulation<sup>6</sup>".

In the context of the issue of the subjects of rule-making in the field of regulation of relations in the electronic space, the issues of the relationship between the subjects of international and domestic law are relevant. In the Russian scientific literature, slightly differing opinions are expressed about the possible potential of the respective levels of regulation. So, according to V.B. Naumova: "The branches of law turned out to be not ready for technological globalization, which led to a conflict of jurisdictions ... in Russia and in any developed state, law enforcement is faced with questions about which state's laws to apply to information legal relations that "begin" on the territory of one, and "end" on the territory of another. The unresolved problem of the jurisdiction of the information space leads to a "race of laws", when states begin to extend the effect of their own laws to any information legal relationship where there is a national element, for example, a resident of the country, to whom information can be targeted, or the placement of an information server within the state's borders. Analyzing the current legislation, we can conclude that the normative description of digital processes lags far behind the actual development of digital institutions<sup>7</sup>".

Other authors, in connection with the characteristics of legal regulation, also note that: "The law in many respects lags behind the actually established relations<sup>8</sup>". According to A.O. Kozyreva and T.N. Mikheeva: "New technologies change the established legal relationship so much that we

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<sup>6</sup>Kasenova M.B. Problems of legal regulation of the cross-border use of the Internet. M. MGIMO-University. 2015P 21

<sup>7</sup>Naumov, V.B. Spec. work. P 5

<sup>8</sup>Quoted from the article: Mikheeva T.N. On the issue of the legal framework for digitalization in the Russian Federation // Bulletin of the University named after O.E. Kutafin 2019. № 9 (61). P.115

are now starting to regulate not from legal relations, but from technologies. Never before have we planned to regulate, for example, the very technology of storing information in databases. Now we need special legal regulation for technologies such as blockchain, artificial intelligence and the Internet of things".

In order to comment on the position of the above authors, we note that there is also a deficiency in international legal regulation, although: "the need for the recognition and protection of digital rights has been proclaimed in a number of international legal acts. Thus, the Charter of the Global Information Society (Okinawa, July 22, 2000), adopted by representatives of the eight leading world powers, including Russia, proclaims the need to strengthen relevant policies and regulatory frameworks that promote cooperation to optimize global networks and combat abuses that undermine the integrity of the network, to narrow the digital divide, invest in people and ensure global access and participation in this process<sup>9</sup>". The UN General Assembly Resolution № 68/167, adopted on 18 December 2013, "The Right to Privacy in the Digital Age", "calls upon all states to: a) respect and protect the right to privacy, including in the context of digital communication; b) put an end to violations of these rights and create conditions for the prevention of such violations, including by ensuring the compliance of national legislation with their international obligations"<sup>10</sup>, etc.

Referring to the discussion in the scientific doctrine of the issues of correlation between the national-state and international legal levels of law-making, M.B. Kasenova, in her study on the relationship between domestic and international law, draws attention to the fact that national, domestic regulation of cross-border relations in terms of the time of its emergence is ahead of international legal, which, in our opinion, is characteristic of international law in full: international law as a whole "grew" on the basis of the advanced legal experience of national states, from domestic rules. M.B. Kasenova notes that: "The problem of legal regulation of the Internet for quite a long time was limited to the national level and the international legal context of regulating the use of the Internet remained outside the legal analysis ... although due to the global nature of the Internet, the specifics of the cross-border functioning of the technological infrastructure of the Internet, the Internet should have become a natural object of interest in international law. In any case, it is obvious that the cross-border function-

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<sup>9</sup>Valery Zorkin (Chairman of the Constitutional Court of the Russian Federation). Reflection on the sidelines of the St. Petersburg International Legal Forum. Power Law in the digital world. Russian newspaper - Stolichny Issue № 115(7578) 29.05.2018 17:58 Heading:

<sup>10</sup>Quoted from the article: Valery Zorkin. Spec. work.

ing and use of the Internet objectively affects the paradigm of international legal interaction between states and international organizations, as subjects of international law<sup>11</sup>". The named author also focuses on the evolution of scientific views on the purpose of the Internet, described in a fundamental study by D. Goldsmith and T. Wu "Who Controls the Internet?: The Illusion of a Boundless World", published in 2006 by W. D. Goldsmith and T. Wu: "Global views" of the Internet cybertopians, who believe in the creation of a separate cyber-state, in which like-minded people "realized the dream" of an open, interacting and creative virtual world, and people who are worried about the "dark side of cyberspace", which gives shelter to pornography, fraud, terrorism and anarchy; stages of "transformation" of the Internet from the search network into the main means of communication, and so on. The main fundamental conclusion that D. Goldsmith and T. Wu come to is that "all our assumptions about the future of the Internet were wrong, since "territorial regulation is possible and in fact in demand, "the Internet" should be considered as a virtual space, in which territorial law, state power and international relations play the same role as technological inventions<sup>12</sup>".

In addition to the above, another aspect in the development of the scientific theory of rule-making in the field of regulation of relations in the electronic space is associated with the issue of determining the place of Internet norms in the systems of international and domestic law. Various points of view have been expressed in the scientific literature regarding the "industry anchoring" of Internet norms. According to one of them (quite widespread in Russian science): "at the present stage of development of the information society, the use of infocommunication technologies and information resources is becoming increasingly important. Information, being a convergent and backbone resource, "provides all the processes of society, enriches and harmonizes relations in all areas of its life" [Bachilo 2016: 6–7]. It is worth agreeing with the deep analogy proposed by M. A. Kudryavtsev, who compared information law with the "conductor of the orchestra" of the legal system, that is, one of its most important organizing principles [Kudryavtsev 2018: 100]. The role of information law in the processes under consideration could become system-forming, but this has not yet happened, and it seems that this branch of law at the present stage of development of legal science is underestimated". However, not all authors agree with this point of view.

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<sup>11</sup>Kasenova M.B. Problems of legal regulation of the cross-border use of the Internet. M. MGIMO-University. 2015. P 21

<sup>12</sup>Quoted from the book: Kasenova M.B. Spec. work. P 20

The reason is that in the Russian Federation there is no single special act regulating Internet relations and types of activities on the Internet, however, there are separate norms (groups, blocks of norms) concerning the status of participants in virtual relations, included in the legislation regulating the relations of subjects in the traditional living space. The legal norms on the Internet are thus "torn" between different branches of law and "scattered" in the texts of various sources of Russian law.

In legislation and scientific doctrine, special attention is paid to the issues of proper legal registration of digital economic relations<sup>13</sup>. In the Russian Federation, there is a Program "Digital Economy of the Russian Federation" adopted in order to implement the Strategy for the Development of the Information Society in the Russian Federation for 2017 - 2030.

Let us also turn to the issue of the constitutional and legal foundations of the Internet. The Russian legal basis for regulating relations on the Internet is the principles and norms of the Constitution of the state. The concept of "Internet" is not mentioned in the text of the 1993 Constitution of the Russian Federation. However, the Constitution provides for a norm according to which: "Everyone has the right to freely seek, receive, transmit, produce and disseminate information in any legal way. The list of information constituting a state secret is determined by federal law. Freedom of the media is guaranteed. Censorship is prohibited" (clause 4 of article 29 of the Constitution of the Russian Federation of 1993). At the same time, there is a "constitutional segment" in the sphere of regulating relations in the Internet space in the Russian Federation, since, as V.D. Zorkin rightly notes: including judicial, acts) universal human rights guaranteed by international law and constitutions of states - in relation to the needs of a person and a citizen in a society based on information. The task of the state - on the basis of the Constitution and taking into account these international documents - is to recognize and protect the digital rights of citizens from all kinds of violations, while ensuring the constitutional and legal security of the individual, society and the state".

In addition, the issues of legal regulation of the Internet space are related to the fundamental principles of the constitutional system, formulated in Chapter 1 of the Constitution of the Russian Federation, including: the principles of state sovereignty and state security, the unity and territorial integrity of the state, a single economic space, etc. attention to the FZ "On the Security of the Critical Russian Federation" adopted in the Russian Federation (dated July 26, 2017 № 187-FZ), designed to ensure "the sta-

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<sup>13</sup>Vaipan V.A. Legal regulation of the digital economy // Appendix to the journal "Entrepreneurial Law"2018:№1. P. 12

ble functioning of the information infrastructure when carrying out against its computer attacks" (art. 1 FZ).

As for the place of Internet norms in the information law system of the Russian Federation, there are grounds for formulating a hypothesis about Internet law as a sub-industry or institution of information law according to a number of criteria. Firstly, although in the Russian Federation there is no single special normative act regulating Internet relations and types of activities on the Internet, however, the institutional (or sub-industry) self-determination of the rules of Internet law in the domestic legal system is the FZ "On Information, Information Technologies and Protection information" (dated June 27, 2006 № 149 - FZ, as amended and supplemented). Numerous amendments and additions to the FZ "On Information, Information Technologies and Information Protection" (dated June 27, 2006) concerning the regulation of Internet relations, in our opinion, have largely changed the overall volume and balance of legal regulation implemented by this law. therefore, there is reason to say that the FZ "On Information, Information Technologies and the Protection of Information" (dated June 27, 2006), in fact, can be characterized as a special law on the Internet. The corresponding expansion of the subject of legal regulation (due to Internet norms), in our opinion, could be reflected in the expansion of the name of the Federal Law. The participants in Internet relations include specific categories of subjects, the conceptual apparatus of Internet law is specific, as well as specific sanctions and procedures for applying legal liability measures for violations of Internet norms. The organizational criterion through which Internet relations arise as objects of regulation by the norms of Internet law - electronic information technologies - is also specific.

## METHODS OF FORMING METHODS OF MENTAL ACTIVITY OF SECONDARY SCHOOL STUDENTS WHEN TEACHING CHEMISTRY

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**Annotation.** The current level of development of society, science and technology requires the preparation of a comprehensively developed young generation. The upbringing of such a personality is an urgent task of the Russian school. The solution to this problem occurs in the process of developing education, which is characterized by both the assimilation of the knowledge system by students and the development of their thinking and mental abilities.

The article discusses the methodology for the formation of methods of mental activity of secondary school students in teaching chemistry.

**Keywords:** mental activity, formation technique, technique, concept, chemistry, substance.

When studying a school chemistry course, students must master the system of methods of mental actions: the identification of essential features, recognition of concepts, comparison, generalization, the formation of methods of mental activity should be carried out in stages [1,2].

A correctly formed method of mental activity is a generalized knowledge of the method of action and the ability to use it. The modes of action by which mental activity is carried out can be expressed in a list of actions. The latter usually has the character of instructions or rules, recommendations indicating how to carry out mental activity, certain processes in solving problems [7].

In general, the methodology for the formation of methods of mental activity can be represented [7] as follows:

- firstly, the teacher shows the knowledge of the technique, explains why the student needs it;

- secondly, it is necessary that students use the appropriate theoretical knowledge when mastering the technique;
- thirdly, students' knowledge of the result of their actions;
- fourthly, students' independent application of this technique in solving new theoretical and practical problems.

Thus, the formed method has two sides: it is generalized knowledge about the mode of action and the possession of this method.

Let us consider how the formation of methods of mental activity occurs when studying a school chemistry course.

For the formation of the ability to identify essential features, students are introduced [1] to the mental operations included in the specified method: 1) highlighting the most common, basic feature;

2) highlighting those signs that show that this object, a phenomenon differs from similar ones, for example, explaining the presence of certain physical properties in metals, students note a common, basic feature inherent in all metals - the nature of a chemical metal bond. Based on this, they call those properties that distinguish metals from other substances - electrical conductivity, metallic luster, etc.

The next method of mental action is concept recognition. In this technique, the following mental operations can be distinguished: 1) identification of each main feature of an object, phenomenon; 2) establishing the presence in the object, the phenomenon of each of these signs from the system necessary.

Concept recognition tasks are composed as follows. Usually, students are offered a list of features that characterize an object or phenomenon, and their task is to determine which object or phenomenon is being discussed. For example, a list of signs is given: 1) the presence of electrons is characteristic; 2) there are positive ions in the nodes of the crystal lattice; 3) the presence of neutral atoms; 4) electrons bind all atoms (ions). On these grounds, the students conclude that we are talking about a metal bond.

If the students have learned to distinguish essential features, have mastered the methods of recognizing objects, phenomena, then they proceed [1] to the formation of the following method of mental activity of comparison in them. The essence of comparison as a technique is to compare objects in order to identify features of similarity or features of difference between them (or both together) [5].

This technique includes the following mental operations: 1) the definition of an object, phenomenon; 2) comparison of objects, phenomena, first according to the most general, basic characteristics; 3) comparison of objects, phenomena on those grounds that show the similarity or difference

between objects, phenomena from similar ones; 4) establishing the similarity of objects, phenomena and determining by what signs or properties they are similar; 5) establishing the difference between objects, phenomena and determining by what signs or properties they differ.

If the students have mastered the above methods of mental actions, then they form such a complex method as generalization.

From the point of view of logic, generalization is the construction (derivation) of universal statements from the epistemological and methodological points of view, the generalization procedure can be described as follows [5]:

1. Identification of signs common to the objects under consideration, properties, relationships, development trends, etc.

2. Establishing one common view on complex subjects.

The teaching method for this technique can be represented as follows [6]:

- 1) establishing a list of compared features based on the mental action of identifying essential features;

- 2) the implementation of the mental action of comparison;

- 3) generalization of the comparison results in the form of inference: a) on the basis of similarities or differences of objects, phenomena; b) according to the most essential features characteristic of a given subject, phenomenon.

If students are able to concretize the generalization made by them with examples, this indicates the development of their abstraction technique.

When carrying out such a mental operation as abstraction, students are guided by the following plan:

1. Establishing a list of common characteristic features for the substances proposed in the task.

2. Identification of essential signs (properties) of substances or phenomena.

3. Generalization in the form of a detailed conclusion, formulation of a rule, concept, law and concretization of generalization by examples.

To develop the ability to abstract, students are offered tasks in which they need to define a concept and give several examples, characterize a substance (phenomenon) from several different points of view, group substances, phenomena according to different classification criteria, for example:

1. Describe the given concepts: oxide, base, acid, salt from different points of view. Explain the answer.

2. Which of the compounds has alkaline properties to a greater extent:

a) hydroxide of lithium, sodium, potassium; b) barium or zinc hydroxide. Why? What experiments can confirm the conclusions?

3. How much and what substances can be obtained with magnesium, water, hydrochloric acid, copper (II) chloride.

Tasks using the technique of abstraction contribute to the formation of various types of communication.

When generalizing disparate objects, phenomena are brought into a certain order, systematized.

The systematization of objects is a special case of classification, when features that are convenient for this purpose, but not essential for the objects themselves, are chosen as the basis.

By classification we mean a special case of using a logical operation of dividing the volume of a concept, which is a certain set of divisions (dividing a class into types, dividing these types into subspecies, etc.) [3,5]. Usually, signs that are essential for these objects, essential signs of similarity and difference between objects are chosen as the basis for division in the classification).

Here is an example of a task that allows for the classification [8]: "Divide the substances, the formulas of which are given below, into classes. Name the essential feature of each of them: P,  $\text{HNO}_3$ ,  $\text{CuO}$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{Ca}(\text{OH})_2$ , Na,  $\text{N}_2\text{O}_5$ , Cu,  $\text{Zn}(\text{OH})_2$ ,  $\text{HCl}$ ". In this task, it is necessary to highlight the signs of similarity and differences in the composition of the molecules of substances and divide them into simple and complex. Complex, consisting of two elements, oxygen-containing and oxygen-free; oxygen-containing - on those in which the element is a metal or non-metal. That is, by carrying out the classification, we thereby divide the class into species, species for genera, etc.

As an explanation, let us take such a concept as "substance", which can be characterized as a class one. We get such a specific concept as "complex substances". Further implementation of the classification leads to a generic concept, for example "salt". It is distinguished on the basis of two features: the presence of an acid residue and metal atoms.

Such a mental division of concepts into narrower ones helps to better understand their essence, contributes to the development of the mental activity of students.

Thus, the systematic use of comparison tasks in the study of chemistry, the isolation of signs of similarity and difference in chemical processes, concepts, the ability to classify features corresponding to a given concept, abstraction from a number of properties and the ability to make inferences on some of them - all this leads to the activation of the PDU, the development of their logical thinking.

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## **ANALYSIS OF THE PSYCHOMOTOR INDICATORS OF THE SKA-NEFTYANIK-2 BALL HOCKEY PLAYERS DURING THE TWO-YEAR PERFORMANCE PERIOD**

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**Abstract.** The article is devoted to the problem of studying psychomotor indicators in ball hockey players during two-year training cycles 2018-2019, 2019-2020 and before the start of the new season. In the course of the study conducted from August 2018 to September 2020, it was revealed that the persistent positive dynamics of changes in psychomotor indicators in ball hockey players during the two-year period of performance was registered in such indicators as: mobility of nervous processes, approximate visual search reaction (OSPR), volumetric attention and discrimination reaction.

**Keywords:** psychomotor skills, ball hockey players, training cycle, annual cycle, mobility of nervous processes, hardware software complex "Neurosoft-Psychotest", psychophysical state.

### **Introduction**

From 2018 to 2020, a research group of teachers of the Far Eastern State Academy of Physical Culture carried out state-funded research work on the topic ""Development of methods of competitive training of athletes in bandy "" by order of the Ministry of Sports of the Russian Federation for 2018-2020.

Currently, the issue of the need for systematic comprehensive monitoring of the psychophysical state and indicators of technical and tactical training of athletes, adjusting the training process taking into account their

individual characteristics, the specifics of climatic and geographical conditions is becoming particularly relevant.

The purpose of this work is to improve the system of training ball hockey players, taking into account regular monitoring of their condition and timely correction of the training process in the conditions of the Far East.

To do this, it will be necessary to study the parameters of the psychophysical, emotional and functional state of hockey players in the annual cycle of training athletes, which will further make a certain contribution to improving the system of training ball hockey players on the basis of regular monitoring of their condition and correction of the training process, taking into account the specific climatic and geographical conditions of the Russian Far East.

The choice of psychomotor testing is due to the fact that in situational sports, which include ball hockey, the qualities of psychomotor skills (reaction speed, reaction to a moving object, volume and concentration of attention, etc.) that prevail in game actions or contribute to making a decision about action are of significant importance. To a large extent, these qualities can determine the success or failure of purposeful game activity in bandy [3].

To assess the dynamics of changes in psychomotor indicators, the hardware software complex "Neurosoft-Psychotest" was used, which allows us to assess the current functional state of the central nervous system, reflecting the psychomotor abilities of an individual.

### **1. The experimental part**

During the competitive period of two annual cycles from August 2018 to September 2020, changes in psychomotor indicators were studied in the ball hockey players of the SKA-NEFTYANIK-2 team. The following methods were studied: approximate visual-search reaction according to the Schulte-Platonov tables (OSPR), simple visual-motor reaction (PZMR), choice reaction, reaction to a moving object (RDO), discrimination reaction, concentration of attention, volumetric attention.

To assess the speed of the course of nervous and mental processes in the central nervous system (CNS), the average time of PZMR for diagnosing the mobility of nervous processes in the central nervous system was subtracted from the average time of the discrimination reaction.

Studies of psychomotor indicators of ball hockey players were conducted in the preparatory period (August 2018, September 2019 and 2020) of the 2018-2019 season, 2019-2020 and 2020-2021, during the team's competitive activities (December 2018, 2019) and after the end of the 2018-2019 season. (July 2019). In July 2020, the study was not conducted due to restrictive measures to prevent the spread of COVID-19 coronavirus

infection in the Khabarovsk Territory.

The athletes of the SKA-NEFTYANIK-2 team were examined in the morning hours in the laboratory of "Monitoring of physical condition" of the Far Eastern State Academy of Physical Culture. The number of examined ball hockey players varied between 19-23 people.

## 2. Results

Analysis of the dynamics of changes in psychomotor indicators in ball hockey players from August 2018 to September 2020 showed that such indicators as: PMR (ms) (on average-212ms – the average reaction speed during the study), choice reactions (ms) (on average - 317ms - high reaction speed during the study), the number of errors on the green color in the choice reaction (on average – 0.6 times during the study), the number of accurate reactions to a moving object (times)( on average -14 times - the average level of accuracy of reactions during the study) and the concentration index (ms) (on average - 268ms- intermediate type between the inert and mobile type of higher nervous activity during the study) there were no significant differences between the intermediate studies until September 2020. The results are presented in Tables 1 and 2.

**Table 1-Changes in the psychomotor indicators of SKA - Neftyanik-2 ball hockey players in the annual cycle 2018-2019.**

Psychomotor indicators	August 2018	December 2018	July 2019	September 2019
PZMR (milliseconds)	210±3,2	208±3,8	216±7,2	216±3,8
OZPR (seconds)	45,5±2,3	40±2,2	39±3,1	35±3,0
Choice reaction (milliseconds)	305±8,3	310±7,8	323±8,6	326,5±6,1
Number of errors per red color (times)	0,7±0,1	0,4±0,5	0,15±0,08	0,6±0,2
Number of errors per green color (times)	0,8±0,1	0,7±0,1	0,7±0,2	0,6±0,08
Concentration of attention (milliseconds)	277±5,6	268±5,2	269±1,7	262±7,2
Volumetric attention (milliseconds)	378,5±9,5	370±7,8	350±7,3	357±9,2
Mobility of nervous processes (milliseconds)	148±2,6	124±1,4	113±3,2	102±2,4
Discrimination reaction (milliseconds)	358±5,8	332±5,2	329±10,4	318±6,2
The number of exact reactions (times) in the RDO	12±0,4	13±0,3	14±0,25	14±0,4

**Table 2-Changes in the psychomotor indicators of SKA- Neftyanik-2 ball hockey players in the annual cycle 2019-2020**

Psychomotor indicators	September 2019	December 2019	September 2020
PZMR (milliseconds)	216±3,8	214±3,4	210±3,3
OZPR (seconds)	35±3,0	37±2,7	35±2,8
Choice reaction (milliseconds)	326,5±6,1	321±6,9	315±7,2
Number of errors per red color (times)	0,6±0,2	0,4±0,1	0,5±0,2
Number of errors per green color (times)	0,6±0,08	0,5±0,1	0,5±0,09
Concentration of attention (milliseconds)	262±7,2	268±6,4	264±5,8
Volumetric attention (milliseconds)	357±9,2	354,5±8,8	351±8,1
Mobility of nervous processes (milliseconds)	102±2,4	100±2,4	106±2,3
Discrimination reaction (milliseconds)	318±6,2	314±5,8	316±5,6
The number of exact reactions (times) in the RDO	14±0,4	15±0,3	14±0,5

After studying the dynamics of changes in the indicator of the time of the approximate visual search reaction (OZPR), it was revealed that in July 2019 ( 39 seconds - the average indicator) and September 2019 and 2020 (35 seconds - the average indicator) these indicators significantly improved compared to the indicator of August 2018 (45,5 seconds-below the average) by 14,3% and 23,1%, respectively ( $p < 0,05$ ).

During the study of the indicator of the number of errors for red in the choice reaction, it was found that the indicator of July 2019 (0,15 times) had a significant improvement by 78,6% compared to the indicator of August 2018 (0,7 times) and the indicators of December 2018 and 2019 (0.4 times) by 42,9% also had a significant improvement compared to the indicator of August 2018 (0,7 times).

The study of the volume attention index (ms) revealed a stable positive dynamics of improvement of this indicator from 378,5 to 351milliseconds, but significant differences were recorded between the indicator of July 2019 (350ms) and December 2020 (351ms), which, respectively, improved by 7,5% and 7,3% significantly compared to the indicator of August 2018 (378 millisecond- is an intermediate type between the inert and mobile types of higher nervous activity).

During the study of the discrimination response index (ms), there was a tendency to improve it from 358ms (intermediate type between the inert and mobile types of higher nervous activity) (August 2018) to 314-316 milliseconds (intermediate type between the inert and mobile types of higher nervous activity) (December 2019 - September 2020) by 12,3% and 11,7%, respectively ( $p < 0,05$ ).

And finally, the indicator of the mobility of nervous processes (ms) recorded in August 2018 (148 milliseconds - below the average level) had a positive dynamics of a significant decrease during the study to 100 milliseconds - above the average level (December 2019). This indicator has improved by 32,4%.

As a result of the analysis of psychomotor indicators recorded during the two-year cycle from August 2018 to September 2020, it can be noted that most of the indicators tended to improve, but significant differences were found only in four indicators: Mobility of nervous processes - by 32,4%, OSPR - by 23,1%, Discrimination response - by 12,3% and Volume attention - by 7,5%.

The indicators of PZMR, concentration of attention and choice reaction between the studies of August 2018 and September 2020 had no significant differences ( $p < 0,05$ ), and even a slight deterioration in the final indicator of the choice reaction was recorded - 315 milliseconds (September 2020) compared to the indicator of August 2018 (305ms) - by 3,3%.

### **3. CONCLUSIONS**

During the study, it was revealed that the indicators of psychomotor activity recorded in ball hockey players during the two-year cycle from August 2018 to September 2020 have a significant difference ( $p < 0,05$ ) in such indicators as: mobility of nervous processes (milliseconds), OSPR (seconds), discrimination reaction (milliseconds) and volumetric attention.

Having analyzed the change in psychomotor indicators in ball hockey players for two years, we can say that a stable positive dynamics of improvement during this period was registered in such indicators as: mobility of nervous processes, approximate visual search reaction (OSPR), volumetric attention and discrimination reaction.

Some indicators of the speed of psychomotor reactions (PZMR, concentration of attention, choice reaction) recorded in ball hockey players of different qualifications during the preparatory and competitive period of the annual cycle differ slightly from each other, which suggests that the mental qualities associated with performing complex psychomotor actions are quite stable and individual.

Based on the conducted research, we can speak about the effective-

ness of corrections promptly introduced into the training process of ball hockey players based on the results of the performance of the SKA-Neftyanik-2 team, which became the bronze medalist of the Russian youth championship among the teams of the Highest League of the 2018-2019 season. Khabarovsk residents were the only ones among the youth teams who managed to climb the podium along with adult teams of masters from Sayan (Abakan) and Mayak (Krasnoturinsk)[1].

From October 7 to 13, 2019, SKA-Neftyanik-2 hockey players performed at a representative tournament in Kemerovo dedicated to Mikhail Volkov, one of the discoverers of Kuzbass. For the first time in the organization of this tournament in 2016, the team took an honorable third place out of 8 teams participating in the tournament. Moreover, the 1st and 2nd places were taken again by adult teams of masters from Sayan (Abakan) and Kuzbass (Kemerovo) [2].

From March 18 to 28, 2020, the 2nd stage of the final All-Russian competitions among the teams of the Highest League in bandy for the 2019-2020 season was canceled by the Directorate for organizing and conducting competitions of the Russian Bandy Federation due to the threat of the spread of a new coronavirus infection in Russia (2019-nCoV) [4].

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## EXPERIMENTAL STUDY OF THE STATE OF THE VOICE UNIVERSITY TEACHERS

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**Annotation.** Specialists working in the field of staging, restoring and treating the voice (phoniatriests, phonopedists, otolaryngologists, speech therapists) note a tendency towards an increase in diseases of the vocal apparatus among teachers, which leads to dysphonia and aphonia. A university teacher is a voice-speech profession that requires an increased tension of the vocal apparatus. The problem of detecting voice disorders in persons of the voice-speech profession is social and economically in demand.

**Keywords:** voice, functional voice quality, voice-speech profession, higher school teachers.

The teaching profession is one of the most important speech professions for society. A number of factors, namely prolonged speech stress, difficult acoustic conditions and emotional fatigue, often lead to voice disturbances. The consequences of these violations may be both the teacher's voice discomfort and acoustic difficulties in perceiving the material of the lesson among students, and the teacher's complete inability to further professional activity due to dysphonia (partial voice impairment) or aphonia (complete absence). The social significance of this kind of consequences can hardly be overestimated, since the quality of education directly depends on the teacher's ability to present educational material.

In 2020, on the basis of PNU, the head (candidate of pedagogical sciences, associate professor Larina Elena Anatolyevna) and students of the speech therapy scientific and educational laboratory "Logos" of the Faculty of Primary Preschool and Defectological Education of the Pedagogical Institute with the methodological support of the Department of Sociology,

Political Science and Regional Studies as part of the student project "Appreciate your voice!" a sociological study was organized and carried out on the google forms platform. 95 teachers took part in the survey.

The sociological survey "Assessment of the state of the voice" was prepared on the basis of theoretical sources on phonopedics and phoniatics by the authors Vasilenko Yu.S., Dmitriev LB, Ermolaeva V.G., Levina R.E., Maksimova I. Orlova E.V. , Lavrova O.S. [1; 2: 3].

The purpose of this survey is to improve the functional quality of the voice of university teachers, to identify factors, poor voice health. The respondents were asked 27 questions with the choice of the most suitable respondent. Filling out the questionnaire did not take much time: about 10-15 minutes.

1. Your gender:
  - Female
  - Male
2. Select your age range:
  - 18-25
  - 23-35
  - 35-45
  - 45-55
  - 55-65
  - 65 and more
3. What is your professional experience?
  - Up to 5 years
  - 5-10 years
  - 10-15 years old
  - 15-20 years old
  - 20-25 years old
  - 25-30 years old
  - 31 and up
4. Do you consider your profession to be voice and speech?
  - Yes
  - No
5. Do you know what professional voice training is?
  - Yes
  - No
6. For your entire working day, the total voice load reaches:
  - Less than 3 hours
  - 3 hours
  - 5 hours

- 6 hours
  - More than 6 hours
7. Do you do vocals?
- Yes
  - No
8. Do you consider your voice to be intonationally expressive?
- Yes
  - No
  - I find it difficult to answer
9. Is the intonational expressiveness of speech important in the teacher's professional activity?
- Yes
  - No
  - I find it difficult to answer
10. During the working day, do you feel voice discomfort, voice change and fatigue?
- Yes
  - No
  - Sometimes
11. Do you see the symptoms presented? Choose one or more of the answers provided.
- Hoarseness
  - Hoarseness of voice
  - Tired of a voice after a working day
  - Pain in the larynx
  - Sore throat
  - Desire to cough up
  - Shortness of breath
  - No, I do not observe any of the presented symptoms
12. After how many years of teaching, have you felt unhealthy changes in your voice?
- Up to 5 years
  - 5-10 years
  - 10-15 years old
  - 15-20 years old
  - 20-25 years old
  - 25-30 years old
  - 31 and higher
13. When you feel changes that are unusual for your physiological voice (select one or more answer options)

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- In the morning
  - In the afternoon
  - In the evening
  - At the end of the working week, semester, at the end of the academic year
  - No voice changes
14. How long does it usually take for you to recover your voice and sore throat?
- One evening, assuming the vocal cords are at rest
  - Two days off
  - More than two days
  - Not necessary
  - I find it difficult to answer
15. In your opinion, do voice problems affect your professional activity?
- Do not affect
  - Influence
  - Influence insignificantly
  - Impossible to engage in professional activities
16. Which of the following options is the main reason for your voice impairment?
- Unfavorable working conditions
  - My speech apparatus has a large speech load
  - Lack of voice acting
  - Presence of ENT diseases
17. How often do you suffer from infections of ENT organs, various colds?
- Often (more than 2 times a year)
  - Sometimes (1-2 times a year)
  - Very rarely (less than once a year)
18. Do you have a chronic respiratory disease?
- Yes
  - No
19. Do you have a thyroid disease?
- Yes
  - No
20. Have you had any previous larynx / vocal cord surgeries?
- Yes
  - No
21. Do you have paresis or paralysis, scars, tumors, polyps, cysts, singing nodules in the larynx or vocal cords?

- Yes
  - No
22. Do you often experience nervous tension?
- Often
  - Rarely
  - I do not feel
23. Do you use tobacco products?
- Yes
  - No
24. Would you like to do voice production?
- Yes
  - No
  - I find it difficult to answer
25. Are you aware of who a phoniatriest and phonopedist is?
- Yes
  - No
26. Do you know about ways to prevent voice disorders and voice hygiene?
- Yes
  - No
  - I find it difficult to answer
27. Are video master classes and courses on voice training and expressiveness in demand for you personally?
- Yes
  - No
  - I find it difficult to answer

Evaluation of the obtained sociological survey data allows us to make a general qualitative and quantitative analysis of the sought problem.

1. The number of respondents (PNU teachers) is 95 people.
2. The age of the respondents (over 60%) is from 35 to 55 years.
3. The average work experience of the respondents ranged from 10-30 years (66.3%), women - 76.8%, men - 23.2%.
4. 55.8% of teachers note frequent discomfort, change and fatigue of the voice.
5. Symptoms: sore throat 50.5% of participants, hoarseness 26.3% and hoarseness 40%.
6. Statistics of the total voice load: for the majority of respondents (54.7%) it was 6 or more hours.
7. Unhealthy voice changes 25.3% of the respondents noted during the first 5 years of professional activity, and 30.5% - after the first five years

of work.

8. 49.5% of respondents experience physiological changes in their voice in the evening, at the end of the working day 23.2%, 27.4% experience discomfort during the working day.

9. General somatic factors affecting the state of voice health: (78.9%) suffer from colds no more than 2 times a year, 22.1% suffer from chronic respiratory diseases, thyroid diseases in 13.7% of respondents, 13, 7% have ENT diseases, 51.6% of teachers often experience nervous tension.

10. The influence of bad habits on the health of the voice: the vast majority of teachers (91.6%) do not use tobacco products.

11. (98.9%) of the respondents consider their profession to be voice-speech, that is, they recognize the influence of voice on professional activity in general, and also recognize the importance of intonational expressiveness of speech in the activities of a teacher (98.9%).

12. 26.3% of teachers are not familiar with activities related to professional voice training, 67.4% of respondents are not aware of the methods of preventing voice disorders and hygiene of the voice.

13. 66.3% expressed interest in video master classes and courses on voice training and speech expressiveness and recognize the impact of problems with voice on professional activity.

According to the results of the study, it was found that in persons of speech professions, the main provoking factor causing voice pathology is excessive voice load, and it was also confirmed that the majority of teachers, although they experience voice health problems, do not take any effective measures to prevention of violations, the main reason for which is the lack of information on the rules for the prevention of voice disorders and voice hygiene.

Thus, as a result of the experimental-experimental study, reliable data were obtained on the functional state of the voice of higher school teachers, whose profession is associated with a large professional load, factors influencing the health of the voice were identified, and the need for preventive measures was updated.

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**A REVIEW OF THE STUDENTS' EXPECTATIONS, SATISFACTION AND RECOMMENDATIONS FOR THE STRUCTURE AND CONTENT OF AN EMP COURSE AS REFLECTED IN THE RESULTS OF A STUDENT OPINION SURVEY (2019/2020; 2020/2021)**

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**Abstract.** The research presented in this paper is based on the results from 3 conducted student opinion surveys among a total number of 82 students of Medicine who attended the English for Medical Purposes (EMP) course at the Medical University Prof. Dr. Paraskev Stoyanov – Varna during the 2019/2020 and 2020/2021 academic years with the author Tsvetelina Vateva as their lecturer and who agreed to fill in an anonymous student opinion survey that included questions about their EMP course after they had completed it.

The 2019/2020 student opinion survey included 21 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) and 2 open-ended questions that prompted the students to write in their own words what they liked most about the conducted teaching process and what they would suggest for optimization of the teaching process.

This paper presents the summarized student assessments given on the 2019/2020 student opinion survey by 61 students who attended the English for Medical Purposes (EMP) course at the Medical University Prof. Dr. Paraskev Stoyanov – Varna during the 2019/2020 academic year.

In 2020/2021, 2 separate student opinion surveys were conducted: one official survey that included 20 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) and 2 open-ended questions that prompted the students to write in their own words what they liked most about the conducted teaching process and what they would suggest for optimization of the teaching process; one unofficial extended survey that included the same 21 Likert-scale questions for assessment on a scale from 1 to 5 (1 =

fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) as in the 2019/2020 survey and 9 open-ended questions that prompted the students to write in their own words what they liked most about the conducted teaching process, what they would suggest for optimization of the teaching process and which particular teaching strategies, types of exercises and provided additional materials they found most useful for themselves and why.

This paper presents the summarized student assessments given on the official 2020/2021 student opinion survey by 17 students who attended the English for Medical Purposes (EMP) course at the Medical University Prof. Dr. Paraskev Stoyanov – Varna during the 2020/2021 academic year, as well as the summarized student assessments given on the unofficial extended 2020/2021 student opinion survey by 4 students who attended the English for Medical Purposes (EMP) course at the Medical University Prof. Dr. Paraskev Stoyanov – Varna during the 2020/2021 academic year.

**Keywords:** student opinion survey, results, expectations, recommendations, EMP course

### INTRODUCTION

Until the 2019/2020 academic year, the EMP course offered at the Medical University Prof. Dr. Paraskev Stoyanov – Varna was structured mostly around the main course textbook used – Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House – and the author Tsvetelina Vateva had little data about the additional materials that may have been utilized by the lecturers conducting the EMP course to supplement the main course textbook before 2019.

Thus, during the 2019/2020 and 2020/2021 academic years when the author Tsvetelina Vateva was assigned as a new lecturer to teach the EMP discipline, she decided to create, collect and utilize some new additional materials to supplement the main textbook that was still used for the course – Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House.

The authors of this main course textbook have managed to structure it in a very logical and comprehensive way with regard to the included medical topics: the textbook consists of 12 units that encompass teaching materials related to all major human body systems, the different types of diseases that affect them, as well as other relevant medical topics, which are a definite object of interest for the students of Medicine attending the specialized course in English for Medical Purposes. As the authors themselves have indicated on the back cover of the textbook, “it contains a wide range of ac-

tivities developing the receptive and productive psycholinguistic skills and strategies: reading, listening, writing and speaking” (Dokova, A., Trendafilova, S., Angelova, V., 2009), while “the tasks allow the students to enrich their vocabulary in English as well as recycle and consolidate grammar typical for medical contexts” (Dokova, A., Trendafilova, S., Angelova, V., 2009).

However, as two of the authors of the textbook have also pointed out in one of their articles entitled “Natural Recycling of Grammar While Teaching Medical English”, “the students who study English for Medicine, Dental Medicine, Obstetrics, Pharmacy and other Health Care subjects at Varna Medical University in Bulgaria are usually in mixed-level groups” (Raynova, Valentina Angelova, Trendafilova, Svetla Dimitrova, 2013), and “since they are at different levels of language proficiency, the students are at a different stage of language acquisition and understandably they have different needs” (Raynova, Valentina Angelova, Trendafilova, Svetla Dimitrova, 2013). Therefore, “because it is difficult to find adequate books on the market that meet the special requirements of this specific context of teaching and learning English for medical purposes, there emerges a dire necessity for designing and writing our own materials” (Raynova, Valentina Angelova, Trendafilova, Svetla Dimitrova, 2013).

It was precisely this “dire necessity” (Raynova, Valentina Angelova, Trendafilova, Svetla Dimitrova, 2013) for trying to provide suitable materials to all students from the mixed-level groups attending the EMP course during the 2019/2020 and 2020/2021 academic years with the author Tsvetelina Vateva as their lecturer that led the author to create, collect and utilize some new additional materials to supplement the topics of the main textbook and try to make the EMP course as useful as possible for both the more advanced students and the students with lower levels of English language proficiency.

These new supplemental materials created, collected and utilized in the EMP course during the 2019/2020 and 2020/2021 academic years by the author Tsvetelina Vateva included:

- detailed English-Bulgarian glossaries compiled and translated by the author Tsvetelina Vateva that contained the most essential vocabulary (both medical and general) from the materials included in each of the 12 units of the main course textbook (Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House);
- additional short explanations with short general examples of the included grammatical topics in the 12 units of the main course textbook (Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House);

- additional texts related to some of the discussed medical topics in the 12 units of the main course textbook (Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House) with detailed English-Bulgarian glossaries compiled and translated by the author Tsvetelina Vateva that contained the most essential vocabulary (both medical and general) from the provided additional texts;
- additional images illustrating the main and secondary parts of the major systems in the human body, as well as the most important processes that occur within these human body systems, with detailed English-Bulgarian glossaries compiled and translated by the author Tsvetelina Vateva that contained the medical terminology included in the provided additional images;
- additional videos providing further explanations related to some of the discussed medical topics in the 12 units of the main course textbook (Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House);
- additional short texts related to some of the discussed medical topics in the 12 units of the main course textbook (Dokova, A., Trendafilova, S., Angelova, V. (2009). *English for Medicine*, Varna, STENO Publishing House) that were provided to the students as optional sources of information for the purposes of writing short summaries of some of these additional texts for assessment;
- additional general reference materials from a medical dictionary that included a list of the most widely used prefixes, roots and suffixes in medical terminology; a list of the most widely used medical abbreviations; a list of the names of the most widely used laboratory samples and tests; and a copy of the International Phonetic Alphabet;
- additional writing reference materials including excellent samples of the different types of short writing tasks that the students were required to fulfil for assessment;
- an additional short English-Bulgarian glossary of US army and navy basic military equipment compiled and translated by the author Tsvetelina Vateva; an additional short English-Bulgarian glossary of weapons terminology compiled and translated by the author Tsvetelina Vateva; a list of useful links to databases of military terms and abbreviations – all compiled and utilized by the author Tsvetelina Vateva for the specific needs of 2 of the groups of students of Medicine specializing in Military Medicine.

All of these described additional materials were uploaded by the author Tsvetelina Vateva to the Blackboard electronic teaching platform used by the university, where all students of Medicine attending the EMP course

could access, download and use them freely at all times. Then, at the end of the EMP course during the 2019/2020 and 2020/2021 academic years, the students were provided with an opportunity to fill in anonymous students opinion surveys and share their assessments of whether and to what extent this additional-material-upgraded EMP course with the author Tsvetelina Vateva as its conducting lecturer had been useful and suitable to their needs and had met their initial expectations.

### **PURPOSE OF THE STUDY**

The 2019/2020 and 2020/2021 anonymous student opinion survey results are presented in this paper with the aim to compare the 2019/2020 with the 2020/2021 student assessments given for both the additional material-upgraded EMP course and the author Tsvetelina Vateva as its conducting lecturer.

The ultimate purpose of this study is to draw conclusions regarding the extent to which the additional-material-upgraded EMP course offered to the students of Medicine at the Medical University Prof. Dr. Paraskev Stoyanov – Varna during the 2019/2020 and 2020/2021 academic years with the author Tsvetelina Vateva as its conducting lecturer satisfied the mixed-level students' specific English language needs and met the students' initial expectations for the course.

The paper also aims to present the students' opinions and recommendations for possible improvements of the structure and content of the offered EMP course with the author Tsvetelina Vateva as its conducting lecturer.

### **METHODOLOGY**

The 2019/2020 student opinion survey included 21 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) and 2 open-ended questions that prompted the students to write in their own words what they liked most about the conducted teaching process and what they would suggest for optimization of the teaching process. The 21 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) included in the 2019/2020 student opinion survey were presented to the students in the following order:

1. There is an adequate amount of course content, the lectures and the seminars are meaningful and informative.
2. The lectures and the seminars are clearly structured.
3. A variety of audio-visual aids and media (audio/video, movies, Blackboard) are used.
4. The topics and the resources used in the foreign-language module were up-to-date, engaging and interesting.

5. The seminar time is used properly; current issues are discussed.
6. The instructional materials are sufficient.
- 7.1 During the seminars, I was provided with sufficient opportunities to practice my listening comprehension skills.
- 7.2 During the seminars, I was provided with sufficient opportunities to practice my speaking skills.
- 7.3 During the seminars, I was provided with sufficient opportunities to practice my reading comprehension skills.
- 7.4 During the seminars, I was provided with sufficient opportunities to practice my writing skills.
8. I got a good feeling of my learning progress.
9. I was provided with sufficient sources and additional materials for self-study.
10. The teaching pace was exactly right for me.
11. The content of the test tasks was directly linked to the course content and instruction.
12. There was a good learning atmosphere and I could concentrate efficiently.
13. The seminars began and ended on time.
14. The lecturer was always well-prepared.
15. The lecturer acted friendly and respectfully towards the students.
16. The lecturer responded to the questions comprehensively and motivated the students to participate actively.
17. The lecturer was interested in the students' learning progress.
18. The students felt free to express their opinions during the seminars.

The official 2020/2021 student opinion survey included 20 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) and 2 open-ended questions that prompted the students to write in their own words what they liked most about the conducted teaching process and what they would suggest for optimization of the teaching process. The first 19 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) included in the official 2020/2021 student opinion survey were the same and were presented to the students in the same order as questions 1-16 of the 2019/2020 student opinion survey presented above. The 20<sup>th</sup> Likert-scale question that came under No. 17 in the official 2020/2021 student opinion survey was formulated as follows:

17. The teaching style helps me improve my learning attitudes, behaviour and motivation.

The unofficial extended 2020/2021 student opinion survey included the same 21 Likert-scale questions for assessment on a scale from 1 to 5 (1 = fully disagree, 2 = disagree, 3 = average/neutral, 4 = agree, 5 = fully agree) as in the 2019/2020 survey presented above and 9 open-ended questions that prompted the students to write in their own words what they liked most about the conducted teaching process, what they would suggest for optimization of the teaching process and which particular teaching strategies employed by their lecturer (including provided preliminary guidelines and instructions for fulfilment of their different types of writing assignments; provided preliminary guidelines and instructions for preparation and delivery of their oral presentations; provided samples of successfully fulfilled writing tasks and students' presentations from previous years; provided feedback regarding each of their fulfilled writing assignments; constant working-hours availability of the lecturer for email consultations), as well as which types of listening, reading, writing and speaking exercises and which of the additional materials uploaded on Blackboard by their lecturer they found most useful for themselves and why.

The summarized student assessments given on the 2019/2020 student opinion survey by 61 students who attended the EMP course during the 2019/2020 academic year, the summarized student assessments given on the official 2020/2021 student opinion survey by 17 students who attended the EMP course during the 2020/2021 academic year and the summarized student assessments given on the unofficial extended 2020/2021 student opinion survey by 4 students who attended the EMP course during the 2020/2021 academic year with the author Tsvetelina Vateva as their lecturer are presented and discussed below.

### **RESULTS AND DISCUSSION**

The summarized student assessments given on the 21 Likert scale questions of the 2019/2020 student opinion survey by 61 students who attended the EMP course during the 2019/2020 academic year with the author Tsvetelina Vateva as their lecturer are presented in Table 1 below.

The summarized student assessments given on the 20 Likert scale questions of the official 2020/2021 student opinion survey by 17 students who attended the EMP course during the 2020/2021 academic year with the author Tsvetelina Vateva as their lecturer are presented in Table 2 below.

The summarized student assessments given on the 21 Likert scale questions of the unofficial extended 2020/2021 student opinion survey by 4 students who attended the EMP course during the 2020/2021 academic year with the author Tsvetelina Vateva as their lecturer are presented in Table 3 below.

**Table 1 – 2019/2020 summarized results from the 21 Likert scale questions – 61 student assessments**

2019/2020 Survey Question No.	1	2	3	4	5	6	7.1	7.2	7.3	7.4	8	9	10	11	12	13	14	15	16	17	18
No. of ass. 5 (fully agree)	46	48	58	52	46	51	52	45	54	42	42	50	53	52	46	55	59	59	57	56	56
No. of ass. 4 (agree)	11	11	2	9	10	7	7	8	6	10	12	9	6	9	11	5	1	2	3	5	4
No. of ass. 3 (average/neutral)	3	2	1	0	5	2	1	4	0	6	7	1	2	0	4	1	1	0	1	0	1
No. of ass. 2 (disagree)	0	0	0	0	0	1	1	3	1	2	0	1	0	0	0	0	0	0	0	0	0
No. of ass. 1 (fully disagree)	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0

**Table 2 – 2020/2021 summarized results from the 20 Likert scale questions of the official 2020/2021 survey – 17 student assessments**

2020/2021 Official Survey Question No.	1	2	3	4	5	6	7.1	7.2	7.3	7.4	8	9	10	11	12	13	14	15	16	17
No. of ass. 5 (fully agree)	9	11	11	13	14	13	10	11	12	11	10	12	11	13	12	14	17	17	16	15
No. of ass. 4 (agree)	5	6	3	4	2	3	6	3	5	6	6	4	4	2	2	3	0	0	1	1
No. of ass. 3 (average/neutral)	2	0	2	0	0	1	1	1	0	0	1	1	1	1	1	0	0	0	0	0
No. of ass. 2 (disagree)	0	0	0	0	1	0	0	2	0	0	0	0	1	0	2	0	0	0	0	1
No. of ass. 1 (fully disagree)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

**Table 3 – 2020/2021 summarized results from the 21 Likert scale questions of the unofficial extended 2020/2021 survey – 4 student assessments**

2020/2021 Unofficial Extended Survey Question No.	1	2	3	4	5	6	7.1	7.2	7.3	7.4	8	9	10	11	12	13	14	15	16	17	18
No. of ass. 5 (fully agree)	4	4	2	3	3	4	2	3	4	3	3	4	3	3	2	4	4	4	4	4	4
No. of ass. 4 (agree)	0	0	2	1	1	0	2	1	0	1	0	0	1	0	2	0	0	0	0	0	0
No. of ass. 3 (average/neutral)	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
No. of ass. 2 (disagree)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No. of ass. 1 (fully disagree)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The most frequent answers to the open-ended questions regarding what the students liked most about the conducted teaching process and what they would suggest for optimization of the teaching process given among the total number of 82 students who completed the 3 presented student opinion surveys during the 2019/2020 and 2020/2021 academic years are included in Table 4 below.

**Table 4 – Most frequent student answers to the open-ended questions about the best-liked teaching practices and recommendations for course optimization – 2019/2020 and 2020/2021**

What did you like most about the teaching process?	What are your suggestions for optimization of the teaching process?
<ul style="list-style-type: none"> <li>• the lecturer’s teaching approach/ methodology – 32 answers</li> <li>• the lecturer’s attitude and behaviour towards the students – 25 answers</li> <li>• the additional materials provided by the lecturer – 21 answers</li> <li>• the whole course content and structure – 17 answers</li> <li>• the pleasant learning atmosphere – 5 answers</li> </ul>	<ul style="list-style-type: none"> <li>• nothing needs to be changed; the course is optimized as it is – 26 answers</li> <li>• separate the groups according to their English language proficiency level – 5 answers</li> <li>• introduce more types of speaking tasks – 4 answers</li> <li>• reduce the seminar duration; give more breaks – 3 answers</li> </ul>

The 4 students who completed the lecturer’s 2020/2021 unofficial extended student opinion survey gave the following summarized answers to the additional 7 open-ended questions regarding the particular teaching strategies, types of exercises and provided additional materials they found most useful for themselves:

- most useful lecturer’s teaching strategies: all listed strategies (2 answers); guidelines and instructions for oral presentations (1 answer); guidelines and instructions for writing assignments (1 answer);
- most useful types of exercises: listening multiple choice (4 answers); listening True/False (1 answer); listening gap-fill (1 answer); listening open-ended questions (1 answer); reading True/False (3 answers); reading gap-fill (3 answers); reading multiple choice (1 answer); reading missing-sentence-filling (1 answer); reading missing-paragraph-filling (1 answer); writing an essay (1 answer); writing a summary (1 answer); writing a referral letter for a patient (1 answer); all writing task types (1 answer); speaking – oral presentation (3 answers); speaking – group discussions (1 answer);
- most useful additional materials provided by the lecturer: all provided additional materials (2 answers); the provided additional texts (1 answer); the provided English-Bulgarian glossaries for each unit of the textbook (1 answer).

### CONCLUSION

As it is evident from the results of the 3 presented student opinion surveys, the 82 students' assessments of the additional-material-upgraded EMP course that was offered to them with the author Tsvetelina Vateva as its conducting lecturer are predominantly high (with most Likert scale assessments of 5 = fully agree or 4 = agree and mostly positive feedback on the open-ended questions) for both the upgraded course structure and content and the lecturer's teaching methodology, strategies, approaches and attitude to the students.

These high assessments are an indisputable indicator that both the offered upgraded EMP course and the lecturer managed to meet the students' expectations and the mixed-level language needs of the majority of both the more advanced students and the students with lower levels of English language proficiency who attended the presented EMP course during the 2019/2020 and the 2020/2021 academic years.

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**INNOVATIVE CHANGES IN THE MANAGEMENT OF PERSONALIZED  
TRAINING OF STUDENTS IN THE CONDITIONS OF THE  
PENITENTIARY SYSTEM FROM THE STANDPOINT OF PEDAGOGY  
OF THE XXI CENTURY**

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**Abstract.** The article deals with the problems of innovative changes in the management of the personification of training in general and for students receiving higher education in the conditions of the penitentiary system. The results of research on the management of personifications of educational interactions from the standpoint of challenges and trends in pedagogy of the XXI century are presented. The authors propose the theory and practice of a personified approach in the management of student training, taking into account the peculiarities of the penitentiary system. The authors also consider some options for solving the problems of resocialization of student-prisoners through personification management when they receive higher education in places of detention.

**Keywords:** innovative change, personalized training, penitentiary system, personification management

In recent years, interest in innovations has increased significantly, this is justified by the fact that they have become one of the important factors of changes in all economic and social spheres. Informatively, innovative management in the XXI century acts as a unique field of activity: such spheres of knowledge as technology, economics and ecology, social psychology and sociology, professional pedagogy and social pedagogy, fundamental applied sciences, theoretical and practical aspects, as well as strategy and management tactics in general [1].

However, scientific pedagogical research pays insufficient attention to innovative changes in management from the standpoint of challenges and trends in pedagogy of the XXI century. This explains the relevance of the study of the theory and practice of a personified approach in the management of student training, taking into account the peculiarities of the penitentiary system [2].

Personalized education (or personalized approach in education) is a way of designing and implementing the educational process, in which the student acts as a full-fledged subject of educational activity. The personalized approach is based on the position that a student learns and develops better if he is motivated, active and if his individual characteristics are taken into account [3].

We consider the management of personifications of educational interactions from the standpoint of challenges and trends in pedagogy of the XXI century, such as:

1. The use of digital services and platforms in the organization of the learning process and management of an educational organization, allowing to transform the management system, speed up information processing processes and, ultimately, personalize the educational requests of students;
2. Formation of an information space based on knowledge, ensuring the right of a citizen and a person to objective, reliable, safe information and creating conditions for meeting the need for constant, continuous development, obtaining high-quality and reliable information, new competencies, expanding horizons;
3. The use of electronic, digital and robotic technologies, which provide the most active processes of transformation of pedagogy of the XXI century towards individualization and personification of educational activities;
4. Organization of management of the learning process in conditions of social constraints, taking into account the personal requests of students.

Building an effective management system for the personalized training of students in the penitentiary system is impossible without using the innovative, technological potential of modern educational technologies and taking into account the constraining factors caused by the very essence of the penitentiary system.

We see a personalized approach in the management of student training, taking into account the peculiarities of the penitentiary system, as a process of building a personalized educational trajectory for each student, in which, along with the student's personality, his needs and life goals, essential factors influencing the development of a personalized learning

path are the actual conditions for organizing the process training, conditioned by the regime factors of the student's maintenance, the technical and technological capabilities of the correctional institution and the educational organization that manages the learning process. An important factor is also the social and socio-psychological relations that exist within the correctional institution, which affect the formation of opinions about the resocializing role of education and, ultimately, the motivation of students.

In the course of many years of research on the problem we declared, specific organizational and socio-psychological conditions were identified that significantly affect the management and implementation of the educational process in conditions of imprisonment, taking into account these factors, a structural-logical model of personified professional training of students in the penitentiary system was designed and pedagogical conditions.

Speaking about the special conditions for managing the educational process in a correctional institution, we primarily talk about the following factors that directly affect the implementation of the proposed model of personalized professional training of students in the penitentiary system:

1. Determination of the order of organization and time for training and self-study not by the student, but by the requirements of the functioning of the regime object, the goals and objectives of the functioning of which do not coincide with the goals of the student's personality and the tasks of the teaching organization;

2. Lack of specially equipped premises for organizing training in programs of higher professional education;

3. The impossibility of using traditional forms of education due to organizational and economic factors, since in fact, in a separate correctional institution, from 1 to 20 students study, who have no coincidence either in the direction of training or in the stage of mastering educational programs;

4. The difference in personality traits, motivation, disposition for cognition and other individual psychological characteristics of the personality among students mastering the programs of higher professional education and the impossibility of exerting direct pedagogical influence on them;

5. Inconsistency of the ability to learn, self-study, the use of intellectual capabilities with the requirements of the traditional system of higher education among students;

6. A predominantly negative attitude towards the very possibility of receiving higher education by convicts, both from other convicts and from the leadership and employees of the correctional institution;

7. Insufficient guarantee of the general availability of higher education;

8. Difficulties in ensuring the continuity and continuity of education due to changes in the student's legal status (changes in the conditions for serving sentences both in the direction of mitigation and in the direction of tightening, changes in the place of serving the sentence, etc.);

Speaking about the pedagogical conditions for the implementation of the presented model, it seems necessary to highlight their main groups:

- Normative, taking into account the requirements of the current legislation on education, as well as legal guarantees of the convict to exercise the right to receive education;

- Organizational, reflecting the previously indicated factors that are subject to consideration when organizing the educational process according to the program of higher professional education;

- Technological, allowing to organize training in indirect interaction with the teacher and auxiliary pedagogical staff, and maximally personify training, depending on the characteristics of a particular person and the conditions of his training;

- Socio-psychological, associated with the impact of the immediate environment, the reference social group (family, like-minded people, etc.) and society in the broadest sense on the formation of the student's motives both directly for learning and for further self-realization in decriminalized life.

It is the pedagogical conditions associated with the technology of education that are the innovative factor that will make it possible to talk broadly about the management of personalized professional training of students in the conditions of the penitentiary system.

The model we have constructed and the pedagogical conditions allow us to create and test the structure of management of personalized professional training of students in the conditions of the penitentiary system. The structure, built on the basis of scientific research in the field of pedagogy of the XXI century, a strategic view of management in education, a systematic approach to management, covers, at this stage, nine components of digitalization that ensure the quality of management through the use of digitization and equipping with digital services. The use of digitalization of management also ensures the efficiency and quality of individual elements of the personified training of students in prison: educational, administrative, educational, etc. [6].

Digital management tools for personalized training of students are:

1. Digital core curriculum for vocational training;

2. Personalized modular curriculum for each academic semester;

3. Personalized curricula for each module of the personalized modular curriculum;

4. Personalized educational route of the student in each academic semester with a level of assimilation that takes into account the educational achievements of the student in the previous period;
5. Personalized educational trajectory of professional training;
6. A reference system that helps to learn consciously and effectively in the zone of proximal development, including big ideas, scaled learning goals, assessment schemes (rubricators), cognitive techniques (student tools), etc.;
7. Diagnostics, which helps to identify gaps in subject knowledge, as well as to draw up an individual student profile, which indicates his educational style, recommendations are presented so that he makes an informed choice;
8. Educational strategies for realizing your own goals and recommendations regarding the content and structure of the educational program.
9. Elements of a personalized approach, providing continuous assessment and adjustment of the individual characteristics of a student and ensuring the achievement of the maximum possible results of professional training.

All the tools we offer are digital and are included in the electronic information educational environment of the educational organization and ensure the management of all interactions between the student in prison and the administrative, methodological, teaching staff, providing full-scale remote support of professional training.

We understand that different pedagogical systems can emphasize different elements. However, the elements designed by us relate specifically to the personified professional training of students in the penitentiary system and provide the professional aspect of the student's resocialization in the course of the personified vocational training of the student in the penitentiary system. They contribute to the formation of a new system of professional knowledge and skills, professional values, professional ethics, which, ultimately, ensures the completeness of a positive change in the life attitudes and values of the convict.

The proposed solution to the problem of innovative management of personification in obtaining higher education in prisons allows a student who has undergone professional training to return to society with a guaranteed opportunity to engage in social and professional activities.

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**MOUNTAINEERS IN THE NOVEL BY M. Y. LERMONTOV  
"THE HERO OF OUR TIME"**

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**Annotation.** The article is devoted to the image of the Caucasian mountaineers, with whom the war was waged in the North Caucasus. In the person of Kazbich, Lermontov shows one of the representatives of the historically established type of fighter against the Russian conquerors – Abrek. On the one hand, the author draws the life and everyday life of a Russian fortress on the so – called "Caucasian line", on the other hand, the mountain village. To recreate the local color, Lermontov turned to the traditional comparison of a woman and a horse in the East. Lermontov is an artist, not a historian or ethnographer, so he did not slavishly follow the facts of life.

**Keywords:** mountaineers, Pechorin, Caucasus, Lermontov, the novel "Hero of Our Time", Maxim Maksimych, Kumyks, Bela, Chechens, Kazbich.

Russian Russian novel "Hero of Our Time" is Lermontov's "most perfect prose work", "amazing", "brilliant", "the best Russian novel" [4, p. 5]. The Caucasian pages of the novel attracted the attention of the Russian advanced public and foreign readers (the first publication of the novel in French under the title "Hero of our Time, or Russians in the Caucasus"). What are the peoples of the Caucasus depicted on the pages of the novel?

The struggle of the peoples of the Caucasus for freedom, their bright life and "wild simplicity", their love for nature, and the nature of the Caucasus itself-all this attracted the poet and was an immense source of inspiration [ 3, p.57].

S. Durylin made an attempt to prove that Bela is from a Chechen family, and the action takes place on the "Sunzhenskaya line or even further south, into the depths of Chechnya" [9, p.55]. Meanwhile, Maxim Maksimych an-

swered the question "Have you been in Chechnya for a long time?" in the most definite way: "in the fortress beyond the Terek", "...at the Stone Ford" [5]. We are talking about a fortification on the Aksay - Tash-Kichu River. For the first time, an indication of the Tashkent as a Stone Ford was made in our literary criticism by I. L. Andronikov.

The Tash-Kichu fortification was located on the Kumyk plane, on the very border with Chechnya and in the immediate vicinity of such Chechen villages as: Kash-Geldy, Kurchi-Aul, Nauruz-Aul, Nuim-Berdy, Oisungur, Istisu. Formally, they were part of the Aksai possessions. There were also Kumyk villages inhabited by descendants of Chechens. The villages of Chechnya – Engel-Yurt, Kadi-Yurt, etc. - were located nearby. Therefore, Maxim Maksimych did not deny that he was in Chechnya, and Pechorin asked Bella if she loved a Chechen [5].

Durylin S. correctly noted that the Chechens did not have feudal princely families. But here we see the Kumyk prince. He is certified as "peaceful" [3, p. 57], and indeed, his behavior towards the commandant of the Russian fortress is calm and respectful. The Kumyks have been economically and diplomatically connected with Russia since the XVI century. Russian Russian tsars protected the interests of the Kumyk feudal lords, and in the XIX century the Russian military administration controlled the Kumyk princes.

Recalling the story of Bela, Maxim Maksimych mentioned the wedding. The narrator forced him to tell more about it with his question. The first phrases refer to the Kumyk wedding in general, and then the staff captain proceeds to the description of the wedding at the prince-kunak. S. Durylin believed that Lermontov made a mistake by forcing the wedding to be celebrated in the bride's house, whereas this does not happen among mountaineers. N. S. Semenov writes that a description of Kumyk wedding ceremonies was found in the bride's house, which coincides with what Maxim Maksimych tells [9, p. 57].

At the wedding, the poor old man strummed on "a three-stringed musical instrument like our balalaika". This is "agachkomuz" [8, p. 44]. The "ragamuffin" took part in the wedding fun, he broke down, clowned, mixed an honest company. At the Kumyk wedding, the participation of the jester-oyunchu is mandatory.

We read further: "Girls and young guys stand in two rows, one against the other, clap their hands and sing. Here comes one girl and one man to the middle and begin to sing verses to each other in a singsong, whatever they can, and the rest take up the chorus." "Whatever happened" [8, p. 44] should be understood as improvisation. In the description, it is not difficult to recognize the song-game characteristic of the Kumyk wedding;

it is called saryn. According to P. Golovinsky, during the performance of saryn, a girl and a guy exchange compliments [3, p. 58] of a love content. Something "like a compliment" [8, p. 45] in the spirit of saryn, Bela sang to Pechorin. She was dragging a Russian officer into the Kumyk wedding game. Her compliment did not have an obvious love content, but to some extent hinted at the feelings of the girl. That's why Kazbich's eyes looked at Bela from a dark corner of the room, "motionless, fiery" [9, p. 56]. The Adats did not allow a woman to have conversations with a strange man. At a wedding – another thing. Lermontov skillfully used the wedding ceremony to create a scene of acquaintance between Bela and Pechorin.

Lermontov is an artist, not a historian or ethnographer, so he did not slavishly follow the facts of life. The Tash-Kichu fortification was located next to the large village of Novy Aksai [3, p. 59]. In the novel, the fortification stands alone on the river bank, "six versts away" is an aul. In fact, the village was located seven and a half versts away and was called Batash-Yurt...

Pechorin, in order to teach Bela the Russian language, hired a dukhanschitsa (a sutler) who knows "Tatar", and he himself studied "Tatar" [8, p. 52]. Lermontov wrote to Raevsky: "I began to learn Tatar [3, p. 58], a language that is necessary here, and in general in Asia, like French." The opinion was established that in this case the Azerbaijani language is meant. N. Semenov writes without looking at Lermontov: "The language of the inhabitants of the area that occupies us (the Kumyk plane) is Tatar, that is, the universal language of Asia" [9, p. 57]. So, it is more correct to say that Lermontov studied the Kumyk language, and therefore could easily master Azerbaijani. Tolstoy L. N. also studied the Kumyk language and called it Tatar.

What ways did Lermontov get acquainted with the life and customs of the Kumyks? Personal acquaintance with Kumyks outside the Caucasus and in the Caucasus is possible. The first Kumyk ethnographer Shikhaliyev was a military man and served in Chechnya in 1840. In the documents, he is sometimes listed as Sheikh Ali. Kumyk Shah-Wali studied at the school of Guards sub-ensigns and cavalry junkers together with Lermontov. Apparently, they are the same person. Shikhaliyev could tell Lermontov a lot about the Kumyks.

In a letter to Rayevsky, he reported: "...I traveled the entire Line along, from Kizlyar to Taman." Usually, fortifications along the Terek rise under the left flank of the Line. Yermolov's chief of staff, General Velyaminov, testifies that Yermolov laid the "second parallel" of the Line: fortifications of the Barrier Camp, Groznaya, Amir-Aji-Yurt, Tash-Kichu, Burnaya, etc.

To "travel" the entire Line means to visit the fortifications on the Kumyk plane [9, pp. 57-58].

Considering the story of Bela, it should be borne in mind that Maxim Maksimych told it, and the narrator wrote it down. About the Caucasian, very similar to Maxim Maksimych, Lermontov said that this is "a half-Russian, half-Asian creature" [2]. The story takes place in the Caucasus. Fidelity to reality required a local flavor. It manifested itself, as Belinsky said, in ethnographic, folklore and linguistic elements (especially Kazbich's story), in the traditional "skeleton of content" [9, p.58].

To recreate the local color, Lermontov turned to the traditional comparison of a woman and a horse in the East. In the story of Maxim Maksimych, the struggle for Bela and Karagez unfolds. The action develops in parallel. Maxim Maksimych expresses himself in the spirit of the East: "How I look at this horse now: black as pitch, legs are strings, and eyes are no worse than Bela's" [8, p. 45]. Kazbich's song ends with the lines:

Four wives will buy gold.

A dashing horse has no price:

He will not leave behind the whirlwind in the steppe,

He will not change, he will not deceive [8, p. 48].

The song does not compare, but contrasts a horse and a woman. The horse will not change, will not deceive [3, p. 58], it will not lag behind the whirlwind in the steppe. And the woman? The conclusion is easy and not at all in favor of the woman.

Literary critics paid attention to the folklore character of the song, but they forgot that the consciousness of the working mountain masses in the past was characterized by inconsistency and did not always correctly reflect the true interests of the people. There were proverbs: "Do not spare either your wife or the horse, "" The wife should work harder than the donkey, because she eats clean bread, and the donkey straw." There were also such: "A wolf is allowed to marry two". "The death of his wife – the collapse of the roof" [9, p. 48] ...

The prince's son Azamat, spoiled by his parents, does what he wants. Burning with a passionate desire to take possession of Karagoz, he tells Kazbich that "he will die if he does not sell him his horse" [8, p.47], offers him his sister Bela for him. Azamat turns from defenders of family honor into an enemy of the family [3, p. 58].

It is known that in the Caucasus in the past, stealing horses was considered a bravado. The folk song of Kumyk says: "Not as an old hound dog who has lost his fame, but as a famous young horse, you will be invaluable when you are fifteen years old."

Kazbich has a different view of a woman. "Kazbich was silent for a long, long time; finally, instead of answering, he began to sing an old song in a low voice" [8, p. 48]. Kazbich considered the answer, weighed all the circumstances and decided that the song that humiliates a woman would best express the idea. This is what the adats demanded, for Kazbich they are the tradition of his ancestors, the collective opinion of his fellow tribesmen, the exponent of moral norms, the truth of life. Kazbich is like everyone else. Not only by tradition, but also by the power of conviction. He responds to an insult with instant revenge, resolutely fulfills his plan. The shadow of Pushkin's Gasub seems to fall on the image of Kazbich. Internally, they are close to each other. Both are almost equally affected by the shock. "Having driven away his son, Gasub lay down on the ground – and closed his eyes. And so he lay until night" [1, p. 592].

Kazbich, having lost his Karagez, fell to the ground and "lay there until late at night and the whole night" [8, p. 51].

Hasub paints a picture of the murder of an Armenian merchant that is pleasing to his heart:

Why an accidental blow

You didn't try to slay him

And did not jump to him from the cliff [1, p. 592]?

Convinced of Tazit's inability to avenge his murdered brother, Gasub scares him with a terrible meeting:

To put a dead brother on your shoulders

He sat down like a bloody cat... [1, p. 592]

Kazbich seemed to realize the dreams of a fantastic follower of Islam: "like a cat, he dived from behind a bush, jumped on a horse from behind him, knocked him to the ground with a dagger blow" [8, p. 65].

For Maxim Maksimych, Karagez is a "robber's horse" [1, p. 45], even in Bela, in his opinion, "robber blood flows" [1, p. 62] But he is a soldier and therefore appreciates the highlanders and admires them: "Live hard, robbers! I have seen others in action, for example: after all, the whole is pierced like a sieve with bayonets, and everyone is waving a saber..." [1, p. 49] And there were many such courageous people in the real life of Chechnya at that time.

Let us now consider the place and meaning of Kazbich's song in the story. The humiliating suspicions voiced in the song were addressed to Bela. Kazbich was referring to her. Meanwhile, the whole course of the narrative, her image, resolutely revolt against this. Gold could not and could not buy Bela. It can be stolen, killed, but not forced to fall in love. Kazbich believed the horse [3, p. 58]. And what happened? The boy Azamat became his

master: he raced off to the mountains on it, like the wind. Karagez Kazbich was "deceived". This is how the patriarchal-feudal attitude towards women is condemned, and with it Kazbich.

Semenov L. P., relying on N. Lerner and M. Olshansky, put forward in 1939 the assumption that the prototype of Kazbich was the Kizilbech Sheretlukov. In 1960, an article by L. P. Semenov was published, in which the assumption turned into a statement. In the academic edition of Lermontov (note to "Bela"), it is stated that Kazbich is "a completely real historical person". We think that there are no sufficient grounds for such statements.

First of all. Sheretlukov died at the end of the 30s at an advanced age. Maxim Maksimych's story dates back to 1832, when the fame of Sheretlukov was already booming. Maxim Maksimych said: "... I heard that the Shapsugs have some kind of Kazbich on the right flank." In this case, we are talking about Sheretlukov. But the staff captain did not say: some Kazbich appeared.

Secondly. The appearance of Lermontovsky Kazbich (small, dry...) is a sharp contrast to the appearance of Sheretlukov. here is how the Adyghe writer Akhmetukov draws his portrait: "Kizilbech... was of enormous height, with rich blue eyes, with an iron chest, a large head, a rather pleasant-looking man..." [9, p. 61]

The "Hero of Our Time" stubbornly emphasizes the connection of appearance with the human psyche, with his character. And in this case, we can not ignore the Lermontov method. The poet could not "combine" the appearance of one person with the character of another, a well-known contemporary, and pass off such a combination as a historical person.

Third. The character of Lermontov's Kazbich is different. About the historical Kazbich, Maxim Maksimych says: "... a daredevil who rides around in a red beshmet step by step under our shots and bows politely when a bullet buzzes close..." [8, p. 68] Before us is a reckless brave, a favorite of luck, a daring man. And what is Lermontov's Kazbich like? He came to the wedding in chain mail, treacherously attacked the old man and killed him, quickly retreated from under the walls of the fortress from a single soldier's shot. The following characteristic from the "Tazit" is more suitable for him: courage, cunning and agility, a crafty mind and strength of hands" [1, p. 589].

It is customary to say about Bela that she is all in love. Bela died because she only knew how to love. And yet the pathos of the image of Bela is not only and not so much in her strong, noble heartfelt feeling.

The fiery love of a mountain woman, the passion of an eastern woman is a traditional romantic motif.

Bela fell in love with Pechorin. And difficult questions arose before her. Revealing the secret corners of Bela's inner world, Lermontov showed not only her fiery feelings, but also her awakening intellect.

"Listen, my peri," Pechorin turned to Bela, " you know that sooner or later you must be mine – why are you only torturing me? Do you love any Chechen? If so, I'll let you go home now. "She shuddered slightly and shook her head." Returning home did not bode well. And she did not love anyone except Pechorin. "Or, – he continued, – do you absolutely hate me?" "She sighed." The girl confessed her feelings. "Or does your faith forbid you to love me? "She turned pale and was silent." Bela is shocked by the question. This question, the most terrible, tormented her, making her suffer and toss around. She understood that she was ready to cross the boundaries of what was allowed by the Adats and Sharia. "Believe me, Allah is the same for all tribes, and if he allows me to love you, why will he forbid you to reciprocate me? She looked him full in the face. As if struck by this new thought, distrust and a desire to make sure were expressed in her eyes" [8, p.53]. There is a gleam of inquisitive thought in her eyes, an acute desire to understand the circumstances, to comprehend her actions and feelings.

Marlinsky saw in the mountain women "greed" even in love. The gifts did not affect Bela. Maxim Maksimych said: "They have their own rules: they are brought up differently" [9, p. 63]. And that's right. The Kumyk song says: "Let the stupid girls be cursed, whose mind is short, their hair is long; who love a rich young man for his wealth and, having married a rich man, dress in silk dresses" [9, pp. 63-64].

In the episode of Pechorin's decisive explanation with Bela, the ideal of a man native to her heart appeared. Pechorin " dressed in Circassian style, armed himself and went in to her." A saddled horse was waiting for him in the courtyard. He entered as a batyr enters, who has gathered for a brave feat. Pechorin did not flatter, did not deceive. He expressed the truth about love briefly and energetically. Bela got complete freedom. The song is sung: "The batyr does not resort to flattery, which is used to gain the favor of people." - Goodbye, I'm going-where? How do I know! Maybe I won't be chasing a bullet or a saber strike for long: then remember me and forgive me" [8, p.54]. That's what Pechorin said. The song says: "A batyr, both on a dark night and on a thin horse, will achieve what a coward will never achieve. The batyr does not run away from danger, but hurries to meet it." Pechorin resolutely hurried towards death [9, p. 64].

Pride, generosity, courage, sincerity (at the moment Pechorin was immensely sincere) conquered the girl...

Dying, Bela does not condemn her love. From the dogmatic positions of Sharia, she is a terrible criminal and a great sinner. She doesn't belong in heaven. Bela did not admit this, did not blame herself, but decided to carry her love for the Russian into the afterlife, she regretted that she would not meet Pechorin's soul in the next world and that another woman in paradise would be his friend.

But maybe Lermontov wanted to show that, having fallen in love with Pechorin, Bela changed her people? No! Her ardent love for Russian did not extinguish, did not change her devotion and love for her native land. Before her death, she "spoke incoherent speeches about her father, brother: she wanted to go to the mountains, home" [8, p. 66].

As a result, it is worth noting that today we are living witnesses of how Lermontov's poetic divine gift was gaining height [6, p. 270]. How many beautiful works of Lermontov could have come to light if he had lived at least until the age of Pushkin. But, this was not destined to come true. One thing is clear that "the Caucasus, being the cradle of Pushkin's poetry, has also become the cradle of Lermontov's poetry" [10, p.39]. After all, the Caucasus has become a place of inspiration for the great writer, his outlet [3, p. 60]. And it was not for nothing that Belinsky foreshadowed Lermontov an honorable place in Russian literature next to Gogol and Pushkin. He wrote to Botkin that the third Russian poet was being prepared in this young man, and that Pushkin did not die without an heir [7, p. 79].

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## SALTYKOV-SHCHEDRIN AS A MASTER OF SATIRE

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**Abstract.** The purpose of the article is to show the skill of the unsurpassed artist of the word in the field of socio-political satire, the successor of the traditions of Gogol-Saltykov Shchedrin, for whom the main weapon of satire that exposed human vices was laughter, and the social ideal was the future society of equal and free people. Shchedrin, like Gogol, became an outstanding master of irony. He widely used it in his satirical works, knowing perfectly well that irony is a "terrible tool". Saltykov was called a brilliant artist, a master of psychological analysis, who surpassed even Dostoevsky in this respect. Saltykov-Shchedrin could clearly see things as they really were, and it was this state that was reflected in many aspects of his satirical poetics and style.

**Keywords:** Saltykov-Shchedrin, master of irony, laughter, satire, sense of humor, talent, comedy.

There are writers by the very nature of their talents who are prone to wit, that is, to unexpected, sharp comparisons and comparisons that instantly expose the comicality of certain aspects of reality. One of them is Saltykov-Shchedrin—an unsurpassed artist of words in the field of socio-political satire [4, p. 43], who made a huge contribution to both Russian and world literature. This is a satirist of universal significance, who has always had his own individual vision of the world, his attitude to it, whose works, while remaining a valuable means of education, are still an indispensable source of knowledge by the power of his gift [2:6:9], and by the scale of satirical creativity. Yeliseyev G. Z. noted that Shchedrin was "a man of remarkably bold and strong thought", that his journalistic speeches "were masterpieces of their kind" [8, p. 349].

To understand Saltykov-Shchedrin, to feel him, can only be someone who seriously, not hastily, not on the move, will try to read him. He devoted almost all his conscious years to writing, native literature, and satirical art. No wonder Dobrolyubov said that "our literature began with satire and con-

tinued with satire and still stands on satire [8, p. 4].

Saltykov-Shchedrin's artistic talent and satirical skill are appreciated by the largest Russian writers. Turgenev I. S. believed that he dissociated himself from our literature an entire area in which he was "an indisputable master and an advanced person" [6, p. 5]. Tolstoy L. N. found in Shchedrin "everything that is needed" to win the recognition of the people: "a concise, strong, real language", character, "cheerful laughter", "knowledge of the true interests of the people's life" [6, p. 5]. Gorky M. considered Shchedrin more "instructive and valuable writer with a surprisingly wide creative scope than they talk about him" [6, p. 6].

Shchedrin's sharp and penetrating mind penetrated into the phenomena, into their innermost essence, he never stopped on the surface of life. "Saltykov, knowing perfectly well the psyche of the representatives of the cultural society of his time, which was formed before his eyes, was smart, honest, harsh, never hid the truth, no matter how deplorable it was" [6, p.7]. His ideals were "the ideals of the future" [8, p. 54], "to the pain of the heart" [10, p. 4]. He believed that, in the end, freedom, equality, justice would prevail. Everything that came into conflict with living life caused him to laugh angrily. Everything that was afraid of laughter became the subject of his satirical denunciation.

Shchedrin was an advanced figure of his time, a preacher of high social and ethical ideals, a passionate fighter against everything low, deceitful and mean, as well as a brilliant artist who created such satirical works that represent enduring aesthetic values [4, p.43].

Shchedrin's satire is highly intellectual, it is not just saturated, but over-saturated with thought, which is the source of its immortality. This is a vast and extremely diverse field of art, which has given people a lot of aesthetic masterpieces, striking with the depth of its thought. The purpose of satire is to expose vices. Even in Ancient Rome, Diomedes emphasized that "satire was born to fight against human vices" [8, p. 37].

The Russian critic N. K. Mikhailovsky, considering that "talents are bright, strong, so to speak, one-color, called Shchedrin's talent iridescent. The iridescence of this brilliant rainbow is as beautiful as it is rare in literature" [8, p. 5]. His talent was surprisingly multifaceted, versatile.

Shchedrin was a great satirical writer, an outstanding life writer, critic, publicist, playwright. Working tirelessly in literature for more than forty years, he created diverse, unique, bearing the indelible stamp of his genius, satirical worlds that reflect real life, but born of the unrestrained imagination of the writer. The worlds are scary and at the same time funny [2, p. 112].

Shchedrin's artistic mastery of satire originates from the progressive traditions of Russian satirical literature of the XVIII century and from Gogol [4, p. 43]. Shchedrin, like Gogol, was reproached for showing only negative, bad things, although he could also depict the bright, gratifying things in life [4, p. 44].

Shchedrin himself believed that "satire will become satire if, having achieved its goal, it, firstly, gives the reader a sense of its ideal, from which its creator departs, and, secondly, if it is fully aware of the object against which its sting is directed" [7, p.228]. Belinsky V. G. characterizes Gogol's humor as "calm in his indignation, good-natured in his cunning", at the same time there is another humor, "formidable and open", "bilious, poisonous, merciless" [5, p.227]. This is Shchedrin's humor. If the formula "laughter through tears" can be applied to Gogol's humor [1, p.65], then the formula "laughter through contempt and indignation" corresponds to Shchedrin's humor [5, p. 228].

Saltykov - Shchedrin, like other major writers of his contemporaries, focused on a person. All of them were interested in the question of the free development of a person, about the maximum identification of his potential qualities and properties. However, every outstanding writer has his own "approach" to a person, his own angle of his artistic research.

Saltykov-Shchedrin saw his creative task not in "justifying the humiliated and rejected pariahs of society" [10, p. 86], but in studying the diverse manifestations of human dehumanization. Perhaps someone will find such a task too simple and narrow. In fact, however, it is so broad and complex that the great writer did not have a whole lifetime to fully solve it. After all, in essence, this is the task facing all satire, facing many generations of satirists. But each of them solved it to the best of their talent and their understanding.

Chernyshevsky N. G. wrote that Shchedrin is "a writer mostly mournful and indignant" ... "No one punished with a more bitter word and did not expose public sores and vices with such ruthlessness" [7, p. 23]. When you get acquainted with Shchedrin's works, at first it seems that the writer does not really go into the details of the inner world of his characters. Here we can see brilliant examples of his deep psychological analysis [4: 9].

We meet in Shchedrin's work with a variety of types of satirical images, such as: Judushka Golovlev and Surly-Burcheev, pompadours and toy people, the wise minnow and dried roach, to make sure that we really have different artistic structures in front of us. Saltykov was called a brilliant artist, a master of psychological analysis, who surpassed even Dostoevsky in this respect [4:9]. "For this" Judushka", – V. Garshin wrote – I will give

three Dostoevsky... " [8, p. 89].

In Saltykov-Shchedrin's novel "Gentlemen Golovlevs", an unusually typical personality appeared in the image of Judushka, in which there is a remarkable artistic combination of two opposite elements: almost ridiculous comic with deep tragedy [1, p. 65]. The qualities peculiar to the whole class were manifested in him with greater force and intensity, so the writer sought to reveal his psychology as deeply and thoroughly as possible. Shchedrin's collection of hypocrites is quite original and unique. The first place in it, undoubtedly, is occupied by Judushka Golovlev. It will not pale from our comparison with the best works of this kind of European writers.

Porfiry Vladimirovich Golovlev – "the last representative of the vymorochny family..." [8, p. 107]. Despite the fact that he moves and performs the usual actions, he has long been not only a "living ghost", but also a "living corpse". Being among living people, he is at the same time separated from them by an invisible wall, on one side of which is life, and on the other – death [8, p.110].

The writer deliberately wants to show us that before us is a figure (Judushka) morally ugly, terrible, but at the same time comic, funny. Drawing the image of Porfiry Vladimirovich, the author rarely resorts to external comedy. He purposefully and consistently exposes the inner comic discrepancy between the hero's words and his deeds, between his sermons and his actions, between his statements and his behavior.

Dostoevsky F. M. once said that "satire ridicules vice, and most often vice under the guise of virtue" [8, p. 114]. We see an inert, deadened creature trying to pass itself off as a living person. The writer reveals the comedy of hypocrisy and moral ossification, which appear before us in all their ridiculous and at the same time disgusting, terrible essence [4, p. 45].

Another kind of satirical image that we meet with in Shchedrin is a collectively caricatured image that embodies a certain social group. So, a well-intentioned person is a person who leads a vegetative lifestyle; a person who eats, drinks, reproduces, enjoys, but does not think; a person who is unable to distinguish good from evil. In other words, we are again faced with a dehumanized person [4, p. 44].

Saltykov is well aware that the reality surrounding him is full of contradictions, not only tragic, dramatic, but also comic, which are also the subject of his constant attention. And next to this continuous drama, which often turned into a tragedy, comedy was still going on, because the servants of ghosts were beings who were internally incompetent, flawed, comical. They, as before, were characterized by empty talk and empty-bragging, and besides, many other equally unattractive qualities. It is this complex

combination of different life collisions inherent in real reality that Shchedrin introduced into his satire. In his writings, we encounter conflicts not only comic, but also dramatic, tragic. In almost every work of the writer, we encounter both a life drama (tragedy) and a comedy, which determines the amazing "volume" and depth of his satire.

Shchedrin urged readers of Russia to "cultivate the ideals of the future...not to let their hearts turn to stone. He believed that "it will be terrible to live if the time comes when the most modest references to the ideals of the future will only excite unabashed laughter" [10, p.3-4].

Shchedrin's originality as an artist is most clearly manifested in such features of his satirical poetics as the art of using humor, hyperbole, grotesque, fiction, allegory [3, p.67].

The peculiarity of Shchedrin's style lies in its allegorical nature, on this occasion he wrote: "I am a Russian writer and therefore have two slavish habits: first, to write allegorically and, secondly, to tremble [8, p.315]. In the "Provincial essays" and the works adjacent to them, you can also find images and paintings that acquire an allegorical meaning.

Shchedrin's laughter [4, p. 45] is surprisingly rich and diverse. He possessed all the shades of the ridiculous. In his writings, humor and irony are interspersed with wit and caustic sarcasm [3: 11]. Turgenev I., admiring Shchedrin's "flight of crazy - humorous fantasy", noted that the power of his comedy [11, p.10] "was nowhere shown with greater brilliance than in the "Modern Idyll" [7, p. 67]. This is the "laughter that exposes the "heroes" of political and public reaction to shame and arouses the energy of public protest towards them; laughter that straightens the oppressed and shackles the oppressors; laughter that awakens a sense of shame in people who have not yet lost everything human" [5, p.180].

According to Saltykov, if "we untie a person's hands and give him the opportunity to freely express his thoughts, then we will see not the person we knew, but another. Without this exposure, he believed, it is impossible to reproduce the whole person, a truthful trial over him is impossible" [7, p. 231].

Panaeva A. Ya. writes about him that "I have never seen Saltykov calm, he was always annoyed. The contrast was striking when he was sitting at dinner with Ostrovsky, who portrayed calmness itself, and Saltykov was boiling with nervous irritation" [8, p. 251]. Complacency, like indifference, has never been characteristic of a writer. Wherever he was, whatever he was doing, he always stood up for justice, and therefore he was constantly irritated by something, he was at war with something.

The heart of Saltykov-Shchedrin responded to any pain, to any injustice. "...I can't achieve the indifference that is necessary," "I'm shaking all

over with indignation," he wrote in his letters " [8, p. 254]. "The further away, the more dreary it is to live. Every little thing is annoying, and then writing has become attached, and I can't get rid of it" [8, p.255]. Shchedrin does not have a single page that would be written with an impassive, indifferent hand. The satirist himself once said: "I swear, the minute I feel that my insides are no longer trembling, I will throw down my pen, even if the beggars have to die" [8, p. 255].

So, Saltykov-Shchedrin, in the words of L. Tolstoy, was indignant, bilious, angry all his life. It was this state that helped him to "clearly see things" as they really were, and it was this state that was reflected in many aspects of his satirical poetics and style.

Many contemporaries of the writer emphasize in their memoirs that Saltykov had an organic, natural sense of humor [3, p. 70]. A. N. Pleshcheev in one of his letters noticed that Shchedrin "has his own special humor... that involuntarily makes you laugh", and in another letter he was happy to report that Saltykov visited him: "So snide that it's lovely. Love to listen. I love his conversation terribly" [8, p. 255].

Burenin V. P. writes in his memoirs about Shchedrin's natural, organic humor that he "did not belong to the category of brilliant storytellers-writers, as Turgenev and Grigorovich were considered. His humor and wit [1, p. 68], escaped involuntarily, it was felt that he did it without preparation, ... involuntarily carried away and caused laughter with his humor and sharp, sometimes even rude in form, but witty antics, ...no matter how much he joked, he kept his seriousness and never laughed himself. This, they say, is a trait characteristic of true satirical talents: Gogol and Swift were also distinguished by seriousness and rarely showed gaiety..." [8, pp. 255-256].

Shchedrin admitted that humor can not be "forced", "strained". It should flow naturally, naturally. And for this, "gaiety" was required: "without gaiety, there can be no freedom in writing" [8, p. 261]. Skabichevsky A.M. testifies that the writer had an "organic aversion to everything vulgar, false and insincere". Seeing this, he could not help but express to the person in the eyes the impression that he makes on him, and express it with all his sarcastic wit. It was not his anger that was terrible, but rather those jokes with which he was able to destroy the interlocutor, for one purely external sign, in one or two words, he could very correctly show the personality in the most comical form" [8, p. 256].

Sometimes Saltykov-Shchedrin wanted to be frivolous, but it turned out to be serious. In fact, he managed to preserve, of course, not frivolity at all, but a deep, organic sense of humor, which helped the writer throughout his life to courageously endure the blows raining down on him, did not allow

him to fall into pessimism, supported faith in a better future, dispelled fears, fed the main pathos of Saltykov's satirical work – the pathos of ridicule. Of course, Saltykov did not immediately have his own "satirical voice", his own manner of ridicule. On many pages of the "Provincial Essays", the influence of Gogol's manner of narration, Gogol's style was clearly felt [4, p.48]. Shchedrin, like Gogol, became an outstanding master of irony [11, p. 10]. He widely used it in his satirical works, knowing perfectly well that irony is a "terrible tool" [8, p.268].

Shchedrin's main weapon in the fight against the evil of life was laughter. The writer emphasized that "this weapon is very strong, since nothing discourages vice so much as the consciousness that it has been guessed and laughter has already been heard about it" [8, p.260]. Turgenev wrote that " Shchedrin's laughter is both bitter and sharp, often ridicule offends him, very often his indignation takes the form of a caricature, which is divided into two kinds. One exaggerates the truth, as if magnifying the glass, but without completely distorting its essence, while the other more or less consciously deviates from natural truth and real relations. Saltykov resorts only to the first kind, which is the only one that is permissible" [6, p. 112].

The creative task of the writer is to debunk the vicious, evil, terrible in every satirical work, to make it contemptible and untenable in the eyes of the reader. And it was impossible to solve this problem without a deep, organic sense of humor [4, p.48]. "I cannot treat such phenomena with "proper seriousness", because it is impossible to feel anything but contempt for them, and it should not. For me yet... It's lucky that I have a large stock of humor," he admitted [5, p. 173-174].

In order to truly grasp and expose internal comic contradictions, it is necessary to have not only a sense of humor, but also an extraordinary mind [4, p.49]. Lunacharsky called Saltykov (along with Chernyshevsky) "the most intelligent writer of that era and one of the smartest in all world literature" [5, pp. 230-231]. "His insight, the correctness of his assessment of the surrounding events are amazing" [8, p. 263]. The satirist stressed many times that " laughter was never an end in itself for him. It was a form of revealing the truth, a means of distinguishing the truth from a lie, "no matter how deplorable it may be" [8, p. 263].

Saltykov-Shchedrin has always been among those in whom the desire for independent identity has not died out, who did not succumb to oppression, but opposed it [8, p.31]. "Art, he believed, should 'serve society'. He should use all his efforts, all his energy to establish good and truth in the world, and to eradicate evil" [8, p. 33]. All his life, the writer was worried about a variety of phenomena of the rapidly current modernity. And they

not only excited, but also fed his creativity, became an impulse to create new and new satirical works. Taras Shevchenko wrote: "I am in awe of Saltykov. Oh, Gogol, our immortal Gogol! With what joy would your noble soul rejoice, seeing around you such brilliant students of your own" [7, p. 24].

And every time you read and reread his satirical works, which are "art for art's sake" [8, p. 3], you are amazed not only by their depth and ideological uncompromising nature, but also by their artistic richness and diversity. Saltykov-Shchedrin was and remains not only a great satirical writer, but also an outstanding thinker. Rather, he became a great satirist because he was an outstanding thinker.

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## CREATIVE APPROACH TO METAPHOR TRANSLATING INTO AN IDIOMATIC EXPRESSION

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**Abstract.** This article discusses the reception of updating phraseological units, various types of such updates, their functions, as well as possible ways of transferring them in translation. It should be noted that the transmission of this stylistic device presents very great difficulties, since sometimes it comes close to a play on words.

**Keywords:** phraseological unit, image, component, individual colour, metaphor

One of the types of updating phraseological units is the occasional substitution of one of the components with another word. It can be a synonym or antonym, a word that is similar in its sound form, or even any word determined by the context, intention of the speaker or writer. Many of the synonymous substitutions exist in the language as combinations. Their appearance is caused by the desire for greater expressiveness, since phraseological units lose it due to frequent use. For example, along with combinations "to cry (to shout) blue murder" there is a combination "to scream blue murder".

The introduction of additional words is one of the types of updating phraseological units. It should be noted that the ease with which the phraseological units in the English language are updated, obviously, is explained by the more loose coupling of their components in comparison with the Russian language, which, in turn, greatly complicates the transmission of this technique in translation. The introduction of an additional element is often not a stylistic device at all. Sometimes this is done to clarify or strengthen the statement, and sometimes it is caused by the author's desire to "adapt" the combination to the given context. Replacement of any component of a phraseological unit is not necessarily antonymic or background in nature. Any word the author needs can become a substitute, even a proper name. Usually the leading component of the phraseological unit is replaced.

The revitalization of an erased metaphor in an idiomatic expression can be viewed as a kind of renewal of a phraseological unit. This is usually achieved not by substituting a component or introducing an additional element into the combination itself, but by adding words that return the reader or listener to the original meaning of the metaphor, thus "animating it" [1,216].

His body was transparent, so that Scrooge observing him and looking through his waistcoat, could see the two buttons on his coat behind. Scrooge had often heard it said that Marley had no bowels, but he had never believed it until now. (Dickens. A Christmas Carol)

The idiomatic expression "to have no bowels" means to be ruthless, heartless. The context in which it is said that the body of the spirit was transparent and Scrooge could clearly see both buttons on the folds of his tailcoat brings back to the word "bowels" in this combination its basic meaning of "insides". Translation in this case does not present any difficulty, since in the Russian language there is an analogous expression with the word "heart" – "it has no heart".

"His body was transparent, so that Scrooge, looking at him, could see through his vest both buttons on the folds of his tailcoat. Scrooge often I heard it said that Marley had no heart, but he believed it only now".

The metaphor in the expression "to let the cat out of the bag" is also enlivened by the accompanying context:

"Before I thought, I started to tell the others what an experience I was having. The cat was almost out of the bag when I grabbed it by its tail and pulled it back". (J. Webster. Daddy Long Legs)

In this case, it is rather necessary to limit ourselves to translation by meaning, since there is no analogous expression in Russian, even with a different image.

"Without thinking, I began to tell the others how new these impressions were for me. The mystery almost escaped my tongue, but I caught myself in time."

In some cases, the preservation of the image, which is the basis of the idiomatic expression, is possible with the help of a well-known sacrifice. The meaning of the idiom disappears in translation, but the image remains. For example, the idiomatic expression "he has not a leg to stand on" means: "he has no excuse", "there is not a single argument or fact in support of it". The humorist writer (Woodhaus) uses the technique of updating phraseological units by restoring the direct meaning of the word "leg". This is achieved by expanding the context, thanks to a joking line:

"Father says the defendant hasn't a leg to stand on. — Awkward, if he

wants to roller skate".

If you translate an idiomatic expression according to the meaning, then you have to omit the remark, since it will be devoid of any meaning. It is advisable to preserve the humorous tone of this dialogue, which can be done at the expense of some digression, for example:

"The father says that the defendant has no firm ground under his feet". "How unfortunate, what if he wants to roller-skate."

Thus, updating a phraseological unit, regardless of how it is carried out, is a very common phenomenon in the English language [2,54].

It is found in all emotionally coloured styles of speech and performs a wide variety of functions. Its prevalence is to some extent conditioned by the fact that it is not only a stylistic device, but also a "linguistic means".

The translator should remember that the proportion of this technique is different in English and Russian. Preserving it in translation is not always possible, because of its proximity, in some cases, to word play (hell, -hay), because of different imagery (to let the cat out of the bag), but also and because the translation may sound somehow far-fetched and artificial, while in the original this technique is natural. (She blundered into a mess in her cheerful way).

One of the basic principles of translation is equivalence, that is, the transfer of the usual to the usual, and the original to the original. Failure to comply with this principle leads to distortion of the original in translation.

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## METHODS OF EXPRESSING EVALUATION IN ENGLISH LANGUAGE PAREMIAS

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**Abstract.** The article discusses the question of the types of assessment in the humanities, identifies the main functions of assessment in linguistics, describes the invariant properties of the assessment. The material of the research is English paremias, considered within the framework of the phraseological fund of the English language and a representative of the psychology of native speakers.

**Keywords:** appraisal, positive appraisal, negative appraisal, paremias.

In one way or another, such prominent scientists as: N.D. Arutyunova, N.A. Lukyanova, V.V. Krasnykh, V.M. Mokievich, M.V. Nikitina, M. Fortescue, V. Russel, et al. Initially, the humanities laid the foundation for the concept of assessment, which was further developed in philology.

The purpose of this article is to investigate the ways of expressing assessment on the material of English proverbs and sayings and to identify assessments of various phenomena of life inherent in Angloculture.

From the point of view of aesthetics, the main type of assessment is the beautiful, from the ethical point of view - good and evil. An important type of values - aesthetic value - exists along with moral, utilitarian values, etc. The connection between the values of aesthetics and other types of values is due to their general axiological nature: all types of values characterize the importance of an object for a subject, which is determined by the role of this object in the life of society, class, social group of people or individual. In this regard, in the aesthetic sphere, the concept of "value" is correlated with the concept of "evaluation". They characterize from different sides the system of subjective-objective value relations.

Linguistic science has made a great contribution to the development of the category of assessment. The central works in the category of assessment are the works of N.D. Arutyunova, E.M. Wolf, N.N. Boldyreva, A.A. Ivina, M.V. Nikitin.

M.V. Nikitin notes that evaluation can be found at five levels of description of denotations: ontological, epistemic, pragmatic, emotive and representational [Nikitin 2004: 62]. Hence, evaluation is associated with a person's thinking, which is mainly evaluative.

The fundamental properties of assessment, highlighted and described in the works of scientists, are its anthropocentricity, cognitiveness, diversity and multidimensionality of assessment, its intuitiveness and subjectivity.

M.A. Minina distinguishes the following evaluation functions:

- epistemological, aimed at the relationship between the subject and the object of assessment in relation to the ideal, normative picture of the world;

- communicative - the assessment in a particular statement is perceived by the addressee of the speech, including as information about the subject;

- expressive, having a cumulative character, which is expressed in the fact that the assessment contained in the connotation of words preserves for a long time the system of values operating at a certain time in a given community [Minina 1995: 4].

Pragmatics of assessment in the concept of N.N. Boldyreva correlates with the logic of anthropocentrism; for the study of assessment, a person is important as a native speaker and as a speaking subject in the knowledge of the world [Boldyrev 2003: 104].

When a person interacts with the surrounding world, the phenomena and objects of the latter have an impact on him, which may not correspond to the complex of influences of these phenomena and objects on another person. The subjective nature of evaluative statements is irresistible: otherwise they will cease to fulfill their axiological function [Wolf 2002: 224]. According to M.V. Nikitin, "value judgments refer to judgments of opinion. The latter lie in the area intermediate between doubt and conviction, between assumption and established knowledge, between faith and proof"[Nikitin 2004: 70]. Assessment in connection with its intuitive nature gives knowledge not complete and not accurate, but only preliminary, approximate, entirely dependent on the pragmatic ideas of the subject of assessment.

The motive for the assessment is usually objective. The number of motives may include the observed properties of an object, facts and forecasts associated with a given object, attitude to the goal, patterns and features of the empirical perception of an object, various reactions of a person to different types of objects. It must be emphasized that the motive of the appraisal is not found with the appraisal itself either in causal relations or in the relations of logical inference. There is no direct connection between the assessment motive and the assessment itself, although they are in

constant empirical interaction in the minds of people.

Evaluation, as follows from philosophical and linguistic concepts, is associated with the concept of norms and values. It qualifies and classifies, identifies and equates on the basis of value concepts in the picture of the world of a person in the form of dichotomies: "good - bad", "beautiful - ugly", "useful - not useful", etc. [Nikitin 2004: 73]. M.V. Nikitin reduces all value patterns to two large principled groups: modal-truth and value. Moreover, the modal-truth patterns relate to the cognitive-rational sphere of thinking, and the value patterns - to the cognitive-emotional sphere of the subject.

In our study, we turned to the paremias of the English language as the material on which the score is clearly revealed.

In the history of the study of paremias, there have been several opinions about their status; some linguists consider paremias as part of the phraseology of a particular language, some as a separate layer of vocabulary. Most researchers attribute proverbs and sayings to phraseological units due to the presence of the following features: coherent (phraseological, idiomatic) meaning, stability of the component composition, reproducibility in finished form, expressive-evaluative coloration [Shansky 1996: 23; Maximov 2003: 31; Mokienko 2007]. We will consider paremias (proverbs, sayings) as part of the English phraseological fund.

The term "paremias" is regarded as a synonym for proverbial and conversational formations [Parmenova 2001: 153]. Paremias are a special kind of utterances that express moral norms in a concise form and are figurative in nature. The content of paremias covers all aspects of nature and society: relief, heavenly bodies, animal breeds and plant species, lifestyle, social groupings and religious institutions, all natural and cultural objects [Meletinsky 2000: 173]. The proverbial fund can be viewed as a certain moral code intended for the structuring of all forms of human life: physical, mental, social and natural.

Researchers of paremias identify a number of functions inherent in the linguistic phenomena under consideration: nominative, cumulative, didactic, cognitive-pragmatic, socially-regulating, religious-magical.

The nature of paremias is associated with human cognitive activity - human cognition of the world and experience accumulated as a result. V.A. Pirogov interprets paremias as national-cultural utterances, which are generalized-figurative, syntactically closed semantically integral constructions that express the specifics of life and everyday life of each individual community of people and the directive function they perform [Pirogov 2003: 7]. They give an assessment of a person's knowledge of the world, and through it a certain life attitude of the individual is built.

The paremiological picture of the world is an integral part of a broader education - a naive or prescientific picture of the world. Each natural language reflects a certain way of perceiving and organizing the world. The meanings expressed in it add up to a certain unified system of views, a kind of collective philosophy, which is mandatory for all native speakers.

V.P. Anikin believes that the system of views and representations of the linguistic community, forming a picture of the world, is expressed using various lexical and stylistic means, including paremial. Modern scientists are introducing the concept of "proverbial picture of the world", which is understood as a picture of the world, objectified in proverbs and reflecting the intellectual and emotional-value attitude of the people to the world [Anikin 2001: 25]. Works of oral folk art are the fruit of collective labor. The Paremial Foundation is popular both in the style of content and in the form of conveying the content. It is easy to single out the plots, images, themes, etc. characteristic of folklore.

Paremiias with evaluation semantics are considered in this article as units that realize the axiological potential of the language. One of the most important elements of the value of the units under study is the modus of the overall assessment along the line "positively - negatively" [Karasik 2002: 243]. Evaluative and emotionally expressive elements in the semantics of paremiias constitute the essence of.

Researcher S.E. Nikitina considers paremiias as the property of each member of the traditional society. The author of these works is a collective linguistic personality, folklore society, a subject of a special kind, creating his own universe, his aesthetics, his axiology and his collective cultural texts [Nikitina 1993: 13]. Based on the concept of the evaluation mechanism in axiological paremiias, it is the subject of evaluation. The subject of an evaluative action is rarely expressed directly, which is facilitated by the syntactic structure of the proverb: don't put the cat among the canaries.

In a number of paremiias with the semantics of operational preferences, a superlative is used for emotional-evaluative amplification of statements: he works best who knows his trade.

It should be noted that the semantics of "anti-preferences", expressed by the evaluative markers "worse" and "worst", as well as their synonyms, is presented in the paremiological picture of the world very poorly. This is due to the focus of a person, first of all, on the selection and reflection in the consciousness of the positive. An example of such units is the paremiias: debt is the worst poverty; false friends are worse than bitter enemies.

Sentences with operational preference semantics can be complicated by various syntactic units: adverbial elements: a bit in the morning is better

than nothing all day; attributive elements: a bad compromise is better than a good lawsuit.

Estimates in paremias make extensive use of adjective semantics. Instead of the form better or best, another adjective is used in a comparative degree with a pronounced comparative-evaluative meaning. For example: the eye is bigger than the belly; the grass is always greener on the other side of the fence; one father is more than a hundred schoolmasters; the noblest vengeance is to forgive.

A significant number of paremias with a preference value are built according to the principle expressed in paremia: the best is often the enemy of the good.

Preference for adverbial feature: better have a mouse in the pot than no flesh at all; better be the first in the village than second in Rome.

The purpose of intensifying the assessment in paremias of operational preference in English is lexical and grammatical repetition. Repetition - a figure of speech, consisting in the repetition of words, phrases or sentences in one utterance, accompanied by the expression of the speaker's subjective-evaluative attitude to the subject of speech.

The better  $N_1$  than  $N_2$  model in paremias with the semantics of operational preferences is built on the principle of verbatim repetition of a syntactic construction; the form of the comparative degree and the comparative union or the adjective good are repeated: good acts are better than good intentions.

Here are some examples:

- with verbatim repetition: better a husband with a beetle brow than a husband with a beetle head; good acts are better than good intentions; better to do nothing than to do ill;

- with synonymous repetition: a clean feast is better than a dirty breakfast; better an open enemy than a false friend; a sparrow in the hand is better than a pheasant that flies by;

- with antonymous repetition: better one word in time than two afterwards; better be an old man's darling than an old man's slave.

The not particle in the negative predicate form denies part of the content of the evaluative statement. For example: the tongue is not steel but it cuts; health is not valued till sickness comes.

The negation, expressed by the particle not in combination with the auxiliary verb do, in many paremias can be combined with the imperative mood. For example: don't bite of more than you can chew; don't judge others and God will not judge you; don't make a rod for your own back.

The pronoun nothing, describing inanimate objects, is most often found

at the beginning of paremial units: nothing stings like the truth; nothing should be bought, that can be made or done without; nothing is certain but death and taxes. In some cases, this form occurs in the final position: he that knows nothing, doubts nothing; a wise man wonders at nothing.

Estimated values within the framework of specific statements can be combined, intersected, layered on semantics of a different kind. Expressive-emotional assessment can be expressed in a negative construct. Comparative models containing evaluation can be layered on denial models. In a number of cases, paremias, combining comparability and negation, perform the pragmatic function of clarifying the properties of the object of general assessment, revealing them through some kind of situationalism, for example: a good archer is known not by his arrows, but by his aim; a handsaw is a good thing but not to shave with.

Evaluation in English paremias in interaction with negation explicates normative-evaluative concepts, for example: all bread is not baked in one oven; there is no royal road to learning.

The meaning of a generalized subject in paremias can be expressed in complex constructions with the subordinate determinant one who (those who ... he who). For example: he who says what he likes shall hear what he doesn't like.

English paremias often operate with nominees denoting parts of the human body:

1) tongue - compared with a weapon that can be used for defense, in an ambivalent unit: a good tongue is a good weapon; he who says what he likes shall hear what he doesn't like; such a trait as talkativeness is condemned: let not your tongue cut your throat; silence receives a positive rating: a closed mouth catches no flies.

2) hand - the pragmatic function of prohibition is present in the semantics of units: don't put one's arm out further than you can draw it back again (ERPD: A 338/48) (literally: "do not reach out your hand if you cannot return it to previous position "); stretch your arm no further than your sleeve will reach;

3) eyes - the axiology of preferences in paremias highlights vision as one of the priority values. The pragmatics of wishes in the proverb: better one-eyed than stone-blind carries out an evaluative gradation of the senses, describes the principle of "lesser evil";

4) heart – sanctimony is condemned: religion is in the heart, not in the knees.

English paremias express the attitude of a native speaker to certain phenomena: love for the homeland (dry bread at home is better than roast

meat abroad), attitude to drunkenness (Bacchus has drowned more men than Neptune), to patriotism (dry bread at home is better than roast meat abroad), to a reasonable waste of money (money spent on the brain is never spent in vain).

The paremias represent stereotypical values that are vital for a person, associated with his social role. Such values are family (in connection with which the role of choosing a spouse increases), love, friendship, life experience, obedience, the ability to be content with little, work. At the same time, the anti-values of youth are condemned, which means inexperience, a bad spouse, enmity, insincerity, excessive wealth, stupidity: a good husband makes a good wife; youth and age will never agree; a friend in court is better than a penny in purse; he laughs best who laughs last; the noblest vengeance is to forgive; wealth and content are not always bedfellows; he that has no money needs no purse.

Thus, the analysis of the English paremias, containing the assessment, showed that in the English picture of the world, values such as kindness, love, devotion, friendship, responsibility, etc. are relevant and evaluated positively. Stupidity, betrayal, the severity of poverty, human vices, etc.

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## CONCEPTS OF POLITICAL AXIOLOGY

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**Abstract.** In the article, from the point of view of the theory of values, the main categories of political philosophy are considered: politics, management, power. The tribal community was governed by rituals and taboos. In civil society, it is necessary to develop an order of relations between strangers, and for this it is necessary to adopt some rules of behavior that become laws and develop into legal codes, sets of legal norms.

Two circumstances are of fundamental importance in the functioning of social roles: due to the fact that the social role is a secondary and transformed form of personality, it represents, replaces one, several or many personalities. The phenomenon of representation is dialectically accompanied by its reverse side – the personification of a social role. The performer of a particular social role, occupying a position, being nominated for a particular post, being endowed with a certain rank, rank or degree and title, not only freely, but also out of necessity identifies himself and his social position.

**Keywords:** politics, government, power, representation, personification.

In the political, civil sphere of public life, social institutions are formed and social roles are formed as institutional values. This area is studied by such special disciplines as *political science* and *jurisprudence*. Social philosophy is interested in such problems as the difference between political and legal institutions, their emergence and interaction, as well as the essence of the *social role* as a transformed form of the human person.

The term "*politics*" (anc. Greek πολιτική - civil activity) is a concept that includes issues and events of public life associated with the functioning of the state. Its meaning goes back to the ancient Greek name of the city-state - πολίς. [2, p. 95-98] The art of city management, regulation of relations between people in civil society, Aristotel called the word *polyteia*, and Plato generally used the term *cybernetics*, borrowing the word from sailors

who called the *cybernet* of the helmsman who controlled a stern oar and responsible for the direction of the ship's course.

The need for the art of managing social life arises precisely in cities during the transition from barbarism to civilization. The tribal community was governed by customs and traditions, rituals and taboos. In civil society, it is necessary to work out the *order* of relations between strangers. To do this, you need to accept some rules of behavior, which, by virtue of the dictates of the authorities or with general consent, approval and voluntary submission, become laws and are added to legal codes, codes of legal norms (from Latin *us, uridis* - custom, law, legal) [2, p. 95-98]. Lawlessness is social chaos, anarchy, anarchy and "war of all against all", open and continuous violence. Therefore, among the great sages among different nations were legislators who wrote codes of laws and thus brought peace and order into the lives of their fellow citizens. Such are the Tsar Hammurabi in Shume-re, Solon of Athens in Ancient Greece, Emperor Justinian in Ancient Rome, Prince Yaroslav the Wise in Kievan Rus.

The main value in politics is *power*, [3] and the most important element of the system of political relations in society is the *state*, literally in Russian, *rule*. M. Weber's definition is popular in modern social philosophy: "The state is a human community that claims the monopoly of legitimate physical violence within a certain area - geographic, demographic, economic." [1, p. 645] In turn, the community (*Gemeinschaft*) is understood by F. Tönnis "...as a being or a thing whose actions are united in their internal and external orientation", while he considers society (*Gesellschaft*) as "an aggregate or mechanism based on a convention (the form of universal will, supported and preserved by everyone for his own benefit) and natural law". [5, p. 10]

Political and legal elements in the system of institutional values are classified on the basis of the division of social subjects into *individuals* and *legal entities*, and then the *direct* actions of individuals, spontaneous or organized, riots and uprisings or coups and revolutions - are in essence *political actions*. Whereas the actions of legal entities - parliamentary hearings, congresses of parties, election procedures or plebiscites and referendums - introduced into the legal framework, that is, *mediated* by legal norms, *written* acts and regulations, *officially adopted* codes and *publicly approved* constitutions, are *legal actions*.

Let me give you a mundane example. Let's say that I borrowed a certain amount from a friend and do not give it back. He can put pressure on my conscience, rant about honesty, try to repay the debt by force or denigrate my reputation in front of mutual acquaintances - all these are direct

relationships of individuals. It is quite another matter if I wrote a receipt or concluded an agreement. Then my friend will go to court, he will resort to the intervention of intermediaries in the person of a state body, which will issue a resolution and the bailiffs will recover the debt from me in an indisputable manner, up to the forcible seizure of property and restriction of my freedom. And this will be *right*, in other words, *rightly*, in accordance with a *rule* that has the necessary character, since in this situation I am no longer just a friend as an individual, but a defendant as a legal entity.

You can't live without rules. Suppose we sat down to play chess. We played the opening, and I suddenly declare that from the next move the knight will move not with the letter "L", but with the letter "P". Reluctantly - after all, the position is prepared for the attack - you agree. We played the middlegame, and I again insist that the knight should move with the letter "M" in the future. If you grab the pieces off the board and throw them in my face, you'll be right. You can't play like that! The rules must be negotiated "on the shore" and followed from the beginning to the end of the game.

In the functioning of social roles, two circumstances are of fundamental importance. Due to the fact that the social role is a secondary and transformed form of personality, it *represents*, replaces and represents one, several or many personalities. Representation (from Lat. *Representatia* - new presentation) is a demonstration of a thing or personality in some form of secondary objectivity: not in its own, but in another embodiment, literally *in someone else's body*. Due to the fact that the Russian word for *representation* has several meanings (literally: to put in front of someone - a demonstration, spectacle, show, presentation, idea, concept, understanding), then when it comes to representing one object through another, in modern Russian the language often uses the Latin word representation as a word with a more specific meaning. [2, p. 95-98]

The lawyer represents the client in the court; the delegate represents at a meeting or congress his team, who entrusted him to act "on behalf of and on behalf of"; the deputy in the assembly represents the inhabitants of his district; the president is the popularly elected spokesman for the needs and aspirations of the country's citizens. When we give our vote to one or another candidate in an election, the meaning of this procedure is literal: further we will be silent, and our deputy, if he is elected and represents us in the legislative body, speaks for us, *signifying* that we all speak in his voice, he - our *sign*. At least - *in theory* it should be so.

The phenomenon of representation is dialectically accompanied by its reverse side - the *personification* of a social role. Personification (from Latin *persona* - person, and *facio* - I do) *personification*, *prosopoeia*, *an-*

*thropopathism* (from Greek ανθρωπος - person, and πάθος - feeling) - representation of natural phenomena and forces, objects, abstract concepts in the form of actors, including the number of the likeness of a person, or the recognition of their human properties; attribution of the properties of the human psyche to objects and phenomena of the real or fictional world. [2, p. 95-98]

The performer of this other social role, occupying any position, being promoted to this or that post, being endowed with some dignity, rank or degree and title, not only freely, but also out of necessity, identifies himself and his social position. And then the chairman of the board of directors sincerely says "my firm", and the administrator - "my district". The mayor expresses and realizes the needs of the development of *his* city, and then we see what he is more inclined towards: the construction of the metro or the construction of bridges. A diplomat, foreign minister or president, speaking at an international forum, say: "Russia is against... Russia believes..." [4, p. 193 - 196]

It is not just an impersonation as a figure of the tongue. This is the personification of a social role - a source of influence, *charisma* (charm) of a political leader or statesman, colored with bright colors of originality and attractive power of the personality of the performer of a social role, since a politician, like an actor, can be talented or mediocre. At the same time, a genius actor is powerless if he does not rely on a *social base* - a mass of people who invisibly stand behind him and on whose behalf he speaks and on whose support he relies.

*Institutions* (from Lat. *Institutum* - establishment, foundation) are organizational forms of social life, a set of social roles as matrices of human behavior, where these roles are presented as people transformed into a secondary product. Let's imagine that there is a certain social role: let's say the position is the dean of the faculty. Accordingly, there is an official instruction that prescribes all the actions of the dean, defining his rights and obligations, and this is the form. Who exactly will occupy this position, it matters only under the indispensable condition of the performance of official functions. There is a person as an individual - this is any of us; and there is a person as a legal entity - an official in an office, a defendant in a court, a deputy in the Duma, etc. And a person as a legal entity does not behave at all as he wants, but as prescribed. This is the social role.

We all play many social roles on a daily basis. If you come to the university, you are a student or an assistant professor. I went out into the street - you are a pedestrian. I got on the bus - you are a passenger. When you come home, you are a son or a father, a husband or a son-in-law, and in

each case there are canons of behavior: you can be rude to your mother-in-law, but you cannot be rude to your wife; you need to command your son, but not your mother, and so on. Social roles also set the social status of a person, since they, as a rule, are fixed by documents. The fact that a person is a citizen of the state is certified by a passport; the fact that he has a higher education is confirmed by a diploma; the fact that he is a professor can be declared by presenting a certificate. Thus, a document is a form of objectification of a social role. With a document, you are a full-fledged legal entity: you have presented a mandate or a certificate and you can already demand something and make a claim.

In the same way, the social institutions themselves are for the most part objectified and even reified. For example, our university has not only a legal, but also an actual address; educational buildings, a sports complex, a cultural center, hostels and even out-of-town recreation centers. All this is not just property, but the "body" of our organization. On the pediment of the entrance to the main building, large letters make up the name of our organization, on all buildings there are plaques with the name of the university, on the doors of classrooms and offices there are signs of what is located there or what kind of official works there. This is how the university space is organized. Inside the buildings, there are placards everywhere, which indicate the working hours of the services, the schedule of office hours for officials or the schedule of lectures and seminars, etc. This is how the university's opening hours are organized.

With respect to converted or secondary values, the following dependence will be valid: their high rank is determined not so much by the measure of the costs of forces and means for their production, as by the *measure of the costs of their consumption*. This applies primarily to spiritual or ideological, in particular intellectual values. A scientist makes a discovery, an inventor creates a new structure, a philosopher writes a treatise - and we still know all this, we use it, we read and think about it together with the creators. We re-read great books, we are ready to listen to great music again and again, we can and want to see pictures of great artists dozens of times, and they always evoke in us new and new experiences and associations. The situation is similar in relation to the commandments of religious faith. Canons of faith, such as the Bible or the Koran, have shaped the worldview, morals, and behavior of millions of people for millennia. These are eternal values.

The same principle applies to institutional values. The value of a social role is determined by what we can get from its performer. What exactly depends on this or that official, on what and on whom he can influence. Social

roles, such as positions, degrees, titles, statuses, ranks already constitute a hierarchy in themselves, in which we are looking for the level of competence we need in order to receive a certain service: whether state, expert, legal, intellectual or any other. The higher the status, the more visible is the influence, power, power of its bearer. "Power in general is precisely an institutional value". [3, p. 18]

So it turns out that the *direct dependence* of the rank of value, its significance in the existing hierarchy, its place in the subordination of goods is characteristic of the primary elements of society - people and things, and it is determined by the *measure of costs for their production*. Whereas the *inverse relationship* takes place for the secondary elements of society, transformed forms of people - social roles in institutions, and transformed forms of things - signs and images in the form of ideas and ideals, and it is determined by the *measure of costs for their consumption*. [6, p.100]

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## ON THE CONNECTION BETWEEN PHYSICS AND PHILOSOPHY

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**Abstract.** The views of prominent physicists on philosophy and the influence of philosophy on the development of physical science are considered.

**Keywords:** physics; philosophy; philosophical problems of physics; quantum mechanics; theory of relativity; materialism; positivism.

Physics, as a science that studies the most general laws of nature, is not only the leader of natural science and the scientific basis of most modern technologies, but also represents one of the most important elements of the culture of society. The general cultural significance of physics is primarily due to the fact that the achievements of physics form the basis of the modern natural science worldview and form the basic scientific ideas of mankind about the world around us [1]. Due to the generality and breadth of its laws, physics has always influenced the development of philosophy and itself was under its influence. Physics has always been closely associated with philosophy. Outstanding natural scientists, founders of modern physics M. Plank, A. Einstein, N. Bohr, M. Born, V. Heisenberg and many others not only made a significant contribution to the development of physics, which determined the main directions of its further development, but also in a significant way influenced the style of scientific thinking of their time, his worldview. Therefore, the views of physicists themselves on philosophy and the place of philosophy in their scientific work are of particular interest. There have been no special sociological studies on this issue. But in the works of many physicists one can find statements on this matter. Physics, in their opinion, underlies the scientific worldview, the essence of which is that there are laws of nature that are never violated within the framework of their applicability. The law provides the necessary connection between the present state of the world or any part of it and the state immediately following it. This is the predictive function of physics. At the same time, physics, like other natural sciences, is associated with uni-

versal human culture and, according to E. Schrödinger, its "constructions, which are most relevant and important, serve as a result for inclusion in concepts designed for reliable assimilation by an educated stratum of society and transformation into the organic part of the general picture of the world" [2]. This connection with philosophy and the place of physics in the cultural background of civilization should be paid attention to when presenting a physics course in higher education.

The philosophical understanding of the achievements of science began to acquire especially great importance since the XVII century, when science, primarily physics, began to turn into a significant social phenomenon. But only from the second half of the XIX century, the philosophical and methodological problems of science turned into an independent area of research. The novelty of the ideas of the theory of relativity and quantum mechanics, the impossibility of applying classical concepts to the phenomena of the microworld put before physicists the problem of philosophical generalization of new data. The attention of scientists began to be attracted by such philosophical and methodological problems as the content of the concepts of space, time, causality, mass, force, energy; discontinuity and continuity, a combination in scientific knowledge of analysis and synthesis, induction and deduction, theory and experience; the role of empirical and theoretical hypotheses; the role of intuition in cognition, etc. These problems concern not only physicists, but also philosophers. N. Bohr wrote about this: "The significance of the physical sciences for philosophy lies not only in the fact that they continually replenish the sum of our knowledge about inanimate matter, but above all in the fact that they make it possible to test the foundations on which our most primary concepts, and find out the area of their applicability" [3].

The philosophical foundations of physics are formed through the selection and subsequent adaptation of ideas developed in philosophical knowledge to the needs of physics, which leads to the concretization of the initial philosophical ideas, their refinement and development. M. Born wrote: "True science is philosophical; physics, in particular, is not only the first step towards technology, but also the path to the deepest layers of human thought. Just as three hundred years ago, physical and astronomical discoveries debunked medieval scholasticism and opened the way to a new philosophy, today we are witnessing a process that, starting with seemingly insignificant physical phenomena, leads to a new era in philosophy"[4].

Philosophy is often viewed as a methodological basis for scientific research, as a result of the ultimate generalization of empirical data from various disciplines, as a way to integrate particular sciences into a single

whole, as a basis for creating a holistic picture of the world. This is true, physics can operate with extremely generalized categories formulated in philosophy (matter and motion, space and time, finite and infinite, necessary and random, cause and effect, etc.). On the other hand, physics provides a huge amount of factual material for concretizing and developing philosophical laws and categories, understanding many methodological problems of science; physics data can be a starting point for the creation of philosophical concepts and their development. The most important achievements of physics of the XX century led to the destruction of the immovable system of both physical and philosophical concepts of the XIX century. So, established in the framework of the general theory of relativity, the connection between the geometry of space-time and the distribution of gravitational masses in the Universe in a new form raised the old questions about the finiteness and infinity of space, the beginning and end of time, etc. [5].

First of all, it should be noted the conviction of the creators of modern physics in the objectivity of the existing world and its cognizability. "It is essential...that the external world is something independent of us, absolute, which we oppose...We must admit that there is a real world that does not depend on our consciousness. The laws of nature are not invented by man, he feels them, nature makes itself felt. They are a reflection of its inherent order" wrote M. Planck [6]. I am convinced of the cognizability of the world around us and S. Hawking: "We still do not know a lot about the Universe, we do not understand a lot. But the progress already made, in particular over the past hundred years, should inspire us and give us confidence that full understanding is within the bounds of the possible. I think we are not doomed to feel forever in the dark. Having made a leap towards the creation of a complete theory of the Universe, we will become its true masters...".

Within the framework of physics, the philosophical categories "matter" and "motion" were further developed, the concepts of which were significantly changed by physics of the XX century. The deep meaning of the concept of matter is revealed not in classical physics, but precisely when the concepts of field, physical vacuum, dark matter and dark energy are introduced as different types of matter, i.e. in the theory of relativity, quantum mechanics, atomic and nuclear physics, physics of elementary particles. Here is the point of view of M. Born, expressed by him after the creation of the theory of relativity: "Thus, we have achieved a tremendous unity of our knowledge about the material world: matter in the broadest sense of the word (including light and other forms of pure energy in the language

of classical physics) has two fundamental qualities: inertia, measured by its mass, and the ability to do work, measured by its energy. These two qualities are strictly proportional to each other" [7]. The material unity of the world, which is a moving matter, serves as the philosophical basis for the unity of the system of natural and technical sciences. Moreover, the humanities are gradually being included in this system. M. Plank noted: "Science is an internally unified whole. Its division into separate areas is due not so much to the nature of things as to the limited ability of human cognition. In reality, there is an unbroken chain from physics and chemistry through biology and anthropology to the social sciences, a chain that cannot be broken in any place, unless at will" [6].

The principle of relativity by A. Einstein, the principles of correspondence and complementarity proposed by N. Bohr, the principle of uncertainty by V. Heisenberg and others have become general philosophical principles. According to S. Hawking, "The principle of uncertainty has far-reaching consequences related to our perception of the world around us. Even after more than fifty years, many philosophers have so definitively disagreed with them, and these consequences are still the subject of controversy. The uncertainty principle meant the end of Laplace's dreams of a scientific theory that would give a completely deterministic model of the Universe: in fact, how can one accurately predict the future without even being able to make accurate measurements of the state of the Universe even at the moment!" [8].

The exceptional generality and universality of conservation laws formulated in physics determine their methodological and philosophical significance. A. Einstein emphasized the role of physics in the development of philosophy: "The results of scientific research often cause changes in philosophical views on problems that extend far beyond the limited areas of science itself" [9].

A significant contribution to the development of philosophical thought in the XX century was the scientific work of A. Einstein. The special and general theories of relativity changed the scientific picture of the world, in which they found a new solution to the problem of the space-time structure of the Universe, the idea of its continuous evolution. Einstein's scientific work influenced the style of scientific thinking as a result of the development of new standards of scientific knowledge, in which the Copernican tradition of rejection of anthropomorphic evidence was further developed. Einstein's reflections on the fundamental philosophical problems faced by physics made him a staunch supporter of the materialistic idea of the objectivity of the existence of the world around us: "The belief in the ex-

istence of an external world, independent of the perceiving subject, lies at the basis of all natural science. But since sensory perception provides information about this external world, or about "physical reality", indirectly, we can grasp the latter only through reasoning. It follows from this that our ideas about physical reality can never be final. We must always be ready to change these ideas, i.e. change the axiomatic basis of physics in order to substantiate the facts of perception in the most logical way"[9].

The theory of relativity made it possible to revise the traditional views and ideas about the structure of the material world, revealed the closest connections between philosophy and natural science. It allowed to resolve the internal contradictions between classical mechanics and electrodynamics. The greatest influence on the development of physics was exerted by Einstein's concept of the unity of the world. The ontological aspect of this concept consists in the idea of a single basis of the world, epistemological in the requirement to search for a single general principle, from which special cases can be deduced as particular ones.

In the structure of scientific knowledge, empirical and theoretical levels are distinguished. But for an adequate description of the local area of knowledge, these two levels are not enough. It is necessary to highlight another significant level of the structure of scientific knowledge - the metatheoretical level, which includes the philosophical foundations of science, containing general ideas about reality and the process of cognition, expressed in the system of philosophical concepts. The philosophical foundations of science include philosophical ideas and principles that substantiate the ideals and norms of science, inscribing scientific knowledge in culture, as well as the scientific picture of the world. Philosophical foundations reveal themselves to a greater or lesser extent, depending on what kind of science we are dealing with. But in any science, a scientist proceeds from the philosophical position that all real objects and phenomena that he encounters are causally conditioned. A. Einstein noted that "...philosophical prejudices prevent the correct interpretation of facts even by scientists with bold thinking and subtle intuition. The prejudice, which has survived to this day, is the conviction that facts by themselves, without a free theoretical construction, can and should lead to scientific knowledge"[10].

Physicists usually refrain from claims of belonging to a particular school of thought, even if they are aware of this. The influence of philosophical views on their scientific work is often decisive in the creation of new concepts. M. Jemmer believes that "philosophical considerations affect the thinking of a physicist rather as an underwater current, not visible from the surface, than as an obvious, clearly defined guiding force" [11]. All the

more interesting is the recognition of V. Heisenberg about the influence of Plato's ideas on his views on the nature of elementary particles: "The smallest units of matter are really not physical objects in the usual sense of the word, they are forms, structures or ideas in the sense of Plato, about which we can speak unambiguously only in the language of mathematics. Both Democritus and Plato hoped, with the help of the smallest units of matter, to approach the "one", to the unifying principle, which obeys the course of world events. Plato was convinced that such a principle can only be expressed and understood in mathematical form. The central problem of modern theoretical physics is the mathematical formulation of the law of nature that determines the behavior of elementary particles"[12]. From the mathematical symmetry of Plato's regular bodies, Heisenberg throws a bridge to the group-theoretical structure of the equations of modern physics, to the Lorentz group, which determines the structure of space and time.

The development of theoretical thinking is inextricably linked with the development of philosophical categories. But their development should take place on the basis of new data on the objective properties of the world around us, established by physics and other natural sciences. W. Heisenberg believed that it is most expedient to consider philosophical conclusions from the ideas of modern physics on the basis of a historical analysis of the development of quantum mechanics [5]. The philosophical foundations of science are involved in the creation of new theories, the restructuring of the ideals of research. Paying attention to the importance of philosophy for scientific knowledge, L. Brillouin wrote that "scientists always work on the basis of certain philosophical premises, and although many of them may not be aware of this, these premises actually determine their general position in research." In modern conditions, the share of the philosophical component in decision-making systems, especially when choosing a research methodology, is increasing dramatically. A. Einstein wrote about this: "In our time, a physicist is forced to deal with philosophical problems to a much greater extent than physicists of previous generations had to do. Physicists are forced to do this by the difficulties of their own science"[9].

With the development of physics, the complication of its tasks, the need for a special study of its philosophical foundations is increasingly revealed. According to M. Born, modern physics cannot do without turning to philosophy, which carries out "the study of the general features of the structure of the world and our methods of penetrating this structure" [4]. H. Bohr noted, in turn, the great importance of physics for the development of philosophical thinking: "In our century, the study of the atomic structure of matter has

revealed an unexpected limitation of the range of applicability of classical physical ideas and shed new light on the requirements of scientific explanation contained in traditional philosophy. The revision of the foundations and prerequisites for the unambiguous application of our elementary concepts, which is necessary for understanding atomic phenomena, therefore has a meaning that goes far beyond the limits of physical science alone"[3].

However, there is a definite borderline between physics and philosophy. The problematic of philosophy is always fundamentally different from that of physics. Physics asks questions about the forms and ways of existence of the phenomena of the surrounding world, and philosophy - about the reasons and goals. Unlike physics and other natural sciences, philosophy strives for a holistic perception of the world. In philosophical knowledge, both the objective description of the world as a whole and the subjective, personal position of the philosopher, depending on his personal life and moral experience, are presented at the same time.

The correct philosophical orientation is especially important at the crisis moments in the development of physics, when old ideas are undergoing a radical revision. After the introduction of the quantum of action into physics by M. Planck, the positions of mechanical materialism were significantly shaken. The attention of physicists was attracted by the ideas of positivism, which asserts that every concept of the theory must refer to observable quantities. In the spirit of positivism, W. Heisenberg included only observable quantities in his version of quantum mechanics - matrix mechanics. However, with the development of the atomic theory dealing with unobservable objects, V. Heisenberg not only rejected positivism, but also sharply criticized it [5]. There are sad cases when an incorrect philosophical position led to rejection or denial of the theory of relativity, quantum mechanics, cybernetics, genetics, etc. Only an understanding of the relationship between absolute and relative truth, a conviction in the materiality and knowability of the world around us, within the framework of the correspondence principle, allow us to correctly assess the essence of revolutionary transformations in physics and accept only those of them that do not lead to the collapse of physical theories, but enrich and deepen our ideas about matter and motion. According to V. Heisenberg, "natural science has two tasks: to approach the understanding of nature, thereby creating an opportunity to put it in the service of man, and to determine the place of man in nature by actually penetrating into its internal relations" [13]. It is a well-known point of view that the highest and ultimate goal of science is the construction of the latest theory of Everything, which would fully reflect the most fundamental properties of the real world, including the

inner space of the person himself. Science will never be complete, since the process of knowing the limitless world is endless. In addition, an infinite number of particular problems that need to be solved appear all the time. Regarding the difficulties awaiting the researcher on the endless path of human knowledge, L. de Broglie wrote: "The progress of science cannot be compared with a circular motion, which all the time returns us to the same point; rather, it is comparable to a spiral movement; the spiral movement periodically brings us closer to some of the already passed stages, but we should not forget that the number of spiral turns is infinite and that the turns increase and rise up"[14].

The current stage in the development of an industrial society is often called the "risk society". Risk has become an attribute of today's unstable society. The degree of its uncertainty and instability began to grow since the rate of development of technology began to exceed the rate of understanding by human society of the causes and especially the consequences of this development. The risk is often directly related to the dangers of modern technology that threaten planetary civilization. Evaluation of the positive and negative consequences of a particular technology, which is based on new physical effects, on the environment is often hampered by the lack or even the absence of the knowledge necessary to solve it. For the first time in history, society is dealing with an artificially created prospect of self-destruction [15]. Under these conditions, the responsibility of science and scientists to society increases. V.F. Weisskopf stated: "Physics is not only a search for truth, but also a potential power over nature" [16]. Scientists must foresee what this or that discovery will bring to mankind and society, timely recognize the undesirable consequences of their discoveries and new technologies. Assessing the instability of the current state of civilization from the point of view of the principle of uncertainty, I. Prigogine wrote: "...the idea of instability not only in some sense theoretically supplanted determinism, it, moreover, made it possible to include human activity in the field of view of natural science, thus giving the ability to more fully include a person in nature. Accordingly, instability, unpredictability and, ultimately, time as an essential variable now began to play an important role in overcoming the disunity that has always existed between social research and the sciences of nature"[17].

Global models and forecasts of the development of human civilization made it possible not only to see the real situation of the global crisis, but also raised the question of the need to develop a strategy for the further development of mankind. Knowledge of the laws of the development of the Universe and living communities, knowledge of the causes of environ-

mental and other global crises that threaten civilization, allow mankind to navigate in choosing the path of development of human society, ensuring the survival of both individuals and civilization as a whole [18]. Saying that modern science has enormous achievements that can be used to the detriment of humanity, Heisenberg warns: "The task of science is, perhaps, precisely to awaken in people a sense of how dangerous this world has become, to show them how it is important that all people, regardless of their nationality and ideology, unite to reflect this danger"[13]. The words of V.F. Weisskopf also serve as a warning to scientists: "There is one more side of science... It recognizes the uniqueness of life on Earth, which took several billion years to develop. The loss of a living being means the irreparable loss of a certain genetic combination. The biological heritage fund, formed as a result of a slow evolutionary process, would be irretrievably lost if destroyed by a human-induced disaster. It is our responsibility to preserve and further develop this fund, which is in our hands and the best or worst future of which depends on us. We are now responsible for the successful continuation of this extraordinary experiment that nature began on Earth. Naturally, these aspects of science have a profound influence on our thinking; they can lead to the creation of some semblance of ethical laws, at least among the scientific community, whose members are imbued with these ideas"[16]. There is no doubt that the union of physics and philosophy will play a decisive role in the preservation of civilization on Earth.

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**DEVELOPMENT OF SCHOOL EDUCATION IN THE MORDOVIAN ASSR IN THE POST-WAR PERIOD (1945-1953) <sup>1</sup>**

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**Abstract.** Based on the materials of the Mordovian ASSR, the article analyzes the problem of the development of school education in rural areas in the post-war period. Attention is focused on the involvement in the education of children in rural areas, the training of teaching staff, the material and technical condition of schools, the provision of educational and methodological literature.

**Keywords:** Mordovian ASSR, post-war period, education system, rural school.

Despite numerous human losses in the war with Nazi Germany and its allies, the destroyed cities and villages, the leadership of the Soviet Union understood that it was necessary to solve the problem of restoring the country's socio-economic system, which had been undermined during the war years, as soon as possible. An important role in this was assigned to the development of intellectual potential, which was based on universal school education, which was actively promoted in the 1920s and 1930s and was seriously affected during the four war years. The network of school institutions itself was preserved, continued to work under conditions of great restrictions, but there was not enough teaching staff, the material and technical support and supply of schools with educational and methodological literature were extremely deplorable. Therefore, immediately after the end of the war, the government set clear tasks in overcoming all existing difficulties and further developing the education system, which was really supposed to become universal.

All the difficulties of the post-war education system are clearly visible on the example of certain regions of the country. In particular, the entire spectrum of existing problems and actions to overcome them can be seen

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in the example of the Mordovian Autonomous Soviet Socialist Republic (MASSR), which during the war years was the rear area of the country, but experienced all the difficulties of wartime.

So, for the 1945/46 academic year, it was planned to fully cover school-age children with primary education, to eliminate the shortage of educational and educational-methodical literature. Basically, the tasks were completed. So, in the 1945/46 academic year, 1305 schools operated in the MASSR, of which 917 were primary, 291 were seven-year, and 97 were secondary. The total contingent was 132,926 people, where 101,996 people studied in grades 1–4, 25637 in grades 5–7 and 3,234 people in grades 8–10 [5, p. 145].

However, a large percentage of those not covered by primary education remained, for the 1946/47 academic year there were 5133 people, where 3612 people were supposed to study in general education schools and 1512 people in overgrown groups [5, p. 145]. So, in the school of the village of Novaya Aleksandrovka, Meltsansky District, for the 1946/47 academic year, out of 194 children aged 8 to 11 years old, 6 did not study, and at the age of 12 to 15 years, 17 people did not attend classes [16, l. 2].

In the 1948/49 academic year, the autonomy moved to the implementation of a plan for universal seven-year education in rural areas. So, most of the schoolchildren who graduated from the 4th grade (22344 people) in 1948 were transferred to the 5th grade (22316 people) [13, l. 14-15]. One of the measures to attract public attention to the life of the school, education was to be the establishment of the annual holiday "School Day", the celebration of which was planned on September 1 or the first Sunday in September, starting in 1949 [10, p. 41-43].

By 1950, 43 primary schools were reorganized into seven-year schools, and boarding schools were opened at 20 seven-year schools. And that for the 1949-50 academic year in the republic there were 337 seven-year schools, of which 329 were in rural areas [14, l. 19].

However, there are also shortcomings in the implementation of the seven-year rural education. In particular, for the 1948/49 academic year, about 403 people. at the age of 7 to 15 years were not involved in training [5, p. 148].

Just as in the war years, the percentage of students who do not succeed remains high. So, in the village of Novotroitskoye, Staroshaigovsky district, at the beginning of the 1945/46 academic year, there were 236 students in the school, of which there were 106 underachieving students, who had from 1 to 12 twos - 51 students [2, p. 90]. For 1948/49 ac. year in the republic 561 schoolchildren were expelled, for absences without good

reason and academic failure. In particular, this indicator was significant in the schools of the Saransk district - 46 people, Atyashevsky - 37 people, Elnikovskiy - 36 people, Atyurievskiy - 27 people, Bolshebereznekovskiy - 27 people, Kozlovskiy - 25 people and Temnikovskiy district - 20 people. The dropouts were mainly caused by low school attendance due to the remoteness of settlements from school buildings. At the same time, the District Department of Public Education (DDPE) was unable to properly organize the delivery of children or organize accommodation in apartments, which to a greater extent was reflected in the total dropout rate of students [5, p. 148].

In 1951, a significant attempt was made to enumerate all children between the ages of 6 and 15 who were to be admitted to the 1st grade. On August 1, 1951, a colossal work was carried out by school teachers to sample data on the age of children from household books and by means of house-to-house rounds, as a result of the work carried out, 171303 people were counted. However, universal coverage was again not achieved due to the poor performance of local executive committees, which often did not participate at all in the registration of children. So, in the Kadoshkinskiy district, 4429 people aged from 7 to 15 years old were counted, and in fact, 4601 people came to the classes, in the Lyambirskiy district, 4291 people were counted, and 4402 people came to the classes [5, p. 148].

The total contingent of students for the 1951/52 academic year, together with overgrown classes, amounted to more than 186 thousand people, but about 2822 people remained not covered by education, where 338 people did not attend school due to illness, 514 people did not attend school, 514 people did not work on a collective farm, 533 people did not go to work on a collective farm, housework for hire - 67 people, work at an enterprise - 104 people, remoteness from schools - 190 people, overgrown people - 165 people, and lack of clothes and shoes - 33 people [5, p. 149].

Mishina V.N. recalls: "I really wanted to go to school, but my mother became very ill, I had to take care of my mother and aunt. My girlfriends of the same age had already gone to school, and when they called me for next year, I didn't want to, because my friends were already in the 2nd grade, and I didn't go, and there was no time. Later my mother bought me an ABC book, I learned letters from it, and that's how I learned to write in block letters"[9].

In the 1952/53 academic year, the total number of schools decreased by 15 units due to their temporary closure in sparsely populated areas. Thus, the total number of schools was 1313, including 370 seven-year schools. However, the seven-year general education program, which was

supposed to cover 183 thousand people with education, was not fully implemented, in total there were almost 173.5 thousand students at the end of the school year, since at the end of 1951/52 academic year 5595 people left the republic. [5, p. 149].

In 1953, the total number of schools is also decreasing and is already 1285 educational institutions, and the total number of students is also reduced to 164.7 thousand people. Despite the general increase in the number of schools to 1294 in 1954 and 1293 in 1955, the number of students dropped significantly to 157.5 thousand in 1954 and 147.2 thousand in 1955 [12, p. 118], which was largely due to the degree of reduced post-war birth rate.

In the post-war period, financial receipts for the material and technical support of schools have improved. On average in the country, the cost of improving and equipping schools increased 16 times compared to 1940. In general, in Mordovia in 1950 compared to 1940 funding increased more than 2 times [5, p. 154].

The main part of the expenses was directed to capital and current repairs of buildings. As a rule, the parent community and the patronage of collective farms play an important role in the renovation of buildings. However, it should be noted that due to a shortage of building materials, repairs were often not carried out in full. So it is noted that for the 1945/46 academic year in some schools of the republic, namely in the Insar, Saransk and Romodanovsk regions, instead of major repairs, only the current one was carried out. For example, the iron roofs remained unrepaired and unpainted, some of the windows were filled with plywood, in the winter season in many schools there were not enough double frames [5, p. 154].

In Bolshebereznikovsky district, in preparation for the new 1946/47 school year, it was planned to carry out major repairs in 11 schools of the district, but in the end, only 3 secondary schools were financed, which were on the regional budget, the rest of the schools were on the budget of village councils, as a result of which these schools were able to conduct only routine repairs [18, l. 27].

However, during the period from 1946 to 1951, about the autonomy was repaired about 4820 schools. At the beginning of the 1948/49 academic year, 1220 schools out of 1236 schools covered by repairs were repaired in the republic, where of them 304 out of 320 schools were overhauled and 916 schools were repaired. Also, at the beginning of 1948, it was planned to put into operation 7 new schools, but only one was fully completed. The rest of the schools under construction were 50-85% ready,

where the reason for the cooling in the pace of construction was the lack of building materials and the lack of fuel for the transportation of building materials [11, l. 43]. In the 1949-50 academic year, 41 more new schools were built. In the 1951/52 academic year, 1,093 schools were renovated and 7 new schools were built. In the 1954/55 academic year, 298 schools were repaired, 966 schools underwent current repairs. So, in the Kuldym seven-year school of the Meltsan district in the 1946/47 academic year, 3.7 thousand rubles were spent on major and current repairs, in the 1947/48 academic year, 7 thousand rubles were spent, in the 1948/49 and 1949/50 academic years and - 6.5 thousand rubles [16, l. 22].

However, the pace of construction of new schools was insufficient, as in many schools classes were held in several shifts. So, in 647 schools, training sessions were conducted in 2 shifts, and in one in 3 shifts [5, p. 155]. So, in the Kuldym'skaya seven-year school from 1946 to 1949, the school was trained in two shifts, where 6 classes were engaged in the first shift, and 3 classes in the second shift. For the 1949/50 academic year, 7 classes or 206 people were engaged in the first shift, and 106 people in the second shift of the 3rd class [16, l. 21].

There was a gradual improvement of the material and technical base of schools in Mordovia. During the years of the Great Patriotic War, new furniture practically did not enter the republic's schools, many of which became dilapidated, there was a lack of high-quality blackboards, and there were often no tables and chairs for teachers in the classrooms.

The situation began to improve in the 1946/47 school year, when about 15485 school desks, 2692 tables, 3869 chairs, 5229 benches, 1978 blackboards and 404 cupboards were repaired and purchased in schools. However, the following year, the supply plan was disrupted, which led to the preservation of the existing position until 1950. In 1951, industrial plants and martels produced 3551 school desks, and active restoration of old furniture was also carried out. Compared to 1940, the number of manufactured furniture increased by 3.5 times and amounted to 2,023 desks in the 1954/55 academic year [5, p. 156]. So, in the Temyashevskaya incomplete secondary school of the Meltsan district for the 1946/47 academic year, there were not enough 109 double desks, 2 blackboards, 5 laboratory tables, 6 teachers' tables, 18 chairs, 158 hangers, etc. in the next 1947/48 academic year, the shortage of double desks increased to 123, there was also a lack of 16 chairs, 2 blackboards, and in the 1948/49 academic year the supply of double desks was already beginning and their shortage was only 90 units, there was a shortage of chairs and teacher tables [16, l. 49].

The situation with office supplies also remained difficult. In the 1946/47 academic year, the Mordovian ASSR received more than 5162.6 thousand notebooks, 1027 thousand pencils, 351.1 thousand colored pencils, 2888 thousand pens, 34 thousand student pens, 105 thousand bags of black powder, 20 thousand student rubber bands, 30 thousand student ink, 1020 watercolors, 70 thousand ready-made, 20 thousand cans of ink, 1 thousand compasses. But in 1951 more than 10265.1 thousand notebooks were received in the republic, so each student received on average 50 pieces, as well as a large number of other necessary products [5, p. 157].

The circumstances were more difficult in relation to the supply of school textbooks. As in the war years, an attempt was made to restore old textbooks. In the summer of 1946, schools were collecting and resale of supported textbooks, the number of which amounted to more than 236.6 thousand copies, some of which were practically worn out. In the 1946/47 academic year, the autonomy received 216.6 thousand copies of new textbooks [5, p. 157].

In subsequent years, the situation with the supply of educational literature has improved slightly. Thus, in the 1947/48 academic year, about 463.8 thousand copies of textbooks were received, and in the second half of the year, another 53.5 thousand copies of textbooks were delivered. The situation is also improving with the release of literature in the Mordovian language, about 24 types of textbooks with a total circulation of 238 thousand copies [5, p. 152].

By the beginning of 1948, more than 477.5 thousand copies of textbooks had been received by the schools of the republic (including 151.1 thousand copies for grades 1-4 and 331.3 thousand copies for grades 5-10) and by the end of the year this indicator increased to 760.2 thousand copies of textbooks, in 1949 - 16600 copies from the plan of 1948. From 1950 to 1955 the number of new books amounted to 27334 copies. And from 1950 to 1952, 535 thousand used textbooks were bought and resold [5, p. 158].

So, in Vertelinskaya secondary school for the 1946/47 academic year, with a total student population of 285 people in the school library, the total stock of textbooks was 591 copies, fiction - 15 copies, popular science literature - 10 copies, other literature - 170 units, methodological literature for teachers was completely absent, visual aids were also practically absent [15, l. 4].

In the Bolshebereznekovsky district for the 1946/47 academic year, the fact is noted that by the beginning of the academic year there were practically no ABC books in the first grades. So, there were only 125 primers for

38 schools in the district. And only in the second half of the year, schools received a sufficient number of copies. For 3 grades of Russian schools there were no textbooks "Native speech" at all, and 3 grades of Mordovian schools studied not with their own textbooks, but with other books. For example, in the Simka seven-year school, the 3rd grade teacher Lebedeva taught classes using the 4th grade textbook [18, l. 28].

In the first post-war years, the problem of supplying schools with fuel was also acute. So, because of the untimely delivery of fuel, classes were disrupted. So, in the 1945/46 academic year, the Maresevskaya seven-year school of the Chamzin district could not work for 45 days due to lack of fuel. In total, disruptions of classes from 1 to 156 days were recorded in 68 schools of the republic [5, p. 156]. In the Bolshebereznekovsky district in the 1946/47 academic year, 4 schools were left completely without firewood for 2-3 days, as a result of which classes had to be canceled [18, p. 27].

Relative stabilization began in 1949, when most of the republic's schools were provided with a proper supply of fuel. And in the 1954/55 academic year, 708 schools were provided with fuel for the entire heating season, more than 50% - 490, less than 50% - 71 schools [5, p. 156].

The post-war school undoubtedly acquired greater importance for the entire population of the country, many began to associate hopes for a better future with the school, the opportunity to escape from the countryside. Confirmation of this fact can be seen in the memoirs of eyewitnesses. Zaitseva A.E.: "After the war, more children began to go to school and there were more teachers. Some people were forced to go to school, many did not want to, there was a lot of work at home"[6]. Katyshov N.E.: "I loved going to school, I did a good job, I was given study. We went to school in whatever we have to, in rags, in bast shoes. Textbooks and other supplies were given to us at school. They even fed us there, they cook cabbage soup and let a small piece of meat go. Here you sit and eat from a common dish and no one could eat that piece of meat, just try to scoop it up, it will crack on the back of your head with a spoon, but it hurts, and here you sit, you gulp the broth, and then the meat remains, they will divide it up for everyone"[7]. Mayorova A.V.: "Father always told us – "learn, you will become people". The nanny (older sister Nadezhda Vasilievna Kladova - the author) first finished our 4-year-old school, then finished 7 and then entered. There she had to pay money for the 8th and 9th grades, but they found the money so that she could study further. My father always loved the nanny, he wanted her to learn to be a teacher. And after school she studied at a pedagogical school and worked as a teacher of elementary grades all her life"[8].

It was the shortage of teaching staff that was the main problem for the post-war school system. So, 7590 teachers worked in MASSR, of which 439 people did not have a pedagogical education [5, p. 150]. In this connection, an active work on the training of pedagogical personnel was launched, through the expansion of student admission to the Mordovian State Pedagogical Institute named after V.I. Al Polezhaev and Temnikovskiy Teachers' Institute, as well as in pedagogical schools [5, p. 150]. So for the 1944/45 academic year in the pedagogical and teaching institutes, the total contingent was 528 people, including 21 men and 507 women. According to the ethnic composition, 456 Russians, 63 Mordvins, 2 Tatars and 7 other nationalities studied [17, l. 4]. In 1945, 10 people were released in the specialty of history, 10 people - language and literature specialists, 14 people - natural science, 9 people - physics and mathematics. All teachers were sent to the schools of the Mordovian ASSR [17, p. 5].

Thus, the post-war school education system showed an incredible pace of development in the face of a general shortage of both labor and financial resources. The example of the Mordovian Autonomous Soviet Socialist Republic shows that, in spite of the difficulties, most of the children and adolescents were involved in education and this subsequently gave obvious positive results. Rural schools of Mordovia laid the foundations of education for many famous people in the autonomy and beyond, among them:

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7. FMA. Nikolay Efimovich Katyshov, born in 1939, the village of Podvernikha of the Staroshaigovsky district of the Republic of Mordovia, recorded in 2017

8. FMA. Antonina Vasilievna Mayorova, born in 1930, the village of Govorovo, Staroshaigovsky district, Republic of Mordovia, recorded in 2020.

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## SOCIAL SPACE IN MUSIC: ORGANIZATION AND PROBLEMS OF MEANING FORMATION

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**Abstract.** The problem of social space has been actively developed in philosophy, sociology and the humanities related to art criticism since the end of the XIX century, but has not yet found its proper reflection in musicology, although the social world of a person is one of the most attractive figurative spheres and philosophical themes of musical art. The purpose of the study - is to identify the ways of expression and models of the organization of social space in music. Methods - an integrated approach, methods of experimental sociology, musicological analysis.

**Discussion.** Along with the reflection in music of universal models of human communication by the type of dialogue-dispute in a concert grosso or concert; dialogue-consensus, typical for instrumental pastorals (duets, trios, serenades and cassations), its substantive part also includes specifically musical "models". Often they are recreated by imitating in piano pieces the timbre colors characteristic of musical instruments of trios, duets and quartets, the register contrast of thematism, and recreating the playing techniques inherent in various instruments of the ensemble. In the music of the XX - XXI centuries, instrumental themes more and more often begin to behave like characters in a musical piece, with the instrumentalist transforming into a specific character in the drama. Strings, due to the proximity of their timbre to the human voice, often perform the functions of the main character. Pianos, drums, winds play the role of images of antagonists, for example, in Dialogue for cello and chamber ensemble, A. Schnittke's Second Violin Concerto, S. Gubaidulina's Concerto for Viola and Orchestra and many other works of contemporary music.

**Conclusions.** Thus, the following become significant ways of expressing social space in music: 1) reproduction of universal models of

human relationships, which can be classified according to the interaction of participants in communication - agreement, cooperation, confrontation, competition and others; 2) the recreation in music of specifically "musical" models of interaction, typical for various instrumental ensembles. At the same time, it is important in the ontology of social space in music that these ways of organizing space in music do not exist on their own, but interpenetrate each other.

**Keywords:** musical meaning, organization models, agreement, cooperation, confrontation, competition, social space.

The problem of social space has been actively developed in philosophy, sociology and the humanities related to art criticism since the end of the XIX century, but has not yet found its proper reflection in musicology, although the social world of a person, in our opinion, is one of the most attractive imaginative spheres and philosophical topics in musical art.

"Social space", according to the research of E. Hall, is determined by the norms of proxemics and a distance from 120 cm to 3 m, typical for communication between strangers during official communication [9, p. 121-123]. In music, by social space, we mean different structures of interaction between members of a small group, both in musical practice and in the content of a musical work. Here we are interested in solving the question of how the principles of organizing social space in a small group contribute to the processes of meaning formation in music. The concept of social space in its very formulation covers a wider range of phenomena than those that E. Hall implies, characterizing the distance of official communication. Accordingly, we can talk about the development of only a certain aspect of the concept of "social space", which the American anthropologist chooses for research. The direction of study presented by him, in general, lies in the mainstream of Russian and foreign sociology, where a number of important characteristics of social space are gradually determined.

The study of social space began in philosophy in the context of understanding social processes. So E. Durkheim believed that the category of space is a purely social category determined by human experience [cited in: 5, p. 128]. Nevertheless, initially in the works of philosophers and sociologists of the XIX century, the parameters of physical space were directly projected onto social space. We know that the measurement of physical space occurs in the parameters of continuity/discreteness; connectedness/separateness; symmetry/asymmetry and others. However, in the course of the research it turned out that other factors were important for measuring the parameters of social space, which allowed V.K. Potemkin and A.L.

Simanov to formulate the concept of "social space" as a space formed by social processes and interactions, in which these processes and interactions are realized"[5, p. 130].

A number of studies of social space undertaken by scientists in a historical and geographical key and from an architectural point of view [8, p. 23-31], from the standpoint of social interactions [6, p. 3-17], in a psychological and philosophical key [3, p. 30-42], led to the conclusion that "social space does not exist in the physical and geographic, but against the background of physical and geographic spaces that act as an external necessary condition" [6, p. 4]. Thus, a different nature of social space, which differs from the physical, was designated.

This idea led to the expansion of the conceptual apparatus and the introduction of more adequate values for its measurement, for example, such as "social distance", "social strength", "social dynamics", "field" and others. The listed concepts to the greatest extent reflect the *qualitative* characteristics of interactions occurring in a small group, the dominant principle of which, according to the Russian psychologist A.V. Petrovsky, is *individualism*. The group unites to achieve a common goal, "working" to fulfill, among other things, the individual "goals" of its members. Relationships within the group are variable, dynamic and directly dependent on external conditions. The situation is changing - the leader and the structure of the organization of a small group, including from three to 24 people, is changing [2, p. 137-140].

To prove this idea, we will give a number of examples. In the music of the XVII century, thanks to the traditions of "musical communication", the most common models of human interaction were fixed in the genres of vocal and instrumental duets, trio sonatas, quartets, concerto grosso and concerts. The listed "forms of communication", having become entrenched in the scores of chamber instrumental music, rather easily "migrated" into music for clavier and piano. G.A. Demeshko rightly notes that "genetic stable forms of play dialogue and instrumental forms of communication freely penetrate into a non-dialogical, by its nature, genre context, dialogizing it from within" [1, p. 198]. However, the nature of "musical" communication is characterized not so much by the quantitative parameter and various structural combinations as by the *semantic* aspect of the participants' relationships.

The different meanings of communication recorded by the music are indicated by the program titles, pre-sent, for example, to the sonatas by Domenico Scarlatti – "Bucolica" (sonata in *d-moll* K 8), "Pastoral" (sonata *F-dur* K 9), "Farewell" (Sonata *E-dur* K 206) and others. The specifics of

the interaction of subjects in them is revealed intonationally - through a gesture, as, for example, in the Sonata *B-dur* K 440 (minuet); lyric intonation, as in the Sonata *d-moll* K 77 (*Moderato e cantabile*); Signs-signals inherent in various situations of communication - a call to hunt (in the Sonata *D-dur* K 96), drum rolls and a dotted rhythm formula inherent in the procession (Sonata *E-dur* K 380) and others.

Various relationships between subjects of social communication are modeled in clavier music not only in the form of characteristic intonations and textured formulas, but also in the organization of the composition according to the type of dialogue-dispute in a concert grosso or concert; dialogue-consent, typical for instrumental pastorals (duets, trios, serenades and cassations).

Along with the reflection of universal models of human communication in music, its content part also includes specifically musical "models". Often they are recreated by imitating in piano works various timbre colors characteristic of musical instruments of trios, duets and quartets. This technique is used in works written for one instrument to enhance the relief of other, besides the main, images with the help of register contrast of thematic. For example, on the harpsichord, to compensate for the monotony of dynamics, musicians used a variety of timbres, including the difference in the lute, bassoon registers, the contrast of the upper and lower ranges. The use of contrast in harpsichord timbres can be seen in Jean-Philippe Rameau's "Conversation of the Muses".

In the music of the XX - XXI centuries, instrumental themes are increasingly beginning to behave like characters in a musical play, confirming the thoughts once expressed by Yu.N. Tyulin: "... In major works, the theme is a kind of bearer of the musical image, the basis and focus of its development. In this respect, an analogy can be drawn between the theme in instrumental music and the character (actor) in the opera. Both of them are carriers of the musical image, and not images in themselves"[7, p. 11].

Contemporary composer's opuses tend to transform the instrumentalist into a specific character in the drama. The strings, due to the proximity of their timbre to the human voice and the lyrical expressiveness of the melodic dominant of the instrument, often perform the functions of the main character. Pianos, drums, winds play the role of antagonist characters, for example, in "Dialogue" for cello and chamber ensemble, Alfred Schnittke's Second Violin Concerto, in the Concerto for Viola and Orchestra of Sofia Gubaidulina and many other works of contemporary music.

Thus, the following become significant ways of expressing social space in music: 1) *reproduction of universal models of human relationships*,

which can be classified in accordance with the *meaning* of the interaction of participants in communication - *agreement, cooperation, confrontation, competition and others*; 2) *the recreation of specifically "musical" interaction models in music*, typical for various instrumental compositions and fixed by imitating the timbre characteristics of individual instruments, "register" drama, recreating the playing techniques inherent in different instruments of the ensemble. At the same time, it is important in the ontology of social space in music that these ways of organizing space in music do not exist on their own, but interpenetrate each other.

Thus, in the music of the XVII century, the individual traits of character and temperament of instrumentalists, as well as the types of their interaction, were transferred into musical compositions and preserved there in the form of musical portraits of masters and fixed genre structures - a duet, quartet, concert and others; In the music of the XVII - XIX centuries, elements of the musical language were endowed with the features of acting subjects in music, and nowadays instrumentalists themselves often turn into actors who give life to a musical character in a new interpretation, voicing other types of reflection and comprehension of reality.

The patterns of social space existence in music that we have identified are very specific, but do not contradict the compositional structures established in sociology, since they have a pronounced spatial geometric shape. For example, the circular structure of intra-group communication in the canon "What a Wonderful Moment" from Act I of the opera "Ruslan and Lyudmila" by Mikhail Glinka or in the quintet "I'm scared" from the first picture of the opera "The Queen of Spades" by Pyotr Tchaikovsky creates static mise-en-scenes for an opera production. This feature of the composition led to the rejection of the Vsevolod Meyerhold quintet when staging the opera "The Queen of Spades" by P.I. Tchaikovsky in 1935 at the Maly Leningrad Opera House, as mentioned by Isaac Glickman in his memoirs [4, p. 133].

The latter confirms the need to study social space in music from the point of view of finding the optimal structure of mise-en-scenes when planning the artistic space of specific paintings or actions of synthetic theatrical performances [for more details see: 4, p. 132]. The geometric "figure" of such a composition can become a common basis for communication with similar semantic structures that exist in other types of art, which contributes to the enrichment of artistic meanings in the interpretation of the work.

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## CIRCADIAN INDEX IN THE ACUTE PERIOD OF CONCOMITANT SEVERE TRAUMATIC BRAIN INJURY

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**Abstract.** Fluctuations of the circadian index occurred in the range of 0.9-1.1, which characterized the pronounced rigidity of the heart rate during the acute period of CSTBI. The baseline heart rate indicators corresponded to the age norm. In dynamics in group 1 on days 8 - 15, an increase in the mesor of the HR circadian rhythm by an average of 16% was revealed. In the 3rd group during the indicated period, the mesor of the circadian rhythm HR remained less than in the 1st group by an average of 11%. Hourly heart rate in the circadian rhythm in the acute period of CSTBI for 25 days in the light and dark hours of the day in patients of group 3 were lower than in groups 1 and 2. Throughout the observation, strong direct correlations between the heart rate and the indicators of myocardial oxygen demand in all injured were revealed.

**Keywords:** circadian index, combined severe traumatic brain injury

**Relevance.** In practical medicine, deviations of the circadian index are observed both upward and downward. The norm of the circadian index in adult men and women should be in the range of 1.24-1.44. The indicator is not affected by either the age or gender of the subject. A normal circadian profile indicates a stable autonomic organization of the circadian rhythm. If the CI is elevated, this is a sign of high sensitivity of the myocardium to sympathetic stimulation. In some cases, an enhanced circadian profile is an individual norm of a person accustomed to intense physical activity. A decrease in the index is considered an indicator of cardiovascular disorders. A decrease in CI is an unfavorable symptom indicating autonomic denervation of the heart. This means that the sympathetic and parasympathetic divisions of the ANS do not properly regulate myocardial contractions. With a persistent deviation of the indicator to the lower side, we can say that the contractility of the myocardium has decreased, and the patient has developed irreversible changes in the myocardium and chronic heart

failure. A drop in the circadian index to 1.2 is a sign of heart failure with a probability of death. HR rigidity during treatment is a poor prognostic sign, an increase in the upward direction is a guarantee of the adequacy of the prescribed therapy. However, there is not enough information in the literature about the features of CI HR changes in CSTBI, which prompted us to study this issue [1-4].

**Purpose of the work.** Circadian index in the acute period of combined severe traumatic brain injury

**Material and research methods.** The indicators of a comprehensive examination of 30 patients with concomitant severe traumatic brain injury (CSTBI) who were admitted to the ICU of the neurosurgical department of RSCEMA in the first hours after an accident - 28, catatrauma of 2 patients were studied. Continuous hourly monitoring of heart rate (HR), circadian index (CI), oxygen saturation (OS), stroke volume of blood (SVB), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), pulse pressure (PP), cardiac output (CO), general peripheral vascular resistance (GPVR), estimation of autonomic tone (EAT), the need of myocardium in oxygen (TNMO) were performed within 25 days after CSTBI. Mechanical respiratory support (MRS) started with artificial lung ventilation (ALV) for a short time with subsequent transfer to SIMV. ALV was performed in the mode of normoventilation or moderate hyperventilation (pCO<sub>2</sub> - 30–35 mmHg) with an air – oxygen mixture of 30–50%. At low pO<sub>2</sub> in arterial blood, ALV was performed with constant positive pressure. However, the end-expiratory pressure did not exceed 5-7 cm aq., since higher pressure could impede the outflow of blood from the brain and increase ICP.

The assessment of the severity of the condition was carried out using scoring methods according to the scales for assessing the severity of concomitant injuries - the CRAMS scale, the assessment of the severity of injuries according to the ISS scale. On admission, impaired consciousness in 29 injured patients was assessed on the Glasgow Coma Scale (GS) 8 points or less. Patients were considered in three age groups: group 1, 19-40 years old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients). The division into groups was dictated by the well-known features inherent in each age group, described in detail in the literature. The calculation was carried out according to the formula: CI = Average HR in the daytime (from 8.00 to 22.00)/Average HR at night (from 23.00 to 7.00).

Results and discussion.

**Table 1.**  
**Dynamics of the mesor of the circadian rhythm, heart rate, beats per minute**

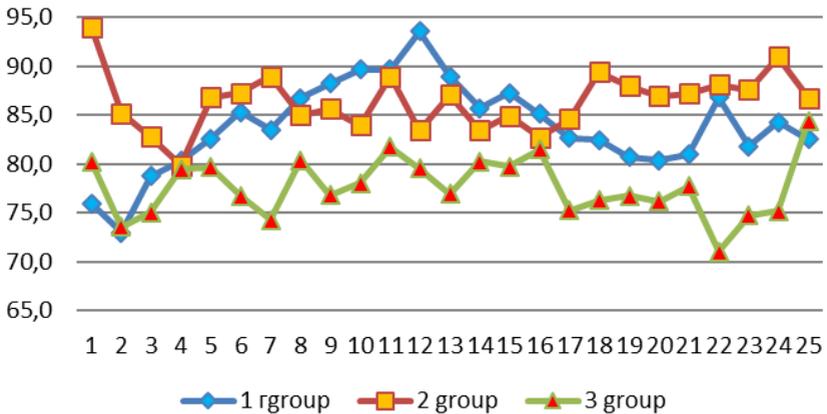
days	group 1	group 2	group 3
1	78.8±4.8	97.4±11.4	83.6±6.1
2	75.7±2.4	88.5±2.9	76.3±4.3
3	81.8±3.2	85.8±4.5	77.9±2.0
4	83.5±1.7	82.7±6.0	82.6±1.6
5	85.8±1.7	90.1±4.5	82.6±5.0
6	88.7±2.3	90.7±2.1	79.7±2.0
7	86.7±2.8	92.4±2.7	77.1±2.8 <sup>m</sup>
8	90.1±2.1*	88.4±2.4	83.4±3.5 <sup>m</sup>
9	91.7±1.7*	88.9±2.5	79.9±4.0 <sup>m</sup>
10	93.1±3.5*	87.2±1.7	81.1±2.5 <sup>m</sup>
11	93.1±2.6*	92.4±3.3	84.9±2.9 <sup>m</sup>
12	97.2±2.9*	86.7±1.9	82.6±2.6 <sup>m</sup>
13	92.3±3.3*	90.4±2.4	79.9±2.1 <sup>m</sup>
14	89.0±2.1*	86.5±4.0	83.3±3.5 <sup>m</sup>
15	90.5±3.8*	88.2±3.3	82.9±1.7 <sup>m</sup>
16	88.3±3.4	85.9±2.8	84.6±2.2
17	85.9±2.6	87.8±3.3	78.0±4.4
18	85.6±2.3	92.9±2.2	79.2±2.5
19	83.8±2.5	91.4±2.3	79.6±4.1
20	83.5±2.2	90.2±3.7	79.1±1.9
21	84.0±2.9	90.5±4.2	80.7±3.3
22	90.1±3.0	91.3±5.0	73.7±3.2
23	84.9±2.2	90.9±3.4	77.6±1.6
24	87.6±2.9	94.5±1.9	78.1±4.7
25	85.7±2.6	90.2±5.1	87.7±5.5

\*the difference is significant relative to the indicator in 1 day

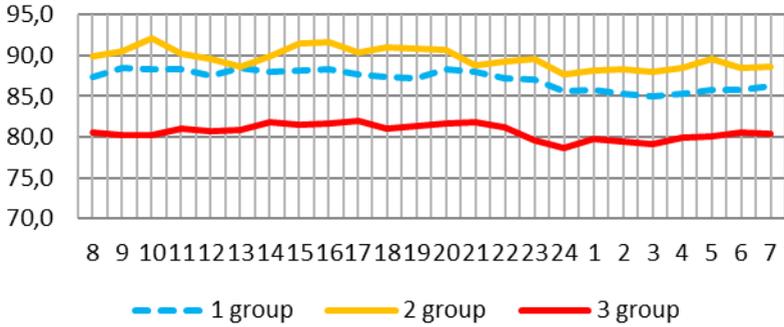
<sup>m</sup> the difference is significant relative to the indicator in group 1

The baseline values corresponded to the age norm. However, the dynamics revealed a reliably significant increase in the HR mesor in group 1 on days 8-15 of the acute period by 14%, 16%, 18%, 18%, 23%, 17%, 12%, 15% ( $p < 0.05$ , respectively). In groups 2 and 3, in the dynamics of significant changes in the mesor of the circadian rhythm HR was not observed, which is most likely due to the large spread of the average deviation of the indicator in 1 day. In group 3, on days 7-15, significantly lower HR indicators were found relative to the HR mesor in group 1 by 11%, 7%, 12%, 13%, 8%, 15%, 13%, 7%, 8% ( $p < 0.05$ , respectively).

Thus, in group 1, the most significant increase in the mesor of the circadian rhythm HR was revealed in the second week, in group 3 during the indicated period, the mesor of the circadian rhythm HR remained less than in group 1, on average by 11% (fig. 1).

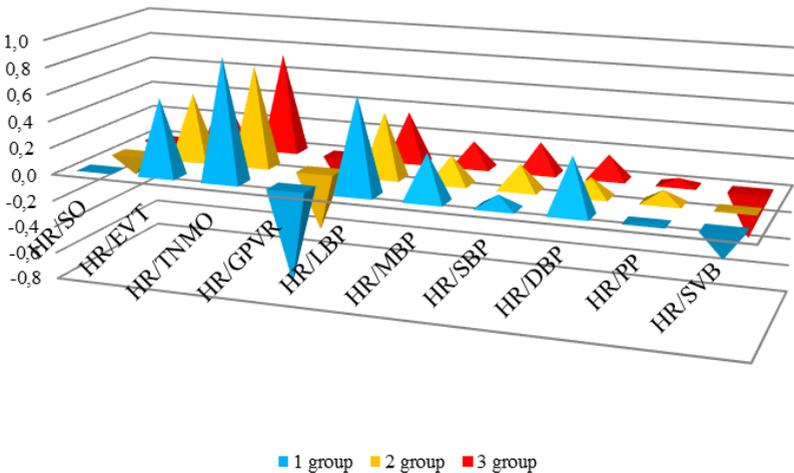


**Fig. 1. Dynamics of the mesor of the circadian rhythm HR in the acute period of CSTBI**



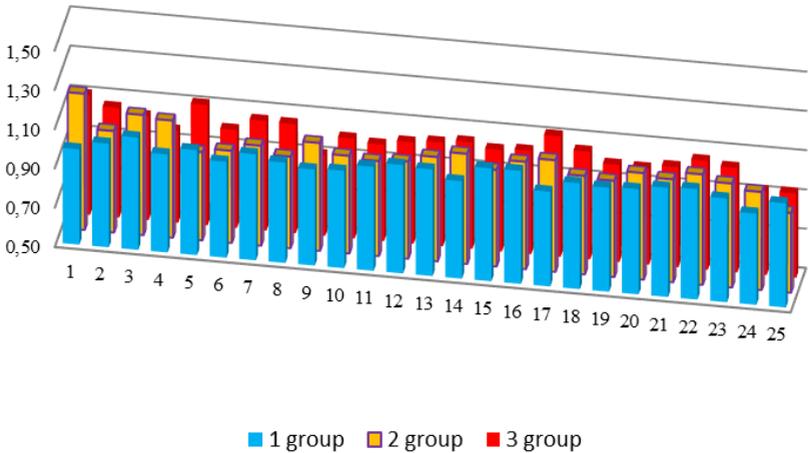
**Fig. 2. Hourly heart rate in circadian rhythm in the acute period, beats per minute**

Hourly heart rate indicators in the circadian rhythm in the acute period of CSTBI for 25 days (fig. 2) of patients of group 3 were lower than in groups 1 and 2 during the day (at night and daytime).



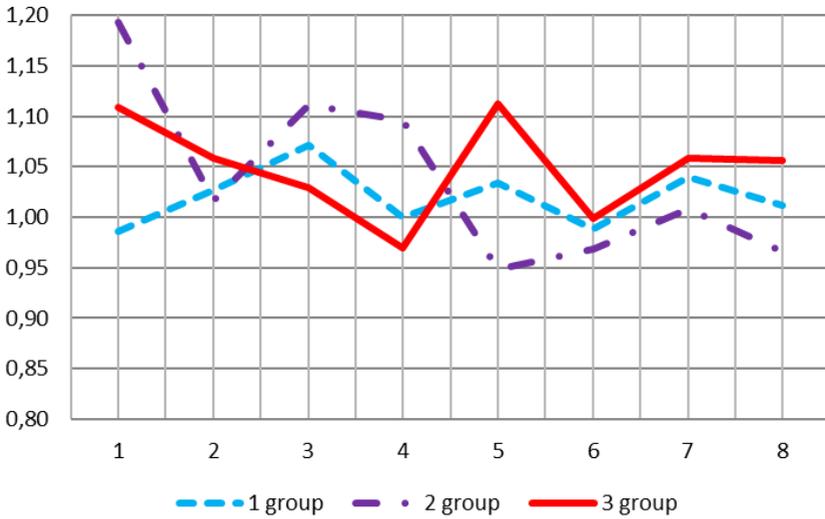
**Fig. 3. HR correlations in the acute period of CSTBI**

The revealed strong direct correlations between heart rate and TNMO indices in all injured patients (fig. 3) indicate that even with normal HR in the early post-traumatic period, the tendency to increase myocardial oxygen consumption persisted. In the previous work, an increase in the mesor of the circadian rhythm of TNMO in group 1 on days 3-15 was revealed, with a tendency to normalization of the indicator on the following days of intensive therapy. In group 2, TNMO on day 12 turned out to be less than in group 1. In traumatized patients of the 3rd group, on the 7th - 13th day, the mesor of the circadian rhythm TNMO was significantly less than the indicator in the 1st group.

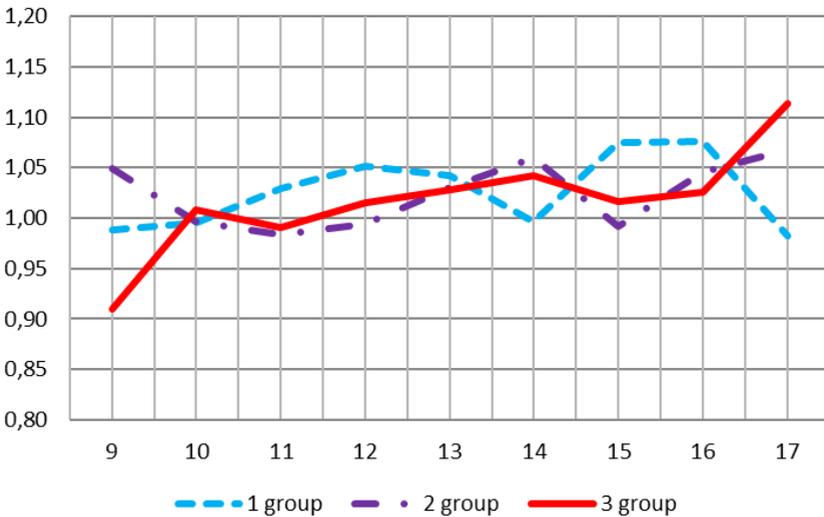


**Fig. 4. Changes in the circadian index in the first 25 days of the acute period of CSTBI**

Fluctuations in the circadian index occurred in the range of 0.9-1.1, which characterized the rigidity of the heart rhythm (fig. 4). In the first week, you can see fluctuations with a period of 3-4 days.



**Fig. 5. Changes in the circadian index in the acute period of CSTBI from 1 to 8 days**



**Fig. 6. Dynamics of the circadian index on days 9-17**

In the second week, the amplitude of CI fluctuations decreased (fig. 6).

On the 18-25th day (fig. 7) the amplitude and wavelength of the CI did not change with signs of an increase in the rigidity of the heart rate on the 22-25th day of intensive therapy. After 20 days in the dynamics of CI, changes appeared indicating cardiovascular disorders caused by autonomic denervation of the heart, a decrease in myocardial contractility, which confirmed the development of irreversible changes in the myocardium and chronic heart failure in patients.

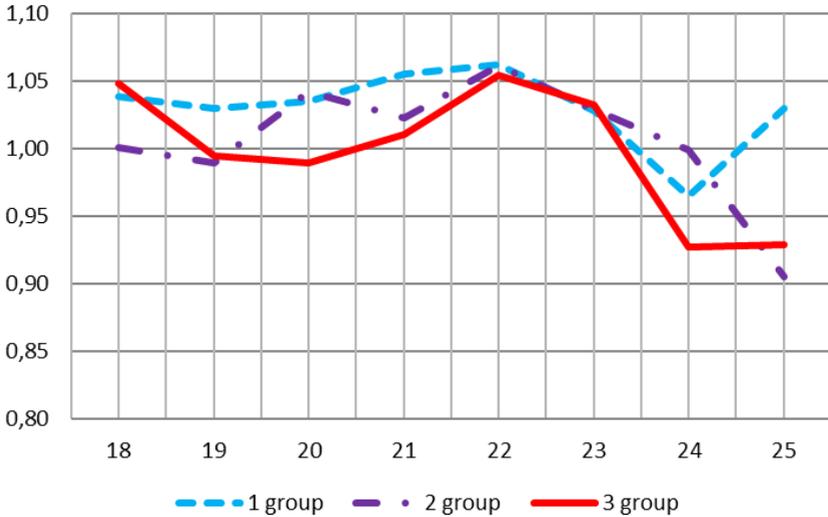


Fig. 7. Change in circadian index for 18-25 days

**Table 2**  
Correlation relationships between HR and hemodynamic parameters in the weekly biorhythm

Days	group 1			group 2			group 3		
	1-8	9-17	18-25	1-8	9-17	18-25	1-8	9-17	18-25 day
HR/oxygen saturation	0.3	0.4	-0.1	0.1	-0.2	-0.2	-0.6	-0.3	-0.2
HR/EAT	0.9	0.9	0.7	0.4	0.9	-0.1	0.4	0.0	0.6
HR/TNMO	1.0	0.9	0.9	0.9	0.9	0.2	0.8	0.8	0.8
HR/GPVR	-0.6	-0.7	-0.7	-0.8	-0.7	0.0	-0.1	-0.3	-0.3
HR/CO	0.6	0.7	0.8	0.6	0.7	-0.1	0.2	0.1	0.6

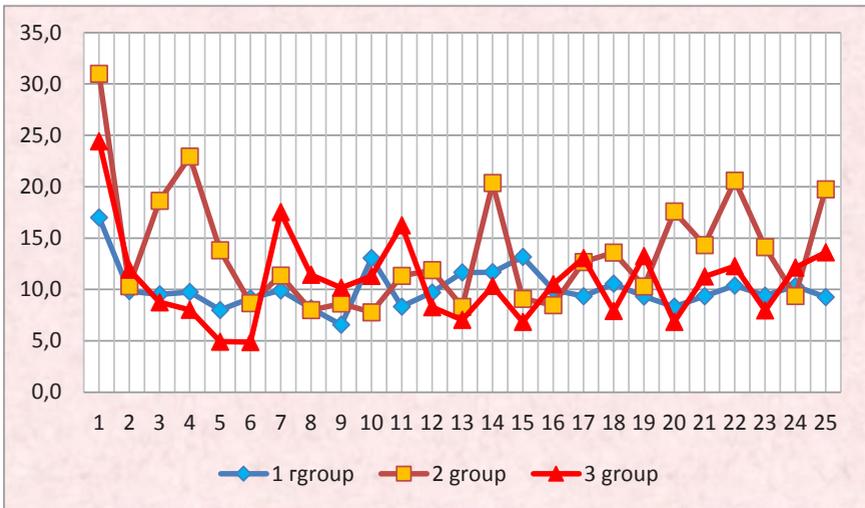
## Process Management and Scientific Developments

HR/MBP	0.7	0.6	0.6	-0.5	0.5	-0.1	0.5	0.0	0.2
HR/SBP	0.3	0.6	0.7	-0.5	0.3	0.0	0.6	0.0	0.2
HR/DBP	0.8	0.5	0.3	-0.5	0.2	0.0	0.4	0.2	0.1
HR/PP	0.0	0.7	0.6	-0.6	0.6	-0.4	0.1	-0.1	0.0
HR/SVB	-0.4	0.0	0.5	-0.4	0.3	-0.3	-0.3	-0.5	-0.2

As shown in Table 2, in the 1st group of patients throughout the observation there was a strong direct correlation between the heart rate and autonomic tone, that is, sympathotonia was accompanied by a tendency to increase the heart rate. In group 2, a strong direct relationship between HR and EAT was found only in the second week of intensive therapy (0.9). In group 3, a certain trend in the influence of sympathetic activity on HR was observed only on days 18-25 (0.6). Direct dependence of myocardial oxygen demand on HR was observed in all patients, except for 18-25 days in group 2 (0.2). That is, in the majority of injured patients, increased heart rate was accompanied by an increase in oxygen demand. In this regard, in the acute period of CSTBI, it is advisable to maintain HR within the age norm. However, knowing that tachycardia is a compensatory mechanism aimed at restoring the increased needs of the brain tissue for oxygen, then, apparently, it is necessary to search for additional methods to effectively combat oxygen starvation, brain hypoxia in other ways. One of them is MRS, which proved to be insufficiently effective in our patients. Therefore, it is necessary to develop additional methods to combat post-traumatic brain hypoxia.

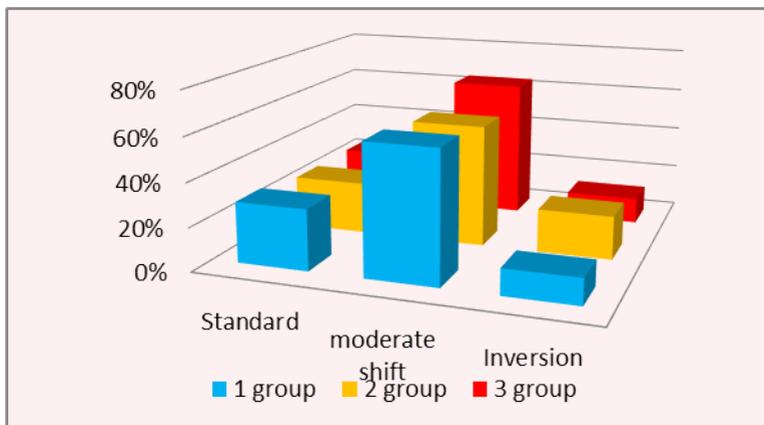
The inverse correlation turned out to be inconsistent, so in group 1 the inverse correlation of HR and GPVR was small in the first week (-0.6), it became significant at 2-3 weeks of treatment, amounting to -0.7; -0.7, respectively. In group 2, the increase in heart rate with a decrease in peripheral resistance in the first two weeks was -0.8; -0.7. However, the compensatory response to a decrease in peripheral vascular tone completely disappeared at 3 weeks of intensive therapy. Group 3 differed from the first two in that the dependence of the heart rate on GPVR was completely absent throughout the acute period of CSTBI. That is, the age-related difference in group 3 patients was the absence of a compensatory reaction of the sinus node in response to changes in peripheral hemodynamics. The latter is most likely associated with a change in the trophism of the sinus node, vascular walls, the adequacy of the functional response of the vasomotor center under conditions of ischemia - damage to the mesencephalobulbar structures of the brain caused by STBI against the background of age-related chronic oxygen deficiency.

Direct strong correlation characterized the adequate compensatory reaction of blood circulation in response to stress tachycardia in group 1 0.6; 0.7; 0.8. While in group 2, a strong direct correlation between HR and CO in the first 17 days after injury, on days 18-25 practically disappeared (-0.1). In group 3, the correlation between CO and HR was absent until the 17th day, appearing on the 18-25th day (it became 0.6). Interestingly, correlations between HR and SVB, as well as with SBP, DBP, PP, were not revealed in almost all patients. Only group 1 showed a direct correlation between HR and MBP in the acute period of CSTBI. In groups 2 and 3, the relationship between cardiac function and MBP level was not revealed. Thus, the study of the correlations between HR and other circulatory parameters in the peri-weekly biorhythm made it possible to obtain additional diagnostic information that would allow timely or prophylactic correction of metabolic changes in the circulatory system in order to optimize intensive therapy and increase the viability of organs and tissues in the acute period of CSTBI.



**Fig. 8. Dynamics of the amplitude of the circadian rhythm HR, beats per minute**

As shown in fig. 8, the greatest amplitude of daily fluctuations was observed on day 1 in group 2 (30 beats per minute), the smallest in group 3 (17 beats per minute). On the following days, the amplitude of the HR circadian rhythm turned out to be greater in group 2 at 4, 14, 22, 25 days.



**Fig. 9. The duration and degree of shifts in the acrophase of the circadian rhythm of the heart rate**

The most prolonged inversion of the HR circadian rhythm was also found in patients of group 2 than in groups 1 and 3.

**Conclusion.** Fluctuations of the circadian index occurred in the range of 0.9-1.1, which characterized the pronounced rigidity of the heart rate during the acute period of CSTBI. The baseline heart rate indicators corresponded to the age norm. In dynamics, in group 1 on days 8 - 15, an increase in the mesor of the HR circadian rhythm by an average of 16% was revealed. In group 3, during the indicated period, the mesor of the circadian rhythm HR remained less than in group 1 by an average of 11%. Hourly heart rate in the circadian rhythm in the acute period of CSTBI for 25 days in the light and dark hours of the day in patients of group 3 were lower than in groups 1 and 2. Throughout the observation, strong direct correlations between the heart rate and the indicators of myocardial oxygen demand in all injured were revealed.

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## FEATURES OF THE WATER BALANCE IN THE ACUTE PERIOD OF CONCOMITANT SEVERE TRAUMATIC BRAIN INJURY

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**Abstract.** The average daily volume for 25 days in group 1 was 48.3 ml/kg/day, in groups 2 and 3 34.6 ml/kg/day and 33.5 ml/kg day. A gradual restriction of parenteral administration was revealed in group 1 at 2 weeks of observation (by 34%), more pronounced in groups 2 and 3 on days 18-25 by 76% and 52%, respectively. The indicators of hourly urine output in groups 2 and 3 were less than in group 1 by 0.5 ml/kg/hour less. In the acute period of CSTBI, compensatory mechanisms for water load, aimed at adaptation to extremely changed life support conditions, were preserved only in traumatized patients under the age of 40.

**Keywords:** water balance, concomitant severe traumatic brain injury.

**Relevance.** According to numerous studies, more than half of patients who are in a coma within 24 hours after a traumatic brain injury develop disorders of water and electrolyte balance. They are often a consequence of treatment, but metabolic changes in traumatic brain injury are similar to those in injuries of any other location and are important in determining treatment tactics. Water restriction and osmotic drugs cause hyperosmolarity and hypervolemia in most patients, which necessitates monitoring of osmolarity and sodium concentrations. The secretion of aldosterone and antidiuretic hormone (ADH) in response to stress contributes to sodium and free water retention, respectively. The latter usually predominates, leading to minor hypervolemic hyponatremia in untreated patients, which is masked by the simultaneous administration of osmotic drugs. Severe hyponatremia is associated with excessive secretion of ADH, which can occur with increased intracranial pressure (IIP), fractures of the skull base, and after prolonged mechanical ventilation. In traumatic brain injury, potassium is lost due to trauma-induced hypersecretion of aldosterone, drug osmotic diuresis, and corticosteroids. Because potassium is predominantly an intracellular ion, hypokalemia often presents with hypochloremic alkalo-

sis with normal or minimally reduced serum potassium levels. In this case, adequate replacement therapy with the introduction of KCl is required [1-3].

With traumatic brain injury, all types of exchange are affected. But the degree and depth of these shifts (and not only in the brain, but throughout the body) are directly proportional to the severity of the injury. So with a slight injury, metabolic changes are barely perceptible, but they are distinct with severe brain damage and increase in the absence of adequate treatment.

According to some recommendations, planned infusion therapy requires the management of the patient in a moderate dehydration regimen (up to minus 10 ml/kg per day). The attitude to the use of such osmодиuretics as mannitol, urea, glycerin is ambiguous [4,5]. Taking into account the lack of information on the volume of infusion therapy in the acute period of CSTBI, we made an attempt to analyze and present the traditional picture of prolonged infusion therapy in the acute period of CSTBI in RSCEMA.

**Purpose.** To study the features of water balance in the acute period of concomitant severe traumatic brain injury

**Material and research methods.** The indicators of a comprehensive examination of 30 patients with concomitant severe traumatic brain injury (CSTBI) who were admitted to the ICU of the neurosurgical department of RSCEMA in the first hours after an accident - 28, catatrauma of 2 patients were studied. Continuous daily monitoring of the volumes of injected fluid (intravenous, oral, total), the amount of water loss (volume of urination + stool + from drainage systems), hourly monitoring of the oxygen saturation index (OS), cardiac output (CO), systolic (SBP), diastolic (DBP), pulse (PBP), average (AvBP) blood pressure were performed within 25 days after CSTBI. mechanical respiratory support (MRS) was initiated by artificial lung ventilation (ALV) for a short time followed by transfer to SIMV. ALV was performed in the mode of normoventilation or moderate hyperventilation (pCO<sub>2</sub>— 30—35 mmHg) with an air-oxygen mixture of 30—50%. The assessment of the severity of the condition was carried out using scoring methods according to the scales for assessing the severity of concomitant injuries - the CRAMS scale, the assessment of the severity of injuries according to the ISS scale. On admission, impaired consciousness in 29 injured patients was assessed on the Glasgow Coma Scale (GS) of 8 points or less. Patients were considered in three age groups: group 1, 19-40 years old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients). Infusion therapy is carried out with crystalloid and colloidal solutions and, if indicated, with vasoactive and inotropic drugs (preferably

dopamine or norepinephrine). Recent studies have demonstrated the high efficacy of hypertonic sodium chloride solution (NaCl 7.5%), especially in combination with dextrans or HESs. Taking into account the authors' opinion that the infusion of a 7.5% NaCl solution quickly restores BV without causing an increase in IIC, from the first day, according to indications, 100 ml of 0.9% NaCl+100 ml of 10% NaCl was administered 1-2 times a day. In order to compensate for the BV deficiency in patients, crystalloid (Ringer's solution, NaCl solution 0.9%) and artificial colloidal solutions (hydroxyethyl starches) were traditionally used, as a rule, in a ratio of 3:1.

**Results and its discussion**

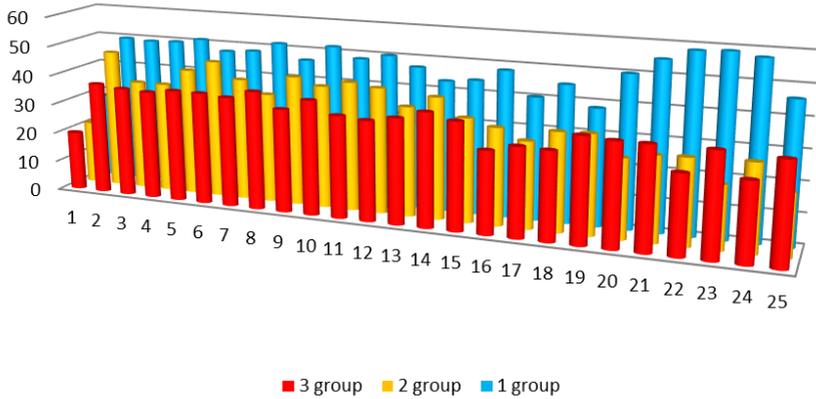
As can be seen from the data presented in tab. 1, in group 1 the average daily volume for 25 days in group 1 was 48.3 ml/kg/day, in groups 2 and 3 at 14 and 15 ml/kg per day (by 28%, 29%) less than in the first (p <0.05, respectively).

**Table 1.**  
**Dynamics of water balance parameters in the acute period of CSTBI**

	Daily volume, ml/ kg/day	Intravenous, ml/ kg/day	Intake, ml/ kg/day	Diuresis, ml/kg/ hour
Group 1	48.3±4.4	16.4±3.3	31.9±4.1	1.5±0.2
Group 2	34.6±6.4*	10.8±5.2	24.0±3.1	1.0±0.2*
Group 3	33.5±3.5*	9.9±3.1	23.4±2.79	1.0±0.1*

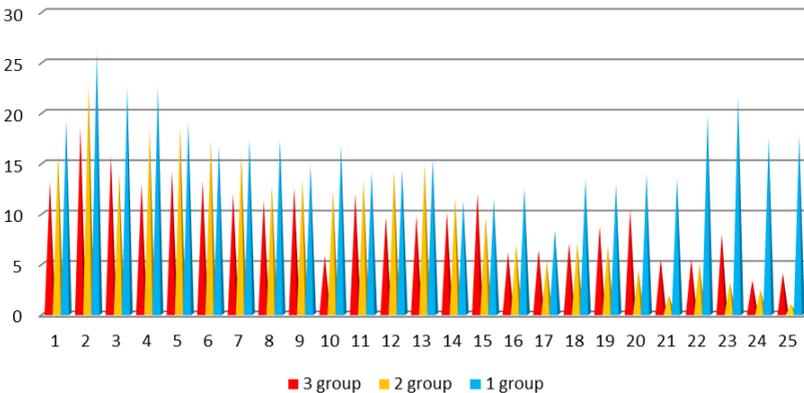
\*-reliable relative to the indicator in group 1

Attention was drawn to the tendency towards a decrease in intravenous and oral water load depending on age. At the same time, the indicators of hourly urine output in groups 2 and 3 were less than in group 1 by 0.5 ml/kg/hour (p <0.05, respectively).



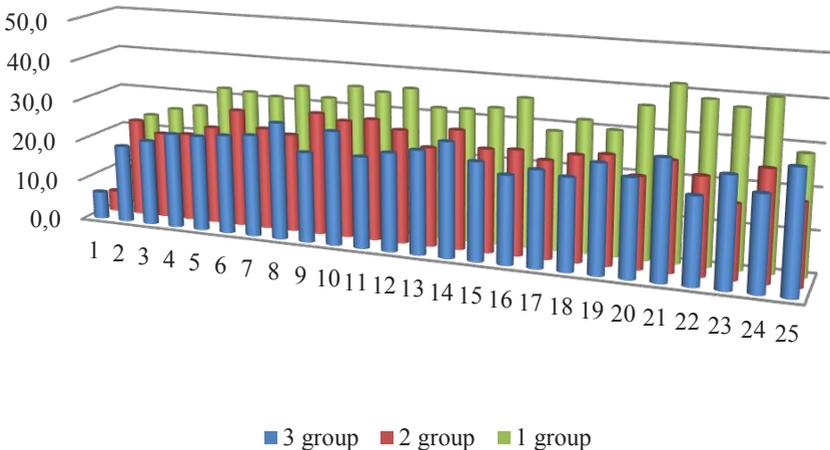
**Fig. 1 Dynamics of the total water load in the acute period of CSTBI, ml/kg/day**

Changes in the volume of infusion therapy occurred in waves, in group 1 on days 20-25 with a slight increase, in groups 2 and 3 a slight tendency towards a decrease in the daily volume of water load (fig. 1). Throughout the observation, the indicators in group 1 remained higher than in groups 2 and 3.



**Fig. 2. Dynamics of parenteral administration in ml/kg/day**

Fluctuations in the volume of intravenous infusion therapy in group 1 occurred from 19 ml/kg/day on day 1 after injury to 25 ml/kg/day on day 2, gradually decreasing to 10 ml/kg/day on day 14 with a gradual re-increase to 21 ml/kg/day on the 23rd day of treatment (fig. 2). In group 2, 15 ml/kg/day was administered intravenously on day 1, increasing by day 2 to 22 ml/kg/day and gradually decreasing to 5 ml/kg/day on day 17, and on day 25 to 2 ml/kg/day. In group 3 of patients, 12 ml/kg/day were administered intravenously on day 1, 18 ml/kg/day on day 2 and gradually decreased to 3 ml/kg/day on day 25.



**Fig.3. Enteral volume in ml/kg/day**

The minimum enterally administered volume of water per day was 9 ml/kg/day in group 1, 5 ml/kg/day in group 2, and 6 ml/kg/day in group 3. Feeding volume gradually increased, reaching the highest value in group 1 on day 21 (42 ml/kg/day), in group 2 - 29 ml/kg/day (on day 9), in group 3 - 27 ml/kg/day on day 8 (fig. 3).

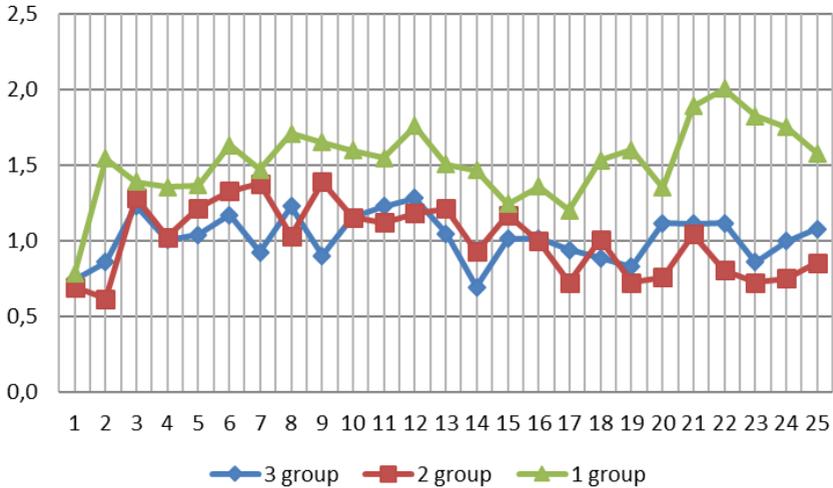


Fig. 4. Hourly urine output in ml/kg/hour

Hourly urine output fluctuated within the acceptable values typical for normal renal excretory activity. However, the indicator of hourly urine output in group 1 fluctuated at a slightly higher level than in the injured in older age groups. Most likely, this was due to a relatively higher water load than in groups 2 and 3 (tab. 1).

Table 2. Comparative assessment of weekly average water balance

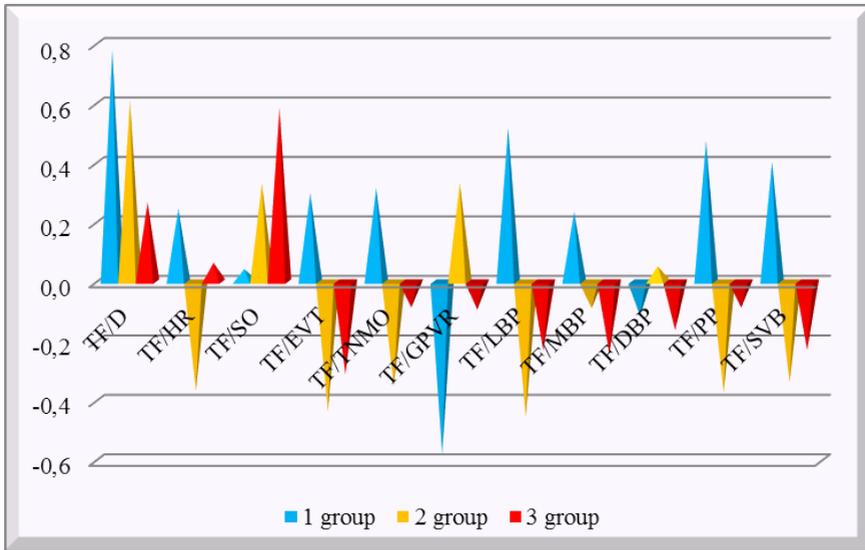
Days	Group 1				Group 2				Group 3			
	Total volume, ml/kg/day	I.v, ml/kg/day	In-take, ml/kg/day	Diuresis, ml/kg/hour	Total volume, ml/kg/day	I.v, ml/kg/day	In-take, ml/kg/day	Diuresis, ml/kg/hour	Total volume, ml/kg/day	I.v, ml/kg/day	In-take, ml/kg/day	Diuresis, ml/kg/hour
1 - 8	47.1± 4.6	20.1± 2.7	27.0± 5.5	1.4± 0.2	38.4± 5.6	16.9± 2.3	21.6± 4.3	1.1± 0.2	35.2± 3.8	13.9± 1.7	21.3± 4.4	1.0± 0.1
9 - 17	46.8± 2.7	13.2± 2.1	33.2± 1.9	1.5± 0.1	37.8± 4.4	11.3± 2.7*	26.8± 2.2	1.1± 0.1	33.9± 2.6	9.4± 2.2*	24.0± 1.8	1.0± 0.1
18 - 25	51.3± 6.3	16.3± 2.9	35.6± 4.2	1.7± 0.2	27.2± 3.6*	4.0± 1.9*	23.2± 2.7	0.8± 0.1	31.4± 3.2	6.6± 2.0*	24.8± 2.6	1.0± 0.1

\*- reliably relative to the indicator for 1-8 days

As shown in tab. 2, a significantly significant decrease in the total daily fluid intake was found in group 2 on days 18-25 (by 28%,  $p < 0.05$ ). The volume of intravenous infusion therapy in group 1 on days 9-17 was limited by 34% (by 7 ml/kg/day,  $p < 0.05$ ) with a tendency to increase in the next 18-25 days by 3 ml/kg/day. Attention is drawn to the significant limitation of intravenous administration in group 2 on days 9-17 by 33% (by 5 ml/kg/day,  $p < 0.05$ ), and on the next 18-25 days by 76% (by 12.9 ml/kg/day,  $p < 0.05$ ). In group 3, on the second week of treatment, the limitation of intravenous infusion therapy was 32% (4.5 ml/kg/day,  $p < 0.05$ ), in the next 18-25 days, the gradual limitation of intravenous infusion continued and amounted to 52% (by 7, 3 ml/kg/day,  $p < 0.05$ ).

Thus, a gradually increasing restriction of parenteral administration was revealed in group 1 at week 2 of observation, and more pronounced in groups 2 and 3 at days 18-25 by 76% and 52%, respectively. In group 1, the daily volume of enteral administration showed a tendency to increase by 8 ml/kg/day. In group 2, oral administration in the second week showed a tendency to increase by 5 ml/kg/day, in the next 18-25 days, a decrease by 3 ml/kg/day.

In group 3, as well as in group 2, a tendency to increase enteral administration on days 8-17 only by 3 ml/kg per day was revealed, remaining unchanged until the end of intensive therapy. Thus, the restriction of parenteral administration does not always correspond to the favorable dynamics of the condition; it may turn out to be a forced measure aimed at reducing the load on the heart function; an increase in the enteral administration of fluid is not an indicator of an improvement in the general condition. The study and development of optimal methods for correcting the water balance need further improvement, taking into account the severity of the injury, the individual characteristics of the response to water, drug loads, including age-related anatomophysiological differences, the influence of concomitant aggravating factors, chronic diseases, and the state of the cardiovascular system at the time of severe injury.



**Fig.5. Correlations between daily water load and hemodynamic parameters**

As shown in fig. 5, only group 1 showed a direct correlation between daily water load and urinary volume (0.78), less pronounced with CO (0.48), PBP (0.41) and SV (0.38 ) and inverse with GPVR (-0.6). In groups 2 and 3, the correlations were significantly less significant. That is, in the acute period of CSTBI, compensatory mechanisms for water load, aimed at adaptation to extremely changed life support conditions, were preserved only in traumatized patients under the age of 40.

**Conclusion.** The average daily volume for 25 days in group 1 was 48.3 ml/kg/day, in groups 2 and 3 34.6 ml/kg/day and 33.5 ml/kg/day. A gradually increasing restriction of parenteral administration was revealed in group 1 at 2 weeks of observation (by 34%), more pronounced in groups 2 and 3 on days 18-25 by 76% and 52%, respectively. The indicators of hourly urine output in groups 2 and 3 were less than in group 1 by 0.5 ml/kg/hour. In the acute period of CSTBI, compensatory mechanisms for water load, aimed at adaptation to extremely changed life support conditions, were active only in traumatized patients under the age of 40.

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## STUDY OF THE ANTICONVULSANT PROPERTIES OF NEW BENZOTHIENOPYRIMIDINE DERIVATIVE<sup>1</sup>

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**Abstract.** New anticonvulsant compounds have been identified, which are derivatives of benzothieno pyrimidines and have anticorazole activity. Comparison with known functional analogs showed the advantages of the studied substances in terms of both anticonvulsant activity and neuro- and acute toxicity. Comparison with the structural analogue pyratidine, which is at the stage of preclinical trials, showed that the most active compound of them has therapeutic and protective indices comparable to it.

**Keywords:** derivatives of pyrimidines, anticonvulsant activity, corazole convulsions.

### **Introduction**

Derivatives of pyrimidine play an important role in many biologically important processes, and synthetic fused pyrimidine derivatives exhibit a wide range of pharmacological actions. Condensed thienopyrimidines are a new class of anxiolytics. Among them, thieno [3,2-*d*] pyrimidines, structural analogs of purines, are also biologically active substances [1-4]. On the other hand, tetracyclic fused systems including pyrano, pyridine, thiophene, and pyrimidine rings can be considered as analogs of heterosteroids, which are known to exhibit various biological effects.

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The **purpose** of this study was to study the anticonvulsant effect of new benzothienopyrimidine derivatives using experimental models and seizure tests to obtain and introduce a new anticonvulsant drug into medical practice.

### **Materials and methods**

All experiments with laboratory animals were carried out in accordance with the Guidelines for the maintenance and use of laboratory animals [5].

The anticonvulsant spectrum of action of the compounds was investigated by tests: corazole (pentyletetrazole, PTZ) convulsions, maximum electric shock (MES), camphor, thiosemicarbazide (TSC), picrotoxin, strychnine convulsions [6-8]. The PTZ test is an experimental model for obtaining absences and myoclonic seizures and for predicting the anxiolytic properties of compounds. The PTZ test was carried out in mice by subcutaneous injection of an analeptic at a dose of 90 mg / kg, the effectiveness of the drugs is determined by the prevention of clonic seizures.

The anticonvulsant activity of the compounds was also determined by the prevention of the tonic-extensor phase of the seizure MES. The parameters of the maximal electroshock are 50 mA, the duration is 0.2 sec., The oscillation frequency is 50 imp./sec., The assessment criterion is the prevention of the tonic-extensor phase of a convulsive seizure.

Camphor clonic convulsions were obtained by intraperitoneal (i.p.) administration of camphor at a dose of 1 g/kg and the intensity of convulsions and the viability of animals were assessed by an alternative method. TSC was administered at a dose of 18 mg/kg subcutaneously, and picrotoxin at a dose of 5 mg/kg. The effectiveness of the compounds is determined by the latency of the onset of seizures, as well as their prevention and intensity. Strychnine tetanic convulsions were obtained by administering strychnine nitrate at a dose of 1.5-2 mg/kg. The presence and latency of seizures were assessed.

The substances were injected intraperitoneally at doses of 10-300 mg/kg suspended with carboxymethylcellulose (Viadi - Ingredients) and tween-80 (Ferak Berlin) 45 minutes before the administration of convulsive agents and electrical irritation. Control animals were injected with an emulsifier. Each dose of the compounds for each test was studied in five animals. The analogs of comparison were the anticonvulsants from the group of succinimides ethosuximide and pufemide - 3- p-isopropoxyphenyl succinimide [9], as well as pyratidine, an antiepileptic substance with a tranquilizing effect from the group of thienopyrimidines, created at the Institute of Fine Organic Chemistry of the STC NAS RA and being a structural

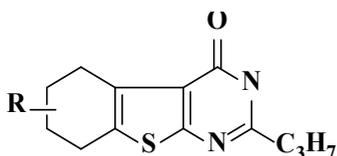
analogue of the studied compounds.

The side neurotoxic (muscle relaxant) effect of compounds and analogs in doses from 50 to 1000 mg/kg, as well as acute daily toxicity in doses from 500 to 2000 mg/kg with intraperitoneal administration was also studied. Myorelaxation was studied using the "rotating rod" test in mice [6, 10]. For this purpose, the mice were placed on a metal rod with a corrugated rubber coating, which was rotated at a speed of 5 rpm. The number of animals unable to stay on it for 2 min was determined.

To determine 50% effective doses -  $ED_{50}$  (causing an anticonvulsant effect in 50% of animals), as well as 50% neurotoxic -  $TD_{50}$  and 50% lethal doses -  $LD_{50}$ , we used the statistical method of probit-analysis according to Litchfield and Wilcoxon [11]. The therapeutic ( $TI = LD_{50}/ED_{50}$ ) and protective ( $GI = TD_{50}/ED_{50}$ ) indices were determined.

### Research results

The neurotropic properties of 3 derivatives of tetrahydrobenzothienopyrimidines with the general structure were investigated:



where R= H (№ 3212-1, №1);  
R= 6-CH<sub>3</sub> (№ 3212-2, №2);  
R= 7-CH<sub>3</sub> (№3212-3, №3)

As shown by the research results presented in table 1, the compounds have a pronounced anticorazole effect and are several times superior to their functional analogs. They have low toxicity and high therapeutic and protective indices. Of these, compound 2 is the most active,  $ED_{50} = 16$  mg/kg for antagonism with corazole. The compound is statistically significantly superior to zarontin by 10 and puffemid by 5 times. The compound is the least toxic ( $LD_{50} = 2300$  mg/kg) and the least neurotoxic ( $TD_{50} = 660$  mg/kg). The therapeutic and protective indices of the compound are superior to zarontin 17 and 13 and pufemid - 6 and 8 times, respectively. In comparison with its structural analogue, pyratidine, the compound is less active, but less toxic, and as a result, the therapeutic and protective indices of the compound are comparable with the data obtained with pyratidine.

**Table 1.**  
**Corazole antagonism and toxicity of compounds № 1-3, pufemide, zarontin and pyratidine**

Compound №	Corazole antagonism, ED <sub>50</sub> , mg/kg	LD <sub>50</sub> mg/kg	TD <sub>50</sub> mg/kg	TI	ZI
<b>1</b>	35 (28 ÷ 43.75)	1350 (900 ÷ 2025)	480 ( 369 ÷ 624)	8.57	13.7
<b>2</b>	16 (10.32÷24.8)	2300 (2000÷2645)	660 (528 ÷ 825)	143.75	41.25
<b>3</b>	28 (16÷49)	1150 (718.7 ÷ 1840)	785 (628 ÷ 981)	41	28
<b>Zarontin</b>	155 (117.5÷204.5)	1325 (1200÷1462)	520 (412.6-655.2)	8.55	3.35
<b>Pufemid</b>	86 (58.1÷127.3)	2150 (1930÷2390)	450 (365.8-553.5)	25	5.25
<b>Pyratidine</b>	1.7 (1.0÷2.7)	245 (207.5÷289.5)	70 (60.3÷81.2)	144.1	41.1

Note: The mean values are shown, their confidence intervals (in brackets). \* Statistically significant changes compared to control at a level of significance  $P \leq 0.05$ .

Among the above new selected compounds, the most active and promising is compound № 2 (registration № 3212), a tetrahydrobenzothienopyrimidine derivative.

To study the spectrum of anticonvulsant action comp. № 3212, we used the following additional tests: antagonism with MES, camphor, TSC, picrotoxin, strychnine (tab. 2). The studied compound in terms of antagonism with camphor surpasses pufemide and zarontin by 2.8 and 4 times, respectively ( $ED_{50} = 32$  mg/kg). According to the test of maximal electroshock, the compound is inferior to pufemid, and zarontin is inactive. By antagonism with TSC and picrotoxin, compound № 3212 prevents clonic convulsions at the following doses -  $ED_5 = 84$  mg/kg and 190 mg/kg, respectively, while pufemide and zarontin only increase the latent period of the onset of convulsions. Compound # 2 at a dose of 150-300 mg/kg increases the latency period of strychnine convulsions (pufemide and zarontin are active).

In general, in terms of spectrum of anticonvulsant activity, the compound is more similar to pufemide than to zarontin. In addition, a seizure model, corazole titration, was used. The change in the threshold of the extensor phase, caused by the intravenous administration of a 1% solution

of corazole at a constant rate, was studied in experiments on mice after preliminary administration of comp. № 3212, pufemis and zarontin. Studies have shown that all three drugs increase the threshold for corazole tonic extension (tab. 3).

**Table 2.**  
**Comparative anticonvulsant activity of compound № 3212, zarontin and pufemide according to various convulsive tests**

Compound	ANTAGONISM				
	Camphor	MES	Picrotoxin	TSC	Strychnine
№3212	32 (21÷49.8)	320 (278.5÷368)	190 (108.6÷333)	84 (65.6÷108)	Increase of the latency period by 3.0 times
Zarontin	131 (100÷171)	-	Increase of the latency period by 1.5 times	-	152 (109÷213)
Pufemid	90 (57.0÷142)	77 (52.7÷112.3)	Increase the latency period by 2 times	Increase of the latency period by 2.3 times	110 (80.4÷151)

Notes: Average values and their divergence intervals are shown; \* Statistically significant changes compared to control at a significance level of  $P \leq 0.05$ .

**Table 3.**  
**The influence of the comp. № 3212, pufemide and zarontin on the threshold of corazole convulsions during intravenous titration**

Compound, Dose, mg/kg	Average dose of corazole (mg/kg) inducing tonic extension	
	M with confidence intervals	Increase of the threshold
Control	76.73(67.94÷85.52)	1.00
№3212	25	94.5(80.2÷108.8)
	50	121.25(100.46÷142.04)*
	100	148.9(131.0÷166.8)*
	200	200.0(161.8÷238.2)*
Pufemid	100	124.16 (89.9÷158.42)*
	200	239.2 (212.94÷265.45)*

<b>Zarontin</b>	<b>200</b>	114.0(89.08÷138.92)*	1.48
	<b>300</b>	149.5 (120.0÷179.0)*	1.95

Notes: Average values and their confidence intervals are shown; \* Statistically significant changes compared to control at a significance level of  $P \leq 0.05$ .

Pufemide at a dose of 200 mg/kg increases the threshold by 3.11 times, zarontin at a dose of 300 mg/kg - 1.95 times. Compound № 3212 was studied at various doses (25,50,100,200 mg/kg). In the study of compound № 3212 on this test, a dose-dependent increase in the seizure threshold is observed. The average dose of corazole, causing tonic extension, increases from 94.5 (80.2 ÷ 108.8) against the background of the action of compound № 3212 at a dose of 25 mg/kg to 200 (161.8 ÷ 238.2) at a dose of 200 mg/kg, and the threshold compared with the control, respectively rises from 1.23 to 2.6. At all studied doses, the compound statistically significantly ( $P \leq 0.05$ ) increases M in comparison with control animals. We also studied the duration of action № 3212 according to the test of corazole convulsions in mice, both with intraperitoneal and oral administration (into the stomach through a metal probe).

The anticonvulsant effect of effective doses № 3212 (50 mg/kg with i.p. administration, 100 mg/kg with oral administration) were tested every half hour in separate groups of animals, 5-8 in each. Determined  $TE_{50}$  (the time during which the anticonvulsant effect persists in 50% of the animals). With intraperitoneal administration,  $TE_{50}$  is 270 (243.2 ÷ 299.7), with oral administration - 300 (267.8 ÷ 336) minutes, with  $P \leq 0.05$ . In fact, with oral administration, the duration of the anticonvulsant action is somewhat longer than with intraperitoneal administration.

Thus, the new synthesized 3-substituted benzothienopyrimidine derivatives showed high anticonvulsant activity, especially according to the test of corazole seizures. The compounds are superior to the well-known drugs used in medical practice, pufemide and ethosuximide, and the most active compound in terms of the therapeutic and protective index is not inferior to the new antiepileptic substance pyratidine, which is at the stage of preclinical trials.

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**COMPARATIVE ANALYSIS OF THE EVOLUTION OF INFLUENZA,  
ARI, SARI AND COVID-19 FOR THE 2019/2020 - 2020/2021 SEASONS  
IN THE REPUBLIC OF MOLDOVA**

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**Annotation.** In the Republic of Moldova, influenza and acute viral respiratory infections are registered every year, the number of cases varying from one year to another, but generally representing 2/3 of the total number of infectious diseases registered during the year. However, the flu season 2020/2021 is special compared to the other seasons, not only in the country. For these reasons, this study aimed to highlight the differences between the 2020/2021 season and the 2019/2020 season on the evolution of influenza, ARI and SARI, including the evolution of COVID-19 during these seasons.

**Keywords:** ILI, ARI, SARI, COVID-19

**Introduction**

Influenza, acute respiratory infections (ARI) and severe acute respiratory infections (SARI) are infectious diseases that require increased attention due to the level of morbidity and mortality that cause it, producing a negative impact on the health of the population, the health system and directly on the national economy. [1]–[5].

Diseases caused by influenza viruses can develop into epidemics lasting 4-6 years or even pandemics lasting decades, inducing a high number of cases from mild to severe severity or even death. The need for hospitalization and deaths occur more frequently in people in at-risk groups, such as: children, adults over 65, people with chronic diseases, etc. [1], [3], [5], [6].

Globally, influenza epidemics are estimated to cause approximately 3 to 5 million severe illnesses and 290,000 to 650,000 deaths. As a result, epidemics lead to high levels of job losses, increased absenteeism and declining productivity. [3], [5].

In the Republic of Moldova, influenza, acute respiratory infections and

severe acute respiratory infections are registered every year, the number of cases of diseases varying from year to year, but generally representing 2/3 of the total number of infectious diseases registered during the year. [3], [6], [7], [8]. In the Republic of Moldova there is the routine epidemiological surveillance system of influenza, ARI and SARI (36 administrative territories) and the sentinel surveillance system (9 sentinel points) represented in figure 1 from which the data are collected weekly, and during the weeks 40-20 samples are collected weekly for investigation of the presence of influenza viruses from the 9 sentinel points.

The appearance of the new type of coronavirus (SARS-CoV-2) in 2019, in China, disturbed everyone. Thus, on March 11, 2020, the WHO stated that due to the rapid spread of this virus we can characterize it as a pandemic. [9]. In the European region the first cases caused by SARS-CoV-2 were registered in France, Germany, Italy and Spain [10], [11]. In the Republic of Moldova, the first case was registered on March 7, 2020, a case of import from Italy [12].

In the flu season 2019/2020 the circulation of both type A and B virus was observed in the European region, namely subtypes A(H1N1)pdm09, A (H3N2), B/Victoria [13]. According to published data from 2182 laboratory-confirmed cases in the intensive care unit, 64% were of type A, and 36% of type B. In the report of week 15/2021, in the European region it is observed that the flu activity that is at the interseasonal level [14]. During the 2020/2021 season, out of 682,485 investigated samples, 791 were confirmed, of which 396 were type A and 395 type B [14].

The interaction between the SARS-CoV-2 virus and the influenza virus is not clear yet, but it is certain that they played an important role in morbidity, mortality and the capacity of medical services. [15]. There is evidence that there is a pathogenetic competition between these 2 viruses, this may be due to short-term immune-mediated interference in the host, which has the ability to decrease the activity of another virus in its peak activity, otherwise this is a known phenomenon several decades [16]. Another study showed that seasonal flu vaccination may increase the risk of developing other viruses, this phenomenon is called viral interference [17].

Both COVID-19 and influenza remain a public health threat, although anti-epidemic measures can prevent them from spreading. [18].

### **Materials and methods**

Epidemiological data were collected through the national system of surveillance and monitoring of influenza, ARI and SARI from all administrative territories of the Republic of Moldova.

Virus detection in samples of nasopharyngeal exudates from individuals with influenza, ARI or SARI was performed by molecular biology (rRT-PCR) techniques.

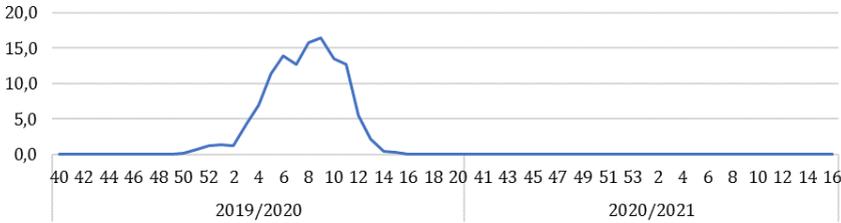
A descriptive incidence study was planned with the evaluation of the following data: Cases of influenza, ARI and SARI submitted weekly (week40-week20) to the section for surveillance and control of influenza and viral respiratory infections in the seasons 2019/2021 (2331 completed annexes from 37 administrative territories); Accompanying bulletins for pathological products for laboratory diagnosis of human influenza virus infection in the seasons 2019-2021 (1601 accompanying bulletins for pathological products); The results of laboratory investigations on the presence of influenza virus in patients with a presumptive diagnosis of influenza, ARI and SARI in the seasons 2019-2021 (285 positive results); Reports of deaths with the presence of influenza virus confirmed by the laboratory submitted to the National Agency for Public Health in the seasons 2019-2021 (10 reports).

The volume of research and interpretation of the study results is based on traditional statistical methods, ensuring the degree of representativeness of the data accepted for medical studies. The obtained data are processed with the help of Epi Info™ 7 programs and Microsoft Excel 2019.

### **Results and discussions**

The flu season 2020/2021 is totally different from the flu season 2019/2020 both at national and international level. Referring only to influenza, then in the 2020/2021 season no cases of influenza were registered compared to the 2019/2020 season when 3258 cases of influenza were registered.

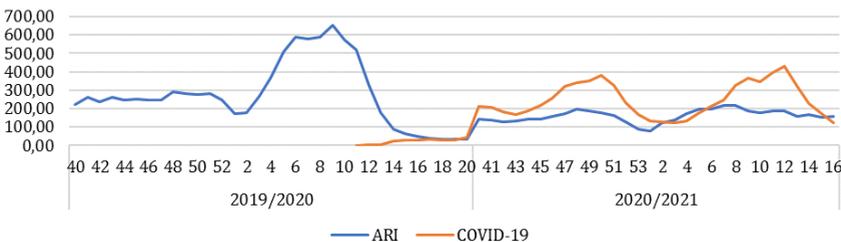
In the 2019/2020 season, the first 2 cases of influenza were registered in week 48/2019, following week 51/2019, a sudden increase up to 21 cases, maintaining up to 35 cases in week 02/2020. Subsequently, influenza cases increased exponentially until the week 06/2020 to 372 cases (13.9 cases per 100,000 population) following a small decrease after which in the week 09/2020 there was a peak of 442 cases of influenza (16.5 cases per 100,000 population). The last case of influenza in the 2019/2020 season was registered in week 16/2020 (figure 1).



**Figure 1. Evolution of influenza morbidity per 100,000 population, 2019/2020-2020/2021 seasons**

The cases of acute respiratory infections also had a different evolution in these 2 seasons. Thus, during the weeks 40/2019 - 16/2020, 243045 cases of ARI were registered compared to 128883 cases of ARI during the weeks 40/2020 - 16/2021, in other words in the 2020/2021 season there were registered by almost 2 times fewer cases.

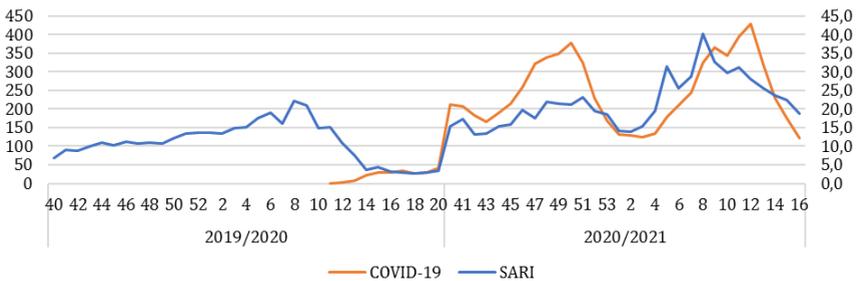
For the 2019/2020 season, the epidemic threshold of 308.32 cases per 100,000 population was established, of medium intensity - 463.45, of high intensity 626.14 and of very high intensity 715.19. Respectively, this season the epidemic threshold was exceeded in week 04/2020 (370.96 cases per 100,000), the average intensity threshold was exceeded in week 05/2020 (511.09 cases per 100,000) and the high intensity threshold of was exceeded in the week 09/2020 when the peak of this season of 17518 ARI cases was registered (653.24 per 100.00 population) following a decrease of up to under a thousand cases in the weeks 18/2020 - 20/2020, being few in compared to previous seasons, probably due to the start of COVID-19 cases in the country (Figure 2).



**Figure 2. Evolution of morbidity through ARI and COVID-19 per 100,000 population, 2019/2020-2020/2021 seasons**

For the flu season 2020/2021, the epidemic threshold of 283.63 cases per 100,000 population was established, of medium intensity - 399.20, of high intensity 535.01 and of very high intensity 608.93. During this season, the number of IACRS cases did not exceed the epidemic threshold, having a evolution without pronounced peaks, registering between 2058 cases (76.74 cases per 100,000 population) and 5856 cases of ARI (218.37 cases per 100,000 population). However, two increases in the intensity of ARI cases were registered in the same period when there were the 2 peaks of increase in the intensity of COVID-19 cases.

In the compartment of severe acute respiratory infections, a difference is observed between the analyzed seasons. Thus, if we refer to the total number registered, then in the period 40/2019 - 16/2020 9408 SARI cases were reported compared to the period 40/2020 - 16/2021 when 17568 SARI cases were registered, being almost 2 times more.



**Figure 3. Evolution of morbidity through SARI and COVID-19 per 100,000 population, 2019/2020-2020/2021 seasons**

Thus, in the 2019/2020 season there was a slow increase in the number of SARI cases until week 08/2020 when 592 cases were registered (22.1 per 100,000 population) following a decrease until week 14/2020 following a plateau until the end of the season of up to 100 SARI cases per week (figure 3).

The 2020/2021 season started with an increased number of SARI cases (15.4 per 100,000) gradually increasing after which two peaks were recorded, one in week 05/2021 with 843 cases (31.4 per 100,000) and the second in the week 08/2021 - 1079 (40.2 per 100,000). It is curious that the evolution of SARI cases coincides with the evolution of COVID-19 cases which denotes that the COVID-19 pandemic had an influence on both the registration of ARI and SARI cases.

As the flu was registered only in the 2020/2021 season, we can see that the highest share was among children up to 14 years with 59%, namely in the age group 5-14 years with 38%. The lowest percentage of all influenza cases was recorded in people over 65 years of age (3%).

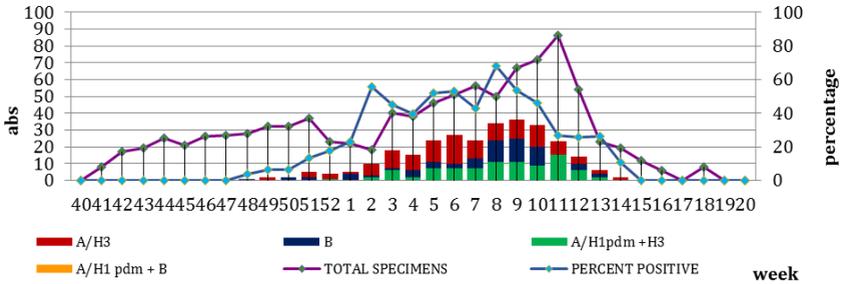
Of the total number of ARI cases registered in the 2019/2020 season, most were among children aged 0-14 years with a share of 67% compared to the 2020/2021 season where 48% were registered in this age group. An inverse situation is observed in the age category over 30 years, registering 20% of the total number of cases in the 2019/2020 season and 36% of the total number of cases in the 2020/2021 season, at the same time we observe that most cases of COVID-19 were registered in this age group.

Among severe acute respiratory infections, there is a major discrepancy in the recordings of these cases in different age groups. Thus, if in the 2019/2020 season most cases of SARI were registered in the age group 0-14 years - 64%, followed by the age groups 30-64 years with 16% and the group 65+ with 15%, then in 2020/2021 season the least cases of SARI were registered in the age group 0-14 years - 12%, and the age group 30-64 has 51% and the age group 65+ has 33%. Percentage of COVID-19 cases registered in the age category 30+ is practically similar to the percentage of SARI cases registered in the same category. This again demonstrates the influence of the COVID-19 pandemic on the influenza epidemiological surveillance system, ARI and SARI.

During the weeks 40/2019 - 16/2020 in the virological laboratory of NAPH were investigated 955 samples collected in the sentinel and non-sentinel points. Of these, 29% were positive for the presence of influenza viruses (14% - influenza A(H1N1)pdm09 virus, 7% - influenza A(H3N2) virus and 8% - influenza B virus).

During the weeks 40/2020 - 16/2021 in the virological laboratory of NAPH were investigated 638 samples collected in the sentinel and non-sentinel points, being 33% fewer samples than in the same period of previous season. However, no influenza viruses were identified in any sample but it should be noted that all samples were investigated including for SARS-CoV-2 virus. Thus, in 31% of the samples, the virus that causes COVID-19 infection was identified.

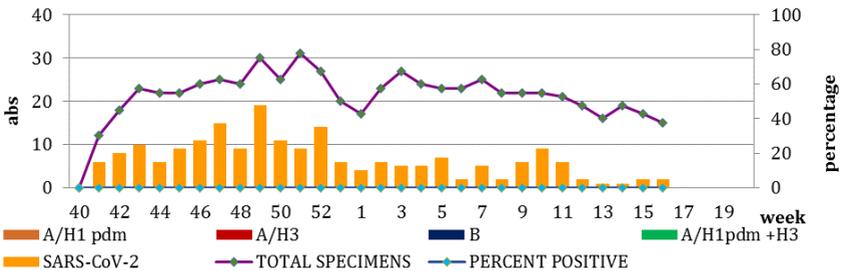
The detection of the presence of influenza viruses in the 2019/2020 season per week is represented in figure 4. Thus, the first influenza virus was identified in week 48/2019 being A(H3N2) and the last 2 were recorded in week 14/2020 being A(H1N1)pdm09. During the season, all 3 types of influenza virus A(H1N1)pdm09, A(H3N2) and type B virus were recorded.



**Figure 4. The evolution of the investigated samples and the laboratory results, 2019/2020 season**

In the flu season 2020/2021 the number of samples investigated per week varied between 12-31 samples, without an increased number during the weeks 09-12 as in the previous season when it reached 86 samples per week.

Even if the number of samples per week remained almost constant, SARS-CoV-2 virus has come to detect less, from 50% to 60% of the samples investigated in the first part of the flu season to 5% -12% of the investigated samples towards the end of the season (figure 5).



**Figure 5. The evolution of the investigated samples and the laboratory results, 2020/2021 season**

The percentage of samples examined in these 2 seasons by age group and gender shows that most samples in the 2019/2020 season were collected from children up to 9 years (37.6% CI [34.4-40.7]) and predominantly male (21.0%). In the flu season 2020/2021 also, most samples were collected from children in the age group 0-9 years but with a lower% with 10 (27.5% CI [24.1-31.0]) however, there was an increase in the percentage of samples collected in adults, namely in the age groups 50-59 years

and 60-69 years, mainly in females.

Analyzing the percentage of samples collected depending on the presumptive diagnosis established, it was found that most samples were collected from people with a presumptive diagnosis of ARI, however a higher percentage was recorded in the flu season 2020/2021 of 63.0% CI [59.2-66.6].

At 9.2% CI [7.1-11.6] of the samples were collected in the 2020/2021 season from people with a presumptive diagnosis of ILI but who have not been confirmed by the laboratory. Also in the current season, the percentage of people analyzed with the diagnosis of SARI increased by about 10% more compared to the previous season.

With regard to influenza deaths, in the influenza season 2019/2020 there were 10 deaths, and in the 2020/2021 season, taking into account that there were no cases of influenza, there were no cases of death due to influenza infection. So, we deduce that all deaths in the 2019/2020 season were recorded during the 50/2019 - 12/2020 weeks, most being found in the 08/2020 week - 4 cases of death.

Analyzing the reports of deaths, it was found that people also had concomitant diseases as follows: in 10% of cases - cardiovascular disease, in 10% of cases - obesity and in 20% of cases - diabetes.

### **Conclusions**

The 2020/2021 flu season is totally different from the 2019/2020 flu season due to the COVID-19 pandemic. Thus, in the 2020/2021 season no case of influenza was registered, ARI cases had a constant evolution without exceeding the epidemic threshold being 2 times less than in the previous season, and SARI cases were reported by 2 or more cases compared to the previous season and had an evolution practically similar to the evolution of COVID-19 cases.

The cases of ARI in the 2019/2020 season were mainly registered in the age group 0-14 years and in the 2020/2021 season mainly in people over 30 years. SARI cases in the 2019/2020 season were also registered mainly in the age group 0-14 years, while in the 2020/2021 season in this group were registered 6 times less SARI cases, being the most in the group 30+, a situation similar to the share of COVID-19 cases.

Despite the fact that the sentinel surveillance system operated without deviations, with the weekly collection of samples and their investigation for the presence of influenza viruses, however, laboratory-confirmed cases of influenza were not recorded.

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**CYTOLOGICAL STUDY OF THE DYNAMICS OF THE WOUND  
PROCESS IN PURULENT DISEASES OF SOFT TISSUES USING  
PROGRAMMABLE SANITATION TECHNOLOGIES**

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Purpose of research: to study the cytological features of the healing processes in patients with soft tissue phlegmons using programmable sanitation technologies.

Methods: The study involved 245 patients with purulent phlegmon of soft tissues of various localizations. Patients were randomized into two groups. In the comparison group ( $n=118$ ), patients received traditional local treatment after surgery. In the main group ( $n=127$ ), in the postoperative period, programmed readjustments were performed using the AMP-01 device. At the same time, the purulent wound was drained with tubular drains, taken out through separate incisions, and a blind suture was applied to the wound. The device operates on a cyclical principle in an autonomous mode, allows you to select the parameters of sanitation (speed, volume of injection or aspiration) and to carry out an individual approach to the treatment of each specific case. The dynamics of reparative processes in purulent wounds was assessed by the cytological picture of the material taken by the method of superficial or puncture biopsy.

Results: In the main group of patients, a higher rate of cellular reactions in purulent wounds was noted. By the 9th day after the operation, the cytological picture corresponded to the regenerative type of cytograms.

There was a statistically significant faster decrease in degenerative forms of neutrophils, positive redistribution of stab and segmented neutrophils in combination with high values of the regenerative-degenerative index ( $p < 0.001$ ), indicating an acceleration in the relief of the inflammatory process. Also, in the main group, the appearance of macrophages and cells of young connective tissue in the form of fibrocytes, fibroblasts, fibrous fibers ( $p < 0.001$ ) was observed at an earlier date, which indicated active regenerative processes in the wound. In the comparison group, a lower intensity of cellular reactions in the wound, a lengthening of the inflammation phase, a significant duration of the regeneration phase, and later periods of the onset of the scar reorganization phase were revealed.

**Conclusion:** The conducted cytological study proved the effectiveness of the use of programmable sanitation technologies that help to reduce the phase of inflammation, accelerate the reparative processes of purulent foci with phlegmon of soft tissues.

**Keywords:** Purulent-inflammatory diseases of soft tissues, phlegmon of soft tissues, programmable sanitation technologies, cytological examination, reparative process.

### Introduction

Treatment of purulent-inflammatory diseases of soft tissues is one of the most difficult and intractable problems of practical surgery [1,2,3]. According to domestic and foreign experts, the urgency of this problem in modern conditions is associated not only with the widespread incidence of surgical infection, but also with the difficulties of its diagnosis, variability and persistence of the clinical course, the complexity of treatment and unpredictability of prognosis [4,5,8]. According to US national statistics, more than 3 million people visit emergency departments every year for skin and soft tissue infections, of which more than 500,000 patients are hospitalized, and the cost of their treatment is over 10 billion dollars [6,7].

In recent years, fundamental research in molecular cell biology has made it possible to better understand the basic mechanisms of wound healing. It has been proven that the healing process in any wound is genetically determined, initially there is always a phase of inflammation, followed by a phase of regeneration and a phase of scar reorganization and epithelialization [5,9,10,11].

At the present stage, it is becoming increasingly important to solve the problems of predicting the course of reparative processes that underlie the structural and functional restoration of altered tissues. In this regard, there is an urgent interest in the development of both new approaches to treat-

ment and methods for assessing the dynamics of healing of wound defects [12-15]. To obtain quick and objective information about the course of reparative processes in wounds of various origins, it is preferable to use the cytological method [5,16,17,18,19]. A cytological study allows one to characterize various types of the course of the wound process, to reliably assess the effectiveness of the treatment [5,20,21, 24,25]. There are 6 types of cytological picture according to V.F. Kamaev (1954), corresponding to different stages of the wound process: degenerative-necrotic type, degenerative-inflammatory type, inflammatory type, inflammatory-regenerative type, regenerative-inflammatory type, regenerative type [5,22]. For a complete assessment of the picture of wound healing, the regenerative-degenerative index (RDI) is calculated using the formula [23]. The RDI value less than one indicates a pronounced inflammatory process in the wound, and if the value of this indicator becomes more than one, then this means the transition of the wound process to the regeneration phase. Assessment of the reparative response in the wound based on cytological verification is one of the objective methods for studying the characteristics of the course of the wound process, which allows to optimize the treatment tactics.

**Purpose:** to study the results of a cytological study of healing processes in purulent diseases of soft tissues using programmed sanitation technologies.

### **Material and methods**

During the period 2011-2020, under our supervision there were 245 patients with purulent phlegmon of soft tissues of various localizations. Inclusion criteria for this study: the age of the patients over 18 years, the presence of phlegmon of the soft tissues of the limb or neck, the presence of informed voluntary consent. Exclusion criteria for the study: the presence of extensive skin defects in the area of surgical treatment, signs of anaerobic infection, pregnancy, diabetes mellitus, oncological pathology, circulatory insufficiency and respiratory failure of the III degree.

All patients were randomized into two groups depending on the methods of debridement of purulent foci in the postoperative period. In the comparison group, after surgical treatment, patients received traditional local treatment using iodophore solutions, polyethylene glycol-based ointments. In the main group, after surgical treatment, the wound was drained with tubular drains, taken out through separate incisions, and the wound was then sutured tightly. The drains were connected to the original AMP-01 device (patent for invention № 176572 dated January 23, 2018), with the help of which programmed sanitation was carried out in the postoperative period. On the control unit of the device, an individually selected program of

cyclically occurring processes of irrigation, aspiration of an antiseptic and constant evacuation, carried out in an autonomous mode, was installed. Programmable sanitation was carried out every 3 hours, alternating with a vacuum period of 1 hour. The preset level of vacuum in the purulent cavity (80-100 mmHg) was maintained using a built-in pressure sensor. Basic therapy was the same in both groups of patients.

In the main group, the average age of patients ( $M \pm \sigma$ ) was  $59 \pm 13$  years, in the comparison group -  $60 \pm 11$  years. In the main group there were 68 men, 59 women, 62 and 56 in the comparison group, respectively. Thus, there are no statistically significant differences between the study groups by sex and age, which made it possible to judge the homogeneity of the groups ( $p = 0.845$  and  $p = 0.875$ , respectively).

The distribution of patients with soft tissue phlegmon in the study groups according to the phlegmon localization is presented in table 1.

**Table 1. Distribution of patients by nosological form in the study groups**

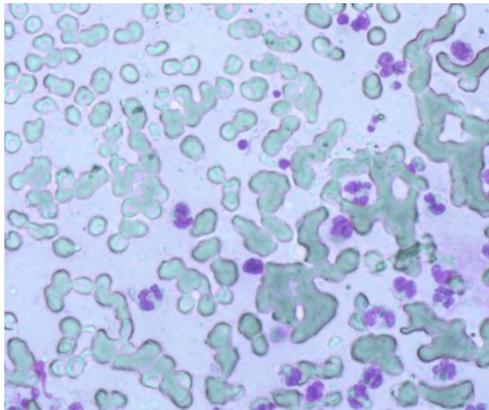
Nosological form	Main group <i>n</i> (%)	Comparison group <i>n</i> (%)	Total <i>n</i> (%)
Phlegmon of the wrist	10 (7.9)	8 (6.8)	18 (7.3)
Phlegmon of the forearm	33 (25.9)	29 (24.6)	62 (25.3)
Phlegmon of the shoulder	11 (8.7)	13 (11.1)	24 (9.8)
Phlegmon of the foot	13 (10.2)	15 (12.7)	28 (11.4)
Phlegmon of the lower leg	38 (29.9)	29 (24.6)	67 (27.3)
Phlegmon of the thigh	13 (10.2)	13 (11.1)	26 (10.6)
Phlegmon of the neck	9 (7.1)	8 (6.8)	17 (6.9)
Total	127 (100)	118 (100)	245 (100)

According to the independent criterion  $\chi^2$ -Pearson ( $p = 0.953$ ) the dependence of the distribution of patients by nosological form in the study groups was not found.

To assess the healing of purulent foci, a cytological research method was used. We used the technique of surface biopsy according to M.P. Pokrovskaya and M.S. Makarov (1942) modified by M.F. Kamaeva (1954). In the comparison group, the material was taken by light scraping of the surface layer of the wound with the handle of a surgical scalpel. The resulting material was applied to glass, fixed, and stained according to the May-Grunwald-Romanovsky-Giemsa method. In the main group of the study,

the collection of cellular and tissue elements was performed by the method of "puncture biopsy" (Kayem R.I., Karlov V.A., 1977; Sergel O.S., Goncharova Z.N., 1990). 4-5 smears were sequentially taken from the same area of the wound. Cytological examination of smears from the surface of wounds was carried out on the first day, and then on the 3rd, 5th, 7th, 9th days. The smears were studied under microscopy with a  $\times 40$  objective, while the formed elements were counted and the average value was deduced over 10 fields of view. The value obtained was expressed as a percentage per 100 counted cells. We used an Axio A1 light microscope (Zeiss, Germany) with a set of accessories.

At the time of randomization in both study groups, in patients with soft tissue phlegmons, the cytological picture was characteristic of the degenerative-necrotic type of cell reaction. Among the cellular elements, degenerative neutrophils (DN) prevailed ( $64.5 \pm 9.2\%$ ), and there were very few preserved forms of leukocytes. The regenerative-degenerative index (RDI) was well below unity ( $0.2 \pm 0.1$ ). Microflora was found in large quantities, mainly extracellular. In the preparations, accumulations of necrotic masses and an amorphous gelatinous interstitial substance were observed. Figure 1 shows a fragment of a cytological smear from the wound surface in patients with soft tissue phlegmon at the time of randomization on the 1st day of the study.



**Figure 1. Fragment of the cytogram of a smear from the wound surface in patients with phlegmon of soft tissues on the 1st day. Degeneratively altered polymorphonuclear leukocytes predominate, microflora is found in large numbers, mainly extracellularly, there is an accumulation of necrotic masses and an amorphous gelatinous intermediate substance. Staining according to Romanovsky-Giemsa. Lens  $\times 40$**

The cellular composition of cytological smears in patients with soft tissue phlegmon in the study groups at the time of randomization is presented in table 3.

**Table 3. Cell composition of cytological smears in patients with soft tissue phlegmon in the study groups at the time of randomization, in% per 100 cells**

Cell types	Main group		Comparison group		p-value t-criterion
	M±σ, in% per 100 cells	Me[Q1;Q3]	M±σ, in% per 100 cells	Me[Q1;Q3]	
STN	1.8±0.2	1.82 [1.77;1.87]	1.7±0.2	1.74 [1.64;1.81]	0.682
SGN	15.2±0.6	15.19 [15.07;15.32]	16.2±0.4	16.16 [16.07;16.25]	0.647
DN	64.5±9.2	65.89 [63.65;68.13]	62.2±6.2	68.84 [67.57;70.09]	0.022
RDI	0.2±0.1	0.18 [0.16;0.21]	0.2±0.1	0.18 [0.16;0.21]	0.976
L	0.4±0.2	0.39 [0.35;0.43]	0.2±0.1	0.17 [0.15;0.19]	0.000

Note: STN – stab neutrophils, SGN - segmented neutrophils, DN - degenerative neutrophils, RDI - regenerative-degenerative index, L - lymphocytes

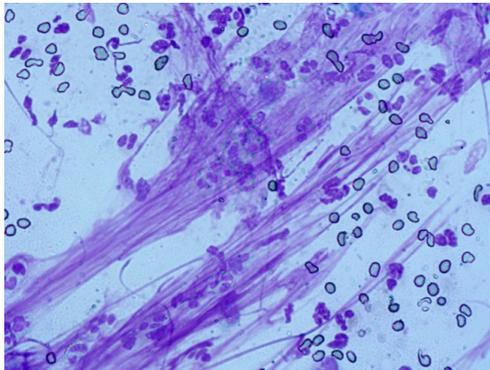
Most of the parameters of the statistical assessment of the cellular composition of cytological smears on the first day of observation in both study groups were similar in values ( $p > 0.05$ ), which made it possible to judge the homogeneity of the groups. However, the indicators DN and L were not statistically proven to be homogeneous, which can be explained by the small sample of the study.

The work was carried out in the design of a simple, randomized, comparative controlled study in parallel groups. The SPSS Statistics 25 software (IBM) was used for statistical processing of the obtained data. To study the relationship between qualitative characteristics, contingency tables were constructed and the  $\chi^2$ -Pearson test or Fisher's exact test was calculated. To assess the change in the dynamics of quantitative indicators, analysis of variance with repeated measurements was used with the setting of the time factor and the group. Differences were considered statistically significant if the probability value was less than 0.05 for the two-sided critical region.

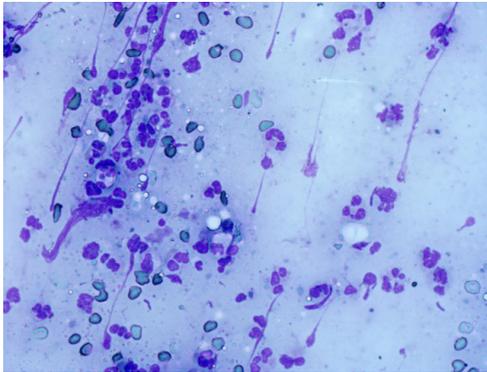
## Results

The cytological picture of smears in the main group on the 5th day from the moment of randomization corresponded to the inflammatory or inflammatory-regenerative type of cellular reaction. There was a statistically significant decrease in the number of degenerative neutrophils (DN) ( $16.7 \pm 2.2\%$ ), an increase in the number of intact forms of neutrophils: segmented (SGN) ( $41.6 \pm 3.8\%$ ) and stab neutrophils (STN) –  $6.2 \pm 0.8\%$  ( $p < 0.001$ ). There was a statistically significant increase in RDI –  $2.9 \pm 0.4$  ( $p < 0.001$ ). Plasma cells, histiocytes appeared. There was a statistically significant increase in the number of active macrophages –  $4.6 \pm 0.6\%$ , lymphocytes –  $5.8 \pm 0.6\%$ , fibroblasts –  $4.2 \pm 0.5\%$  ( $p < 0.001$ ). Found groups of cells of young connective tissue in the form of fibrocytes, fibroblasts, fibrous fibers. Microflora was detected in a small amount at the stage of complete phagocytosis.

In the comparison group, on the 5th day of treatment, the cytological picture in smears was characterized by a neutrophilic reaction – the number of intact forms of neutrophils increased: SGN –  $42.6 \pm 3.8\%$ , STN –  $6.2 \pm 0.8\%$ . The number of degenerative forms has decreased –  $56.7 \pm 2.2\%$ . The RDI was close to unity –  $0.9 \pm 0.2$ . The microflora was determined intra- and extracellularly, but cases of complete phagocytosis were more common. There were single actively phagocytic leukocytes, macrophages, lymphocytes. Elements of granulation tissue are rare. The cytological picture corresponded to the inflammatory type of the cellular reaction. Figures 1, 2 show fragments of cytological smears from the wound surface on the 5th day in the study groups.

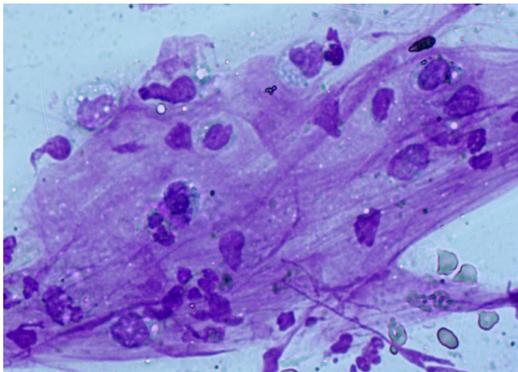


**Figure 1. Fragment of the cytogram of a smear from the surface of the wound on the 5th day, the main group. Fibrocytes, fibroblasts, fibrous fibers were found among neutrophils and polyblasts. Staining according to Romanovsky-Giemsa. Mag.× 40**

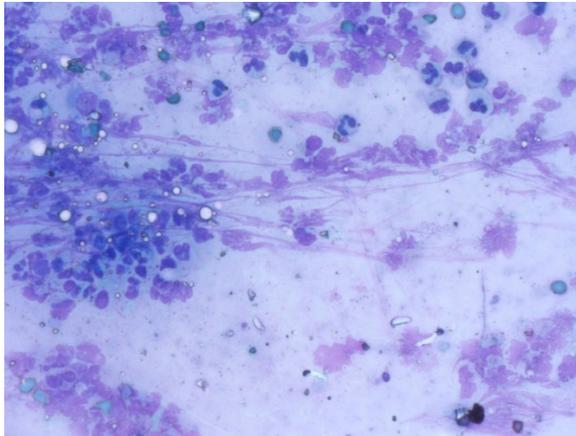


**Figure 2.** Fragment of the cytogram of a smear from the wound surface on the 5th day, comparison group. There are single actively phagocytic leukocytes, macrophages, lymphocytes. Elements of granulation tissue are rare. Staining according to Romanovsky-Giemsa. Mag.× 40

On the 9th day of the postoperative period in the main group, the cytological picture corresponded to the regenerative-inflammatory or regenerative type of cellular reactions. Figures 3,4 show fragments of cytological smears from the wound surface on the 9th day in the study groups.



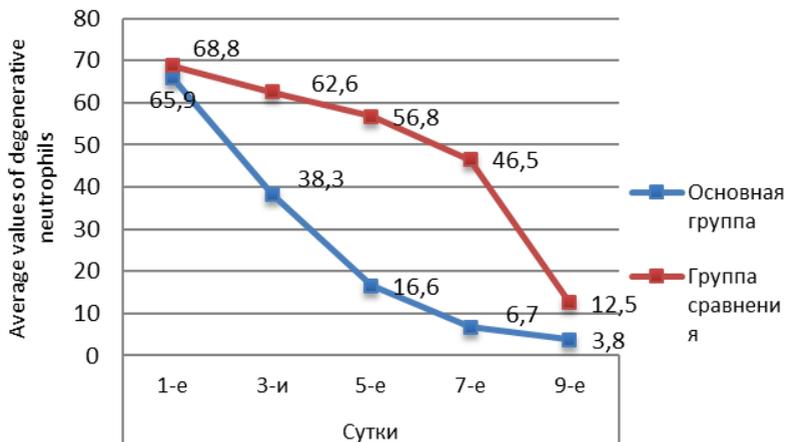
**Figure 3.** Fragment of the cytogram of a smear from the surface of the wound on the 9th day, the main group. Young elements of connective tissue, fibroblasts, polyblasts, macrophages are located among the fibrous structures of the intermediate substance. The epithelium is presented in the form of layers of cells. Staining according to Romanovsky-Giemsa. Mag. × 40



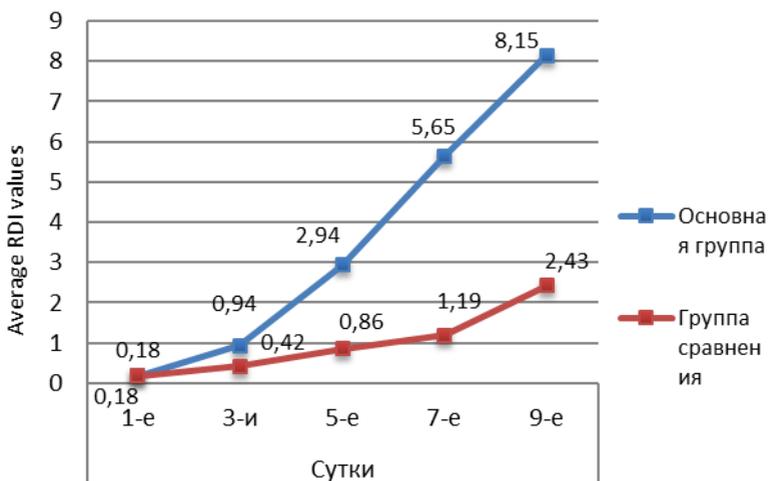
**Figure 4. Fragment of the cytogram of a smear from the wound surface on the 9th day, comparison group. Decreased the number of mononuclear cells, increased the number of polyblasts, fibroblasts, macrophages. Delicate fibrous structures of the intermediate were observed. Staining according to Romanovsky-Giemsa. Mag.×40**

Based on the results of the analysis of variance with repeated measurements for both groups, statistically significant changes in the cellular composition in cytograms on the 1st and 9th days of the postoperative period were proved. The number of DN in the main group significantly decreased from  $64.5 \pm 9.2\%$  to  $3.8 \pm 0.3\%$ , in the comparison group from  $68.8 \pm 6.2\%$  to  $12.5 \pm 0.4\%$ ; RDI values in the main group increased significantly from  $0.2 \pm 0.1\%$  to  $8.2 \pm 0.1\%$ , in the comparison group from  $0.2 \pm 0.1\%$  to  $2.4 \pm 0.1\%$ . Statistically significant differences were proved between the groups as a whole for the entire observation period from the first to the 9th day, therefore, we reject the hypothesis about the equality of the means between the groups without taking into account the time ( $p < 0.001$ ). The presence of a significant interaction between the time factor and the group was also proven ( $p < 0.001$ ). In the main group in the postoperative period, there was a faster decrease in the number of DN, which on the 9th day was  $3.8 \pm 0.3\%$ , in contrast to the comparison group -  $12.5 \pm 0.4\%$ . There was also a more rapid increase in RDI values in the main group, which on the 9th day increased to  $8.2 \pm 0.1$ , in contrast to the comparison group ( $2.4 \pm 0.1$ ). This indicated a more active phagocytosis, more intense cleansing of the purulent cavity of purulent foci in patients of the main group. The dynamics of the mean values of degenerative neutrophils and RDI values

in cytological smears in patients with phlegmon of soft tissues of both study groups are shown in figures 5 and 6.

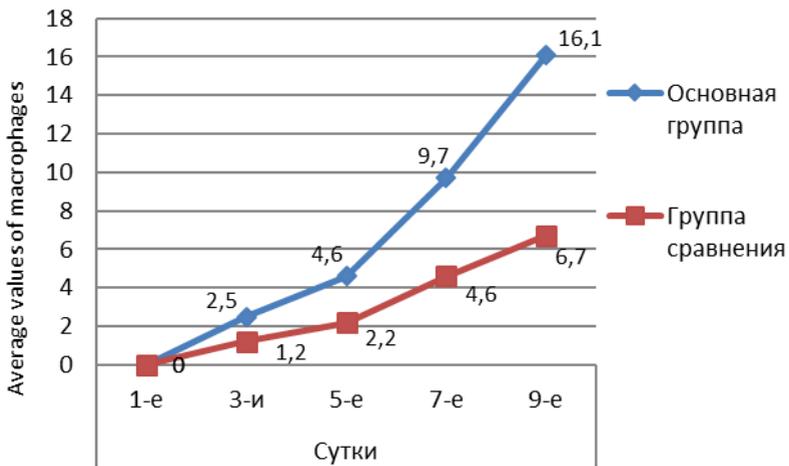


**Figure 5. Dynamics of average values of degenerative neutrophils in cytograms of both study groups in patients with soft tissue phlegmon**

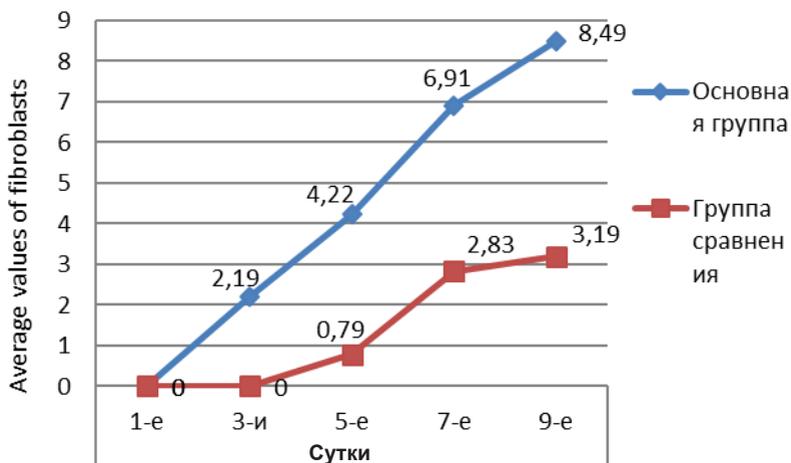


**Figure 6. Dynamics of the average values of the regenerative-degenerative index in the cytograms of both study groups in patients with soft tissue phlegmons**

To assess the reparative potential of purulent wounds, a cytological assessment of the quantitative composition of lymphocytes, macrophages and fibroblasts in the study groups on the 1st and 9th days of the postoperative period was carried out. The results of calculating the analysis of variance with repeated measures showed that for these variables we reject all three null hypotheses, for all three hypotheses  $p < 0.05$ . The difference between groups for these variables is statistically significant as a whole for the entire observation period. In the main group, where programmable sanitation technologies were used, the number of lymphocytes, macrophages and fibroblasts was always higher. Also, these variables were found to have a significant interaction between the time factor and the group. This indicated active regenerative processes in the wound in the main group of patients, and the structure of cytograms in cytological smears in the main group was characterized by a regenerative type.



**Figure 7. Dynamics of mean values of macrophages in cytograms in study groups in patients with phlegmon of soft tissues**



**Figure 8. Dynamics of mean values of fibroblasts in cytograms in study groups in patients with phlegmon of soft tissues**

### Discussion

Analyzing the dynamics of the cytological picture in patients with phlegmon of soft tissues in the study groups, it was noted that in the comparison group with traditional treatment, a low intensity of cellular reactions in the wound, lengthening of the inflammation phase were revealed, and the inflammatory type of cytograms was noted only by 9 days after surgery. Also, in the comparison group, the lethargy of the reparative processes in the wound was observed, causing a significant duration of the regeneration phase, the later timing of the onset of the scar reorganization phase. This led to a lengthening of the healing time.

The use of programmable sanitation technologies made it possible to create conditions for better sanitation of a purulent focus, and led to a reduction in all phases of the wound process. Surgical treatment of a purulent focus, prolonged lavage of the wound cavity in the postoperative period, software of the drainage process made it possible to quickly cleanse the wound from non-viable tissues, toxins and proteolytic enzymes, reducing microbial contamination in the wound. As a result, the stage of rejection of necrotic tissues was extremely reduced. Early closure of the wound with sutures using active drainage under conditions of a minimally pronounced inflammatory reaction in the wound significantly accelerated the reparative processes, creating conditions for the development and completion of the regeneration phase.

### Conclusion

Cytological examination of smears in patients with soft tissue phlegmon using programmable sanitation technologies revealed a higher rate of cellular reactions in the wound. At the same time, a statistically significant faster decrease in degenerative forms of neutrophils was noted, a positive redistribution of stab and segmented neutrophils in combination with an increase in the regenerative-degenerative index, indicating a more rapid relief of the inflammatory process. The appearance of macrophages and cells of young connective tissue in the form of fibrocytes, fibroblasts, fibrous fibers was also observed at an earlier date, which indicated active regenerative processes in the wound.

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## THE ROLE OF SOME MICRORNAS IN THE PATHOGENESIS OF INTRAUTERINE GROWTH RESTRICTION

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**Abstract.** MicroRNAs (miRNAs) are small RNA sequences, on average 22 nucleotides in length, with the ability to regulate gene expression in different organisms. Their action is mediated through the inhibition of translation or the promotion of mRNA degradation. Their genes are encoded within the genome, suggesting that their transcription might be coordinated with the transcription of other genes. In summary, generation of the mature miRNA molecule involves the processing of a primary miRNA transcript in the nucleus to obtain the final product in the cell cytosol, a small single RNA strand which participates in a variety of cellular processes (development, proliferation, function, and differentiation) and in the pathogenesis of many human diseases. miRNAs can target genes with relative specificity [1].

Interestingly, recent studies have shown that miRNAs are also expressed in the placenta, suggesting a potential regulatory role in its development. In addition, some miRNAs have been described to be hypoxia-regulated and associated with intrauterine growth restriction [2].

**Keywords:** intrauterine growth restriction, microRNA, hypoxia, placenta

There are about 2,500 miRNA sequences which are known in humans (miRbase v21), and it was predicted that 30–80% of the human genes may be influenced by at least one miRNA.

Human placental dysfunction has been associated with common complications of pregnancy, primarily preeclampsia and fetal growth restriction (IUGR) [3].

IUGR comprises two varieties: early-onset IUGR (<34 weeks) is less frequent and is characterized by the existence of placental disease, deceleration of fetal growth, and progressive hemodynamic dysfunction, typically affecting in its onset the uterine and umbilical Doppler examination, while late-onset IUGR (>34 weeks) is more frequent and is defined by the unbalance between fetal demands and placental supply, resulting in the detection of a characteristic low cerebroplacental ratio (CPR) regardless of the estimated fetal weight (EFW). Late-onset IUGR tends to be subtle. However, despite what might be thought, it is especially harmful, as it leads to frequently undiagnosed suboptimal arborization and brain underdevelopment [4].

IUGR entails significant fetal and maternal morbidity and mortality. Newborns surviving these pregnancies are at a higher risk of short- and long-term diseases during infancy, childhood, and adulthood [5].

Attempts to achieve a better understanding of placental dysfunction leading to intrauterine growth restriction have been hampered by insufficient in vivo models, inaccurate diagnostic tests, and limited therapeutic and preventive approaches.

Diagnostic imaging by sonography or magnetic resonance imaging has markedly improved in the last decade, yet their impact on elucidating disease pathobiology or on diagnostics in the context of these conditions has been limited [6].

The search for blood tests that can be harnessed for understanding diseases of human pregnancy has been bolstered by the identification of circulating placental proteins that may aid in disease diagnosis even before full clinical manifestation.

Intrauterine growth restriction is a syndrome with multiple causative pathways that often reflect earlier placental maldevelopment, and generally become symptomatic in the third trimester.

Maternal–fetal microRNAs uptake could modulate key pathways in pregnancy establishment and maintenance, from implantation to immune modulation. MiRNAs are sensitive to small changes in the cellular environment, making them potentially powerful biomarkers but difficult to delineate without proper patient stratification [7].

Partly owing to these challenges, investigations of the same pregnancy pathology have identified different altered miRNAs in the maternal circulation.

To date, most studies have focused on profiling maternal circulating miRNAs in intrauterine growth restriction diagnosed in the second trimester. This information could give some indication of markers or mediators of

disease progression; however, any miRNA with value as a biomarker or plausibility as a mediator of pathogenesis must be measurably altered at the gestational week at which pathology arises, or at least before the current point of diagnosis. As such, miRNAs altered in early pregnancy are of most interest [8].

One of the most well characterized miRNAs in pregnancy complications is miR-210 . Under hypoxic conditions, miR-210 is upregulated by the transcription factor HIF-1 $\alpha$  . The intrauterine environment in pregnancies complicated by IUGR or preeclampsia has been suggested to be hypoxic due to decreased perfusion of maternal blood to the fetoplacental unit. miR-210-3p is common to all patient groups [9].

In many research works about IUGR the majority of miRNAs remained unique. There are some clusters: C19MC (520a-3p, 520f-5p, 515-5p, 519-5p), C14MC (299-3p, 494-3p, 376a-5p, 382-3p, 154-3p, 369-3p), the two miRNA clusters known to be specific to the placenta. Enrichment of gene targets in GO categories such as cell migration and proliferation is not a surprising finding since recent literature evidence has shown the role of miRNAs in these functions, in addition to cell invasion and differentiation [10].

Its interesting that intrauterine growth restriction pathogenesis includes the disorder of neuronal plasticity and cellular growth.

miR-148b seems to have special relevance in diverse molecular mechanisms related to neuronal hypoxia, neurogenesis, and neuronal metabolism and development. Particularly, miR-148b-3p upregulation promoted Schwann cell (SC) migration, whereas silencing of miR148b-3p inhibited SC migration *in vitro* . The molecular background of miR-148b-3p is in fact very interesting. It belongs to the miR-148/152 family , which includes miR-148a, miR-148b, and miR-152 and is considered a placenta-associated miRNA, which means it is expressed ubiquitously , not only in the placenta butalso in other tissues. Overexpression of miR-148-3p enhanced the migratory ability of SCs, while inhibition attenuated SC migration *in vitro* . These effects occur in unison with other miRNAs such as miR-132, miR-210, miRNA sc-3, miR-221, and miR-222, which also increase the migratory ability of SCs, and miRNA sc-8, miR-9, miR-98, miR-1, and miR-182, which diminish this ability [11].

A parallel may therefore be drawn between peripheral nerve repair and axonal development (arborization) in the central nervous system. A good example of this is miR-132, which apart from promoting peripheral nerve repair mediated by SCs, as indicated, has been found to protect the central nervous system: miR-132 controls dendritic plasticity and is required for

normal dendrite maturation in newborn neurons [12] .

Therefore, in an analogous way, miR-148b-3p might also play a role in the protection of the central nervous system. In theory, as brain tissue depends on myelination, miR148b-3p might contribute to the protection of brain tissue under different circumstances, such as in chronic hypoxia [13].

Regarding carbohydrates, miR-148b inhibits hypoxia-induced elevation of lactate production and hypoxia-induced increase in glucose consumption, thereby reducing cellular growth . Regarding amino acids and proteins, miR-148b-3p and miR-25-3p behave as key regulators of biosynthesis of valine, leucine, and isoleucine and also regulate protein processing at the endoplasmic reticulum, both pathways of special relevance to fetal growth during the last trimester of pregnancy and during periods of nutritional deprivation. Finally, regarding fatty acid metabolism, both miR-25-3p and miR148b-3p control biosynthesis of fatty acids and sphingolipids , essential molecules for stem cell differentiation morphogenesis and embryo development that are also related to preeclampsia and IUGR [14].

Since the pathological processes precede the clinical signs and symptoms of IUGR, it is possible that the miRNAs identified in different studies may be altered in the maternal circulation early in pregnancy and may serve as potential biomarkers that may predict the disorder.

Future studies may include analysis of maternal plasma samples completed retrospectively by measuring miRNA levels in plasma samples obtained early in pregnancy as a part of routine clinical care to more accurately assess diagnostic value across gestation.

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## FEATURES OF GENETIC POLYMORPHISMS AND CLINICAL MANIFESTATIONS OF PRIMARY THROMBOPHILIA IN CHILDREN

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**Annotation.** Early detection of thrombophilia is one of the main factors in the prevention of thrombotic events in the future. The presence of thrombogenic polymorphisms and their combinations determines the tactics and prognosis of the complicated course of primary thrombophilia.

Our aim was to study the features of clinical manifestations and genetic status of children with idiopathic thrombophilia, depending on the age of debut (according to the data of the multidisciplinary hospital Krasnoyarsk Regional State Budgetary Institution of Health "Krasnoyarsk Regional Clinical Center for Maternity and Childhood Protection" (KRSBIH «KRCCMCP»)).

A retrospective analysis of the case histories of children who were hospitalized at the KRSBIH «KRCCMCP» in the period 01.2014 - 01.2020 was carried out. 25 case histories of children were selected, two groups were formed.

The clinical manifestation of thrombophilia in newborns is represented mainly by venous thrombosis of the extremities in 42.86% (3 cases) or thrombosis of the renal, portal or vena cava - 42.86% (3 cases). In children aged 1 month before the age of 18, the most common vascular thrombosis of the central nervous system - 88.24% (15 patients). It was found that all patients in group 1 had a decrease in the activity of natural anticoagulants - antithrombin III and protein C. In newborns, the MTHFR gene mutation was found twice as often as in the second group (62.5% versus 29.4%, respectively). The risk of a complicated course is significantly higher in

group 1, where the RR (95% CI) was 1.821 (1.012 - 3.279). A tendency was revealed for the association of a complicated course of thrombophilia with such combinations as MTHFR: g.677C> T, MTHFR: g.1298A> C, MTR: g.2756A> G, and MTRR: g.66A> G.

**Keywords:** thrombophilia, thrombosis, thromboembolism, hemostasis, genes.

### INTRODUCTION

Thrombophilia is a hereditary or acquired condition that predisposes to pathological thrombosis [1]. Primary thrombophilia is characterized by a genetically determined tendency to form venous thromboembolic complications (VTEC) [2].

According to the literature, there are conflicting data on the incidence of this pathology in childhood, especially in the neonatal period: from 13% to 78% of all thrombosis in children are formed against the background of hereditary thrombophilia [3,4].

The urgency of the problem is also determined by the risk of a complicated course and / or re-thrombosis with disabling and lethal outcomes, which may depend on persistent risk factors such as mutations and defects in the hemostatic system [1,4,5,6].

Considering the many uncertain questions of the observation of children with primary thrombophilia, especially in the neonatal period, the study of the clinical and genetic parallels of the course and outcomes of the disease remains relevant.

During the diagnosis of primary thrombophilia, it is essential to analyze the risk factors of the disease, which are classified into clusters: A (a proven influence on the development of thrombosis in children), B (not proven, but potential risk factors), C (not proven, but possible markers) [7, 8].

Group A [9, 10, 11,12]:

- deficiency of natural anticoagulants (protein C, S);
- resistance to activated protein C;
- carriage of prothrombotic polymorphisms *F5: g.1691G> A, F2: g.20210G> A, MTHFR: g.677C> T*;
- increased concentration of lipoprotein (a);
- positive test for lupus anticoagulant;
- an increase in the titer of antiphospholipid antibodies (anti-β2-glycoprotein 1 - IgG and IgM, and anti-cardiolipin antibodies IgG and IgM).

### RESULTS

In the initial sample, 25 case histories of children who were in hospital were selected according to the inclusion and exclusion criteria. One child

from dichorionic twins (a girl) at the time of examination did not have a clinic of the onset of thrombosis, while her brother had a detailed clinic of peripheral thrombosis. Since the diagnosis of hereditary thrombophilia in both children was confirmed by the presence of multiple thrombophilic mutations, aggravated by a family history of thrombotic events, the child was included in the analysis of the molecular genetic characteristics of thrombophilia in newborns.

At the beginning of the study, two age groups were formed: group 1 consisted of 8 newborn children, group 2 - 17 patients aged 28 days to 18 years. This division is due to the physiological characteristics of hemostasis in the neonatal period, which include a transient deficiency of natural anticoagulants - pC and ATIII, which is most pronounced in premature infants [13, 14].

The median gestational age of the observed group 1 was 29.8 [26.75; 38.36] weeks, 71.43% (5 people) observed were premature. The median age of patients in group 2 is 10.83 [7; 15] years (Table 1).

**Table 1. Age and sex characteristics of the children under study**

Specifications		Group 1, n	Group 2, n
Sex (m/f)		4/4	7/10
Debut age	0 – 28 days	7	-
	29 days – 17 years	-	17

Note. M is male, F is female.

The clinical manifestation of the onset of thrombophilia in group 1 is represented by venous thrombosis of the extremities, as well as thrombosis of the renal, hollow, portal veins in 42.86% (3 cases each) (Table 2).

In most cases, it is difficult to identify the provoking factors for the manifestation of thrombosis. The most frequent localization of thrombosis was the vascular system of the brain with a clinical picture of transient ischemic attack (TIA) or ischemic stroke - 88.24% in group 2 (15 people).

**Table 2. Clinical characteristics of the manifestation of primary thrombophilia in children**

Parameter	Group 1 (n, %)	Group 2 (n, %)	RR (95% CI)
Venous thrombosis of the upper / lower extremities	3 (42,86)	1 (5,88)	7.286 (0.906- 58.612)
Pulmonary embolism	1 (14,28)	1 (5,88)	2.429 (0.175- 33.639)

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Superior / inferior vena cava / portal / mesenteric / renal vein thrombosis	3 (42,86)	-	-
Acute myocardial infarction	-	1 (5,88)	-
TIA / Ischemic stroke	1 (14,28)	15 (88,24)	0.162 (0.026- 1.002)

Note: RR (95% CI) - 95% confidence interval.

Evaluation of proven risk factors (cluster of risk factors A according to clinical guidelines) established lower values of the activity of natural anticoagulants ATIII and pC in all patients of group 1 and significantly confirmed a higher probability of their presence when calculating the risk ratio: 2.833 (1.489-5.393) for pC and 8.5 (2.312-31.247) - ATIII. When analyzing the characteristics of the genetic status of patients, it was revealed that in patients of group 1, the mutation of the *MTHFR g.677 C>T* was twice as common - 62.5% versus 29.41% in group 2 - RR (95% CI) was 2.429 (1.015-5.813), and also recorded the presence of mutations that were completely absent in the 2nd group - this is FII, and the V factor Leiden mutation (Table 3). In group 2, the detectability of the above risk factors for cluster A was significantly lower, but more often a high level of homocysteine and a decrease in pC activity were recorded.

**Table 3. Proven risk factors for primary thrombophilia (risk factor cluster A)**

Risk factor	Group 1		Group 2		RR (95% CI)
	n	%	n	%	
Decreased pC activity*	7	100	6	35,29	2.833 (1.489-5.393)
Decreased pS activity	0	0	2	11,76	-
Decreased activity of AT III*	7	100	2	11,76	8.5 (2.312-31.247)
Increase in homocysteine	1	12,5	6	35,29	0.429 (0.062-2.949)
<i>F5: g.1691G&gt;A</i>	1	12,5	0	0	-
<i>F2: g.20210 G&gt;A</i>	2	25	0	0	-
<i>MTHFR: g.677 C&gt;T*</i>	5	62,5	5	29,41	2.429 (1.015-5.813)

Note: RR (95% CI) - 95% confidence interval. \*p≤0,05

In group 1 patients, mutations associated with folate (*MTHFR: g.677C>T*) and methionine cycles - (*MTRR: g.66A>G* and *MTHFR: g.1298A>C*) were the most widespread (Table 4).

In group 2, the frequency of detection of the studied polymorphisms is comparable to that of newborn children. An important difference is the absence in group 2 of patients of the F5 mutation: g.1691G> A, which determines the formation of factor V resistance to one of the main physiological anticoagulants, protein C; as well as the frequency of the *MTHFR*: g.677C> T mutation, which in this group was twice as rare as in group 1.

The study of allelic variants of polymorphisms in group 1 revealed the predominance of heterozygous carriage of thrombogenic mutations in genes regulating the folate cycle - from 62.5% (5 cases) *MTRR*: g.66A>G and 37.5% (3 cases) *MTR*: g. 2756A>G and *MTHFR*: g.677C>T (Table 4). The frequency of carriage of the homozygous state of the *MTHFR* variant: g.677C>T was 25% (2 cases), which corresponds to the literature data [15]. Other genes such as *MTHFR*: g.1298A>C and *MTRR*: g.66A>G had a homozygous state in 12.5% (1 case) (Table 4).

**Table 4. Thrombogenic polymorphisms of hemostasis factors in primary thrombophilia**

Gene	Genome variant	Group # 1		Group # 2		RR (95% CI)
		n	%	n	%	
<i>F7</i> : g.10976G>A	Heterozygote	0	0	1	5,88	-
<i>F7</i> : g.10976G>A	Homozygote	0	0	0	0	-
<i>F2</i> : g.20210G>A	Heterozygote	2	25	0	0	-
<i>F2</i> : g.20210G>A	Homozygote	0	0	0	0	-
<i>F5</i> : g.1691G>A	Heterozygote	1	12,5	0	0	-
<i>F5</i> : g.1691G>A	Homozygote	0	0	0	0	-
<i>MTHFR</i> : g.1298A>C	Heterozygote	2	25	5	29,41	0.85 (0.208-3.475)
<i>MTHFR</i> : g.1298A>C	Homozygote	1	12,5	2	11,76	1.063 (0.112-10.067)
<i>MTHFR</i> : g.677C>T	Heterozygote	3	37,5	4	23,53	1.594 (0.462-5.501)
<i>MTHFR</i> : g.677C>T	Homozygote	2	25	1	5,88	4.25 (0.449-40.267)
<i>MTR</i> : g.2756A>G	Heterozygote	3	37,5	3	17,65	2.125 (0.544-8.296)
<i>MTR</i> : g.2756A>G	Homozygote	0	0	1	5,88	0

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<i>MTRR: g.66A&gt;G</i>	Heterozygote	5	62,5	5	29,41	2.125 (0.854-5.286)
<i>MTRR: g.66A&gt;G</i>	Homozygote	1	12,5	6	35,29	0.354 (0.051-2.472)
<i>ITGA2: g.807C&gt;T</i>	Heterozygote	1	12,5	1	5,88	2.125 (0.151-29.82)
<i>ITGA2: g.807C&gt;T</i>	Homozygote	0	0	0	0	-
<i>PAI-1: g.(-675)5g&gt;4g</i>	Heterozygote	1	12,5	0	0	-
<i>PAI-1: g.(-675)5g&gt;4g</i>	Homozygote	0	0	1	5,88	-

Note: RR (95% CI) - 95% confidence interval.

Among the most significant polymorphisms in group 2 patients were identified: homozygous mutation *MTRR: g.66A>G* in 35.29% (6 cases), and *MTHFR: g.1298A>C* - 11.76% (2 cases). Most of the mutations in both groups are in the genes responsible for the exchange of folate, methionine and homocysteine. Polymorphisms of genes encoding key proteins of the hemostasis system were found only in the heterozygous state - in group 1 *F5: g.1691G>A* and *F2: g.20210G>A* (12.5% - 1 patient and 25% - 2 people, respectively), in group 2 *F7: g.10976G>A* - 5.88% (1 patient).

When assessing the outcomes, a tendency to the presence of a high number of disabling complications was found in both groups, which amounted to 85.72% (6 patients) and 47.06% (8 people), respectively, and more often in the neonatal group, which is confirmed by the RR parameter (95% CI) - 1.821 (1.012 - 3.279) with a high survival rate after thrombotic events. In patients of group 2, the development of delayed complications in the form of paresis / paralysis was noted in 41.18% of cases after suffering from stroke with the following localizations of the thrombus in the basins:

- left middle cerebral artery - 4 cases (23.52%)
- right middle cerebral artery - 1 case (5.88%)
- cerebellar arteries on both sides - 1 case (5.88%)
- vertebrobasilar basin - 1 case (5.88%).

Analysis of outcomes against the background of thrombotic events (Table 5) showed that in the group of newborns, one of the two cases of mortality is due to the development of sepsis. The second case of death is associated with the development of pulmonary embolism (PE). In group 2, two deaths were recorded: the first - against the background of progressive pulmonary arterial hypertension after undergoing sarcoidosis (age 7.5 years), the second case of death of the patient due to cerebral edema against the background of acute ischemic stroke (age 10.8 years).

During the analysis of the complications of thrombosis, among the patients of our study, the following were found: conditions requiring necrectomy, paresis, paralysis, pulmonary embolism, acute renal failure, cerebral edema. In the considered cases of group 1, complications prevailed, which required the removal of necrotic tissues, and in group 2, paresis, paralysis. The likelihood of a complicated course was significantly higher in group 1, where the RR (95% CI) was 1.821 (1.012 - 3.279).

**Table 5. Outcomes of the first episode of thrombosis in primary thrombophilia**

Outcome	Группа №1		Группа №2		RR (95% CI)
	n	%	n	%	
Lethal outcome	2	28,57	2	11,76	2.429 (0.422-13.993)
Full recovery	5	71,43	15	88,24	0.81 (0.491-1.334)
Complications of thrombosis*	6	85,72	8	47,06	1.821 (1.012 - 3.279)

Note: RR (95% CI) - 95% confidence interval. \*p≤0.05

## DISCUSSION

In group 1, according to our data, the leading criteria for confirming the diagnosis in all newborns should be considered a decrease in the activity of natural anticoagulants - ATIII and pC, less often the presence of the MTHFR mutation: g.677C> T. The features of hereditary thrombophilia in newborns include: peripheral venous disease, a high incidence of acute complications and a high mortality rate, which to a certain extent corresponds to the literature data, according to which the main manifestations of thrombophilia are: stroke (most often), thrombosis of peripheral vessels, renal veins, and the main trigger is vascular catheterization (except for situations with stroke) [7,12].

In group 2, the predominant localization of thrombosis was the vessels of both midbrains, cerebellar and vertebrobasilar arteries; therefore, in most patients, the leading clinical syndrome was acute cerebrovascular accident of varying severity, or a clinic characteristic of a transient ischemic attack. In 58.3% of all cases (14 patients), there was a complicated course of thrombophilia, more often in the group of newborns, the total mortality rate in both groups was 16.7%, which may be associated with the presence of multiple persistent risk factors for the implementation of thrombosis.

We identified the most frequent mutations in both group: *MTHFR*:

*g.1298A>C, MTHFR: g.677C>T, MTR: g.2756A>G, MTRR: g.66A>G.* In the second group, the genotype of patients with ischemic stroke and TIA course is represented by carriage of folate cycle genes and / or key genes of the hemostasis system, which is consistent with the literature data, which indicate a more frequent occurrence of *MTHFR: g.677C> T*, as well as a deviation from the canonical Hardy-Weinberg equilibrium for the frequencies of the MTR genotype: *g.2756A> G* [15].

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**ON THE PROBLEM OF WEAK POWER CONJUGACY IN A SPECIAL CLASS OF ARTIN GROUPS**

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**Abstract.** The article gives an algorithm that allows solving the problem of weak power-law conjugacy of words in Artin groups, which are tree products of Artin groups with a tree structure and Artin groups of extra-large type.

**Keywords:** Artin group, tree structure, weak power conjugacy, diagram.

Let  $G'$  – be a finitely generated Artin group with co-representation

$$G' = \langle \sigma_1, \dots, \sigma_n; \langle \sigma_i \sigma_j \rangle^{m_{ij}} = \langle \sigma_j \sigma_i \rangle^{m_{ji}}, i, j = \overline{1, n}, i \neq j \rangle,$$

where  $\langle \sigma_i \sigma_j \rangle^{m_{ij}}$  – consisting of  $m_{ij}$  alternating generators  $\sigma_i, \sigma_j, i \neq j, m_{ij}$  – element of the matrix  $(m_{ij}): m_{ii} = 1, m_{ij} \geq 2$  or  $m_{ij} = \infty, i \neq j$  [1].

The extra-large type of groups  $G'$  was introduced by K. Appel and P. Schupp [1]. It is typical for it that  $m_{ij} > 3$  for all  $i \neq j$

For  $G'$  we construct a graph  $\Gamma$  so that  $\sigma_i, i = \overline{1, n}$ , correspond to the vertices of the graph  $\Gamma$ , and  $\langle \sigma_i \sigma_j \rangle^{m_{ij}} = \langle \sigma_j \sigma_i \rangle^{m_{ji}}, m_{ij} \neq \infty$ , – an edge with ends  $\sigma_i, \sigma_j, i \neq j. G'$  has a tree structure if  $\Gamma$  – is a tree.

$G'$ , which has a tree structure, is a free product with amalgamation by cyclic subgroups of Artin groups on two generators.

The woody structure for  $G'$  in 2003 was identified by V.N. Bezverkhnny [2].

Now

$$G = \langle \prod_{s=1}^t * G_s; \sigma_{i_m} = \sigma_{j_l}, i \neq j, i, j \in \overline{1, t} \rangle,$$

tree product  $G_s$  with tree structure or extra-large type, where the union  $G_i, G_j$  is taken over  $\langle a_{i_m} \rangle, \langle a_{j_l} \rangle$ , where  $a_{i_m}$  – is the generator of  $G_i, a_{j_l}$  – is the generator of  $G_j. G$  will be called an Artin group with a generalized tree structure or a special class of Artin groups.

It is known that in Artin groups of extra-large type, with a tree structure, and in a special class of Artin groups, the problems of equality and conjugacy of words are solvable [1] - [3].

Let an annular map  $M$ , be given on the plane, that is, its complement - two components. We assume that  $K$  is unbounded, and  $H$  is the bounded component of  $M$ , while  $\partial M \cap \partial K$  is the outer, and  $\partial M \cap \partial H$  is the inner boundary of  $M$ . The cycle  $\sigma$  of the smallest length, including the edges  $\partial M \cap \partial K$ , is the outer boundary cycle of  $M$ . Similarly,  $\tau$  is the inner boundary cycle of  $M$ . Further, we denote a free product as  $F, R$  - symmetrized subset of  $F, N = (R)^F$  - normal closure. If  $u$  and  $z$  are cyclically reduced in  $F$ , do not lie in  $N$ , are not conjugate in  $F$ , but conjugate in  $F/N$ , then there exists a reduced ring  $R$ -diagram  $M$  with at least one domain, and  $\sigma, \tau$  are the inner and outer boundary cycles of  $M, \varphi(\sigma) = u, \varphi(\tau) = z^{-1}$ . Let  $u, z$  be two cyclically reduced words,  $u, z \notin (R)^G$ , are not conjugate in  $F$  and are conjugate in  $G$ . The boundary marks of the regions  $D$  of the  $R$ -diagram  $M$  are relations from  $R$ . Consider the transformations of the  $R$  - diagram of  $M$ . If  $D_1, D_2$  intersect along the edge  $e$  so that the common label is either a relation from  $R_{ij}$ , or a single word in  $F_{ij} = F_i * F_j$ , then we erase  $e, D_1$  and  $D_2$  are united into a single region, and in the latter case we cut out the resulting region by gluing its border. As a result, we obtain a reduced, that is, invariant under the considered transformations, ring  $R$ -diagram  $M'$  with boundary marks  $u$  and  $z^{-1}$ . In what follows, we will consider only such diagrams.

$\partial D \cap \partial M$  is a regular part of  $M$  if  $\partial D \cap \partial M$  is the union of a sequence of closed edges occurring in the same order in  $\partial D$  and in  $\partial M$ .  $D$  is simple when  $\partial M \cap \partial D$  is the correct part of  $\partial M$ . Further  $d(D)$  is the number of edges of  $D$ ;  $d(v)$  is the degree of the vertex  $v$ ;  $i(D)$  is the number of internal edges,  $||w||$  is the syllable length  $w$ . A simple domain  $D$  is Denov's [2] for  $i(D) < 2$ , the distance  $\partial D \cap \partial M$  of the Denov's domain  $D$  is Denov's reduction  $M$ .

Definition 1 [2]. A sequence  $\Pi$  of domains  $D_1, D_2, \dots, D_n$  forms a strip in  $M$  with  $\partial M = \gamma \cup \delta$ , if:

- 1)  $\forall i, 1 \leq i \leq n, \partial D_i \cap \gamma$  - connected path of syllable length at least 1;
- 2)  $\forall i, 1 \leq i < n$ , boundaries  $D_i, D_{i+1}$  are crossed by  $e$ ;
- 3)  $||\partial D_1 \cap \gamma|| = ||\partial D_1 \cap \delta|| + 2, ||\partial D_n \cap \gamma|| = ||\partial D_n \cap \delta|| + 2$ ;
- 4)  $||\partial D_j \cap \gamma|| = ||\partial D_j \cap \delta||, 2 \leq j < n$ .

Removing  $\partial \Pi \cap \partial M$  in  $M$  is an  $\bar{R}$ -reduction [2].

Lemma 1 [2]. There is an algorithm that finds out for each cyclically reduced word  $w$  of the group  $G$  its  $R, \bar{R}$ -irreducibility.

If  $D$  is located on both sides of the edge  $e$  and  $\partial D = e\gamma e^{-1}\delta$ , the glued edges  $e$  and  $e^{-1}$  intersect  $\partial D$ , then we have  $(s - i)$ -domain [2].

Theorem 1 [3]. If  $M$  is the  $R$ -conjugacy diagram of words  $\phi(\sigma), \phi(\tau) \in G$  without  $(s - i)$ -domains; moreover  $\phi(\sigma), \phi(\tau)$  are cyclically  $R, \bar{R}$ -uncancelable, then  $M$  is one-layer.

The  $R$ -diagram  $M$  of conjugacy of cyclically  $R$  and  $\bar{R}$ -irreducible words  $\phi(\sigma), \phi(\tau)$  from  $G$  is considered especially special if  $M$  has a unique  $D$  with  $|\phi(\partial D \setminus (\partial D \cap \sigma))| = |\phi(\partial D \cap \sigma)|$ . Replacing  $\phi(\sigma)$  by  $\phi(\tau)$  is a special ring  $R$ -cancellation [2].

Definition 2 [2].  $w$  is dead-end if it is cyclically  $R, \bar{R}$ -irreducible and cannot be specially annular  $R$ -reduced.

It follows from [1] - [3] that one can effectively establish whether  $w$  is dead-end.

Lemma2. For conjugate dead-end words  $v, w \in G$  their syllable lengths are equal and minimal in the sense that a word of shorter syllable length  $v$  is not conjugate to  $w$ .

The argument is obvious.

Definition 3 [2]. In  $G$  the weak power conjugacy problem is algorithmically solvable if, for any  $v, w \in G, w \notin \langle v \rangle$  the existence of an integer  $n$ , is effectively defined for which  $v, w^n$  are conjugate in  $G$ .

Lemma 3. Given any dead-end  $w$  from  $G$ , we can construct a word  $w_0$  conjugate to it or its square, any power of which is  $R, \bar{R}$ -irreducible.

The proof is similar to the proof of lemma 11 in [4]. This is possible because we introduce the concept of a strip, which is identical to Artin groups with a tree structure, which is identical to that given in Definition 1, as well as the one-layer structure of the  $R$ -diagram  $M$  of conjugacy of words considered in theorem 1.

Theorem2. For any  $w$  from  $G$  one can construct a word  $w_0$  conjugate to it or its square, any power of which is  $R, \bar{R}$ -irreducible.

Proof. Let us execute  $R, \bar{R}$ -reductions in cyclic  $w$ , then a special ring  $R$ -reduction, if any. We get the dead-end word conjugate to  $w$ . Next, we apply lemma 2 to the resulting word.

Lemma 3. For every cyclically irreducible  $v$  from  $G$  one can construct its cyclically conjugate  $R, \bar{R}$ -irreducible.

Theorem 3. In  $G$ , the weak power conjugacy problem is algorithmically solvable.

Proof. Suppose that  $w^n, v$  are conjugate in  $G$ . We must show that  $n$  is bounded.

Based on Theorem 2, we pass from  $w$  to  $w_0$ , each degree of which is  $R, \bar{R}$ -irreducible. Note that  $w_0$  is conjugate to either  $w$  or its square.

Lemma 4. Let  $w_0^n$  and  $v_0$  be conjugate. Then  $n < (2|v_0| + 1)(|w_0| + |v_0| + 2)$ .

Proof. It follows from [1], [5] that these problems have been solved in the factors of  $G$ .

The following cases are possible:

1. From  $w$  go to  $w_0$ .

Suppose that  $w_0^n = z^{-1}v_0z$ , that is  $w_0^n \sim v_0^2$ .

Consider the ring diagram of  $M$  conjugacy of  $w_0^n$  and  $v_0$  with  $\partial M = \gamma \cup \delta, \varphi(\gamma) = w_0^n, \varphi(\delta) = v_0$

According to theorem 1,  $M$  is a one-layer diagram. Let  $t$  denote the number of domains with access to  $\gamma$  and  $\delta$ . The number of edges going to  $\gamma$  does not exceed  $|v_0|$ , the number of vertices does not exceed  $|v_0| + 1$ , then  $t$ , obviously, does not exceed the sum of edges and vertices, that is  $2|v_0| + 1$ . We have  $n < |w_0^n| < t|r_0| \leq (2|v_0| + 1)|r_0|$ ,  $r_0 \in R$  and has maximum length. Obviously,  $|r_0| < |w_0| + |v_0| + 2$ . Hence  $n < (2|v_0| + 1)(|w_0| + |v_0| + 2)$ .

2. From  $w^2$  go to  $w_0$ .  $w^n \sim v$ . Then  $(w^2)^n \sim v^2$ . We replace  $w^2$  by its conjugate  $w_0$ , any degree of which is cyclically  $R, \bar{R}$ -irreducible according to theorem 2. We obtain  $w_0^n \sim v^2$ . Replace  $v^2$  by its equal in the group  $G$   $R, \bar{R}$ -irreducible  $v_0$  according to lemma 3. Next, we use case 1.

The theorem is proved.

Note also that the special class of Artin groups considered in this paper belongs to the almost large Artin groups considered in [6]. Investigations of a special class of Artin groups by diagrammatic methods lead to simpler algorithms for solving the problems of equality, conjugacy, and weak power conjugacy. These methods are supposed to be used in the further study of these groups, in particular, to solve the problems of power conjugacy and intersection of cyclic subgroups.

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## ENERGETICS OF PULSE GENERATORS WITH CURRENT INTERRUPTION IN AN INDUCTIVE STORE

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The paper presents an electrotechnical analysis of circuits based on an inductive energy store and an opening switch for operation with no load, with an inductive load, and with a resistive load, and also with two-stage pulse sharpening and upstream-of-switch load connection. The function of a switch is to cut off the load of a pulse generator during energy storage and to provide fast energy delivery to the load on approaching a certain critical current. The analysis suggests simple and useful formulae to estimate the load pulse parameters at a linearly rising switch resistance. The approximation of a linear resistance rise at the phase of current cutoff is a useful tool to assess the energetics of pulse generators both with plasma opening switches and with exploding wire switches. The estimates are compared with experimental data. The use of a more complex resistance approximation can improve the agreement between calculations and experiments, but it inevitably deprives the relations of their simplicity, clarity, and promptitude.

### I. Introduction

Inductive energy stores, being ten times superior to capacitive ones in energy density, can greatly decrease the weight, dimensions, and cost of pulsed power systems [1]. However, their efficient use needs a switch capable of providing high-current interruption, many-fold pulse compression, and power amplification at a load. Among the most widespread types of switch are exploding wire switches [2], [3] and plasma opening switches [4], [5]. The function of a switch is to cut off the load of a pulse generator during energy storage and to provide fast energy delivery to the load on approaching a certain critical current.

This paper analyzes the operation of circuits based on an inductive en-

ergy store and an opening switch (shortly, inductive store–switch circuits) with no load, with an inductive load, and with a resistive load, and also with two-stage pulse sharpening and upstream-of-switch load connection. The analysis suggests simple and useful formulae to promptly estimate the load pulse parameters at a linearly rising switch resistance. The estimates and respective current and voltage waveforms are compared with experimental data.

## II. Inductive Store–Switch Circuits

Figure 1 shows three main circuits with an inductive energy store and a switch. When the switch is conducting, the inductance  $L_g$  is charged from the primary capacitive energy store to a current  $I_0$ . The voltage at the instant of current cutoff depends on the circuit parameters and on the rate of rise of the switch resistance.

When the switch also serves as a load (Fig. 1a), the discharge current is determined by the equation  $L_g \dot{I}_s(t) + R_s(t)I_s(t) = 0$ , where (like in all further expressions) the dot over the current symbol stands for a time derivative.

The solution of this equations has the form  $I_s(t) = I_0 \exp[-L_g^{-1} \int_0^t R_s(t') dt']$  with  $I_0$  for the inductance current at the instant of switch operation. Because the current decays exponentially, the switch voltage  $V_s(t) = I_s(t)R_s(t)$  reaches its peak subject to  $\dot{R}_s(t) = R_s^2(t) / L_g$ . For the resistance rising linearly  $R_s(t) = \dot{R}_s t$  with a constant rate  $\dot{R}_s = Const$ , the peak voltage

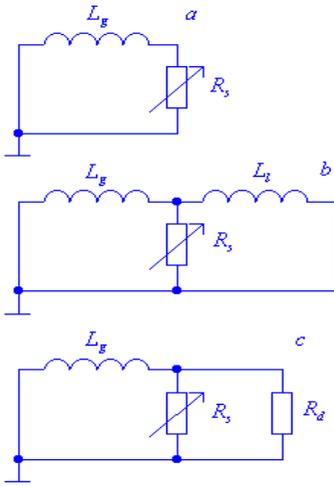
$$V_m = I_0 (\dot{R}_s L_g / e)^{1/2}, \tag{1}$$

where  $e$  is the base of natural logarithms, is attained at the point in time

$$t_m = (L_g / \dot{R}_s)^{1/2}. \tag{2}$$

The voltage full width at half maximum  $\Delta t \approx 1.60 t_m$ , where the numerical factor is equal to the difference of roots of the equation  $2xe^{(1-x^2)/2} = 1$ ,  $x = t / t_m$ .

Because the maximum energy store current is  $I_0 = U_0 / \rho$ , where  $U_0$  is the output voltage of the primary capacitive store with a discharge capacitance  $C$  and  $\rho = (L_g / C)^{1/2}$  is the wave impedance, the voltage multiplication factor according to (1) is  $K = (\dot{R}_s C / e)^{1/2}$ .



**Fig. 1. Inductive store–switch circuits.**

The dissipated switch power reaches its extremum  $P_{s\max}$  at the time point  $t'_m$  determined from the equation  $\dot{R}_s(t) = 2R_s^2(t) / L_g$ . From this we have  $t'_m = (L_g / 2\dot{R}_s)^{1/2}$  and  $P_{s\max} = (L_g \dot{R}_s / 2e)^{1/2} I_0^2$ . For  $L_g = 100 \div 400 \text{ nH}$ ,  $I_0 = 1 \text{ MA}$ , and  $\dot{R}_s = 0.1 \text{ } \Omega/\text{ns}$ , the voltage rises to  $V_m = 2 \div 4 \text{ MV}$  in  $t_m = 30 \div 60 \text{ ns}$  at  $P_{s\max} = 1.4 \div 2.8 \text{ TW}$ .

When the switch operates into an inductance  $L_l$  (Fig. 1b), the store current  $I_g(t)$ , the switch current  $I_s(t)$ , and the load current  $I_l(t)$  are determined from the system of equations

$$\begin{cases} I_g(t) = I_s(t) + I_l(t); \\ L_l \dot{I}_l(t) = R_s(t) I_s(t); \\ L_g \dot{I}_g(t) + R_s I_s(t) = 0, \end{cases}$$

where the initial conditions are  $I_g(0) = I_s(0) = I_0$ ,  $I_l(0) = 0$ . Thus, we have the load current  $I_l(t) = I_0 [L_g / (L_g + L_l)] \{1 - \exp[-L_l^{-1} \int_0^t R_s(t') dt']\}$  and the switch current  $I_s(t) = I_0 \exp[-L_l^{-1} \int_0^t R_s(t') dt']$ , where  $L_l = L_g L_l / (L_g + L_l)$ . The parameters  $V_m$ ,  $t_m$  are given by (1) and (2) with  $L_g \rightarrow L_l$ . At  $L_g = L_l$ , these parameters decrease  $\sqrt{2}$  times compared to their values for the circuit in Fig. 1a.

For full opening of the switch, the total energy in the circuit elements is  $W_f = W_0 L_g / (L_g + L_l)$ , where  $W_0 = L_g I_0^2 / 2$  is the stored energy. The ratio  $W_f / W_0 = L_g / (L_g + L_l)$  decreases from unity at  $L_l \rightarrow 0$  to zero at  $L_l \rightarrow \infty$ . On the contrary, the dissipated energy  $W_{R_s} / W_0 = L_l / (L_g + L_l)$  increases from zero at  $L_l \rightarrow 0$  to unity at  $L_l \rightarrow \infty$ . The load energy  $W_l = W_0 L_g L_l / (L_g + L_l)^2$  is maximal at  $L_g = L_l$  for which  $W_l = 0.25 W_0$  and  $W_{R_s} = 0.5 W_0$ .

The load pulse power  $P_l(t) = [L_g / (L_g + L_l)] R_s(t) I_0^2 f(t)$ , where  $f(t) =$

$= \{1 - \exp[-L_l^{-1} \int_0^t R_s(t') dt']\} \exp[-L_l^{-1} \int_0^t R_s(t') dt']$ , is maximal at the time point  $\tilde{t}_m$  determined from the equation  $e^{-\theta} = (1-2\theta)/(1-4\theta)$ , where  $\theta = \dot{R}_s \tilde{t}_m^2 / 2L_l$ . From this we have  $\theta \approx 1.06$ ,  $P_{I_{\max}} = \alpha(L_l \dot{R}_s)^{1/2} L_g I_0^2 / (L_g + L_l)$ , where  $\alpha = (2\theta)^{1/2} e^{-\theta} (1 - e^{-\theta})$ . At  $L_l = L_g / 2$ , the power reaches its absolute extremum  $P_{I_{\max}(L_l)} = (2\alpha / 3^{3/2})(L_g \dot{R}_s)^{1/2} I_0^2$ . At  $L_g = L_l$ , the power is  $P_{I_{\max}} = (\alpha / 2^{3/2})(L_g \dot{R}_s)^{1/2} I_0^2$ .

With a resistive load (Fig. 1c), the currents are determined from the equations

$$\begin{cases} I_g(t) = I_s(t) + I_d(t); \\ R_d I_d(t) = R_s I_s(t); \\ L_g \dot{I}_g(t) + R_s(t) I_s(t) = 0, \end{cases}$$

where the initial conditions are  $I_g(0) = I_s(0) = I_0$ ,  $I_d(0) = 0$ . For  $R_d = Const$ , the switch current is

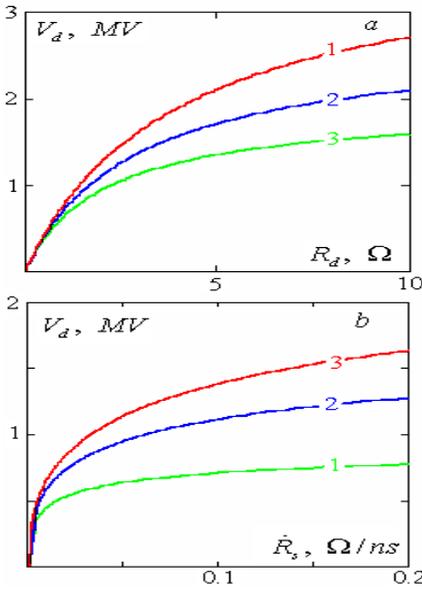
$$I_s(t) = I_0 \exp\left[-\int_0^t \{[L_g \dot{R}_s(t') + R_s(t') R_d] / L_g [R_s(t') + R_d]\} dt'\right].$$

This current can be expressed as  $I_s(t) = I_0 \{R_d / [R_s(t) + R_d]\} \exp[-f(t) R_d / L_g]$ , where  $f(t) = \int_0^t \{[R_s(t') / R_d] / [1 + R_s(t') / R_d]\} dt'$ . For  $R_s(t) = \dot{R}_s t$ , we have the function  $f(t) = t - k^{-1} \ln(1 + kt)$  and the switch current is

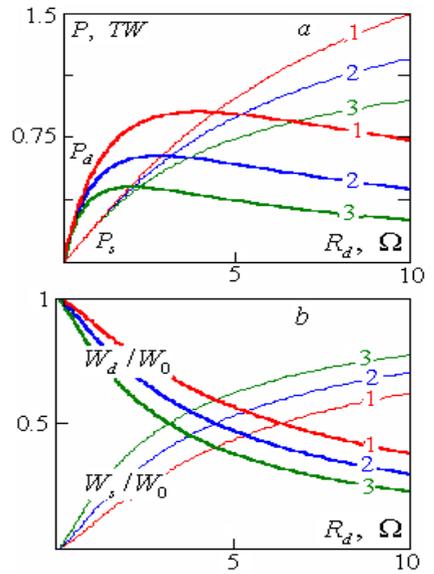
$$I_s(t) = I_0 (1 + kt)^{(1 - k\tau)/k\tau} \exp(-t / \tau), \tag{3}$$

where  $k = \dot{R}_s / R_d$ ,  $\tau = L_g / R_d$ .

The peak voltage across the load  $V_d(t)$  is reached at the time point determined from (2), which is independent of  $R_d$ . However, the value of the peak  $V_d(t)$  depends both on the load resistance  $\propto R_d^{0.4+0.5}$  (Fig. 2a,  $L_g = 200$  nH,  $I_0 = 1$  MA) and on the switch resistance rise rate  $\dot{R}_s$  (Fig. 2b). At  $R_d \rightarrow \infty$ , the voltage tends to  $V_m = I_0 (\dot{R}_s L_g / e)^{1/2}$  because, in view of (3),  $V_m = I_0 (\dot{R}_s L_g)^{1/2} (1 + x^{-1})^{x^2-1} e^{-x}$ , where  $x = R_d / (\dot{R}_s L_g)^{1/2}$ , and at  $x \rightarrow \infty$ , the limit is known and is  $\lim_{x \rightarrow \infty} (1 + x^{-1})^{x^2-1} e^{-x} = e^{-1/2}$ .



**Fig. 2.** Peak voltage  $V_d(R_d)$  at  $\dot{R}_s = 0.2$  (1),  $0.1$  (2),  $0.05$  (3)  $\Omega/\text{ns}$  (a), and  $V_d(\dot{R}_s)$  at  $R_d = 1$ (1),  $2$ (2),  $3$ (3)  $\Omega$  (b).



**Fig. 3.** Load and switch powers (a) and energies (b) versus  $R_d$  at  $\dot{R}_s = 0.2$  (1),  $0.1$  (2), and  $0.05$  (3)  $\Omega/\text{ns}$ .

As can be seen in Figure 2a, the voltage first rises quasi-linearly with the load resistance. Such a behavior can be interpreted as *load-limited* operation [6] in which the load current depends weakly on the load resistance. Further increasing the load resistance slows down the voltage rise, and this can be interpreted as *switch-limited* operation in which the load current is approximately inversely proportion to the load resistance. For the curves in Figure 2a, the conditional boundary between the two operation modes lies at  $\sim 1.5 \Omega$ .

The dissipated switch power reaches its peak at  $t_m'' = (\tau/4)[(1+8/k\tau)^{1/2}-1]$ . The load power shows its absolute extremum  $P_{d\max} = (kt_m)''^2(1+kt_m)''^{2(1-k\tau)/k\tau}[\exp(-2t_m''/\tau)]R_d I_0^2$  at an optimum resistance  $R_{d\text{opt}} \approx \beta(\dot{R}_s L_g)^{1/2}$ . The coefficient  $\beta = (k\tau)^{-1/2} \approx 0.62$  is the solution of the equation  $4\beta^2 \ln(1+\beta^{-1}) = 4\beta - 1$ . For such a load,  $I_{d\max} \approx 0.48 I_0$ ,  $P_{d\max} \approx 0.14(\dot{R}_s L_g)^{1/2} I_0^2$ , and the peak voltage  $V_{d\max} \approx 0.30(\dot{R}_s L_g)^{1/2} I_0$  is two times lower than (1). The voltage FWHM is  $\Delta t \approx 2.93 t_m''$

Here, the numerical factor is the difference of roots of the equation  $[(a + 1) / (a + x)]^{a^2-1} e^{-a(1-x)} = 2x$ , where  $x = t / t_m$ ,  $a = (kt_m)^{-1}$ .

At other values of  $R_d$ , the energy characteristics behave as expected (Fig. 3). Increasing  $R_d$  (e.g., at  $L_g = 200$  nH,  $I_0 = 1$  MA) increases the dissipation in the switch and hence decreases the energy extraction. Increasing  $\dot{R}_s$  increases the load energy. Because  $R_{dopt} \approx \beta(\dot{R}_s L_g)^{1/2}$ , its value tends to increase as  $\dot{R}_s$  is increased (Fig. 3a).

For a load with  $R_{dopt}$ , the overvoltage coefficient is  $K = V_{dmax} / U_0 \approx 0.30(\dot{R}_s C)^{1/2}$ . For  $K$  as a parameter, we have  $R_{dopt} \approx 2.0K\rho$ , and

$$P_{dmax} \approx 0.95KW_0\omega_0, \tag{4}$$

where  $W_0 = CU_0^2 / 2$ ,  $\rho = (L_g / C)^{1/2}$ ,  $\omega_0 = (L_g C)^{-1/2}$ .

With no switch, the load current is  $I(t) = [(U_0 / \omega L_g) \exp(-Rt / 2L_g)] \sin \omega t$ , where  $\omega = \omega_0(1 - \nu^2)^{1/2}$ , and the damping decrement  $\nu = R / 2\rho$  is less than critical [7]. The current amplitude  $I_m = I_0 \exp\{-\nu(1 - \nu^2)^{-1/2} \arctg[(1 - \nu^2)^{1/2} / \nu]\}$ , where  $I_0 = U_0 / \rho$ , is attained at the time point  $t_m = \omega_0^{-1}(1 - \nu^2)^{-1/2} \arctg[(1 - \nu^2)^{1/2} / \nu]$ . The load power is maximal at  $\nu_{opt} = 0.55$ , which is the solution of the equation  $2\nu \arctg[(1 - \nu^2)^{1/2} / \nu] = (1 - \nu^2)^{1/2}(1 + \nu^2)$ . The peak power

$$P_m \approx 0.60W_0\omega_0 \tag{5}$$

is dissipated at  $R_{opt} \approx 1.1\rho$ . From comparison of (4) and (5) it follows that the use of a switch which provides an overvoltage  $K \sim 10$  can increase the load power about 15 times.

### III. Two-Stage Pulse Sharpening

Figure 4 shows two series-connected inductive store-switch circuits. On opening of the first switch  $R_{s1}$  with the second switch  $R_{s2}$  closed, the energy from  $L_g$  is extracted to  $L_{int}$ . On opening of  $R_{s2}$  the energy is switched from  $L_{int}$  to the load. Increasing the rate of rise of the current in the switch  $R_{s2}$  increases the rate of rise of its resistance and hence the output generator voltage and the load power. For example, in experiments [8], the voltage reached  $\sim 1$  MV on operation of the first plasma opening switch (conduction time  $t_c \approx 1.2$   $\mu$ s, conduction current  $t_c \approx 1.7$  MA), and on operation of the second one ( $t_c \approx 130$  ns,  $I_c \approx 0.55$  MA), the voltage

across the diode load reached  $\sim 4$  MV. The resistance  $R_{s1}$  rose to about  $1 \div 1.5 \Omega$  in 50 ns, and  $R_{s2}$  to about  $10 \div 15 \Omega$  in 10 ns.

For an inductive load with fully open switches, the intermediate store current is  $I_{int} = L_g I_0 / (L_g + L_{int})$  and the load current is  $I_l = L_{int} L_g I_0 / [(L_{int} + L_l)(L_g + L_{int})]$ . The maximum load current  $I_{lmax} = I_0 [1 + (L_l / L_g)^{1/2}]^{-2}$  is reached at  $L_{int} = (L_g L_l)^{0.5}$ . The load energy  $W_l = W_0 L_g L_{int}^2 L_l [(L_g + L_{int})(L_{int} + L_l)]^{-2}$  with  $W_0 = L_g I_0^2 / 2$  is maximal at  $L_g = L_{int} = L_l$ , measuring  $W_l / W_0 = 1/16$  or 6.25% of the inductive store energy. This casts doubts on the efficiency of multistage pulse sharpening for linear loads.

The switch voltage ratio for linearly rising switch resistances  $(V_{s2} / V_{s1})_{max} = \{(\dot{R}_{s2} / \dot{R}_{s1}) [L_g L_l / (L_g + L_{int})(L_{int} + L_l)]\}^{1/2}$  at  $L_g = L_{int} = L_l$  is equal to  $(\dot{R}_{s2} / \dot{R}_{s1})^{1/2} / 2$ . Hence, for increasing the load voltage, the rate of rise of the resistance  $\dot{R}_{s2}$  should be four times higher than that of  $\dot{R}_{s1}$ .

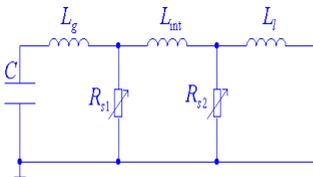


Fig. 4. Two-stage pulse sharpening circuit.

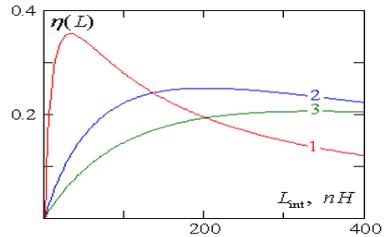


Fig. 5. Dependences  $\eta(L)$  at  $L_l = 20$  (1), 200 (2), and 400 (3) nH.  $L_g = 200$  nH.

The peak load power  $P_{max} = \alpha [L_{int}^3 L_l / (L_{int} + L_l)^3]^{1/2} [L_g / (L_g + L_{int})]^2 \dot{R}_{s2}^{1/2} I_0^2$  is attained at the time point  $t_m = (2\theta L_l / \dot{R}_s)^{1/2}$  with  $L_l = L_{int} L_l / (L_{int} + L_l)$  and with  $\theta$  and  $\alpha$  being the same as those for the one-stage circuit in Fig. 1b. The absolute extremum  $P_{lmax(L_{int}, L_l)} = (\alpha / 8) (\dot{R}_s L_g)^{1/2} I_0^2$  falls on  $L_{int} = L_g / 3$ ,  $L_l = L_g / 6$  but the energy extraction efficiency, in this case, decreases to  $1/24$ . At  $L_g = L_{int} = L_l$ , the peak power is equal to  $P_{lmax} = (\alpha / 8\sqrt{2}) (\dot{R}_s L_g)^{1/2} I_0^2$ . The power ratio for the two- and one-stage circuits is  $\eta = 0.25 (\dot{R}_{s2} / \dot{R}_{s1})^{1/2}$ . Thus, for the most efficient energy ex-

traction, the second stage is reasonable only if  $\dot{R}_{s2} / \dot{R}_{s1} = 16$ .

For other values of  $L_g, L_s, L_l$ , the power ratio is given by  $\eta = (\dot{R}_{s2} / \dot{R}_{s1})^{1/2} \eta(L)$ , where  $\eta(L) = L_{int}(L_g L_l)^{1/2} (L_g + L_{int})^{-1/2} (L_{int} + L_l)^{-3/2}$ , and its extremum is reached at  $L_{int} = [(L_g - L_l)^2 / 16 + L_g L_l]^{1/2} - (L_g - L_l) / 4$  (Fig. 5).

#### IV. Upstream-of-Switch Load Connection

One of the ways of eliminating the adverse effect of plasma from switch to load is to connect the load upstream of the switch [9]. Such a circuit (Fig. 6) includes a separating closing switch  $Sw$  which cuts off the load from current till the opening switch gets open. Let the switch  $Sw$  turns on at the onset of current interruption, and after fast switching, its resistance drops to zero. Before opening, the currents through the inductances  $L_s$  and  $L_g$  are equal to  $I_0$ . After opening, the currents are determined from the system of equations

$$\begin{cases} L_g \dot{I}_g(t) + L_s [\dot{I}_g(t) - \dot{I}_l(t)] + R_s(t) [I_g(t) - I_l(t)] = 0; \\ L_g \dot{I}_g(t) + L_l \dot{I}_l(t) = 0. \end{cases}$$

Solving the system gives the same time dependences as those for the circuit in Fig. 1b but with  $L_t = L_s + L_g L_l / (L_g + L_l)$ . The presence of  $L_s$  increases  $t_{max} = (L_t / \dot{R})^{1/2}$  and decreases the peak voltage across the load  $V_{lmax} = I_0 (\dot{R}_s / eL_t)^{1/2} L_g L_l / (L_g + L_l)$ . At  $L_l = L_g$ , the peak voltage  $V_{lmax}$  is  $(1 + 2L_s / L_g)^{-1}$  of the switch voltage. The maximum load power is  $P_{lmax} = \lambda \dot{R}_s^{1/2} I_0^2$ , where  $\lambda = \alpha L_g^2 L_l (L_g + L_l)^{-3/2} [(L_g + L_l) L_s + L_g L_l]^{-1/2}$ .

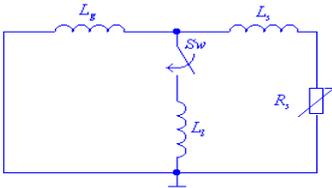


Fig. 6. Upstream-of-switch load connection.

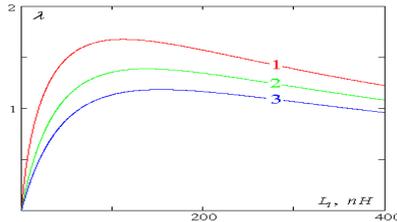


Fig. 7. Dependences  $\lambda(L)$  at  $L_s = 10$  (1), 50 (2), and 100 (3) nH.  $L_g = 200$  nH.

The dependences  $\lambda(L_l)$  at different values of  $L_s$  are shown in Figure 7. As can be seen, varying  $L_s$  by an order of magnitude influences

$\lambda$  only slightly. At the same time, the presence of  $L_s$  greatly decreases the load power at a load inductance of less than 100 nH. The power  $P_{I_{\max}}$  reaches its absolute extremum at  $L_l = \varphi(L_s/L_g)L_g^2/4(L_g+L_s)$ , where  $\varphi(x) = 1 + [1 + 16x(1+x)]^{1/2}$ . At  $L_s \ll L_g$ , we have  $L_l = L_g/2$  and  $P_{I_{\max}(L_l)} = (2\alpha/3^{3/2})(L_g \dot{R}_s)^{1/2} I_0^2$ .

The ratio of the load energy  $W_l = W_0 L_g L_l / [(L_g + L_l)^2 (L_g + L_s)]$ , where  $W_0 = (L_g + L_s) I_0^2 / 2$ , to its value in the conventional circuit is  $(1 + L_s/L_g)^{-1}$ . At  $L_g/L_s \sim 10$ , the decrease in the energy extraction efficiency is less than  $\sim 10\%$ .

### V. Comparison With Experiments

According to empirical data [10], the voltage multiplication factor provided by an exploding wire switch at a load with  $R \approx 28\rho$  is  $K \approx 13$ . For this value of  $K$ , the optimum resistance is  $R_{dopt} \approx 26\rho$ . The fact that  $R_{dopt}$  is close to  $R$  justifies the assumption of a linear resistance rise on current cutoff for calculations of the load pulse parameters.

Let us refer to experimental data. Figure 8 shows waveforms recorded on operation of one of the generators built around an inductive energy store and an exploding wire switch for high-power microwave sources [11]. The store, having an inductance of  $\sim 4.6 \mu\text{H}$ , and the switch represent a series connected circuit into which a capacitor of  $\sim 4 \mu\text{F}$  ( $U_{ch} = 70 \text{ kV}$ ) is switched. The voltage  $U_s$  that arises on interruption of the current  $I_g \approx 30 \text{ kA}$  is applied via a sharpening switch to a resistive load of  $\sim 40 \Omega$ . The rate of rise of the load current is  $\sim 0.5 \text{ kA/ns}$ , the voltage is  $U_l \approx 600 \text{ kV}$ , and the pulse power is  $P_l \approx 9 \text{ GW}$ .

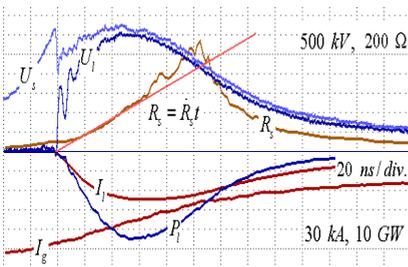


Fig. 8. Shot with wire switch. Interpretation of traces is given in respective paragraphs.

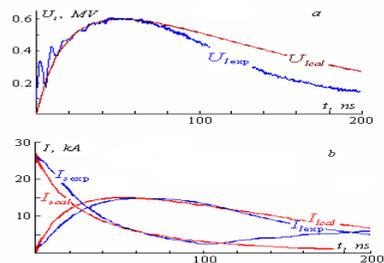


Fig. 9. Load voltage (a) and switch and load currents (b).

Figure 9 compares the experimental and calculated waveforms of the load voltage, switch current, and load current. The calculation is by formula (3) for  $\dot{R}_s \approx 1.7 \Omega/\text{ns}$ , which approximates the steep rise of resistance on current cutoff. As can be seen, the experimental and calculated current waveforms, being coincident in amplitude, show some difference during the pulse rise time, and this is due to the transient response of the sharpening switch whose resistance decreases to  $\sim 1.5 \Omega$  only within  $\sim 60 \text{ ns}$  after the onset of current flow through the load. The finite resistance of this switch delays the extraction of energy. The increase in  $I_{s\text{exp}}(t)$  within  $\sim 100 \text{ ns}$  after the instant of current cutoff suggests that the exploding wire switch recovers its conductivity, which shows up as a decay of  $R_s(t)$  in Figure 8.

The assumption of a linear resistance rise can also be justified by the example of experiments on GIT-4 and GIT-12 mega-joule setups with mega-ampere plasma opening switches [10]. In the GIT-4 setup, the stored energy is  $\sim 550 \text{ kJ}$  at a charge voltage  $U_{ch} = 40 \text{ kV}$ ; the discharge current rises to  $\sim 3 \text{ MA}$  in  $\sim 1.1 \mu\text{s}$ . In the GIT-12 setup, the stored energy is  $\sim 5 \text{ MJ}$  at  $U_{ch} = 70 \text{ kV}$ ; the current rises to  $\sim 6 \text{ MA}$  in  $\sim 1.7 \mu\text{s}$ .

Figure 10a shows waveforms for one of the shots on the GIT-12 setup with a radial plasma opening switch [12]. In its energy store with  $\sim 160 \text{ nH}$ , the current  $I_g$  reaches  $\sim 1.2 \text{ MA}$  in  $\sim 550 \text{ ns}$ . The switch operates into a load of  $\sim 50 \text{ nH}$ . On current cutoff, the switch resistance increases with a rate of  $\sim 17 \text{ m}\Omega/\text{ns}$ . As can be seen in Figure 10b, the curves  $U_{cal1}(t)$  and  $U_{cal2}(t)$  calculated for this value of  $\dot{R}_s$  and for its two times lower value lie above and below the amplitude of the experimental curve  $U_s(t)$ .

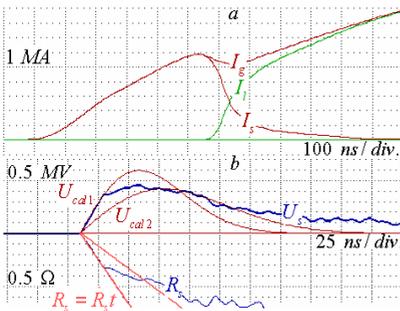


Fig. 10. Shot on GIT-12 setup at  $L_f \approx 50 \text{ nH}$  with  $I_s$  for switch current.

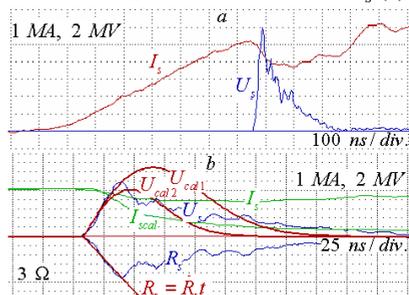


Fig. 11. Shot on GIT-4 setup.

Figure 11a shows waveforms for one of the shots on the GIT-4 setup in open-cathode mode [12]. In its energy store with  $\sim 270$  nH, the current reaches  $I_s \approx 1$  MA in  $\sim 800$  ns. The voltage that arises on current cutoff is  $U_s \approx 2$  MV. The switch resistance  $R_s$  increases with a rate of  $\sim 85$  m $\Omega$ /ns (Fig. 11b). At this value of  $\dot{R}_s$ , the switch fully open into a load with an unlimited impedance would provide a peak voltage of  $U_{cal1}(t) \sim 3$  MV. However, in the shot considered, the increment of the discharge circuit inductance after opening of the switch is limited to  $L_x \approx 230$  nH. For this load, the calculated voltage  $U_{cal2}(t)$  has its amplitude close to the peak of  $U_s(t)$ . The current  $I_{scal}(t)$  calculated for experimental values of  $R_s(t)$  and finite value of  $L_x$  decays more appreciably than the switch current  $I_s(t)$ , suggesting that  $I_s(t)$  is prevented from decay by certain processes which are discussed, e.g., elsewhere [13-15].

The foregoing demonstrates that the approximation of a linear resistance rise at the phase of current cutoff is a useful tool to assess the energetics of pulse generators both with plasma opening switches and with exploding wire switches. Certainly, the use of a more complex resistance approximation can improve the agreement between calculations and experiments, but it inevitably deprives the relations of their simplicity, clarity, and promptitude.

## **VI. Conclusion**

Thus, the electrotechnical analysis of inductive store-switch circuits provides simple analytical formulae which are useful both for experimental data interpretation and for predication of load pulse parameters in generators based on this type of circuit. The load pulse parameters depend on the rate of rise of the switch resistance. For its estimation, which is left untouched in the paper, one should consider physical processes responsible for current interruption in one or another switch. For example, as applied to plasma opening switches, such a consideration gives  $\dot{R}_s$  as a function of the switch parameters and rate of current rise [16]. As applied to exploding wire switches, the rate of rise of the resistance can be estimated from empirical similarity criteria [10].

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## DEVELOPMENT OF TECHNOLOGY FOR "GREEN" CEMENT COMPOSITES WITH NEW TYPES OF HYBRID ADDITIVES<sup>1</sup>

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**Abstract.** The article is devoted to the development and research of new types of "green" hybrid additives based on energy and ferrous metallurgy waste and composite Portland cements with their use.

**Keywords:** inorganic waste, disposal, silica fume, TPP ash mixture, dry removal, hybrid additive, composite Portland cement, strength, structure, efficiency.

**Introduction.** Due to the continuous rise in prices for fuel, energy and material resources and in order to save them, reduce carbon dioxide emissions, there is currently a worldwide trend for the production and use of composite Portland cements with hybrid additives that include two or more mineral ingredients of natural or man-made origin [1-3].

BioScience has published articles on climate change over the past year by researchers from the US, UK, France, Australia, Germany, the Netherlands and Bangladesh. According to their estimates, the number of natural disasters caused by climate change has increased sharply compared to 2019, with 2020 becoming the second hottest year in history (2016 remains the hottest year and all temperature records fall in the period after 2015). Three key greenhouse gases (carbon dioxide, methane, nitrous oxide) set

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<sup>1</sup>Research is carried out within the framework of the joint Uzbek-Chinese project "Joint development of "green" composites using ash-and-slag mixture of power engineering and metallurgy slags. – Tashkent, 2021-2022

records for atmospheric concentration last year. In April 2021, the carbon dioxide content in the atmosphere reached its highest monthly average of 416 ppm [4]. 2020 is the second hottest year on record, according to the International Group of Experts on Average Annual Temperatures. Scientists from the University of Colorado have named the most environmentally "dirty" power plants in the world. Scientists at the University of Cambridge believe that in places of tectonic faults, atmospheric carbon is converted into diamonds.

A group of researchers from the University of Colorado has estimated that 5% of the Earth's power plants emit 73% of greenhouse gases. Many power plants in the USA, Europe, East Asia, Poland and India are coal-fired and have low efficiency. Researchers at the University of Southern California found that reducing the amount of fine particulate matter PM in the air 2.5 (roughly the size of coal dust) reduces the risk of dementia by 14% and slows down the rate of cognitive decline in older American women by 26%. Scientists from the University of California at San Diego have found that reducing the amount of the same fine particles reduces the risk of developing Alzheimer's disease by 17%.

Based on the results of such studies, at present all over the world there is a tendency to reduce the influence of harmful dust and gas emissions into the atmosphere of industrial enterprises, to fight against the formation of greenhouse gases and for a clean climate.

In Uzbekistan, there are also many enterprises in the energy, metallurgical, processing sectors of the economy, which contribute to the deterioration of the environmental situation: these are enterprises of ferrous and nonferrous metallurgy, the cement industry, fuel and energy complexes that generate electrical energy by burning coal fuel, enrichment factories, etc.

Therefore, at present in our republic the problem of ecology is being solved at the state level, in this connection, consistent work is being carried out in the field of environmental protection, rational use of natural resources, improvement of sanitary and environmental conditions. To achieve the National goals and objectives in the field of sustainable development for the period up to 2030, the Concept of Environmental Protection of the Republic of Uzbekistan establishes all aspects of maintaining the ecological balance in the republic, starting with "improving the environmentally safe waste management system" to "economic incentives for the development and implementation of waste-free and low-waste technologies in production, as well as technologies for the processing of waste from mining and processing industries"[5].

In his speech at the second international summit "Partnership for Green Growth and Global Goals - 2030" (P4G), held in Seoul, the President of Uzbekistan outlined the key areas of reforms in the country and shared his vision of the prospects for international cooperation in the field of green recovery. The commitment of Uzbekistan to fulfill its commitments to reduce greenhouse gas emissions by 2030 under the Paris Agreement was reaffirmed. In this regard, it was noted that the widespread introduction of "green" technologies and the implementation of projects in the field of green energy in Uzbekistan will allow to increase the share of renewable energy sources by more than 3 times in the next ten years. In order to expand practical cooperation in this important area, the President declared Uzbekistan's readiness to join the P4G partnership and become its full-fledged participant [6].

The accumulated and current waste of mining and metallurgical production and heat power engineering, represented by overburden, enclosing rocks, poor, off-balance, substandard ores, tailings, man-made placers, ash and slag from thermal power plants, slags and sludge from metallurgical production, have significant resource potential and are increasingly considered as a promising reserve, stored mineral raw materials [7].

In TPP sludge plows, a huge amount of ash waste from hydro removal is accumulated, which has a negative impact on the environmental situation, and low hydraulic activity inhibits their large-scale utilization in the production of a wide range of construction products [8]. Therefore, preference is given to the dry method of removing them from the furnaces of coal-fired boilers. This method increases the degree of their useful consumption by developing resource-saving and environmentally friendly technologies for the production of construction products, in particular, cement. In this regard, in 2016, the Chinese company Harbin Electric International Company Ltd, based on the Angren TPP, upgraded and commissioned one power unit for dry ash disposal. The power unit will annually generate 1,050 million kilowatt-hours of electricity and 642.2 thousand Gcal of thermal electricity [9]. A new power unit with a capacity of 130-150 megawatts with a cogeneration extraction for burning high-ash coal was put into operation, in connection with which there was a problem of utilization of the dry ash-and-slag mixture (hereinafter ASM).

Disposal of industrial waste is also one of the most important problems at metallurgical enterprises all over the world [10]. Being potential resources capable of expanding the country's mineral resource base for ferrous, non-ferrous, noble metals, technogenic formations have a very aggressive effect on the natural environment, therefore, interest in their processing is

due not only to commercial objectives, but also to increased environmental requirements. Of all the variety of technogenic formations involved in processing, the main volume is made up of metallurgical slags formed during the processing of ores of various genesis.

The Joint Stock Company "Uzbek Metallurgical Plant" is the leading enterprise of ferrous metallurgy in Uzbekistan. During the years of independence of Uzbekistan, the enterprise has been dynamically developing. The enterprise increases its capacity every year, which naturally, along with an increase in the output of steel products, also leads to an increase in the output of "tailings" suitable for recycling and their waste, for use in the manufacture of various construction products. Currently, "Uzmetkombinat" JSC, in addition to the production of commercial steel products, also produces silicon alloys, where waste is formed in the form of ultrafine ash - microsilica, which is mainly represented by thermally activated aluminosilicates, which can be used as an additive in the production of cement to save expensive clinker with a simultaneous increase in the construction and operational properties of concrete based on it. When adding MC, the permeability of the cement stone will decrease by fifty percent, and the sulfate resistance will increase by one hundred percent, it gives low permeability to gases and water W12-W16, frost resistance F200-F600, increased durability [11]. The need to utilize the named man-made raw materials to ensure a "clean" climate, ensure the ecological situation of the population of industrial regions, preserve flora and fauna, determined the goal of research on the development of compositions of hybrid additives based on energy and metallurgy waste and technology for producing "green" composites using them.

**Research objects and methods:** To form the composition of new types of "green" hybrid additives (HA) and composite Portland cements (CP): ash and slag mixture of dry removal of Angren TPP (ASM-active component) and microsilica "Uzmetkombinat" JSC (MS-ballast component).

The matrix for obtaining Portland cements with hybrid additives was an ordinary Portland cement of JSC "Bekabadcement" according to O'z DSt 2801: 2013 "Portland cement clinker. Specifications "and gypsum stone of the Bukhara field according to O'z DSt 760-96" Gypsum and gypsum anhydrite stone for the production of binding materials". The chemical compositions of the components are determined in accordance with GOST 5382-91 "Cements and materials for cement production. Methods of chemical analysis", the definition of their hydraulic - according to GOST 25094-94 "Active mineral additives for cements. Test methods", evaluation of the

results of hydraulic activity by the value of the Student criterion - according to O'z DSt 901-98 Additives to cement. Active mineral and filler additives. Technical conditions". The physical and mechanical properties of composite Portland cements were determined on small sample cubes with a face size of 4 sm with a composition of 1:0 (without sand). To assess the results obtained, the indicators of Portland cement PC400-D0, obtained by testing the same samples, were taken as an object of comparison.

**Results and its discussion:** In accordance with the data in tab. 1, in terms of chemical composition, the activated ash-and-slag mixture of dry removal of Angren TPP belongs to the acidic type ( $\text{SiO}_2$  content is more than 45%, CaO is less than 10% by weight), in terms of the fuel content, determined by the value of losses on ignition, it is ASM with low content (no more than 5%) and meets the requirements of O'z DSt 2912: 2014 "Ash and slag mixtures for the production of Portland cement clinker and Portland cement for ash and slag waste. Technical conditions".

**Table 1**  
**Chemical compositions of ingredients for forming hybrid cement additives**

Material name	Content of mass fraction of oxides, %							
	p.p.p	$\text{SiO}_2$	$\text{Al}_2\text{O}_3$	$\text{Fe}_2\text{O}_3$	CaO	MgO	$\text{SO}_3$	others
Microsilica	2.79	90.84	1.51	1.59	0.56	1.00	0.23	1.48
ASM process test	3.0	62.02	23.55	4.32	3.0	-	1.28	0.8

After statistical processing of experimental data on the determination of the hydraulic activity of the ash-and-slag mixture of dry removal of Angren TPP for compressive strength, the value of Student's criterion  $t=52.92 > 2.07$  was obtained, which, according to the requirements of the O'z DSt 901-98 standard, characterizes it as a mineral additive high hydraulic activity. The value of the t-criterion for microsilica was equal to  $t=13.47 > 2.07$ , which also characterizes it as a mineral additive suitable for use in the cement industry as an additive in order to save clinker, electricity for grinding and improve technical and operational properties. cement and concrete.

Taking into account the previously obtained results of studies to determine ASM and MS (each separately) of the effect on the physical and mechanical properties of PC [12-15], during the formation of the component composition of Portland cements with new types of hybrid additive "ASM

+ MS", the content of ASM in the primex including "50-70% clinker + 5% "gypsum stone" was (15-25)%, MS - 10% (tab. 2).

**Table 2**  
**The substance composition of the charge for the production of PC with CP "ash-and-slag mixture of dry removal: silica fume**

№	Conventional designation of cements	PC clinker	ASM	MS	$\Sigma$ HA, %	Gypsum	Grinding time, min	Sieve residue № 008, mass. %
1	C-D 0	95	-	-	0	5	45	14
2	CP with ASM+MS	70	15	10	25	5	40	13
3	C-D ASM+MS	60	25	10	35	5	45	13,5
4	C-D ASM+MS	50	35	10	45	5	45	12

With such a ratio of components, the mixtures were ground to a fineness not exceeding the regulated value of not more than 15% in accordance with GOST 10178. Testing of samples of composite Portland cements with new types of "green" hybrid additives showed that at a HA content of 25% and 45% at a ratio of 15% ASM+10% MS and 35% ASM+10%, composite Portland cements reach the level of strength indicators PC400-D0 (tab. 3).

**Table 3**  
**Strength characteristics of Portland cements with new types of HA**

№	Conventional designation of cements	w/c	Compression strength of specimens, kg/sm <sup>2</sup> , after (days);			
			1	3	7	28
1	C - D 0	0.24	133	358	529	540
2	<b>C-D ASM+MS</b>	<b>0.24</b>	<b>83</b>	<b>279</b>	<b>400</b>	<b>525</b>
3	C-D ASM+MS	0.24	116	320	420	450
4	<b>C-D ASM+MS</b>	<b>0.24</b>	120	245	450	<b>500</b>

Taking into account the positive results of research, it is possible to replace up to 45% of the energy-intensive clinker component in cement with new types of "green" hybrid additives, consisting exclusively of technogenic waste, as optimal for their further technological tests in accordance

with the requirements of GOST 310.1-310.4 and the issuance of practical recommendations for mastering the technology of obtaining "green" cement composites at JSC "Bekabacement", selected compositions № 2 and № 4, containing 25% and 45% HA.

### **Conclusion:**

1. The hydraulic activity of the ash-and-slag mixture of dry removal of Angren TPP and microsilica of JSC "Uzmetkombinat" was determined according to the value of Student's criterion, which ensures their use as ingredients of hybrid additives for Portland cement.

2. Compositions of "green" cement composites containing up to 45% of hybrid additives "active ash and slag mixture + microsilica" have been developed and their compositions have been optimized to issue practical recommendations for mastering the technology of their production at JSC "Bekabacement".

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## RESEARCH OF TRANSPORT PROCESSES IN INFORMATION NETWORKS

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**Abstract.** The report is devoted to research on the capacity of information networks and related stochastic fluctuations and bursts. In open systems, the exchange of energy and information with surrounding bodies, due to their complexity, generates the formation of various structures. This process of creating structures is especially relevant when it comes to systems with a fractal structure. Analysis of such processes should be carried out in terms of fractional geometry. The dynamics of such processes are characterized by such effects as memory, complex spatial mixing processes and self-organization. The use of fractional dynamics methods opens up new possibilities for solving problems of forecasting and decision making in complex systems.

**Keywords:** Stochastic processes, entropy of Tsallis, branching processes, percolation, Deep Learning.

### 1. INTRODUCTION

It is known that during the operation of complex transport systems (networks) both the capacity of the network (channels) and the demand for traffic are subject to stochastic fluctuations and bursts (Levy flight) [1-5]. These random fluctuations are the main sources of uncertainty of the transit time, and a result, losses information (technological losses).

It is important to note that the heterogeneity of stochastic processes and the asymmetry of claims causes uncertainty, different from the traditional one. In the context of the coordinate of emerging problem, for the purpose of traffic assignment, the model of entropy of Tsallis is proposed that allows tracking coherent processes.

It is known that stochastic transport processes represent a generalization of the diffusion process, which is expressed in the transition from the

usual root dependence to the ratio [1]:

$$\langle r^2 \rangle \propto t^{2/z}, \quad (1)$$

characterized by dynamic exponents  $z \neq 2$  (here  $r$  - the coordinate of the wandering particle,  $t$  - time).

When sub diffusion, the presence of traps leads to a divergence of the average waiting time for jumps  $\langle t \rangle = \infty$ , so that the latter acquire a discrete character in space and the transport process slows down ( $z > 2$ ).

Its acceleration in the process of super diffusion of levels is due to the fact that the particle at discrete instants of time performs jumps of arbitrary length, characterized divergent mean square displacement  $\langle x^2 \rangle = \infty$  [1].

## 2. Mathematical Model of Fractional Traffic Levy Motion

$\alpha$  - stable Levy motion,  $L_{\alpha,H}(t)$ . The in terms of the Riemann-Liouville operator, we have [2, 3]:

$$L_{\alpha,H}(t) = \frac{1}{\Gamma\left(H + \frac{1}{2}\right)} \int_0^t dL_{\alpha}(\tau) (t - \tau)^{H-1/2}, \quad (2)$$

where  $L_{\alpha}(t)$  is the ordinary symmetric  $\alpha$  - stable Levy Motion (oLm), and  $\Gamma(\cdot)$  denotes the gamma function,  $H$  - Hurst parameter.

From a mathematical model of fractional traffic Levy will be expressed as [2, 3]:

$$\tilde{A}(t) = mt + (\bar{\sigma}m)^{1/\alpha} L_{\alpha,H}(t), \quad (3)$$

where  $m > 0$  is the mean input rate,  $\bar{\sigma}$  is the scale factor, and  $L_{\alpha,H}(t)$  is the fLm process defined by (2).

The model has four parameters  $m, \alpha, \bar{\sigma}$  and  $H$  with the following interpretations [2, 3]:

- $m > 0$  is the mean constant input rate
- $\alpha \in (1, 2]$  measures the “thickness” of the tails of the stable distribution
- $\bar{\sigma} > 0$  is the scaling parameter that can be seen as the dispersion around the mean of the traffic
- $H \in \left[\frac{1}{2}, \frac{1}{\alpha}, \frac{3}{2}, \frac{1}{\alpha}\right]$  is the Hurst parameter (index of self-similarity)

Based on the mathematical model of traffic (3) transport models of the types: Branching processes as a particle branching and fractional Brownian motion (fBm).

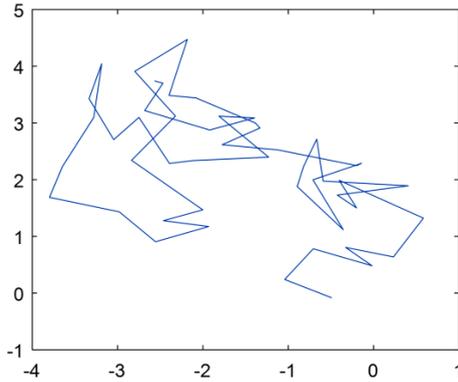


Figure 1. Levy motion

**2.1 Branching processes as a particle branching**

In this section deals with general Bienayme-Galton-Watson processes describing branching particle systems in the discrete time setting [6, 7]. We denote by  $Zn(A)$  the number of  $n$ -th generation particles whose types belong to  $A \in \xi$ . The same generation particles are assumed to produce offspring to a random algorithm.

A key characteristic of the multi-type reproduction law is the expectation kernel [4]:

$$M(x, A) := E_x Z_1(A), \quad x \in A, \quad A \in \mathcal{E}, \tag{4}$$

where the operator  $E_x$  is indexed by type  $x$  of the ancestral particle.

Here  $LF$  - processes, branching particle systems are characterized by general linear-fractional ( $LF$ ) distributions.

It is assumed that the type of the desired genus  $x$ , the total number of offspring  $Z1 \approx Z1(E)$  follows linear-fractional distribution [6]:

$$E_x s^{Z_1} = P_0(x) + (1 - P_0(x)) \frac{s}{1 + m - ms}, \tag{5}$$

where  $m \in (0, \infty)$ .

If  $P_0(x) = 1 - k(x, E)$ , where  $k$  is kernel, the ancestral particle has no offspring, and with probability  $1 - P_0$ , it produces a shifted-geometric number of offspring [6]:

$$E_x (s^{Z_p} | Z_p > 0) = \frac{s}{1 + m - ms}, \tag{6}$$

where parameter  $m$  is independent of  $x$ .

Then on the basis of [7] the model of fractional traffic Bienayme-Galton Watson processes will have the form:

$$\bar{A}(t) = (et + \bar{\sigma}l)E_x s^{Z_1}, \tag{7}$$

where  $l > 0$ ,  $\bar{\sigma}$  - scale factor.

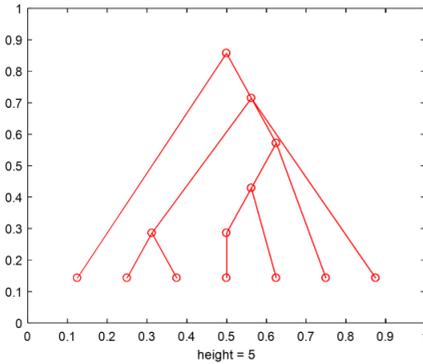


Figure 2. Branching process

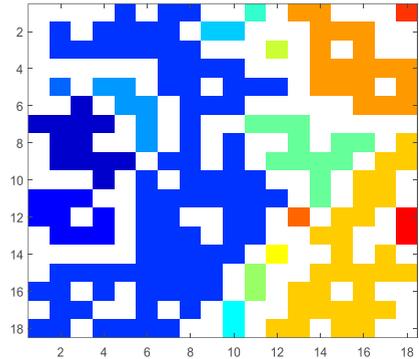


Figure 3. Percolation lattice

### 2.2 Fractional Brownian Motion (fBM)

Fractional Brownian motion is defined by its stochastic representation [8]:

$$B_H(t) := \frac{1}{\Gamma(H + 1/2)} \left( \int_{-\infty}^0 [(t-s)^{H-1/2} - (-s)^{H-1/2}] dB(s) + \int_0^t (t-s)^{H-1/2} dB(s) \right), \tag{8}$$

where  $\Gamma$  represents the gamma function  $\Gamma(\alpha) := \int_0^\infty x^{\alpha-1} \exp(-x) dx$

and  $0 < H < 1$  is called the Hurst parameter. The integrator  $B$  is a stochastic process, ordinary Brownian motion. The traffic model using Brownian motion is defined:  $\bar{A}(t) = (lt + \bar{\sigma}l)B_H(t)$ .

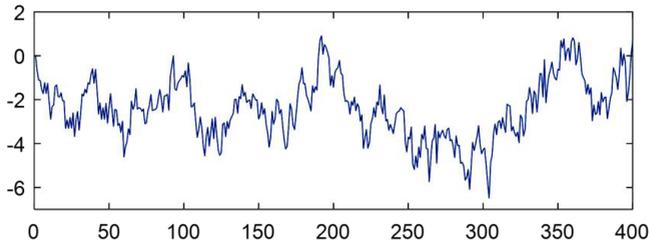
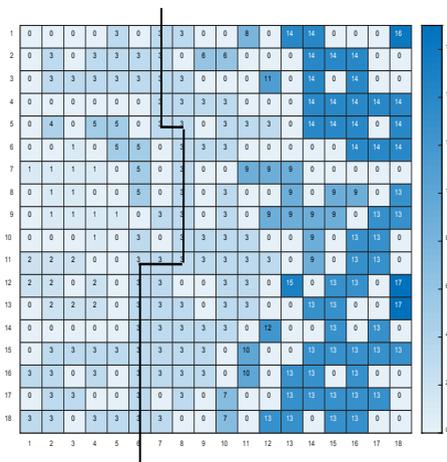


Figure 4. Fractional Brownian motion

### 3. Transport problem on a percolation lattice (algebraic structures)

In report shows the possibility of homomorphism stochastic processes in percolation lattice in the context of recognizing the transport properties of these systems. The formal basis for embedding systems is the results of a modern general algebra on the embedding of complex algebraic structures into relatively simple algebraic structures.

In this connection, the principle of fractal homomorphism (universal similarity), in the context of category theory, fixes on the one hand the fundamentality of **Not What** is reflected, but **How**, and on the other hand means the mutuality of fractional structures of any scale [7, 9].



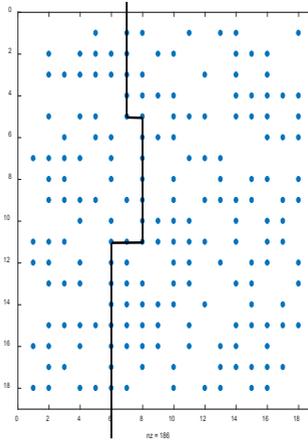


Figure 5. An example of the solution of the transport problem

### 3.1 Main provisions

Percolation represents the basic model for a structurally disordered system. The percolation transition is characterized by the geometrical properties of the clusters near  $p_c$ . The probability  $P_\infty$  that a site belong to the infinite cluster is zero below  $p_c$  as [9, 10]:

$$p_\infty \sim (p - p_c). \quad (10)$$

When  $p_c$  approaches  $p_c$ ,  $X$  increases as [8, 9]:

$$\xi \sim |p - p_c|^{-\nu}, \quad (11)$$

with the same exponent  $\nu$  below and above the threshold and  $X$  - correlation length.

Here  $\nu$  depends on the type of the lattice, the critical exponent and  $\nu$ , and  $\nu$  they are universal and can be depend only from the dimensions of the lattice.

**Axiom of embedding.** Let the one – dimensional array 1D  $\hat{x} = \{x_i\}_{i=1}^N$  be transformed into a square matrix 2d,  $\|a_{i,j}\|$ .

The fractal dimension  $d_f^{\hat{x}}$  of the analyzed segment of the array is empty.

Then the homomorphism  $h$  will be determined as:

$$h : \|a_{i,j}\| \Rightarrow L \times L, \quad L \times L \in E^2, \quad (12)$$

$d_f$  for reliability.

Then the percolation lattice will represent the geometric and dynamic realization of the stochastic cluster.

### 3.2 Conductivity of Percolation Lattice

It is noted [11, 12] that the conductivity is represented as:

$$\sigma_{dc} \sim (p - p_c)^m, \quad (13)$$

where the critical exponent  $m$  is (semi) – universal,  $p_c \cong 0,592746$  - critical probability.

For percolation on a lattice,  $m$  depends only on  $d$ , where  $d$  is lattice dimension.

Critical exponent for two lattice dimension equals  $\mu = 1.30 \pm 0.002$ .

Thus, a transport problem is posed in the context of the homomorphism of stochastic discrete systems onto the percolation lattice.

### Conclusion

As a result of the analytical and numerical studies, it can be concluded that it is necessary to take into account a large number of accompanying and influencing parameters of the information network. This approach will allow you to more reliably assess the resources of the existing network and help in choosing the best configuration. Comprehension and application of a large amount of important visual information requires the use of Visual Thinking technology, as well as the use of a set of Deep learning algorithms.

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## DETERIORATION AND PROTECTION OF CONCRETE STRUCTURES IN INDUSTRIAL FACILITIES

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**Abstract.** Industrial buildings are known as structures that house factories and manufacturing plants. Industrial buildings and structures include separate premises designed to carry out production processes.

It is known that oil products are used in industrial buildings to operate machines. Owing to the possibility that some petroleum products such as kerosene and oil might fall on the ground of concrete structures, required precautions must be taken to prevent the negative effect of oil penetration in concrete holes, which affects the durability of concrete.

An initial objective of this project is to identify the negative effects of oil products on the physical, mechanical, and dynamic properties of concrete. Furthermore, this study set out with the aim of assessing the importance of some solutions in protecting the concrete foundations exposed to oil products in order to maintain their life.

**Keywords:** Concrete, oil, industrial buildings, physical and mechanical properties, protection.

### INTRODUCTION

It is generally acknowledged that concrete is not homogenous composition. It consists of cement materials such as Portland cement, sand or stones with sufficient amount of water. Concrete is one of the most important solid and strong materials. It is used in all kinds of buildings such as industrial constructions. Oil products are always used to operate machines and engines within such buildings. They might fall on concrete structures and lead to great decreasing of their characteristics as a result of their negative effect. Thus , causing deformations in the concrete struc-

ture, hazardous effects and collapse to buildings. The concrete structure is characterized by the existence of pores. The greater the pores, the much penetration of oil products .The main objective of this investigation is to study the effect of oil products (such as kerosene, gas oil and crude oil) on the compressive and tensile strengths of high performance concrete and to compare the behavior with that of conventional concrete [1].

### **THE IMPACT OF OIL PRODUCTS ON THE PHYSICAL PROPERTIES OF CONCRETE**

Several reports have shown that oil products are distinguished by many physical properties that greatly affect the concrete such as oil viscosity. Viscosity is defined as the resistance of a liquid to flow. It is one of the most important physical properties of oil products that differ according to their type.

Oil is a noncompressible liquid. It presses into two directions vertical and horizontal once penetrates the concrete mixture. The defects or weaknesses in the horizontal direction cause destruction to pores structure and lead to create cracks in the concrete while the defects in the longitudinal direction are few because oil is a non-compressible liquid in pores and with the support of the concrete structure they carry this load and prevent distortions in the longitudinal direction.

Many studies reported that the negative effects of oil products increase with decreasing their viscosity. Viscosity has excessive effects on the compressing resistance and splitting tensile strength as they normally decrease with decreasing the viscosity [2].

### **THE EFFECT OF PETROLEUM PRODUCTS ON THE MECHANICAL AND DYNAMIC PROPERTIES OF CONCRETE**

It is important to study the effect of crude oil saturation on the mechanical and dynamic properties of concrete. Thus, the same properties can be compared with water saturated samples. The most important of these characteristics:

- Static modulus of elasticity

It is a constant modulus representing the ratio of axial stress to axial strain of concrete exposed to axial forces. The static modulus of elasticity is higher in dry concrete immersed in water than that of concrete immersed in oil.

Practical experiments have demonstrated the negative effects of oil on the static modulus of elasticity. The modulus of concrete immersed in oil for 600 days decreases by (15.5-14 %) comparing to the modulus of samples immersed in water. The static modulus of elasticity becomes lesser with increasing the period of exposing to oil products as the penetration

of oil in pores increases leading to breaking the pores and reducing the compression strength [3].

- Compressive and tensile strength:

Normally, another risky problem that might be happening in industrial buildings exposed to petroleum products is deformation by the time due to the permeability of oil in the concrete leading to catastrophic results.

In general, oil penetrates the concrete in different directions, not only in the vertical direction. It spreads out in all directions, which leads to changes in the concrete structure [4]. Practical studies stated that the compressive strength of the concrete is reduced by 40% to 70%, in case of compression while it decreases more concerning the samples exposed to the petroleum oils for a long time. The tensile strength is also lower for the concrete samples. The main reason for that dropping is that the molecules of petroleum products can penetrate the existing pores of the concrete and then apply a hydraulic presser inside the pore, which negatively affects the bonding forces of the aggregate and cement in the concrete.

- Modulus of rupture

The modulus of rupture is the resistance of concrete to indirect tension as a result of bending. The resistance of bending is usually greater than tension strength since the tension is equal to 60% of the former one [5].

The test of modulus of rupture is one of the significant tests used for evaluating the bending strength of concrete and study the concrete behavior against bending loads.

The modulus of rupture concerning oil-soaked concrete samples for 24 hours increases by (6 – 3 %). This increasing is followed by continuous decreasing of the modulus value with increasing the amount of oil absorbed and period of immersion (soaking).

- The dynamic modulus of elasticity

Concrete dynamic modulus of elasticity (E) is a ratio of change in stress to the change in strain at a certain level of cement in the concrete according to the following equation:

$$\text{The dynamic modulus of elasticity (E) = Stress } \sigma / \text{Strain } \epsilon$$

This value should be known as it is used in buildings designing and concrete structures. It differs according to the concrete type. Many studies have shown that the dynamic modulus of elasticity increases by (8 – 10 %) in terms of the saturated concrete in oil and based on the immersion period.

Prior studies have clarified that if we take two cubic samples of the same concrete mixture and immerse one of them in water and the other in oil for 25 days, the cubic immersed in water will be fully saturated; while

the cubic immersed in oil is saturated with a rate of 97.5 % for the same period of time. It means that the pores in the concrete cubic sample were still empty. The existing of these pores decreases the density of concrete and consequently, reduces the modulus of dynamic elasticity. Accordingly, decreasing the modulus of dynamic elasticity reduces the concrete resistance against stress, which results in increasing deformations taking place in concrete [1]. Furthermore, the modulus of dynamic elasticity concerning the samples soaked in oil is (60 – 65%) the modulus of samples immersed in water using the same soaking time.

- The Damping Capacity

The damping capacity in concrete is the ability of concrete to absorb vibrations and dynamics forces. It is one of significant dynamic features that should be studied in buildings exposed to continuous vibrations as a result of using equipment and machines, particularly industrial buildings. The damping capacity must be in an acceptable limit as it indicates the safety of concrete structures. It relies on the number of oil particles that fill the pores and the immersion period [4]. Practical studies demonstrated that the damping capacity of dry samples after being immersed in oil significantly rises during early days of soaking. Afterwards, it gradually decreases due to oil evaporation from pores [ 6] .

### **PROTECTION METHODS AGAINST THE OIL PRODUCTS**

As mentioned in the literature review, oil products negatively affect the physical, mechanical and dynamic features of concrete foundations [2] . There are several possible solutions for this hazardous issue as follows:

1. Collect the waste of petroleum products dropped from machines or engines in metal pots.

2. Clean floors and concrete surfaces from the oil products waste.

3. Improve the strength of concrete structures used in the industrial buildings by adding materials such as:

- ADDICRETE BVD that improves the compression resistance of concrete and increase its strength and density [ 7].

- Insoluble materials named as Pozzolans that interact with  $\text{Ca}(\text{OH})_2$  (as a result of the interaction of cement with water). These materials decrease the porosity of concrete as they occupy the concrete structure holes and consequently, reducing the penetration of harmful liquids such as oil.

- Paint the concrete foundations by epoxy for instance as they are tough, tolerate heavy weights resist chemical substances, anti-slip and add aesthetic appearance to the floors.

- Covering the concrete structures by ceramic.

### Conclusion

In conclusion, this paper has dealt with the effects of oil waste on concrete structures. It focused on the impact of used machines oil on the physical, mechanical and dynamic features of concrete. Many comparisons have been clarified for cubes soaked in oil waste for a certain time with that of oil-free concrete cubes. The study proposed that concrete materials or foundations should be free from oil contamination as they deteriorate their performance. Furthermore, in the current study, comparing the properties of oil contaminated concrete with clean one showed that necessary precautions should be taken to avoid the problem of oiling of structural elements presented in industrial building and consequently, prevent the considerable damage, which often impairs a building's exploitation.

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## MICROLEVEL PHYTOSANITARY ZONING OF THE TERRITORY IN RELATION TO WEEDS: CRITERION AND PRINCIPLE OF ISOLATION

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**Abstract.** The formation of territorial complexes of weed species is due to the differentiation of weed flora in different ecotopes at three agrolandscape levels of phytosanitary zoning. The microlevel is determined by the ecosystem of the elementary agricultural landscape, which includes all types of secondary habitats that form the elementary flora. Crop rotation, as well as a separate field, cannot be the level of zoning, since they are the territory of formation only of the flora of segetal ecotopes, but not of the entire weed flora of the agroecosystem.

**Keywords:** weed flora, agrolandscape, agroecosystem, ecotope, ecotope flora.

In the system of plant protection from harmful objects, phytosanitary zoning is of great importance, since the content of protective measures depends on knowledge of the area of distribution of both a separate species and a complex of harmful objects in a certain territory.

Zoning is a process, as well as the result of dividing a territory into districts. On the other hand, zoning is a way of differentiating a certain object according to existing territorial units, taking into account their specifics. The object of zoning may be a separate species of weed plant, but it is extremely important for the plant protection system to show the formation of extensive complexes of weed species in individual territories. Such zoning belongs to the category of general, in which not one leading characteristic is taken into account, but a combination of characteristics, according to which the regions are distinguished, reflecting the specificity and hierarchy of the zoned space, while the districts of both the same and different levels of the hierarchy must meet predetermined classification characteristics (Gorkin, 2006). Consequently, there must be a criterion on the basis of which it is possible to implement regionalization at different hierarchical levels.

The criterion for phytosanitary zoning in relation to weeds cannot be linked to the distribution of agricultural crops over the territory of the regions, since there are very few specialized species of weeds (Ulyanova, 2005), and the same species are involved in the formation of agrophytocenoses with the participation of the overwhelming majority of agricultural crops. The basis of phytosanitary zoning is a weed plant with its requirements for habitat conditions and, since in any secondary habitat there is not one species, but a complex of weed species, the criterion can be a territorial aggregate of species associated with secondary, disturbed habitats, that is, a weed flora as a predetermined classification characteristic at all hierarchical levels (Gorkin, 2006; Luneva, 2020, 2021).

The macrolevel of phytosanitary zoning is determined by the regional weed flora, which includes the entire species composition of weeds growing in all disturbed habitats of the region (oblast) (Luneva, 2018; Luneva, 2020). These are plants not only of agrophytocenoses, but of all secondary habitats on agricultural lands, technogenically disturbed lands and in residential areas (Veselova, 2017), lands intended for afforestation and recreation (GOST 21507 ..., 2015), as well as in habitats, soil and vegetation. whose cover is naturally disturbed (Luneva, 2021). Due to the fact that the principle of phytosanitary zoning consists in the equivalent and irreplaceable action of both natural and anthropogenic factors (Luneva 2019), phytosanitary zoning can only be applied to anthropogenically disturbed habitats (GOST 21507 ..., 2015) and is still used, mainly way, for zoning agricultural land.

It is known that "the main unit of complex natural zoning" is landscapes (Vynaev, 1987, p. 29), the natural differentiation of which is due to geological-morphological and natural-climatic factors (Latypova, 2016). In agricultural zoning, the allocation of districts is based on the differentiation of the regional agricultural landscape, which is understood as a natural landscape modified by agricultural activity with the inclusion of not only arable land, but also other lands intended to support all activities for the cultivation of products (crop and livestock) (Nikolaev, 1999). Regional agrolandscape is defined by anthropogenic boundaries that fit into the natural regional landscape. A lower hierarchical level of zoning (after the macrolevel) is fixed in agroclimatic regions, which are identified by the combination of the above differentiation factors (Zhurina, 2002). The agrolandscape of each agroclimatic region is limited by the boundaries of the natural landscape, which underlies the allocation of a separate agroclimatic region. The zoning of the region into agroclimatic regions illustrates not only the difference in the natural and climatic conditions of the territory of each ag-

roclimatic region (and the agrolandscape within it) from all others, but also the commonality of these conditions for all agroecosystems located within a separate agroclimatic region. The weed flora of the agrolandscape at the level of the agroclimatic region consists of weed species growing in all secondary habitats of all agroecosystems located within the agroclimatic region and is the basis for identifying the meso-level of phytosanitary zoning (Luneva, 2019b, 2020, 2021).

In agricultural ecology, many researchers associate the formation of an agroecosystem with the agrolandscape level (Novozhilov, 1996, 1997; Pavlyushin, Voronin, 2004, 2007), which includes all the diversity of agricultural lands. The point of view that the agroecosystem is also a large agrolandscape complex is adhered to by A.A. Zhuchenko (1990). Since the agroecosystem is characterized by the same properties as the natural (natural) ecological system (Hart, 1987), different levels are distinguished in its structure: from the agroecosystem of a large agricultural landscape (Zhuchenko, 1990) to the agroecosystem of crop rotation (Zubkov, 1992).

If the agroecosystem of crop rotation is understood only as the aggregate of all fields that form a separate crop rotation, then, in this case, such an agroecosystem does not correspond to the concept of a minimum agricultural landscape, since it includes only segetal habitats, not taking into account the adjacent territories, which are mandatory elements of the agricultural landscape and ensure the production of crop rotation: field roads, boundaries, drainage ditches, etc. (Nikolaev, 1999). In some cases, the concept of "agroecosystem" is associated with a separate field (Odum, 1987; Hart, 1987) and then it is part of the "supersystem" of an agricultural enterprise, which, in addition to "agroecosystems of fields and socio-economic subsystems, within which agroecosystems are managed - the crops grown" (Zubkov, 1995, p. 292). Such a "supersystem" does not contradict the understanding of the agroecosystem as an elementary agricultural landscape that includes not only fields for cultivation of crops, but the entire territory that is intended to support activities aimed at obtaining products (Nikolaev, 1999; Mirkin et al., 2003).

It was previously shown that the microlevel of phytosanitary zoning is distinguished on the basis of the weed flora of the agroecosystem (Luneva, 2020, 2021). The weed flora of a separate agroecosystem is formed under the influence of both natural (natural and climatic characteristics of an agroclimatic region) and anthropogenic (administrative isolation of the territory of an agroecosystem of a particular agricultural enterprise) circumstances, which corresponds to the principle of phytosanitary zoning,

which consists in the equivalent and irreplaceable action of a natural and anthropogenic factor (Luneva, 2019a).

An attempt to link the microlevel of phytosanitary zoning to the level of an individual field, as is often done in the implementation of agroecological zoning (Mukhamadyarov and Ashikhmin, 2012; Mukhamadyarov et al., 2013, 2015), seems inappropriate. First, because the basis for identifying the microlevel, as the lowest level, can only be an elementary flora, and the complex of weed species in a separate field does not meet the flora criteria (Luneva, 2020). Secondly, each weed flora, including elementary ones, is characterized by a certain structure due to the diversity of secondary habitats in agroecosystems. This structure includes segetal (formed by species from all segetal habitats of all agroecosystems within the region), synanthropic (formed from species growing on ruderal habitats, young fallow lands and in low-aged crops of perennial grasses of the same agroecosystems) and synanthropic (formed by species growing on pastures, old fallow lands and in old-growth crops of perennial grasses located in the same grow ecosystems) of the group of weed species (Mirkin et al., 2003). Such groupings of species, formed in certain ecotopes within landscapes, are ecotope floras or partial floras (Yurtsev, 1974).

Thus, the weed flora of all levels, formed by the complex of weed plants of agroecosystems, includes several partial floras. Segetal flora consists of partial floras formed in crops (plantings) of types of crops (flora of grain or row crops), as well as in fields under one specific crop. The regional segetal flora is formed in all fields of the region (oblast), the segetal flora of an agroclimatic region consists of weed species growing in all fields of all agroecosystems located in this agroclimatic region. And, finally, the segetal flora of the agroecosystem includes all types of weeds registered in all fields on its territory. At all three levels, the segetal flora is subdivided into partial flora of individual crops (crops of barley, spring wheat, potatoes, cabbage, etc.).

The complex structure, prescribed, among other things, of the elementary flora, does not allow assigning the rank of flora to a complex of weed species of the same field. Most often, such a complex is only part of the partial flora formed in the agroecosystem in the fields where the same crop is cultivated. In addition, the concept of flora is always tied to a specific locality (Tolmachev, 1974), and this is inherent only in the complex of weed species of the entire agroecosystem, or at least crop rotation, but not in the field under a specific crop. The environment-forming role of a cultivated plant, which plays a dominant role in the agrophytocenosis due to its biological characteristics and measures determined by the technology of

growing it, affects the formation of the species composition of weeds and, especially, the indicators of their abundance (Markov, 1972). Therefore, on the same contour of the field, where different crops are cultivated every year, the species composition and indices of the number of species are not similar to the previous field season, and they will change in the next field season (Filippova, 2012).

In some cases, in the process of agroecological zoning, the micro level is associated with crop rotation (Agricultural zoning ..., 2015). This is due to the fact that this type of zoning is based on a cultivated plant with its requirements for growing conditions, and each type of crop rotation includes such a set of crops that can grow in conditions of one field contour, replacing each other over a number of years, and also be located on nearby fields, similar in terms of growing conditions to this field.

Analysis of the possibility of considering crop rotation as the microlevel of phytosanitary zoning in relation to weeds shows the following. Each field included in the crop rotation develops its own species composition of weeds, formed from a bank of seeds and vegetative primordia of those species for which the conditions for the technology of cultivation of an agricultural crop grown on a given field contour in a given field season turned out to be suitable (Markov, 1972). The soil source of the regeneration of weeds is formed over many years in each individual field under the influence of annually changing conditions of agrotechnical and protective measures during the cultivation of annually changing crops, and the same happens in all crop rotation fields. Therefore, within its boundaries, a segetal flora of crop rotation is formed, as a set of species confined to fields, which is a partial flora of a given ecotope (arable land) in the structure of weed flora of the entire agroecosystem (Luneva, 2021). The segetal partial flora of crop rotation cannot be distinguished geographically as a single massif, since it is intertwined in a mosaic manner into the structure of field roads, drainage ditches, border areas, garbage places, wastelands, adjoining territories, pastures, fallow lands and other secondary habitats included in the territorial structure of the agroecosystem (Mirkin et al. others, 2003). The regular introduction of weeds from these habitats to the fields and back is the determining factor that forms the weed flora of the agroecosystem as a whole (Luneva, 2020, 2021). It follows from this that crop rotation can be an object of study of the segetal flora at the level of the agroecosystem (just as the totality of many crop rotations can be an object of study of the segetal flora at the level of an agroclimatic region or region), but it cannot be a criterion for identifying the microlevel of phytosanitary zoning, since it is only a composite part of the weed flora of the agroecosystem.

Agrolandscape and agroecosystem, as well as weed flora, are formed on the basis of the action of both natural and anthropogenic factors. The differentiation of weed flora, following the spatial differentiation of the agricultural landscape, occurs under the influence of both of these factors, which expresses the principle of their indispensability: phytosanitary zoning cannot be carried out, taking into account the action of only one factor. The equivalence of the action of the natural factor lies in the fact that in the course of regionalization, the complex of weeds is tied to the territory, all parts of which are equally characterized in natural and climatic terms. The equivalence of the action of the anthropogenic factor lies in the fact that the complex of weeds is tied to the territory formed by one type of secondary habitat within each level (Luneva, 2019a).

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