



SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the
International Conference

Date:
January 15

Beijing, China 2025

上合组织国家的科学研究：协同和一体化
国际会议

参与者的英文报告

International Conference
“Scientific research of the SCO
countries: synergy and integration”

Part 3

2025 年 1 月 15 日，中国北京
January 15, 2025. Beijing, PRC

Proceedings of the International Conference
**“Scientific research of the SCO countries: synergy
and integration”** - Reports in English

(January 15, 2025. Beijing, PRC)

DOI 10.34660/conf.2025.74.40.008

这些会议文集结合了会议的材料 – 研究论文和科学工作者的论文报告。它考察了职业化人格的技术和社会学问题。一些文章涉及人格职业化研究问题的理论和方法论方法和原则。

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构建国家创新体系模型的概念方法

**CONCEPTUAL APPROACHES TO BUILDING A MODEL OF THE
NATIONAL INNOVATION SYSTEM**

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摘要。本文探讨了定义国家创新体系本质的理论方法，分析了国家创新体系概念的发展阶段。定义了国家创新体系的基本要素，除了科研院所和中心、大学、经济实体部门的创新型企业外，还包括旨在为新产品创造条件的创新基础设施机构。作者提出了国家创新体系运作的模型。该模型反映了国家创新体系基本要素之间产生的联系和关系，这些联系和关系基于合作和伙伴关系的原则，对于实现共同目标——国家经济发展是必要和充分的。

关键词：创新过程、国家创新体系、合作、新知识、技术解决方案、创新机构、结构模型。

Abstract. *The article considers theoretical approaches to defining the essence of the national innovation system, analyzes the stages of development of the concept of national innovation systems. The basic elements of the national innovation system are defined, which, in addition to scientific institutes and centers, universities, innovation-oriented enterprises of the real sector of the economy, include institutions of innovation infrastructure designed to provide conditions for the creation of a new product. The author's model of the functioning of the national innovation system is proposed. The model reflects the connections and relationships that arise between the basic elements of the national innovation system, which are based on the principle of cooperation and partnership, necessary and sufficient to achieve a common goal - the economic development of the country.*

Keywords: *innovation process, national innovation system, cooperation, new knowledge, technical solutions, innovation institutions, structural model.*

Introduction.

The development of new models of the innovation process expands the range of its potential participants, promotes the development of new forms of cooperation in the scientific, technical and innovation spheres. In the definition of V.A. Vasin and L.E. Mindeli “innovation systems within national states are a product of the modern world order”, oriented towards global trends, but at the same time preserving national characteristics. [1, p.7]. It is national interests that should become the driving force of innovative development, helping to overcome the pitfalls that arise on the way to using the “window of opportunity”. In the context of sanctions pressure, a unique situation has arisen for the Republic of Belarus and the Russian Federation, when all three “windows of opportunity” have become available - the technological window, the demand window and the institutional window (as defined by K. Lee and F. Maleob), which allows for a transition to a new development vector based on their own innovations and thereby reducing the level of technological dependence on leading countries [2; 3, p.7]. However, the so-called “traps”, and first of all, these are institutional traps and coordination traps, prevent the full use of the opportunities that have opened up. Inconsistency, delayed response (or lack of response) of existing institutions to technological changes hinder the development of the state’s innovation system. And the unpreparedness (both technological and social) of all links in the value chain to actively engage in the innovation process does not allow for the full use of all the advantages of innovation integration.

A systematic approach to the formation of national innovation systems helps eliminate traps or reduce their impact, which is impossible without creating incentives to create their own innovations.

Main part.

The concept of national innovation systems originated in the 80s of the 20th century. In scientific research circles, the concept originates in the works of Professor B.-A. Lundvall of Uppsala University (Sweden), Professor Christopher Freeman of the Institute for Science Policy Research at the University of Sussex (Great Britain), and Professor Richard Nelson of Columbia University. The first mention of the term “national innovation system” (hereinafter NIS) in official documents of international organizations dates back to 1992 (the study “Technology and Economy: Key Relationships” within the framework of the OECD program “Technology / Economy”). The studies of the NIS concept in the works of K. Freeman, B.-A. Lundvall, R. Nelson are based on the methodological principles of the new growth theory of P. Romer and R. Lucas, the institutional theory of D. Norton, the concept of diffuse knowledge of F. Hayek, and the theory of economic development of J. Schumpeter. K. Freeman defines the NIS as “a network of institutional structures in the public and private sectors of the economy, the

activity and interaction of which initiates, creates, modernizes, and facilitates the dissemination of new technologies” [4]. From the position of R. Nelson, the NIS is “a complex of institutions whose interaction determines the activities of national firms in the field of innovation” [5]. In the definition of B.-A. Lundvall, “NIS are elements and relationships that influence each other in the production, dissemination, and use of new economically useful knowledge” [6].

In defining the main link of the NIS, K. Freeman relies on technology, B.-A. Lundvall - on new knowledge, and R. Nelson - on organizational structures [7, p. 99].

Subsequently, issues of formation and development of national innovation systems are considered in the works of many domestic and foreign scientists: P. Patel, J. Metcalf, C. Edquist, A. Hall; V. A. Vasin, L. E. Mindeli, N. I. Ivanova, O. Golichenko, Yu. A. Levin, A. V. Tambovtsev; V. F. Bainev, L. M. Kryukov, L. N. Nekhorosheva, A. V. Markov, M. V. Myasnikovich, A. G. Shumilin, and others.

Currently, all available definitions of the NIS are presented within the framework of 3 approaches:

1) as a set of organizations implementing a full innovation cycle, and institutions that create conditions and promote innovation activity at the national level.

2) as a set of related mechanisms that ensure innovation processes both in institutional terms and in organizational and financial terms.

3) as part of a higher-level system, which requires the integration of innovation processes into the economic life of society and subordination to general economic laws [1, p. 14].

It should be noted that these approaches do not contradict each other. The use of one or another approach is determined by the level of research and the goals set. The actual unification of all three approaches can be traced in the definition given in the “Model Law on Innovation Activity” (for the CIS member states), according to which “the national innovation system is a system of organizational, legal, socio-economic and institutional relations that establish, in accordance with the constitution, legislation and established business customs of the CIS member states, the conditions <...> for regulating innovation activity, as well as self-regulation, based on the voluntary adoption and implementation of quality standards” [8].

It is worth noting separately that the formation of the NIS is not a one-time process. It is impossible to form a single model of the NIS that is suitable for different economic structures of society. Each stage of social development has its own instruments and mechanisms of influence, which is directly related to the construction of connections and relationships within the national innovation system. At the same time, the goal of creating a NIS remains unchanged - the growth of the country’s GDP and an improvement in the quality of life of the population.

Considering the NIS as a system, it is important to identify its basic elements, build connections between them, determine their type and prescribe the mechanisms of influence of the external environment.

When determining the basic elements of the NIS, we will proceed from the fact that an effective innovation system involves the implementation of a full innovation cycle. The classical cycle of the innovation process includes 3 stages - scientific, production and operational (table 1).

Table 1
Stages of the innovation process

Stage	Phase	Result	Participants	Source of funding
1. Scientific	1.1 Fundamental theoretical research	New knowledge that has no market value	Academic institutes	State budget Specialized funds and grants
	1.2 Exploratory research		1. Academic and industry institutes 2. Universities 3. Scientific and technical centers of industrial enterprises	Budgetary financing within the framework of state programs
	1.3 Applied research	Technical solutions (invention, utility model, industrial design)	1. Universities 2. Scientific and technical centers of industrial enterprises	State budget Customer funds Specialized funds
	1.4 Experimental design work	Prototype	1. Specialized design bureaus 2. Design institutes 3. Laboratories of universities 4. Scientific and technical centers of industrial enterprises	State budget Customer funds Specialized funds
2. Production	2.1 Organization of production preparation	Trial lots of a new product	Production units of industrial enterprises	Own, borrowed and attracted funds of the enterprise
	2.2 Production	Transition to mass production	Production units of industrial enterprises	Own, borrowed and attracted funds of the enterprise

3. Operational	3.1 Dissemination of innovations (diffusion)	Product with improved properties, including in related areas	Production and economic units of industrial enterprises	Own, borrowed and attracted funds of the enterprise
	3.2 Routinization	Maximum volume of new product release	Production units of industrial enterprises	Own funds of the enterprise

The conducted analysis allows us to identify the participants of the innovation process - scientific institutes and centers, educational institutions, innovation-oriented industrial enterprises, as well as a complex of institutions that create conditions for the creation of a new product and its further use in the country's economic turnover. Including universities in the participants of the innovation process, and, consequently, the basic elements of the NIS, it is necessary to clearly distinguish between the educational and research activities of universities:

Educational activities: Training specialists in various specialties through the implementation of educational programs of general and advanced higher education ➡

Educational market (the main participants are households that have a need for high-quality education, obtaining new knowledge for the purpose of its further use in their professional activities).

Research activities: Carrying out fundamental (in classical universities) and applied research, including with the involvement of students ➡ new knowledge embodied in technical solutions ➡ Market of scientific and technical products (the main consumers are entities of the real sector of the economy).

The involvement of universities in solving problems of the real sector of the economy, as well as social and cultural problems of society, changes the role of universities: to the traditional missions implemented in educational and research activities, a third is added, the main areas of which are the commercialization of university developments and social participation. The university becomes an active participant in the innovation process, solving not only specific problems of industrial enterprises, but also presenting its own developments with a focus on the future needs of society.

The inclusion of innovation infrastructure institutions in the composition of participants in the innovation process, and, consequently, the basic elements of the NIS, will contribute to the development of coordinated actions to implement the state innovation policy, which will certainly contribute to increasing the efficiency of the NIS.

Defining the type of relationship between the elements of the National Innovation System as cooperation [9], the structural model of the national innovation system can be presented as follows (Figure 1).

The presented model of the functioning of the national innovation system reflects all the relationships between its basic elements in the implementation of full-cycle innovation projects; clearly defines the results of each stage and the possibilities of their practical application both in the internal environment (national market) and in the external environment (international market).

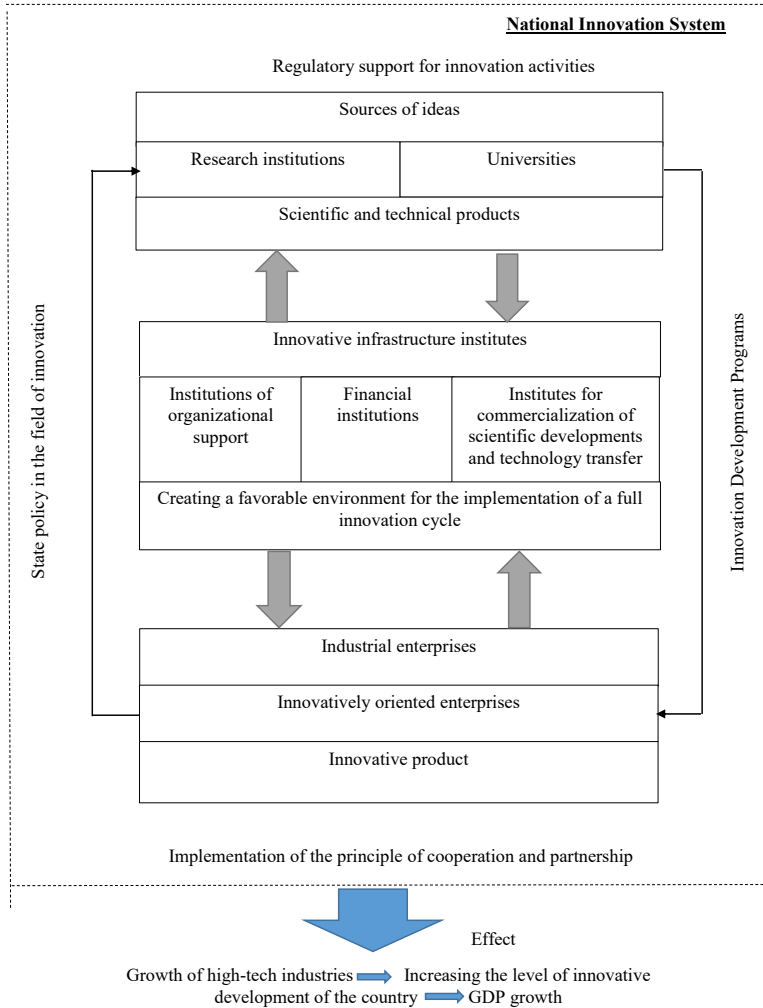


Figure 1. Structural model of the national innovation system

Source: author's development

Conclusion.

Comprehensive development of the national innovation system, rather than the development of each of its elements separately, is capable of ensuring sustainable rates of economic growth on an innovative basis. To do this, it is necessary:

1) to define the type of relationships between the basic elements of the NIS not as interaction, but as cooperation, the necessary and sufficient conditions of which are mutual trust and interest in achieving a common goal;

2) to formulate clear framework conditions for innovation infrastructure institutions that can become independent points of innovation growth under certain conditions in order to eliminate duplicating functions;

3) to create mechanisms for effective cooperation of NIS elements in the implementation of full-cycle innovation projects;

4) to stimulate demand for scientific and technical products from the business sector.

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DOI 10.34660/INF.2025.83.22.105

制裁和地缘政治紧张背景下对外经济战略对俄罗斯经济增长的影响
**THE IMPACT OF FOREIGN ECONOMIC STRATEGIES ON
RUSSIA'S ECONOMIC GROWTH IN THE CONTEXT OF
SANCTIONS AND GEOPOLITICAL TENSIONS**

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摘要。本文考察了制裁压力和地缘政治紧张局势下对外经济战略对俄罗斯经济增长的影响。特别关注分析进出口业务结构的变化以及亚太地区在弥补经济损失方面的作用。提出了提高俄罗斯对外经济政策可持续性的实用建议。

关键词：俄罗斯经济、制裁、对外经济战略、经济增长、亚太地区。

Abstract. *The article examines the impact of foreign economic strategies on Russia's economic growth in the context of sanctions pressure and geopolitical tensions. Particular attention is paid to the analysis of changes in the structure of export-import operations and the role of the Asia-Pacific region in compensating for economic losses. Practical recommendations for increasing the sustainability of Russia's foreign economic policy are presented.*

Keywords: *Russian economy, sanctions, foreign economic strategies, economic growth, Asia-Pacific region.*

The modern global economy faces numerous challenges associated with increased sanctions pressure, disruption of key supply chains and geopolitical tensions. In this context, Russia, as one of the largest economies in the world, is forced to adapt its foreign economic strategies to maintain sustainability and achieve economic growth.

The topic of the study is particularly relevant against the background of intensified cooperation with the Asia-Pacific countries, which are becoming key partners in the context of a changing global economic landscape. This article analyzes changes in the structure of Russia's foreign economic activity, paying attention to strategic measures aimed at diversifying export flows and finding new partnerships, especially in the Asia-Pacific region.

The global structural transformation of the architecture of the world order, which occurred against the backdrop of the development of the crisis in Ukraine and the intensification of confrontation processes between the EU countries, the G7 countries, the United States and their allies on the one hand and the Russian Federation on the other hand, indicate the relevance of the research topic related to the study of the influence of foreign economic strategies on the economic growth of the Russian Federation in the context of sanctions, which entailed the destruction of integration ties between countries of the world community and a severe aggravation of competition in the markets for raw materials and finished products, an intensification of the struggle of states for the sphere of foreign direct investment and for the sphere of development of advanced innovative technologies [8].

As part of the implementation of strategic foreign economic planning, the executive authorities of the Russian Federation adopted a number of program documents: “Unified Plan for Achieving National Development Goals of the Russian Federation for the Period up to 2024 and for the Planning Period up to 2030” dated October 1, 2021 [7]; Forecast of the Socio-Economic Development of the Russian Federation for 2022 and for the Planning Period of 2023 and 2024 dated September 30, 2021 [12] and “Forecast of the Socio-Economic Development of the Russian Federation for the Period up to 2036” dated November 22, 2018 [13].

All the developed program documents are aimed at implementing new models of foreign economic strategies associated with increasing the growth of the country’s economy and providing for the implementation of interrelated measures aimed at maintaining macroeconomic stability of the country’s budget in the face of changes in the cost of mineral resources on world markets, including taking into account the likely possibilities of an export-import turn to the Asia-Pacific region [1]. All the developed program documents are aimed at increasing the sustainability of the system of international relations in the economic, political, and cultural spheres based on the current norms of international law, and nevertheless, in accordance with the strategic goals of foreign economic planning within the framework of the functioning of the models of foreign economic strategies of the Russian Federation, it was assumed that there would be large-scale development of internal import substitution processes in critical areas until 2030 with a total funding of 5.2 trillion rubles [11]. At the same time, the main goal of the developed program documents within the framework of the implementation of new models of foreign economic strategies was the entry of the Russian Federation into the “Top 5 leading countries in terms of GDP”.

At the beginning of the critical review, we will consider the article by K.A. Purik from 2023 “Transformation of the Russian Economy in the Context of Global Sanction Pressure”, which directly affects the implementation of new models of foreign economic strategies of the Russian Federation, influencing the growth of

the country's economy [4]. The author of the article, relying on the analysis of Rosstat data, studied the economic indicators of the fuel and energy complex of the Russian Federation for the time period 2018/2022 and, as the main argument of his position, which was that “the Russian Federation, under the conditions of sanctions, will not be able to redirect oil export flows to the Asian region”, used the opinion of Russian researchers D.N. Nazarchuk and N.I. Promsky [3], who in 2012 studied the characteristics of Russian exports and their problems in the Asian region, meanwhile, more than 10 years have passed since the publication of this work.

K.A. Purik substantiated the dependence of the Russian economy on sanctions and concluded that oil production would sharply decline in 2022 under the impact of EU sanctions, taking into account the ban on Russian oil exports by sea through European ports and the introduction of price ceilings. The author of the article, in an attempt to determine the implementation of new models of foreign economic strategies of the Russian Federation that could ensure the growth of the country's economy, overlooked the measures of state bodies governing economic processes, which should include the Russian Federation's countermeasures in the context of global sanctions pressure related to the ban on the sale of oil under contracts with foreign companies and individuals based on the use of a mechanism for setting a maximum oil price of \$60 per barrel and essentially forcing Russian oil producers to develop alternative sales channels [14]. Obviously, K.A. Purik was obliged to analyze not only the statistical data of Rosstat, but also the statistical data of importing countries from the Asia-Pacific region before arguing his position [10] (Fig. 1).

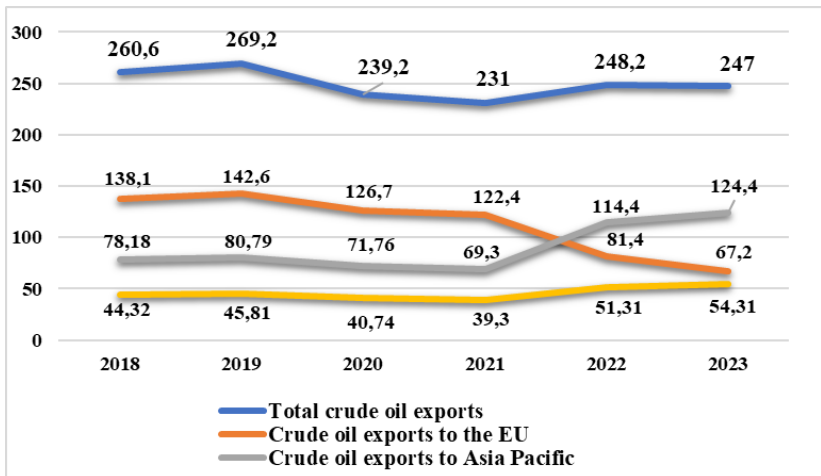


Figure 1. Dynamics of crude oil exports from Russia (million tons)

Summarizing the analysis of the dynamics of Russian oil exports, it can be stated that in the 2022/2023 sanctions years, exports increased by 16 million tons, which is an increase of 6.92% compared to 2021. The key supply destinations were the countries of the Asia-Pacific region.

The implementation of new models of foreign economic strategies of the Russian Federation was based on the introduction of effective control measures by the OPEC+ association of countries, of which the Russian state is a member, aimed at maintaining high oil prices on the world market, which will stimulate the country’s economic growth with a voluntary reduction in oil production volumes and diversification of fuel and energy resources supplies to partner countries. Moreover, the Russian Federation not only fully compensated for lost revenues from oil sales to the European Union, but also achieved additional income of \$2.7 billion due to the expansion of energy supplies in the context of sanctions pressure [12] (Fig. 2).

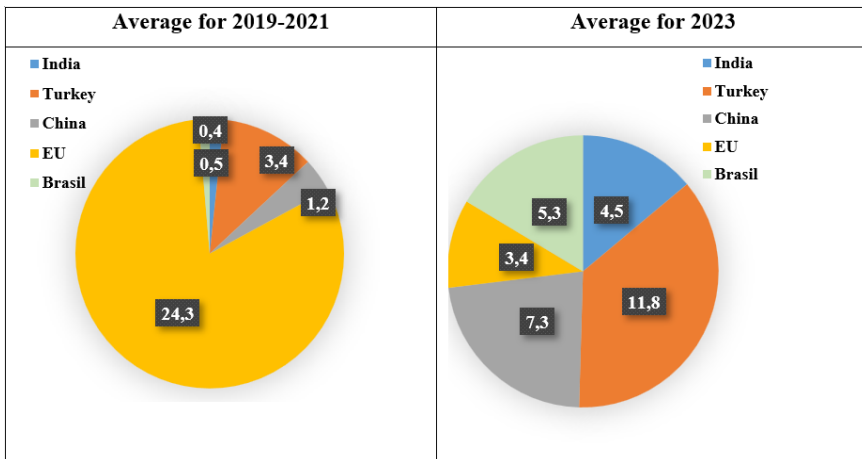


Figure 2. Structure of crude oil exports from Russia (\$ billion)

When considering the structure of Russian oil exports, it should be emphasized that in the period from 2019 to 2021, the average annual sales volume was \$28.8 billion. However, by 2023, this figure increased to \$32.2 billion. Major buyers such as Brazil, India, China and Turkey significantly increased their oil purchases, increasing them by 5.5 times compared to the average figures for 2019-2021. Thus, we can say that K.A. Purik’s thesis that the fuel and energy sector of the Russian Federation will not be able to redirect oil export flows to the Asian region under the impact of sanctions turned out to be untenable.

In the context of the research topic, we will focus on the article by M. R. Safullin and L. A. Elshin “Sanctions Pressure on the Russian Economy: Ways

to Overcome the Costs and Benefits of Confrontation within the Framework of Import Substitution” [5]. The authors of the article examined the breakdown of integration and cooperative ties in the context of sanctions during the implementation of new models of foreign economic strategies of the Russian Federation, substantiating the urgent need to form new sustainable cooperative ties to achieve the proper level of imported raw materials, finished products, equipment and technologies in the context of systemic restrictions.

In the article, the authors, after performing their own calculations to assess the impact of foreign economic indicators on changes in the GDP of the Russian Federation, came to the categorical conclusion that “a decrease in imports by 1 million US dollars leads to a decrease in the country’s GDP by 417 million rubles,” which is equivalent to 4.6 million US dollars. They emphasized that they rely on the basic principles of economic theory, arguing that “the analysis and assessment of the impact of changes in import volumes on the dynamics of Russia’s GDP serve as direct confirmation of the algorithm of relationships they developed.” Let us present data on the dynamics of the volumes of export-import turnover and the volumes of GDP of the Russian Federation over 10 years [6].

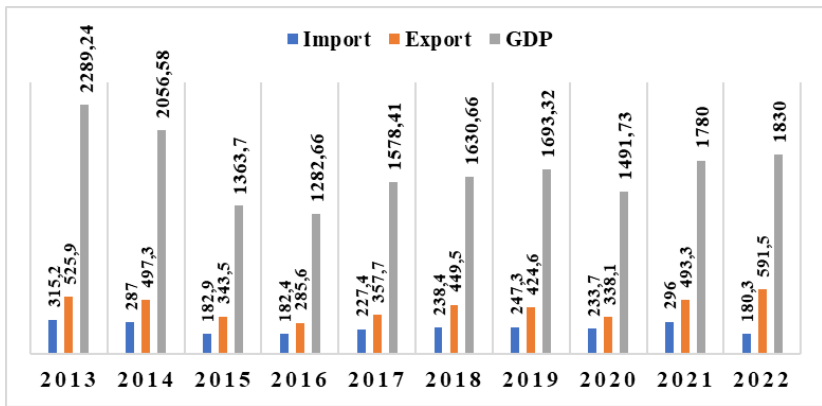


Figure 3. Dynamics of the volumes of export-import turnover and GDP volumes of the Russian Federation (\$ billion)

Studying the impact of import volumes on the GDP of the Russian Federation over the past 10 years, it can be noted that by the end of 2023, the volume of foreign economic transactions on imports decreased by \$134.9 billion, and the country’s GDP decreased by \$459 billion. According to calculations, for every \$1 million reduction in import turnover, there is a decrease in GDP by \$3.4 million, which is \$1.2 million less than the value indicated in the article.

It should also be emphasized that in 2023, the Federal Customs Service for the first time presented data on the foreign economic turnover of the Russian Federation, which reached \$530.2 billion. This year, there was a significant increase in import volumes, which increased by \$43 billion, rising from \$180.3 billion to \$213.3 billion. It is worth noting that 70% of the total import volume came from countries in the Asian region. At the same time, according to the results of 2023, the gross domestic product of the Russian Federation amounted to \$ 1879.5 billion. These data indicate the importance of changes in foreign economic activity and their impact on the country's economic indicators.

The assertion of direct evidence, developed by the authors of the article, of the algorithm for the relationship between import turnover and GDP, looks absolutely absurd, especially if we take the indicators for 2021/2022. Thus, as a result of the introduction of sanctions, import turnover decreased by \$ 115.7 billion, but the GDP of the Russian Federation, on the contrary, increased by \$ 50 billion. This factor indicates the need to analyze the relationship of all characteristics in the current situation (including export turnover, taking into account prices on the world market) and combine them into a single conceptual scheme, only this approach guarantees the authors a new understanding of the objectivity of the knowledge obtained. It should also be noted that, while studying the interrelations between the breaks in integration and cooperative ties under sanctions in the implementation of new models of foreign economic strategies of the Russian Federation, the authors of the article were not at all interested in the methods of calculating GDP, which essentially correspond to different stages of reproduction and can represent either the sum of the gross added value of all industries or institutional sectors at basic prices and net taxes on products, or the sum of the expenditures of all institutional sectors on final consumption, gross accumulation and net exports, or the sum of wages of all employees, gross profit of all industries or institutional sectors and net taxes on production and imports [7].

T. A. Kulagovskaya, D. S. Grigoriev, V. A. Levchenko, A. V. Shapovalova in their article "Assessing the Impact of Sanctions on the Foreign Economic Activity of the Russian Federation" considered the problems of developing the foreign economic activity of the Russian Federation and studied aspects of foreign economic strategies in the context of counteracting violations of key supply chains [2]. The authors noted the regression of the foreign economic activity of the Russian Federation in the sphere of trade with the EU countries against the backdrop of sanctions and at the same time pointed to the revival of Russian import turnover on the eastern and southern borders of the country, expressing the opinion about the collapse of all foreign trade of Russia and the negative impact of countermeasures of the Russian Federation, with which the country tried to cushion the impact of the sanctions bans. It should be noted that this kind of information must

be supported by statistical data that are in the public domain. Thus, according to the results of 2022, the total volume of foreign trade export-import turnover of the Russian Federation amounted to \$ 771,836 million, having decreased compared to 2021 (\$ 789,392 million) by \$ 17,556 million (2.22%). During the same period, there was a significant geographical reorientation of Russia’s foreign economic activity [15], (Fig. 4).

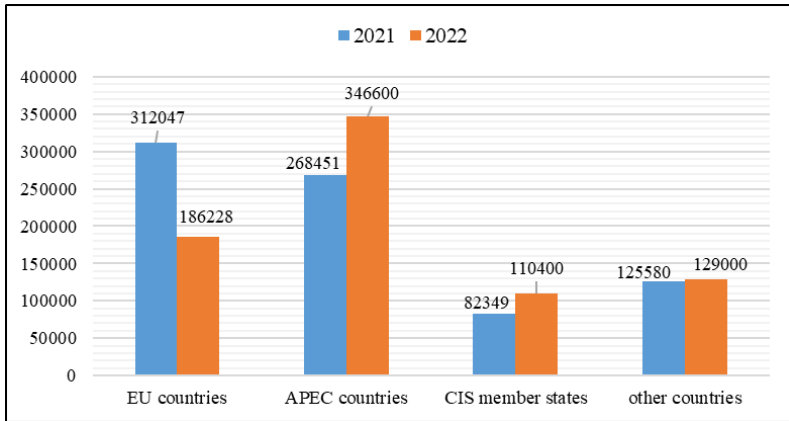


Figure 4. Dynamics of changes in the volume of foreign trade export-import turnover (\$ million)

Summarizing the analysis of changes in the volume of foreign economic turnover of the Russian Federation, it can be noted that the EU sanctions led to a decrease in trade with the European Union by 40%. At the same time, turnover with APEC increased by 29%, with the CIS increased by 34%, and trade with the rest of the world increased by 3%. The Energy Strategy of the Russian Federation for the period up to 2035 noted the possibility of this type of sanction threats arising in the framework of strategic planning in the field of national security and pointed out the need for an immediate geographical reorientation of foreign economic activity of the fuel and energy complex to the Asia-Pacific region, and it is because of this factor that the foreign economic strategies of the Russian Federation in the context of counteracting disruptions to key supply chains by creating alternative sales markets have proven effective [17].

Summing up the results of the study, it should be noted that Russia’s foreign economic strategies in the context of sanctions and geopolitical instability demonstrate high adaptability and efficiency. The strategic turn to the Asia-Pacific region allowed not only to compensate for lost markets, but also to lay the foundation for long-term economic growth.

Among the key areas requiring further development are:

- strengthening cooperation with leading economies of the Asia-Pacific region,
- expanding the use of national currencies in foreign economic settlements,
- increasing the competitiveness of export products.

A comprehensive approach to the development of foreign economic policy will ensure Russia's stable position in world markets and facilitate integration into new economic spaces.

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特朗普对全球金融进行审计前,阿联酋支付系统和数字货币的特点

**PECULIARITIES OF PAYMENT SYSTEMS AND DIGITAL MONEY
IN THE UAE AHEAD OF TRUMP'S AUDIT OF GLOBAL FINANCES**

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摘要。特朗普一月份的就职典礼迫使世界分析和审核现有的支付系统和数字货币,因为美国希望在不久的将来成为所有加密货币的圣地,并以量子解决方案和跨境支付为基础建立数字支付系统,作为工业 4.0 的基础。以及美国昔日强国的复兴。

关键词: 特朗普、美国、数字货币、加密货币、支付系统、阿联酋、元宇宙、人工智能、大数据、工业 4.0。

Abstract. *The January inauguration of D. Trump forces the world to analyze and audit existing payment systems and digital currencies, since it is America that wants to become the Mecca of all cryptocurrencies in the near future and build digital payment systems with quantum solutions and cross-border payments as the basis of Industry 4.0. and the revival of the former power of the United States.*

Keywords: *D. Trump, USA, digital currencies, cryptocurrencies, payment systems, UAE, metaverses, AI, Big Data, Industry 4.0.*

The Middle East is only now beginning to understand the precariousness of its position and the temporary truce between Israel and the Palestinians in Doha does not yet mean the complete end of the 3rd Lebanon War and does not lead to the acceptance of a “new Syria” as an emerging zone of struggle between proxy forces for their interests in the region of a key energy player and transit country for trade flows and monetary resources between Europe and Africa. Donald Trump is eager to expose everyone who used offshores and did not pay the US the required

compensation, to curb the appetites of the US Federal Reserve, which gave free rein to the monarchies of the Persian Gulf. At the same time, if we were to give a brief description of this state, it is necessary to point out the fact that the United Arab Emirates (UAE) is considered one of the most important economic centers of the Middle East. It is also worth noting that, despite the traditional conservatism inherent in this region, the Emirates are one of the most liberal countries in the Persian Gulf. The federal state, consisting of seven emirates, is at the mercy of the prices of “black gold”. The UAE is also one of the most dynamic markets in the world with high economic activity and innovative potential. An effective policy of economic diversification ensures a systematic transition from a raw materials model to a wide range of industries with high added value. It is important to emphasize that the financial structure of the UAE is more complex than in other countries in the region. It includes the Dubai International Financial Centre (DIFC), which was established in 2004 as a financial “free zone” and is home to more than 550 regulated financial institutions and 4,200 companies, backed by contract security, independent courts and a favourable tax regime. The country has three stock exchanges that provide investment security, represented by Nasdaq Dubai, the Abu Dhabi Securities Exchange and the Dubai Financial Market. Private capital with assets of more than \$1 trillion is managed in Dubai by 60 hedge funds.¹ Dubai itself, the financial centre of the United Arab Emirates, claims to be the most modern financial hub along with such cities as New York, London, Singapore and Hong Kong. The plan to turn Dubai into one of the four leading financial centres in the world by 2033 was presented by the Vice President and Prime Minister of the UAE, who is also the ruler of Dubai, Sheikh Mohammed bin Rashid al-Maktoum in early January 2023.²

The payment systems of the United Arab Emirates (UAE) have a number of truly unique features, caused by both the rapid economic development of the country and the introduction of the latest technologies, as well as its cultural traditions and religious aspects. It should be noted that the settlement and payment relations that have developed in the Islamic world have a rather ancient history. Thus, it was in the countries of the Arab world that simple bills of exchange were first used to settle monetary claims and obligations. This action made it possible to significantly separate monetary and information flows for transferring money both over long distances and between different countries. At the same time, the money was placed in a safe place, and the settlements themselves were carried out using paper receipts or some pre-agreed oral messages. The architecture of such a payment system is preserved and exists to this day in the form of an unofficial transfer sys-

¹ The UAE, particularly Dubai, is aiming to become a global financial hub

² Sheikh Mohammed announces new \$56bn Dubai Social Agenda 33 plan to double Emirati families in 10 years

tem called “Hawala” (Arabic: نظام دفع الحوالة - “transfer”). It is worth saying that its creation and formation took place long before the emergence of the Western banking system, and it, in turn, perfectly adapted to modern technologies. The system is a rather informal financial and settlement system, compiled and operating on the basis of mutual offsetting of claims and obligations between brokers. In essence, “Hawala” is a distributed network without centralized management, that is, with the presence of a distributed register of brokers. The most important fact is the existence of a very negative attitude of the world community to this settlement system, first of all, on the part of the intergovernmental global organization for combating money laundering (English Financial Action Task Force, FATF), also the Eurasian Group on Combating Money Laundering and Financing of Terrorism (English The Eurasian Group on Combating Money Laundering and Financing of Terrorism, EAG) and other organizations. The reasons for such an attitude are not at all groundless and have quite constructive explanations. In its essence, “Hawala” allows for cross-border money transfers while maintaining complete anonymity, and this, therefore, can facilitate money laundering, as well as servicing drug trafficking and then financing terrorism. And in general, states that are under pressure from sanctions and restrictions can quite use this system to conduct international settlements. In this context, the experience of Iran is quite curious, whose banks, as a result of a significant number of sanctions, were disconnected from the international system of transferring financial messages called “SWIFT”. Here, some countries, such as the UAE and Turkey, have already provided assistance to Iran, which is “overwhelmed” by sanctions, in implementing international settlements through their credit institutions. But, by the way, this version of the payment channel was ultimately stopped and blocked due to concerns related to the introduction of secondary sanctions. Focusing on the previously mentioned religious rules and cultural customs, it is important to emphasize that the use of the listed and already to some extent “outdated” methods of conducting international payments has become truly possible and feasible, including due to the commonality of several aspects, including religion, ideology, culture, and traditions between counterparties. If we pay attention to the present time, there is a modern systemically important payment system here - speaking of the Islamic world, one of the locomotives of which, by the way, is the UAE - and it is represented by a centralized and multicurrency settlement mechanism used precisely by Islamic central banks. This system is called “Buna” (Arabic: بونا). This cross-border payment system was established by the Arab Monetary Fund in 2018 and is supported directly by Arab regulators. The goals behind it are to support economic and financial integration among Arab countries and to expand trade and investment activities with global trading partners. A visual representation of the existing hierarchy, expressed in specific groups, is shown in Figure 3. ³

³ The Organization, «Buna»



Figure 1. Organization and hierarchy of the Buna payment system
 Source: Buna | Transforming cross-border payments.

In other words, Buna is managed by ARPCSO, which operates as an independent organization wholly owned by the Arab Monetary Fund. The system enables financial institutions and central banks in the Arab region and beyond to send and receive payments in Arab currencies as well as key international currencies. It is through cross-border payment services that BUNA is gradually expanding the possibilities of economic and financial integration in the Arab region and strengthening investment ties with global trading partners. The BUNA payment system offers an ever-expanding list of Arab and international currencies, including the UAE dirham, Egyptian pound, Saudi riyal, Jordanian dinar, US dollar, and euro. It should be noted that the operators of the payment system when working with various currencies are both central banks and the world’s largest TNBs, which is clearly presented in accordance with Table 1.

Table 1
 Key banks - participants of the BUNA system for multicurrency transactions

№	Банк-оператор для обработки платежей в данной валюте	Валюта	Доля валюты в расчетах системы, %
1	Центральный банк ОАЭ	Дирхам ОАЭ (AED)	31
2	Центральный банк Египта	Египетский фунт (EGP)	9
3	Национальный банк Саудовской Аравии	Саудовский риал (SAR)	17
4	J.P. Morgan	Доллар США (USD)	17
5	Standard Chartered Bank	Евро (EUR)	13
6	Центральный банк Иордании	Иорданский динар (JOD)	13

Source: Modern trends in settlements and payments in the Islamic finance system / Pertseva S.Yu.

Modern payment solutions “Buna” meet high international standards of information security and requirements for combating financial crimes. The payment system offers a wide range of products and services that meet various current and potential needs of participants and their end users.⁴

In November 2024, Mastercard joined Buna. The partnership made cross-border payments in the Middle East and North Africa (MENA) region faster and more accessible. This is done through the Mastercard Move service, which combines Buna’s infrastructure with the global Mastercard network.⁵

The system offers a fairly wide range of products and services, among which are multi-currency cross-border interbank payments, commercial payments, consumer money transfers, instant payments, trade finance solutions, securities settlements and ATM payment processing services. Overall, this payment system demonstrates steady progress, dynamic development and a clear trend towards involving more participants, the number of which currently exceeds 122, as well as an increase in the volume of cross-border payments, which is clearly demonstrated in Fig. 2.⁶

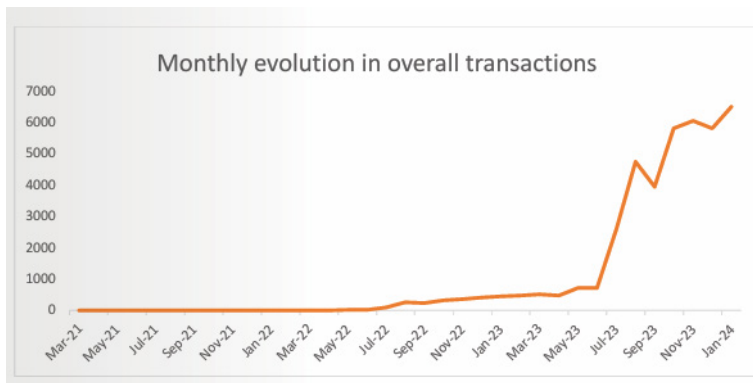


Figure 2. Monthly Total Transaction Volume Dynamics Chart

Source: Buna | Transforming Cross-Border Payments.

However, traditional payment systems in the United Arab Emirates play a critical role in ensuring financial stability and stimulating economic growth. They cover a wide range of services, including bank transfers and credit cards, providing convenience for both consumers and businesses. These systems not only contribute to domestic economic development, but also to integration with the

⁴ Modern trends in settlements and payments in the Islamic finance system

⁵ Mastercard Allies With Buna Cross-Border Arab Payment System

⁶ BUNA Annual Report 2023

international economy. The reliability and accessibility of traditional payment instruments create the basis for innovative financial solutions, which have recently gained popularity in the region.

In recent years, the GCC countries, including the UAE, have undergone significant reforms aimed at strengthening integration development in various economic sectors, which has a positive impact on the development of payment systems. These reforms contribute to the creation of a favorable environment for the introduction of new financial technologies, such as digital wallets and mobile payments. As a result of such changes, traditional payment systems are adapting to digital innovations and becoming more flexible and technologically advanced. Thus, the unique combination of traditional and modern payment systems, which together represent a close interaction, under the influence of factors such as religion and culture, demonstrates truly impressive results and dynamic statistics. This can be confirmed by the results of a detailed report on the UAE, which was published by the International Monetary Fund in December. In this regard, it is necessary to emphasize the high economic growth, which is facilitated by active domestic activity, a sharp slowdown in inflation against the background of declining commodity prices, maintaining international reserves and budget and external balances with relatively high prices for “black gold”. Also, the possession of banks in general with sufficient capital and liquidity reserves and a constant level of activity in the real estate sector, the continuation of significant initiatives and investment expenditures.⁷

As mentioned above, international reserves are to a certain extent dependent on crude oil prices. For a more visual presentation of statistical information expressed for certain groups, the use of the construction and analysis of an economic and mathematical model in the form of regression equations will be demonstrated below. The period from August 2023 to August 2024 was chosen as the time interval under study. For a more accurate expression of the final data and a more complete assessment, the study uses correlation and regression analysis. This method takes into account various statistical aspects and demonstrates more accurate calculations.

In the analysis below, in accordance with Figure 5, the following statistical indicators are highlighted:

- Multiple R - data correlation (t - statistics, subject to Student's distribution).
- R-squared - determination coefficient (f - statistics, subject to Fisher's distribution).
- P-Value – the significance level of the corresponding calculations (if $P < \alpha = 0.05$ by default, then the hypothesis H_0 is rejected, i.e. the estimated parameter is statistically significant).
- Coefficients for the Y-intercept and the variable X.

⁷ United Arab Emirates: 2024 Article IV Consultation-Press Release; and Staff Report

Вывод итогов								
Регрессионная статистика								
Множественный R	0,6193424							
R-квадрат	0,383585008							
Нормированный R-кв	0,327547282							
Ст. ошибка	4,051371642							
Наблюдения	13							
Дисперсионный анализ								
	df	SS	MS	F	Значимость F			
Регрессия	1	112,3531583	112,3531583	6,845120812	0,023985658			
Остаток	11	180,549734	16,41361218					
Итого	12	292,9028923						
	Коэффициенты	Ст. ошибка	t-статистика	P-Значение	Нижние 95%	Верхние 95%	Нижние 95,0%	Верхние 95,0%
Y-пересечение	86,09947222	1,517574092	56,73493813	6,2975E-15	82,75931416	89,43963028	82,75931416	89,43963028
Переменная X 1	-1,101369488	0,4209616	-2,616318179	0,023985658	-2,027899723	-0,174839252	-2,027899723	-0,174839252

Figure 3. Correlation-regression analysis

In the paired linear regression model, the relationship between variables in the general population is represented as:

$Y = a + bX + e$, где a and b – parameters of the equation, e – regression errors.

According to the calculation results, the following regression equation was obtained:

$$y = 31,48 - 0,3483x, \quad R = 0,62, \quad R^2 = 0,3836$$

In addition to the calculations presented, the work demonstrates their graphical representation in accordance with Figure 6.

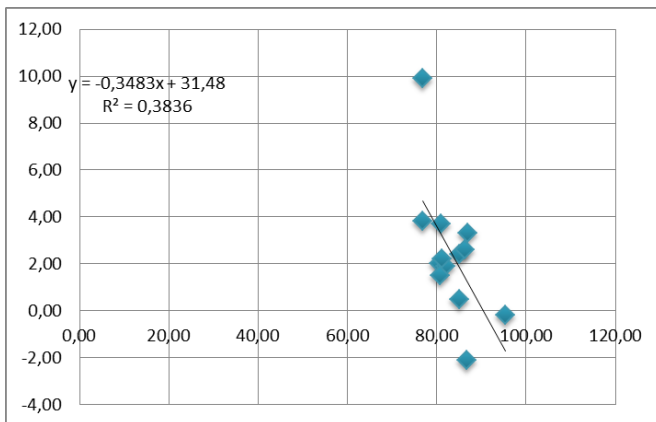


Figure 4. Correlation field

When examining the presented figure, a certain conclusion is formed: the distribution in a relatively larger population passes in the area of the trend line.

Regression parameters: $a = 86.09947$ – statistically significant, since $P\text{-value} = 6.2975E-15$ is less than 0.05; $b = -1.10137$ – statistically significant, since $P\text{-value} = 0.02399$ is less than 0.05.

Correlation coefficient $r = 0.62 < 0.7$, therefore, the relationship between the studied features in this population is close. Determination coefficient $R^2 = 0.3836$, i.e. 39% of the spread of the dependent variable (the indicator of international reserves of the UAE) is explained by the obtained regression. Significance $F = 0.02399$ – less than 0.05, then the equation as a whole is statistically significant. To summarize the above, the dependence of the UAE's international reserves on oil prices is indeed significant, and it, in turn, is determined by the structure of the economy, sources of income and the influence of the oil sector on the country's financial stability.

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残疾学生及其教育的某些特点
**STUDENTS WITH DISABILITIES AND SOME FEATURES OF
THEIR EDUCATION**

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摘要。融合教育是一种基于对每个学生独特性的认可、接受和尊重、为所有儿童提供教育的教育和养育过程，学校努力为每个学生提供合适和方便的教育环境，无论其身体和生理状况、社会地位、心理特征、身体健康状况等如何。在对大量已发现问题的研究分析的基础上，作者得出结论：为了向有特殊需要的学生提供专门的帮助，优化具有各种生理、身体、精神残疾的学生的教育和养育活动，重要的是，综合学校的教师要做好准备，因为这些障碍表现为心理运作不成熟、词汇量和一般知识水平低、儿童行为中游戏动机占主导地位、缺乏参与感和对自己行为和行动的要求。在这种情况下，包容性教育通常应该由教育过程的所有参与者（学校管理部门、教学和学生团体、家长）做好接受残疾儿童的准备。本文证明了这一论点：对智力障碍学童进行适当的矫正工作可以大大提高他们成功融入社会的机会。

关键词：包容性教育、残疾儿童、学童身心残疾、矫正。

Abstract. *Developing inclusive education as an educational and upbringing process based on the recognition, acceptance and respect of the uniqueness of each student, the availability of education for all children, the school makes great efforts to provide an educational environment suitable and convenient for each student, regardless of his or her physical and physiological condition, social status, psychological characteristics, somatic health, etc. Based on the analysis of a fairly large volume of research on the identified problem, the authors came to the conclusion that in order to provide specialized assistance to students with special*

needs, optimize the educational and upbringing activities of schoolchildren with various physiological, physical, mental disabilities, it is important that teachers of comprehensive schools are prepared for the fact that these disorders are manifested in the immaturity of mental operations, a low level of vocabulary and general knowledge, the predominance of play motives in the child's behavior, the lack of a sense of involvement and demand for their actions and deeds. In this case, inclusive education, as a rule, should be preceded by preparation for the acceptance of children with disabilities by all participants in the educational process: school administration, teaching and student bodies, parents. The article proves the thesis that proper correctional work with schoolchildren with mental retardation significantly increases their chances of successful integration into society.

Keywords: *inclusive education, children with disabilities, physical and mental disabilities in schoolchildren, correction.*

At present, there is a tendency towards an increase in the number of children and adolescents with disabilities, manifested in various physiological, physical or psychological disorders, or in the form of deviations from age norms of general development, which interfere with a full social life and the implementation of educational and cognitive activities. Today, the problems of upbringing and education of children with disabilities are gaining increasing importance: the impact of unfavorable exogenous and endogenous factors leads to an increase in the number of children with various health limitations [1; 3]. "New forms of education provide the opportunity for children with special needs and disabilities to receive education in general schools and kindergartens together with normally developing peers. However, it is obvious to specialists that any type of education for such children should be combined with the provision of correctional assistance to overcome deviations in their development. At the same time, the most important task of the system of special and inclusive education is the formation of a flexible educational environment and the reorganization of the educational process to include individuals with disabilities" [5, p. 13]. As is known, in recent years, the problems of students with disabilities have increasingly been solved at the state level, which initiates the emergence of new scientific developments, programs, including in special schools. As the results of numerous studies show, the term "correction" literally means "correction" [8]. According to A.I. Adzhieva and V.M. Pyatunina "...psychological and pedagogical correction is an activity aimed at correcting (adjusting) those features of mental development that, according to the accepted system of criteria, do not correspond to the "optimal" model" [12, pp. 318-321]. A number of researchers in the field of inclusive education (Yu.A. Bystrova, D.M. Mallaev, G.A. Magomedov, A.V. Pushkova) define psychological correction as a

set of measures focused on the maximum possible elimination of imperfections in the psychology of an individual, his behavior and actions with the help of special methods and techniques of psychological influence” [2; 7; 11].

Often in literature and other sources, children with disabilities are defined by such terms as “exceptional children”, “children with problems”, “atypical children”, “children with special needs”, “children with learning difficulties”. This group includes not only children with confirmed disabilities, but also those who experience any difficulties in their everyday life that interfere with a full social life and household activities (authoritarian parenting style, dysfunctional family, etc.). Thus, children with disabilities represent an exceptional class of children who require different forms of education, special attention, assistance and support. According to the classification developed by researchers (L.A. Kazakova, I.V. Maltseva, N.A. Pronina, E.V. Romanova, E.V. Slizkova), children with disabilities are divided into the following groups: - with speech impairments; - deaf or hard of hearing; - visually impaired or blind; – mentally retarded children (with intellectual disabilities); – with mental retardation; – with emotional-volitional disorders; – with musculoskeletal disorders; – with multiple disorders, that is, more than two of the previously listed [4; 10].

In the case of children diagnosed with mental retardation, cerebral palsy and delayed psychological development, the main distinguishing features are: underdevelopment of higher cortical functions of the brain, inertia of mental processes, inability to perform such logical operations as generalization and distraction, total underdevelopment of logical thinking and cognitive activity in general. Cerebral palsy mainly manifests itself in the form of various movement disorders. In some cases, children may suffer more in their legs, in others - in their arms.

Sometimes disorders can manifest themselves in the form of a child’s inability to perform fine differentiated movements of the fingers (fine motor disorders). Also, quite often, children with cerebral palsy experience such disorders as apraxia. In this case, children retain normal muscle tone, they can perform various movements to a sufficient extent, but they have difficulties when it is necessary to perform any purposeful practical actions. For example, they cannot dress themselves, fasten a zipper or buttons, lace their shoes, etc. In some children, cerebral palsy may manifest itself in the form of impaired coordination of movements and inability to maintain balance. Violation of the emotional-volitional sphere of children mainly manifests itself in the form of excessive excitability (N.V. Borisova, Yu.L. Zagumennov, S.V. Lvova, A.N. Popov, S.A. Prushinsky), activity, increased sensitivity to the effects of various irritants, timidity and fearfulness [6; 9]. Also, such children often have hearing impairments, especially in cases where cerebral palsy manifests itself in the form of hyperkinesis. Speech disorders also often occur, since mastering manipulation and walking skills is of great importance for a child to fully master speech skills.

Thus, if a child's motor skills and walking skills begin to form incorrectly or late, this will also lead to a delay in speech development. At the same time, unlike children diagnosed with oligophrenia, individuals with mental retardation are distinguished by intelligence within the limits of the knowledge that they have previously acquired. The literature identifies several reasons for the appearance of health problems in children: 1). internal (endogenous) - prenatal - disorders that appeared before the birth of the child; - natal, that is, disorders that arose during childbirth: these include various birth injuries, hypoxia, etc.; - postnatal - injuries received after the birth of the child, for example, bruises, unsuccessful falls, etc. ; 2. External (exogenous). These disorders arise as a result of the influence of social or biological factors, such as the abuse of alcohol, tobacco products, narcotic and psychotropic substances, etc.

The main distinctive features of adolescents with disabilities are: - a low level of development of education, which occurs due to the fact that such children need more time to perceive and process incoming sensory information, as well as a result of having a limited amount of knowledge about the world around them; - a low degree of development of spatial representation and thinking, manifested in the fact that children with disabilities experience difficulties in identifying the symmetry of various figures, analyzing the shape of objects, when it is necessary to arrange some structure on a plane, connecting different parts of an object into a single whole; - have a low degree of concentration and switching of attention.

These disorders in children with disabilities occur as a result of low intellectual activity, unformed self-control skills, underdeveloped sense of responsibility in the learning process, low degree of interest in educational activities; - in the mnemonic sphere, there is a predominance of short-term memory over long-term, visual figurative over verbal, mechanical memorization over logical, and they also have a limited memory capacity; - children cannot quickly process incoming information, they have a decrease in cognitive activity; - in terms of thinking, children with disabilities have more developed visual-effective thinking than verbal-logical or visual-figurative; - have a low need for communication and establishing communicative connections; - poorly developed play activity, as a rule, game plots are poor, ordinary; - there are violations in speech functions, and in especially difficult cases, the components of the language system are completely unformed; - are more susceptible to increased fatigue and exhaustion, as a result of which they have a low level of performance; - are not able to voluntarily regulate their behavior because they are mentally unstable, they have disinhibition of drives and low motivation for learning.

The impact of these factors leads to the fact that children with disabilities often cannot fully master academic disciplines [11]. They often have difficulties in developing educational skills, such as identifying methods and means of achiev-

ing learning goals, planning the learning process, monitoring the pace of work. Among the problems most often encountered by children with disabilities, the following can be highlighted: - insufficient development of motivation for the implementation of educational and cognitive activities, the presence of narrow, limited ideas about the world around them; - slow pace of completing educational assignments; - the need to constantly resort to the help of a teacher or parents; - insufficient development of such properties of attention as: switching, stability and concentration on the topic being studied; - insufficient development of the processes of thinking and speech; - inability to sufficiently understand the instructions for completing assignments; - impaired arbitrariness and coordination of movements; - low self-esteem; - excessively high levels of anxiety and impressionability, manifested in the fact that children with disabilities note the slightest changes in the mood of the person with whom they communicate and react even to minor changes in the timbre and tone of voice; - insufficient development of fine and gross motor skills of the hands; - excessively high level of muscle tension; - excessive fatigue, which manifests itself in increased irritability, lethargy, tearfulness - as a result, the child cannot sufficiently concentrate on completing school assignments. If any difficulties arise when completing assignments and they fail, then children quickly lose interest and refuse to complete the task. In some cases, when fatigue appears, children may experience motor restlessness; in some cases, severe anxiety, aggressive behavior and excessive excitability may be noted.

Thus, it can be concluded that children with mental retardation, when the necessary correctional work is carried out, have more favorable prognosis for the future, can integrate into society easier and more successfully than those with whom correction was not carried out. It is also important to note that if the child's developmental disorders are organic or psychogenic in nature, then they more often have various social problems, such as various severe or moderate behavioral disorders, which further complicate and slow down the child's development. As a rule, such disorders are observed if the mental retardation is psychogenic in nature, that is, it occurs when from the first days of the child's life he was exposed to a negative, pathological influence from the people around him.

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未来幼儿教师精神和道德发展的心理基础

**PSYCHOLOGICAL FOUNDATIONS OF SPIRITUAL AND MORAL
DEVELOPMENT OF FUTURE PRESCHOOL TEACHERS**

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注释。本文强调了解决精神和道德取向科学研究领域问题的重要性。指出，作为孩子生命中第一位专业教育工作者，未来幼儿园教师的精神和道德发展问题对于滋养他的精神轴并帮助提升精神阶梯尤其重要。基于心理学领域的研究成果，揭示了个人精神和道德领域的结构，并描述了其重要组成部分的发展特征，使我们能够理解未来幼儿园教师的精神和道德发展过程并概述解决问题的方法。

关键词：心理基础，个人的精神和道德领域，精神和道德发展，未来幼儿园教师。

***Annotation.** The article emphasizes the importance of solving problems that lie in the field of scientific research of spiritual and moral orientation. It is noted that the problem of spiritual and moral development of a future preschool teacher as the first professional educator in the life of a child is especially relevant nourishing his spiritual axis and helping to ascend the spiritual ladder. Based on the results of research in the field of psychology, the structure of the spiritual and moral sphere of the individual is revealed and the features of the development of its significant components are characterized, allowing us to comprehend the process of spiritual and moral development of the future preschool teacher and outline ways to solve the problem.*

***Keywords:** psychological foundations, spiritual and moral sphere of the individual, spiritual and moral development, future preschool teachers.*

In the conditions of a deepening spiritual crisis, when, as N.N. Moiseyev asserts, man has already approached the limit that cannot be crossed under any circumstances, and the question “To be or not to be humanity?” is acute, the problems that lie in the field of scientific research of spiritual and moral orientation

are especially relevant, and finding ways to solve them at all levels of education will undoubtedly contribute to the reduction of negative crisis phenomena and the spiritual healing of society. Particularly relevant is the problem of spiritual and moral development of the future preschool teacher as the first professional educator in the life of a child (one of whose main tasks is the moral development of the individual), whose healthy spirit, as A. Diesterweg wrote, is capable of arousing the same in the pupil.

In order to successfully organize the spiritual and moral development of future preschool teachers in the process of professional training, we will identify the structure of the spiritual and moral sphere of the individual in order to have appropriate guidelines for solving our problem.

An analysis of works related to the problem of the development of morality and spirituality as integrative qualities showed that researchers identify the following components in the spiritual and moral sphere of the individual:

-need-motivational, intellectual-creative, emotional-sensory, moral-ethical, behavioral-volitional spheres (L.I. Akatov);

-cognitive (moral consciousness, meaning, values, images, norms), emotional (moral feelings), behavioral (moral behavior, actions and deeds) components (E.R. Gizatullina, N.V. Melnikova, R.V. Ovcharova);

-value-semantic, affective, cognitive, conative spheres, reflection (M.A.-K. Khashumov).

Based on the works of leading psychologists, we will substantiate the essence of the main components of the spiritual and moral sphere of the individual and some features of its development. The founder of humanistic psychology A. Maslow in his work “Motivation and Personality” presents a number of characteristic features inherent in a self-actualizing (moral) personality: the ability to correctly judge other people; to realistically perceive the surrounding reality; simplicity and naturalness of behavior; the presence of moral goals manifested in the fulfillment of a certain life mission; breadth of views and the ability to see globally; the ability to maintain dignity and honor in any circumstances; the ability to experience simple joys of life and admire work, life, people; philanthropy, modesty and respect for others; creativity, etc. [8]. In essence, in order to perform professional activities in the mode of spiritual service, the characteristics of a moral personality presented by A. Maslow must be inherent in a preschool teacher.

A. Maslow notes that the main path to a person making the right value decisions lies through the knowledge of his nature, his characteristics, character, temperament, aspirations, needs and the revelation of the essence of his “I”. As the scientist emphasizes, knowledge of one’s nature-this is the search for truth (collection and processing of facts, information, scientific knowledge, etc.), the understanding of which helps a person to come closer to understanding human

nature and, in general, to comprehend and accept values [7, p. 123]. To a greater extent, this task relates to education, to the creation of conditions for a person to understand his or her nature. In our opinion, it is especially important for a preschool teacher to acquire this ability, since the entrance to the world of childhood, building trusting relationships with students, spiritual community, as was the case, for example, in the pedagogical activity of V.A. Sukhomlinsky, lies through a deep understanding of the spiritual world of a preschooler, which is possible through the educator's understanding of his or her nature and acceptance of the value world of his or her profession.

A. Maslow emphasizes that in the learning process it is important to create conditions for students to experience higher experiences as one of the ways of understanding existence and values., "helping both physical health and personal growth, promoting a person's movement toward self-actualization and humanization" [7, p. 189]. The scientist singles out art as one of the means that evokes higher experiences in a person, helping a person to listen to his inner spiritual world. A. Maslow believes that such a method can become the basis of sensory pedagogy, especially, as we believe, in the preparation of an educator who can succeed in the profession if he has the ability to experience higher experiences, recognize them in other people and develop them in students.

The representative of existential psychology R. May considers human morality as the interrelation of will and love, which are connecting forms of experience. Both love and will characterize a person, his attitude to others, to himself. Love and will give birth to the strength of a person, thanks to which he influences people and the world. From the position of R. May, morality is the ability to live in the coordinates of the good of another person or a community of people, on which one's own satisfaction depends [9]. These qualities are especially valuable for an educator, characterizing his attitude to children. From a pedagogical point of view, the synergy of love and will is a manifestation of the wise love of the educator, allowing him to objectively evaluate pedagogical situations, the behavior of the pupil and, together with him, overcome the difficult steps of ascent up the spiritual ladder (S.A. Amonashvili).

The works of the Soviet psychologist seem valuable for our research. L.S. Vygotsky, who asserts that consciousness decisively influences the development of moral behavior, however, "only that consciousness turns out to be decisive for morality that is directly connected with behavior and is realized in movement" [3, p. 264]. In this regard, the scientist insists on the advisability of the teacher using such methods of influencing the individual, when moral education imperceptibly dissolves into general methods of behavior established and regulated by the social environment. In relation to our study, the spiritual and moral development of future preschool teachers will be successful provided that they understand the essence of

the act, evaluate it (moral or immoral), and realize the moral choice based on consciously accepted values. A.B. Serykh and L.F. Buksha, researchers of the legacy of L.S. Vygotsky, relying on his ideas, note that one of the sources of spiritual and moral development of the student's personality is the cultural environment, where the teacher plays an initially significant role, with whom a value-semantic "meeting" is carried out and a dialogue is built. Then the student's personality is included in group interaction, becoming an active subject of the educational process, using the learned methods and means of development. Based on the study of the cultural and historical concept of L.S. Vygotsky, A.B. Serykh and L.F. Buksha identifies significant aspects in the spiritual and moral development of a student's personality: the presence of ideals and value guidelines, focus on higher values, active interaction of the individual with cultural forms, the use of the transformative potential of art, and the creation of situations of choice [12].

To understand the problem of our research, we relied on the work of A.N. Leontiev "Needs, motives and emotions". As the scientist notes, unlike biological needs, which are associated with the physical state of the body, spiritual needs, figuratively speaking, "are untied" from the objective need states of the body. Motives play a significant role in their development, since the presence of the need itself is not yet able to give the activity the desired direction. A.N. Leontiev notes that motives, in addition to the main motivating function, also perform the function of meaning-formation. This position convincingly proves that the development of spiritual needs in future preschool teachers will be facilitated by their inclusion in the activity, and with the help of identified and conscious motives that give this activity a meaning-forming spiritual and moral direction. According to A.N. Leontiev, emotions perform an important function in motivating activity and in regulating it. They perform the same function in cognitive activity. The most important feature of emotions is their contribution to generalization and communication, in connection with which the emotional experience of a person is much broader than the experience of his individual experiences. The provisions put forward by A.N. Leontiev give us the basis for using in the process of spiritual and moral development of future preschool teachers a set of arts that evoke a number of emotions, which, in turn, contribute to the emergence of feelings, for example, a value attitude towards a person, love for a child, for pedagogical activity, i.e., contributes to the solution of our problem [5].

In order to understand the essence of the moral attitude towards a person, we relied on the judgments of S. L. Rubinstein, since the formation of this attitude is one of the tasks of the spiritual and moral development of the teacher's personality. As the psychologist emphasizes, only through the attitude towards another person does a person exist as a person. It is love for a person that is the affirmation of his existence and the revelation of his essence. The expression of love in its pur-

est form is the manifestation of joy from the very existence of another person. The manifestation of true love consists in the affirmation of goodness in a person [11].

Considering the problem of morality from the point of view of moral relations that determine the motives and choice of a person's actions, V.N. Myasishchev noted that it is the relationships that develop between people in a certain activity that motivate the individual to moral actions [10], which is the basis for the formation of a value-based attitude towards the child and towards the subjects of the educational process in future teachers.

D.A. Leontiev presents spirituality in the form of three components: the priority of spiritual and moral values; spiritual creativity; transcendence to something higher, ascent to God. Recognizing the connection of three contexts, D.A. Leontiev emphasizes that it is wrong to identify spirituality with both selflessness and creativity and religiosity, confirming his position with examples. According to the psychologist, one can talk about real spirituality when a person, firstly, acquires the ability to dialogue with other meanings and values; secondly, on the basis of accepted meanings and values, personal structures arise in him that control his behavior and thanks to which he behaves differently. That is, self-regulation of the personality is activated - a system of the mechanism for managing one's behavior. Thus, D.A. Leontiev defines spirituality as the highest level of self-regulation of behavior, inherent in a mature personality, carried out on the basis of a number of higher values [6].

According to the views of B.S. Bratus, the moral development of the individual is to a greater extent the result of a person going through real life situations and circumstances, which are based on a moral conflict, a clash of different meanings. The psychologist does not belittle the importance of knowledge in this process, it is the basis for understanding and evaluating certain life situations. The scientist emphasizes that the moral principle is born in a person under the condition of their experience, and then the formation of an attitude to reality. In this regard, practical methods acquire great importance in organizing the moral development of the individual, along with verbal methods of education, when joint activities of the subjects of the educational process are organized, in which favorable conditions are created for the formation and development of personally significant traits, i.e., moral behavior [1].

B.S. Bratus, considering three lines of attitude to the problem of man in psychology: humanitarian, moral psychology and Christian, emphasizes that they do not contradict each other, but absorbing the ideas of the previous level, consider man from a different position, thus completing his image to a complete one. If moral psychology gives an understanding of the essence of human development for the acquisition of his essence, his concept, then the line of Christian psychology considers man as the Image of God, and his development as a conscious ac-

ceptance of the absolute foundations of morality and following the path that brings him closer to this Image [2].

The modern rapid development of artificial intelligence and its use in education, according to authoritative scientists, can pose a threat to the development of a person's system of spiritual and moral values. In this regard, the ideas of V.P. Zinchenko and E.B. Morgunov seem relevant to our study. Scientists emphasize that for technocratic thinking there are no categories of morality, conscience, human experience and dignity. According to V.P. Zinchenko and E.B. Morgunov, this thinking is in the middle part of the axis, the poles of which are the thinking of a cultured person and artificial intelligence. In order to avoid dehumanization, which is already observed in the context of a deepening spiritual crisis, according to scientists, it is necessary to expand the general cultural component of education, thanks to which a holistic idea of a person, his purpose, a holistic image of the world filled with objects of scientific reflection, examples of moral behavior, human values will be formed. It is the cultural environment created in the educational sphere, as well as the personality of the teacher as a bearer of culture and a transmitter of values, that will contribute, as V.P. Zinchenko and E.B. Morgunov emphasize, to the cultivation of high-level specialists, since in the exchange of opinions between students and the teacher, the assimilation of the deep cultural postulates of the discipline being studied, refracted through personal knowledge, takes place [4].

V.I. Slobodchikov and E.I. Isaev see the manifestation of spirituality in a person's understanding of the meaning of life, the formation of higher values, moral feelings, experiences and conscience. Finding the meaning of life is expressed in the presence of a life concept in a person, which has a goal and principles for building life. Mastering moral feelings, along with values, participate in regulating human behavior, where the highest regulator is conscience. According to scientists, the signs of spirituality are the formed in a person the need and ability to know the world, oneself and one's place in the world, as well as to carry out a creative transformation of the world.

V.I. Slobodchikov and E.I. Isaev attach special importance to Christian anthropology in understanding the origin and purpose of man and, accordingly, in his spiritual and moral development – the teaching about man as an integral personality, based on biblical texts, in which the main place is occupied by faith in God (unconditional acceptance of Him as the Creator and Legislator of the Universe, His moral standards) and man's relationship with Him (guidance by His norms and laws in life) [13].

In understanding the purpose of man and his place in the world, in knowing his spiritual world, understanding his essence, which is very important for a teacher, an important role, according to my conviction V.D. Shadrikova, spiritual abilities

play a role, which the scientist defines as abilities of a certain spiritual state, characterized as follows: active inclusion of the subconscious in the process of comprehending the truth, establishing its connection with consciousness; harmonization of personality, a positive outlook on life, the presence of aspirations, strengthening of the will; transition to imaginative thinking, to productive imagination; high selectivity of thinking, determined by the spiritual values of the individual; integration of spiritual abilities and properties, feelings and emotions, the unity of mental, moral, spiritual qualities, the desire for spiritual progress. According to V.D. Shadrikov, a sign of human spirituality is the acquisition of the ability to know reality not only rationally, but also through experiences - emotionally [14].

Thus, the analysis of scientific psychological literature enabled us to identify a number of features of the spiritual and moral development of the individual, which allowed us to outline the ways of solving the designated problem: the focus of the educational process on students' knowledge of their nature; development of their spiritual needs and abilities based on conscious motives; acceptance of higher values, search for moral ideals; testing of higher experiences as one of the ways of comprehending existence and values; development of the emotional and sensory sphere, especially love and will, which in fusion are capable of exerting a moral impact on the pupil; students' understanding of the purpose of man and the meaning of life; acquisition of characteristics of a self-actualizing personality through the development of moral consciousness and behavior. The indispensable conditions for a successful solution to the problem of spiritual and moral development of preschool teachers are: creation of a cultural educational environment; presence of a role model (the personality of the teacher as a bearer of spirituality); use of the spiritual potential of art and Christian teaching as a pedagogical tool, which allows us to cognize the spiritual world of man not only at the rational, but also at the irrational level.

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30~35岁男性腰骶骨软骨病患者物理康复指标及心理情绪状态对比分析
**COMPARATIVE ANALYSIS OF INDICATORS OF PHYSICAL
REHABILITATION AND PSYCHO-EMOTIONAL STATE OF MEN
AGED 30-35 YEARS WITH LUMBOSACRAL OSTEOCHONDROSIS**

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注释。该研究比较了30-35岁男性腰骶骨软骨病（PCO）患者在住院治疗病情加重后病情缓解的物理康复指标和心理情绪状态。2022年2月中旬至3月下旬进行的一项研究表明，在下肢灵活性和仰角（FELE）、心理情绪状态（PES）和对治疗过程的满意度（SFM）等四项指标方面，实验组30-35岁男性与对照组30-35岁男性存在显著差异。

关键词：物理康复、腰骶骨软骨病（LSO）、治疗性体育锻炼（物理治疗）、“哈巴罗夫斯克-1站机车乘务员康复中心”，总体幸福感（GWB）、心理情绪状态（PES）、对治疗过程的满意度（STP）。

Annotation. *The study compared the indicators of physical rehabilitation and the psycho-emotional state of 30-35-year-old men with lumbosacral osteochondrosis (PCO) in remission after inpatient treatment for exacerbation of the disease. A study conducted in mid-February - late March 2022 showed that in four indicators, such as flexibility and angle of elevation of the lower extremities (FELE), psychoemotional status (PES) and satisfaction with the treatment process (SFM), there is a significant difference in men 30-35 years old in the experimental group, compared with men 30-35 years old in the control group.*

Keywords: *physical rehabilitation, lumbosacral osteochondrosis (LSO), therapeutic physical training (physical therapy), "Rehabilitation Center for locomotive crews at Khabarovsk-1 station", general well-being (GWB), psychoemotional status (PES), satisfaction with the treatment process (STP).*

During the pedagogical experiment in men aged 30-35 with lumbosacral osteochondrosis, at the “Rehabilitation Center for Locomotive Crews at Khabarovsk-1 Station”, the following indicators were studied: flexibility, deadlift strength and angle of elevation of the lower limbs with the subject lying down, general well-being (GW), psycho-emotional state (PES), satisfaction with the treatment process (ULP) test “Self-assessment”.

The number of male subjects with lumbosacral osteochondrosis who took part in the testing was 24 people, 12 people in each group.

The main indicators of the state of the motor sphere associated with the spinal column, flexibility, deadlift strength and FELE, as well as a subjective assessment of their psycho-emotional state, using the diagnostic technique of operational assessment of well-being, activity and mood (WAM), in the control and experimental groups 41 days after the start of rehabilitation activities. To determine the effectiveness of the combination of physiotherapy and exercise therapy for motor rehabilitation, a flexibility assessment was used (V. A. Nesterov, 1998). The subject stood on a 40 cm high step with straightened knees and bent forward touching a mark below or above the zero point while maintaining the pose for at least 2 seconds. Deadlift strength was measured using a standard method with a flat-spring dynamometer from a standing position, with the feet on the platform, the dynamometer handles at the level of the subject’s knees, with full force, without jerking, the subject straightened the torso and pulled the handles. Determination of the angle of elevation of the lower limbs in the supine position, on a hard couch using a medical goniometer, one of the branches of which was installed on the couch, and the second - on the thigh of the raised leg, the goniometer was centered on the hip joint, the angles of leg elevation were summed up and divided by 2.

The diagnostic method of the operational assessment of well-being, activity and mood (WAM) is a map (table) that contains 30 pairs of words reflecting the studied features of the psycho-emotional state (well-being, mood, activity). Each of them is represented by 10 pairs of words. On the survey form between the polar characteristics there is a rating scale. WAM allows you to quickly process the results and recalculate the resulting assessment of the psycho-emotional state of the subjects into the corresponding points.

Testing of the indicators was carried out during the daytime, on the basis of the “Rehabilitation Center for Locomotive Crews at the Khabarovsk-1 station”.

Research results. At the third stage of the experiment, objective indicators of the state of the motor sphere associated with the spinal column (flexibility, standing strength and FELE), as well as subjective assessment of their condition in the control and experimental groups 41 days after the start of rehabilitation measures were assessed. The data obtained are presented in Tables 3, 4 and Figs. 2, 3.

Table 3

Dynamics of changes in objective indicators (expressed KE) in the control and experimental groups

	Dynamics of indicators (KE in %)		
	Flexibility	Deadlift	FELE
Control group	38,8±2,2	74,4±6,8	49,2±2,9
Experimental group	52,3±3,3	70,5±7,2	65,0±3,8
<i>t</i>	3,38	0,56	3,51
<i>p</i>	>0,05	<0,05	>0,05

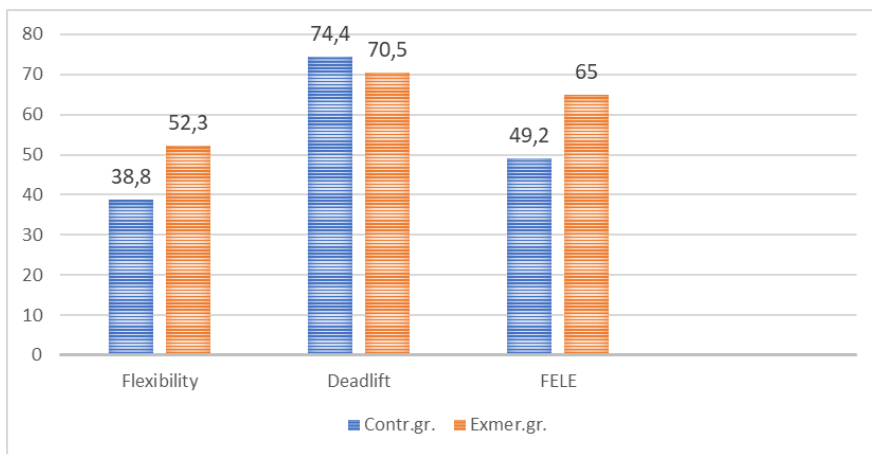


Figure 2. Bar chart of the dynamics of changes in objective indicators in the control and experimental groups, ordinate axis – KE in %, vertical segments – confidence intervals

It is evident that the dynamics of flexibility growth and FELE in the experimental group was more positive than in the control group. This indicates that the combination of physiotherapy and exercise therapy with kinesiotaping and massage is more effective in terms of restoring the muscle balance of the paravertebral groups, reducing their tone and eliminating muscle-pain formations. Similar dynamics of deadlift strength in both groups can be explained by the fact that it is formed not only by the paravertebral muscles, its decrease in lumbosacral osteochondrosis is associated with “sparing” the muscles of the lumbar region, which naturally passes after a certain period after the exacerbation. Thus, it can be considered proven that the combination of physiotherapy-exercise therapy-kinesiotaping-massage at the sanatorium-resort stage of rehabilitation is more preferable

than the combination of exercise therapy-physiotherapy. This was also reflected in the subjective assessments of the subjects themselves (Table 4, Fig. 3).

Table 4.

Subjective assessment of the condition of the subjects after the end of the experiment, GWB- general well-being, PES - psycho-emotional status (mood), STP- satisfaction with the treatment process

	Average self-esteem scores		
	GWB	PES	STP
Control group	2,7	2,5	2,0
Experimental group	2,7	3,0	2,7
Z	0,00	2,78	3,12
p	<0,05	>0,05	>0,05

Note: Z is the Wilcoxon test, *p* is the probability of the null hypothesis
Graphically, this looks like this:

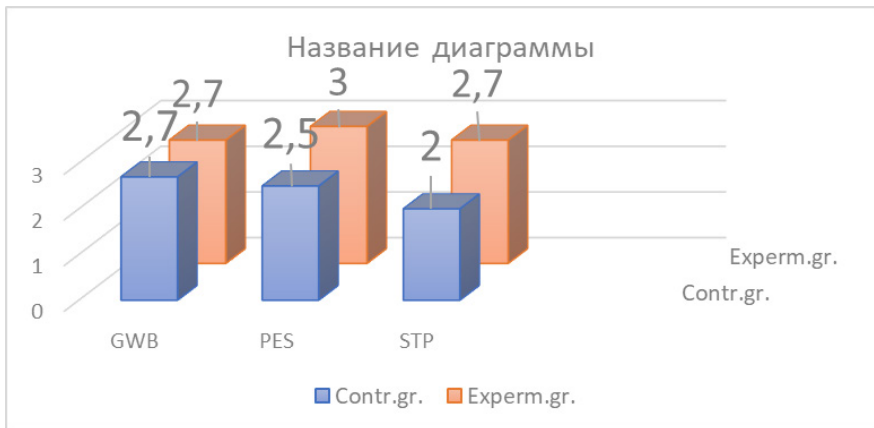


Figure 3. Bar chart of the subjective assessment of the condition of the subjects after the end of the experiment, GWB- general well-being, PES - psycho-emotional status (mood), STP - satisfaction with the treatment process, ordinate axis - average values of self-assessment in points

It is clearly seen that if the general well-being of the subjects according to their self-assessment improved equally in both the control and experimental groups, then their mood and, especially, satisfaction with the treatment process was statistically significantly higher in the experimental group compared to the control. This can be interpreted based on the fact that the general well-being improved under the influence of non-specific sanatorium-resort factors and rest of the subjects,

and the mood and satisfaction with the treatment process (which were probably formed under the influence of factors associated with recovery) depended on the effectiveness of specific rehabilitation factors, in this case - exercise therapy and physiotherapy, kinesiotaping and massage.

In general, the position can be considered quite justified, the essence of which lies in the recommendation to introduce into the practice of adaptive physical culture a combination of diadynamic electrophoresis as a physiotherapeutic tool, therapeutic gymnastics as a means of motor rehabilitation, kinesiotaping and massage as additional means of rehabilitation.

Conclusion. Thus, the conducted analysis of the functional and psycho-emotional state of men aged 30-35 with lumbosacral osteochondrosis, after conducting a pedagogical experiment of the developed method of physical rehabilitation based on the use of passive and active means of exercise therapy, massage and kinesiotaping, proved the effectiveness of the proposed method. In general, it is possible to note quite good indicators of the functional and psycho-emotional state, the proposed method can be recommended for use within the framework of corrective activities in various medical, preventive and rehabilitation institutions.

All this indicates the need for systematic diagnostics of the dynamics of changes in the indicators of the functional and psycho-emotional state and making appropriate adjustments to the process of physical rehabilitation of men aged 30-35 with lumbosacral osteochondrosis.

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DOI 10.34660/INF.2025.26.40.110

用卡通来解决物理问题
CARTOONS IN SOLVING PHYSICS PROBLEMS

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摘要。本文以著名动画片中的情节为基础，展示了在解决物理问题过程中提高学生认知兴趣的方法。

关键词：认知兴趣、物理问题、问题的非常规表述、动画片、解决问题和编写问题。

Summary. *The given article shows the way of increasing the students' cognitive interest in the process of solving problems in Physics based on the plots from the well-known animated cartoons.*

Keywords: *cognitive interest, problem in Physics, unusual statement of the problem, animated cartoon, solving and composing problems.*

Scientific and technical transformations in the world are integrally connected with the progress in the development of Physics, with the new generation of modern scientists-inventors. So the society directly depends on training and education of the younger generation. One of the priority directions of school education at the same time has always been and is inculcation of cognitive interest to students when studying all the school disciplines including Physics.

In the conditions of training the cognitive interest is expressed by the student's proneness to education; to pedagogical cognition of the activity in the field of one

or a number of subjects. K.D. Ushinsky was one of the first, who emphasized how it was important to make serious occupation entertaining for children. For this purpose teachers satiate their activity with methods awakening the students' direct interest. They use various entertaining informative material and subject-role playing, mini-quiz games, tasks on quick-wittedness, rebuses, charades, entertaining situations.

Education of students' interests in the course of solving the problems connected with the development of personality was considered by L.S. Vygotsky, G.I. Schukina. From G.I. Schukina's point of view, the cognitive interest is the selective orientation of personality turned to the sphere of cognition, its subject side and the process of seizing knowledge.

One of the famous Soviet psychologists A.N. Leontyev spoke about the great influence of interest on the development of intelligence, confirming the thought with L. Feuerbach's words: "For what heart is opened can't make a secret for reason".

Psychologists reveal that the sources of interest lie in public life, that interest is developed and enriched in the activity, which also forms the concrete people's interests, i.e. the source of cognitive interest is the environment of a person, his life.

The integral part of any Physics lesson is a display of practical use of theoretical knowledge in practice, for example, while solving problems. With introducing in Russia the USE the requirements to students' ability to solve problems of various types and degrees of complexity independently has sharply raised. It is no secret that repeated repetition of solving the same problems that often occurs while preparing students for the USE leads to students' unwillingness to work further, and it after all influences on all the process of teaching.

For the purpose of solving this problem and activation of cognitive process we offer to use the problems based on episodes and shots from animated cartoons which all the children have loved since childhood.

Regular use of the system of special tasks and exercises aimed at the development of cognitive opportunities and abilities at the Physics lessons broadens the students' mental outlook in Physics, promotes their development, increases the quality of readiness, allows children to be guided more confidently in the elementary regularities of the reality surrounding them and use more actively their knowledge in everyday life.

Students are always fascinated by the use of theoretical knowledge gained at the lesson for explanation well-known phenomena, even such simple as sugar remelting in tea, etc. Therefore it is especially important to show students the practical application of the studied material, which by tradition is considered to be difficult.

Let's consider the possibilities of the use of fragments from animated cartoons for formulating the statement of the problem, or for independent composing problems by students themselves with subsequent solving them.

Everyone knows the Soviet animated serial “Nu, pogodi!” One of the plots from the life of Wolf and Hare can be used at the lesson while solving problems - calculation of lift force of balloons, when studying the topic “Buoyancy force. *Aeronautics*” (the 7th form).

First of all the students are shown the fragment from the second series of Wolf and Hare’s adventures, where Wolf swallows Hare’s balloon and flies up.



Figure 1. Shots from the animated cartoon “Nu, pogodi!” - the 2nd series

The students’ attention is turned to the fact that a balloon has a round form, so it is very simple to calculate its volume. On the base of these three shots from the animated cartoon (figure 1) it is possible to compose two problems.

Problem 1. To calculate Wolf’s mass if the balloon which he has swallowed is pumped with helium and its diameter is 25 cm.

Problem 2. What volume has the balloon filled with helium if it lifts Wolf weighing about 40 kg? Is such a ball safe for Hare weighing 5 kg?

While solving the first problem students come to the conclusion that if we have a balloon with such a characteristic, Wolf’s mass must be no more than 1,5 g, only in this case Wolf can fly up. To lift Wolf weighing 40 kg, according to the statement of the second problem, the volume of the balloon shouldn’t be less than 222 m³. Hare weighing 5 kg would fly away with such a balloon. So we have one of the bright physical “slip-ups” found in this cartoon serial.

Further when watching the cartoon students look for other physical “slip-ups” with pleasure and explain them from the point of view of physical regularities.

After consideration the problems about Wolf’s flight at the lesson we suggest students composing and solving independently the problems based on the fragments from another Soviet animated series “Winnie-the-Pooh”, the first series where Winnie-the-Pooh tries to get honey from “suspicious” bees by means of a balloon. The shots of this fragment are presented in the figure 2.

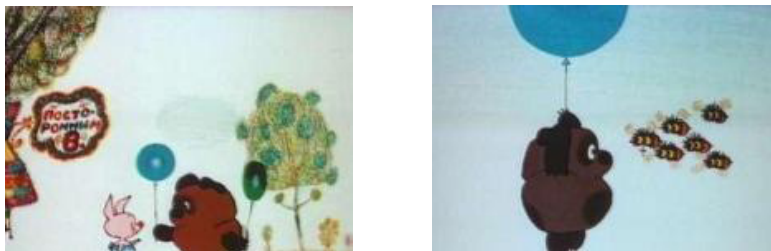


Figure 2. Shots from the animated cartoon “Winnie-the-Pooh” – the 1st series

Let’s give some examples of the problems composed by students of the seventh forms.

Problem 1. What diameter could Winnie-the-Pooh pump the balloon (with helium) to if it could lift the bear cub weighing 3 kg? (3,179 m)

Problem 2. Can the balloon pumped with neon lift a bear cub weighing 2 kg if its volume has increased in 20 times? The initial diameter of the balloon is 20 cm. (No, it can’t).

Problem 3. How much is it necessary to increase the volume of the balloon pumped with hydrogen on to make it possible to lift Winnie-the-Pooh and Piglet weighing half a kilo? (on 5,56 m³)

Problem 4. What is Winnie-the-Pooh’s mass if the balloon pumped with neon has the diameter 1,5 m and can lift the bear to the beehive? (1 kg 589 g).

Except quantitative problems, it is possible to offer a big variety of qualitative ones. Let’s give some examples from A.S. Pushkin’s fairy tales and the animated cartoons based on A.S. Pushkin’s works: (The Tale of Tsar Saltan, of His Son the Renowned and Mighty Bogatyr Prince Gvidon Saltanovich, and of the Beautiful Princess-Swan) – The Tale of Tsar Saltan (figure 3).

But the youngest of the three
Murmured: “If he married me -
I would give our tsar an heir
Handsome, brave, beyond compare.”

At these words their chamber door
Gently creaked-and lo, before
These three maidens’ very eyes
Stood their tsar, to their surprise.

Why did the door creak? How to make it finish creaping? How can we explain the fact that each door has it “special voice”?

Grief is gnawing at my breast,”
Answered Prince Guidon, distressed.
“I have only one desire-

I should like to see my sire.”
“Is that all?” was her reply -
“Listen-would you like to fly,
Overtake that ship at sea?
Why, then-a mosquito be!”
Then she flapped her pinions two,
Loudly thrashed the waters blue,
Drenching him from head to toe
Ere he could say yes or no.
And he hovered, then and there,
A mosquito, in the air.

The *oscillation* frequency of the wings of a mosquito is 600 Hz, and the period of oscillations of the wings of a bumblebee is 5 msec. What insect will make more flaps while flying in 1 min.? Who in flight flaps more often: a fly or a mosquito? (a mosquito, on the sound of its wings).

«O, you wanton waves so blue -
Free to come and go are you,
Dashing when and where you please,
Wearing rocks away with ease -
You, who flood the mountains high,
You, who ships raise to the sky -
Hear my prayer, o waves, and spare us -
Safely onto dry land bear us.»

What is a wave? What waves in the nature can we meet? What type of waves does the sea wave belongs to?



Figure 3. Shots from the animated cartoon “The Tale of Tsar Saltan”

Physics stops being for students a boring and abstract science as it helps to see various physical phenomena and processes around which they haven't noticed before and helps them to be more observant.

As practice shows, students solve physical problems based on the fragments from animated cartoons and feature films with pleasure and at the same time their interest to cognitive activity increases.

Skillful and well-timed use of entertaining problems or exercises at the Physics lessons awakens in students the interest to the studied material, helps them to realize and remember the material better. Besides, the teacher of Physics is given one more opportunity for esthetic education of students.

Thus, solving the problems based on the use of fragments from animated cartoons not only allows to fix the studied material, but makes the process of solving the problems more fascinating for students.

The cognitive interest will have a strong basis for its development only when the link of the content of the studied material and its purpose in real life finds the fixed place in the system of lessons.

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DOI 10.34660/INF.2025.29.23.111

患有书写障碍的学生文本能力形成的心理和教育学方面
**PSYCHOLOGICAL AND PEDAGOGICAL ASPECTS OF THE
FORMATION OF TEXTUAL COMPETENCE AMONG STUDENTS
WITH DYSGRAPHIA**

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摘要。本文介绍了在圣彼得堡大学教师和一些学校代表（行政人员、教师、四年级学生家长）的网络互动框架内实施“我爱俄语”项目的经验。揭示了家庭成员对患有不同类型书写障碍的孩子写作能力的形成进行差异化矫正和发展工作的主要内容。涵盖了主持人、项目经理和教育机构管理层在创作文章文本的所有阶段对家庭成员和孩子互动的组织和方法指导问题。

关键词：书写障碍、言语治疗工作、写作、图形规则、连贯性、文本、文本能力、完整性、语言。

Abstract. *The article presents the experience of implementing the project “I love the Russian language” within the framework of network interaction of university teachers and representatives of a number of schools in St. Petersburg (administration, teachers, parents of fourth-graders with impaired text competence). The main content of differentiated correctional and developmental work of family members on the formation of the ability to write an essay by their children with different types of dysgraphia is revealed. The issues of organization and methodological guidance from the moderator, project managers and the administration of the educational institution on the interaction of family members and the child during all stages of creating the text of the essay are covered.*

Keywords: *dysgraphia, speech therapy work, writing, graphics rules, coherence, text, text competence, integrity, language.*

The process of forming text competence in writing essays in primary school for students with writing disorders is one of the most relevant and widely discussed in the specialized literature [1, 2, 4, 5, 7, 8]. A significant number of students in this category experience persistent and systematic difficulties in mastering subject, meta-subject and personal results, in the process of school adaptation. Shortcomings in text creativity have a negative impact on the development of a linguistic personality with the ability to express their thoughts, interact with society on the basis of scientific knowledge and the ability to apply them in communication.

The positive experience of the research conducted within the framework of the project “I love the Russian language” is based on specially organized interaction of its participants, namely teachers and students of the Herzen State Pedagogical University, speech therapists and administrations of a number of educational institutions in St. Petersburg, fourth-graders with dysgraphia and their parents [5, 6]. Specially organized work is constantly and systematically carried out with parents to develop their ability to actively interact with the child throughout all stages of preparation and creation of the essay text. It is built taking into account the obtained results of studying the state of text competence and identifying three subgroups of children with dysgraphia, aimed at overcoming the existing pathomechanisms in generating a coherent written speech. Let us outline the leading directions of the correctional and developmental process. All schoolchildren develop motivation to write an essay (psychological component of text competence), the ability to select and combine semantic units and syntactic constructions taking into account the given topic. Children are taught to consistently and logically reveal and reproduce their thoughts, divide a written section of speech into parts, paragraphs, separate sentences, select significant and functional words, morphemes, letters and reproduce according to the laws of graphics, spelling, punctuation. For this, work is carried out on all types of self-control. A targeted approach to the text helps to

consider the elements of the text in isolation and in its structure, as well as the forms of its implementation (motives and goals of creation, actions, mechanisms, means and techniques). With schoolchildren with leading dysgraphia based on impaired phonemic recognition (the first subgroup), the main attention is paid to the development of the speech component of text competence, namely the ability to logically present their statements in oral speech and writing (non-common and common sentences, including explanations and evidence), and to use the appropriate morphological tools for this. The ability to determine not only the volume of a given essay topic, but also its subtopics, and to establish a certain hierarchy is significant. To implement their own communicative intention throughout the text, schoolchildren are taught to select the necessary information about the facts and events of what happened (or is happening). At the same time, special attention is paid to enriching the linguistic means that ensure the integrity of the essay text. A variety of lexical and grammatical means of interphrase cohesion between sentences are specially selected. This allows children to establish semantic/logical relationships in written creative work and to implement communicative continuity between its elements.

Parents of schoolchildren of the second subgroup (with leading dysgraphia due to various disorders of language analysis and synthesis) help their children to clarify the scope of the proposed topic and divide it into subtopics, establish connections between them, a certain hierarchy (speech component). In this way, children learn to realize their communicative intention. Thanks to the proposed linguistic means (language component), schoolchildren are taught to use and accurately express factual information in a short written message, and then in an essay. When presenting events or establishing cause-and-effect relationships between them, much work is done on the ability to establish semantic relationships and communicative continuity within the text of the written work, its parts (paragraphs) and fragments (separate sentences). This is facilitated by the enrichment of lexical and grammatical means, which ensure the grammatical and lexical coherence of the written work and its components. With children of the third subgroup (with leading agrammatical dysgraphia), family members work on the ability to substantiate highlight logical connections (speech component) and grammatical means of expressing them (language component) in a sentence, and then in an utterance and text (oral and written). The ability to evaluate the scope of a topic (New Year!), to substantiate highlight its subtopics (Preparing for the holiday. Christmas tree. Fireworks) and to establish complementary and subordinate relationships between them is developed. Children are taught to implement their communicative intention throughout the entire sequential presentation of information, to designate and correlate textual subjects (for example, the characters of an essay) and predicates (what is said about them or what is denied) in detail or

briefly. Selection and then independent finding of a syntactic predicate (predicate from among those proposed allows us to determine the elements of the superficial structure of a sentence, paragraph, and text as a whole. Working on the ability to select from among the proposed options (Dad gives his daughter a gift. Dad gave his daughter a book. The book given by Dad.), and then independently designate a semantic predicate allows us to find the core of a semantic situation/construction (New Year's holiday). Familiarization at a practical level with different types of semantic predicates, namely: taxonomic (This is a gift - a book), relational (Tanya is dad's daughter), characterizing (Christmas tree decorations) - significantly enhances children's ability to understand and subsequently reflect in an essay the essence of an extralinguistic situation, its core semantics. Work on expanding the lexical and grammatical means of interphrase communication allows overcoming the shortcomings of semantic (logical) relations and communicative continuity between individual sentences of the discourse.

In preparation for consulting family members of students with deficiencies in text competence, the project managers conduct master classes. They clarify issues of speech therapy deontology, as well as strategies for communicating with parents based on professional competencies and personal qualities of university teachers, moderators (speech therapists), teachers, representatives of the administration of the educational institution or students that are significant for the project activities.

Knowledge and skills in the field of public speaking are updated. Linguistic and paralinguistic means of professional communication are covered during a dialogue or monologue within the framework of unidirectional addressing (with a relative of a schoolchild) or double addressing (with two or more family representatives). When disclosing the content of work with a child, attention is paid to the optimal amount of information for the meeting, professional concepts and terms, their interpretation or replacement with synonyms. Within the framework of the pedagogy of cooperation, techniques of partner or business communication are selected.

Individual and typological characteristics of close or legal representatives of the child are taken into account. Depending on the degree of involvement of a family member in the correctional and developmental process, a communication strategy of "participation" or "interaction" of communication with parents is selected (according to Zh.A. Paylozyan, 2024). At master classes, members of the project group model such situations. Subsequently, they discuss the results of the consultations held, different in form, type and subject matter. The content of messages (questions, opinions, video messages) that come from parent chats before or after the consultations are also considered, analyzed and summarized. As part of the implementation of the project to overcome the shortcomings of textual competence

when writing essays, the already traditional forms of pedagogical interaction with adult members of the child's family are used, namely: individual, group, one-time, multiple, oral, written, face-to-face or online interaction [3, 9].

Parents meet with teachers, school administration, university professors and student interns. All explanations and recommendations are given taking into account the stage of speech therapy work being carried out. First, in order to provide information about the child's failure at school, writing deficiencies, and ways and timeframes to overcome them, parents are introduced to "worksheets" for completing assignments at home, with educational and methodological literature, dictionaries and with the addresses of websites where the necessary materials are posted. Subsequently, each methodological approach to preparing for an essay, writing, editing and evaluating it is provided with a detailed methodological commentary. Speech and non-speech material and technologies for using them during a future conversation or other form of communication between the parent (parents) and the child are demonstrated. Other family members (in person or online) are also given recommendations. They are related to the ongoing correctional and developmental process, with the organization and content of the family atmosphere, with the rules of general and speech behavior of family members. This largely stimulates the assimilation of psychological components of textual competence by children, allows to consolidate its speech and language components, the formation of which is carried out in speech therapy classes. Communication of project members with the family environment of each child implies that all teachers have interdisciplinary theoretical knowledge and practical skills of consulting, as well as adherence to speech therapy deontology [3]. For the purposes of our study, cognitive, behavioral and emotional components of psychological and pedagogical competence are developed in adult family members [9]. On their basis, skills are developed in the sphere of building a family social and pedagogical environment. This contributes not only to the formation of text competence, but also to the development and, in many ways, improvement of the child's subject, meta-subject knowledge and social skills. The nature of these processes in children of primary school age, the awareness of the need to meet the requirements of the school curriculum pose the tasks of self-change for representatives of the adult family, for example, by raising the educational level in the field of digital technologies.

There is also a need to change the position in relation to the child. The parent feels the need to effectively interact with him, including when doing homework on writing essays. In such cases, he relies on the accumulated socio-historical experience, his own experience, knowledge, parental feelings. Strengthening the traditions of the family and its way of life is important for parents to understand the child and interact with him.

The experience of project activities shows the importance of "teamwork" of specialists in order to form text competence in children with writing disorders and

psychological and pedagogical competence in representatives of their families. It is during the preparation for writing “home” essays, during the creation of such texts, their editing that optimal and effective interaction between the parent and the student is created thanks to the child’s knowledge and skills in working with the text of the essay, as well as the positive and positive emotional family background formed during the implementation of project activities, a certain level of psychological and pedagogical competence of the father, mother and immediate relatives.

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中国的音乐教师培训：乐节运动背景下音乐节的教育和交流潜力

MUSICAL TEACHER TRAINING IN CHINA: THE ENLIGHTENING AND COMMUNICATIVE POTENTIAL OF THE FESTIVAL IN THE CONTEXT OF THE STUDENT FESTIVAL MOVEMENT

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摘要. 文章介绍了在中国音乐教师专业培训体系中中学生音乐节运动条件下音乐节的教育和交流潜力的特点。 这项工作的现实意义在于缺乏对这一问题的专门研究；文章的新颖之处在于提出了中国高等院校学生节日运动理论的部分问题。

关键词: 音乐节；交流潜力。

Annotation. *The article presents the characteristics of the enlightening and communicative potential of the festival in the context of the student festival movement in the system of professional training of a teacher-musician in China. The relevance of the work is determined by the lack of special studies on this issue; the novelty of the article lies in the development of a particular issue of the theory of the student festival movement in higher education institutions in China.*

Keywords: *festival; student festival movement; enlightening potential; communicative potential.*

In the context of the student festival movement, the festival, as a bright festive event in the cultural and enlightening space of Chinese universities, testifies to high achievements in the field of professional training of future music teachers. Since the late 1980s, the festival movement of Chinese students and the festival as its structural unit have been actively developing and have many years of fruitful experience, allowing us to study the types of festival potential in the formation and development of professional competence and values of future specialists. At the beginning of the 21st century, the festival movement of Chinese students covered a number of enlightening institutions and received a wide resonance in society. In this regard, there is an objective need to understand the rich in species diversity potential of the festival in the professional development of specialists in the field of music education.

In view of the diversity of the student festival components and their combinations, it is necessary to talk about the breadth of its potential. Potential (from the Latin *potentia* – “strength”) is the degree of power in some respect, the totality of means, reserves, opportunities necessary for something, as well as means that can be mobilized, put into action, used to achieve a certain goal.

Among the festival projects related to the implementation of the idea of the student festival movement in China and considered by us as material for the study, it is worth mentioning the Golden Autumn Arts Festival (or Luojia Golden Autumn) of Wuhan University (since 1987), the International Culture and Art Festival of Zhengzhou Xia Academy (since 1998), Zhuhai Student Culture and Arts Festival (since 2003), the Yiyuan Golden Autumn Art Festival of Shandong Academy of Arts (since 2005), the Arts Festival of Linnan University (since 2011), the Arts and Music Festival of Duke Kunshan University (since 2020), and the International Piano Pedagogics Festival of Harbin Conservatory of Music (since 2021).

The festival movement, understood as a regularly repeated cultural phenomenon, has received various forms of expression in China, due to socio-cultural and economic reasons. Chinese student festivals are distinguished by a number of essential characteristics. They have an original ideological and conceptual basis and the status of the event (local, regional, international); are characterized by genre and type criteria (specialized and hybrid; professional, folk and mixed, etc.); are held with different time periodicity (annually, once every two years (biennial) or every three years (triennial)); are aimed at solving specific pedagogical problems through the involvement of students in an atmosphere of creative learning; regulated in their organizational and compositional-structural parameters.

Important components of a student festival celebration also include specific elements of semiotic meaning: verbal (name, slogan, etc.), visual (artistic and decorative design: emblem, flyer, costumes, flags, etc.), auditory (festival anthem, call signs, etc.) and other symbolic signs [1, p.10].

The structure of student youth festivals in China consists of competitive events of various types, concerts, master classes, lectures, seminars, contests, reviews, shows, performances, meetings, trainings and interactive classes, exhibitions, fairs, carnivals, processions, tournaments, competitions and other festive mass events.

As a result of studying student festivals in higher education institutions in China, we discovered educational, enlightening, communicative, socio-cultural, image, value and integration potentials [2]. Let us dwell on two of them in more detail.

The essence of the enlightening potential of the festival in the context of the student festival movement in China is that future music teachers have an excellent opportunity to become familiar with highly artistic examples, treasures of

traditional Chinese and world culture. This fact is difficult to overestimate for the development of artistic taste of student youth, who have found themselves in a modern reality in an environment of prevalence (domination) of low-grade music that does not meet the criteria of high spiritual art [3].

Attending lectures, seminars, concerts and exhibitions, and discussion events organized in accordance with the festival programs helps develop tolerance among future music teachers for various creative guidelines and research positions of the participants. Important aspects here also include expanding the students' erudition and horizons in understanding the specifics of various types of art (music, painting, sculpture, theater, choreography, cinema), increasing their interest in public artistic and creative activities with the aim of educating and introducing a wide festival audience to art, and exerting a favorable transformative effect on it. Participants in the student festival movement carry out an important enlightening mission, which is consistent with the humanistic concept of educating and training future music teachers in China.

The festival in the context of the festival movement of Chinese students also has a clearly manifested communicative potential. It is realized in several directions. First of all, the process of interpersonal communication is a priority, affecting the organizers, presenters and participants at all stages of preparation and holding of festival events [4]. No less important is the communicative side of communication between the performer / performers and the audience, associated with such communicative skills and abilities of future music teachers as establishing contact with the festival audience, managing its attention, resolving emerging non-standard stage situations. The communicative potential of the festival is also expressed in the form of intercultural dialogue - not only mutually enriching and harmonious communication between representatives of traditional cultures of different regional identity represented by student participants in festive events, but also mastering the specifics of the local musical cultures of numerous nationalities of China. Thus, the student festival movement actively promotes the formation of a high culture of interethnic relations, which allows for the creation of a solid foundation for a harmonious world order and the coexistence of various social systems.

The Ethnic Culture Festival of Jinan University (Jinan City, Shandong Province) can be used as an example to illustrate the realization of these two types of potential. The festival has the status of a university event; this vibrant audiovisual celebration is very young compared to other Chinese student festivals. The 2nd Ethnic Culture Festival was held on May 22, 2023, at Jinan University, one of the oldest universities in China (since 1906) and distinguished by its diverse enlightening and research activities. The objectives of the festival are to summarize the cultural resources of various ethnic groups in China's regions; present innovative

performance forms that reflect the university's main activities in order to instill in students a deep sense of the unity of the Chinese national community; disseminate traditional Chinese culture to all continents; promote the inheritance and preservation of the cultures of all nationalities and their innovative interpenetration.

More than 150 students and teachers from 26 ethnic groups, including Tibetans, Mongolians, Uyghurs, She, as well as students from Hong Kong, Macau and Taiwan from several colleges of the university, took part in the events. The main form of the ethnic culture festival is a concert.

The audience was treated to magnificent and colorful ethnic customs in the performances of instrumental, theater and dance student groups. The sitcom (situational comedy) "Stamp" introduced the audience to the ethnic groups (peoples) of Dong, Bai, Li with the help of live translation and modern technologies. The Mongolian festival performance "Joyful Naadam" demonstrated the greatness and joy of the Mongols (children of the steppe) in the form of huomai, qin with a horse head and Mongolian dance. In the recitation of "I saw the homeland in a pomegranate", the performers cleverly combined different ethnic languages and dialects. In a bright artistic form, like pomegranate seeds, the close unification of 56 ethnic groups was shown: ideals, beliefs, culture, caring attitude and respect of representatives of all Chinese ethnic groups to each other. The dance program "Beautiful China" presented by the Panyu Campus Dance Troupe depicted a magnificent picture of beautiful mountains and clear waters through dance, costumes and stage lighting. In the costume performance program "Huashan Jiuzhou", students from different ethnic groups and international students from Hong Kong, Macao and Taiwan dressed up in exquisite clothes of their ethnic groups and displayed colorful traditional costumes for the audience to admire and feel the beauty of the ethnic culture of China's regions.

The festival day united the multinational students of Jinan University, allowed them to join the traditional culture of ethnic groups and nationalities of modern China in the language of expression of dance, music, literature, theater and in a bright artistic form, to demonstrate their performing skills and communicative culture. The festival itself has a pronounced enlightening and communicative potential.

Thus, participation in student festivals helps future music teachers to better adapt their professional skills to the needs of Chinese society. This allows them to realize their own goals and directions for self-improvement in the learning process, to appreciate the importance of the teacher's qualifications and skills in developing them into competent specialists in the field of music pedagogy. The competitive nature of competitions in the context of the festival movement of Chinese student youth actively encourages participants to polish and hone their performing culture skills, expand and accumulate a concert repertoire, master various

performance styles and master the art of playing several instruments (including one of the Chinese national instruments), understand the historical significance of the profession of a music teacher and performer, and reveal their creative abilities to create original compositions. This will allow them to be ready in the future for teaching and performing music practice in accordance with the demands of modern Chinese society.

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DOI 10.34660/INF.2025.11.23.113

中亚背景下的小说象征主义

(基于 G.A. Dolgaya 的奇幻小说《中世之神》)

FICTION SYMBOLISM IN THE CENTRAL ASIAN CONTEXT
(based on the fantasy novel by G.A. Dolgaya “Gods of the Middle World”)

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摘要。小说中的象征主义是一种强大的工具，它使作者能够传达深刻的含义，唤起情感反应，并激发读者对文本进行多层次的解读。本文探讨了理解象征主义的理论方法，包括俄罗斯、外国和中亚文学学者的作品，如 A.N. Veselovsky、F. de Saussure、G. Garipova、K.G. Jung 等人。以 G.A. Dolgaya 的奇幻小说《中土世界的众神》为例，对四类符号进行了分析：自然现象、物体、动物和抽象图像。考虑了主要符号的含义，包括河流（时间）、护身符（命运）、乌鸦（预兆）和地窖（恐惧和未知）等符号。小说中呈现的符号在多个层面上发挥作用，结合了原型和区域意义。它们创造了一个多层次的叙事，融合了神话、历史和文化方面，使作品对广大读者具有重要意义。

关键词：象征主义、图像、隐藏意义、意义的不稳定性、原型意义、直觉感知、象征连贯性。

Abstract. *Symbolism in fiction is a powerful tool that allows authors to convey deep meanings, evoke emotional responses, and stimulate readers to engage in multi-layered interpretations of the text. Theoretical approaches to understanding symbolism, including the works of Russian, foreign, and Central Asian literary scholars such as A.N. Veselovsky, F. de Saussure, G. Garipova, K.G. Jung, and others are examined in the article. Using the example of G.A. Dolgaya’s fantasy novel “Gods of the Middle World,” an analysis of four categories of symbols is conducted: natural phenomena, objects, animals, and abstract images. The meanings of the main symbols are considered, including symbols such as the river (time), amulet (fate), raven (omen), and cellar (fear and the unknown). The symbols presented in the novel operate on multiple levels, combining archetypal and regional meanings. They create a multi-layered narrative, integrating mythological, historical, and cultural aspects, making the work significant for a wide readership.*

Keywords: *symbolism, image, hidden meaning, instability of meaning, archetypal meaning, intuitive perception, symbolic coherence.*

Introduction

Symbolism in literature serves as a powerful authorial tool, allowing for the conveyance of deeper meanings and evoking emotional reactions from readers that can go beyond the surface narrative. At its core, symbolism enables writers to imbue objects, characters, and events with significant meanings that resonate with readers on multiple levels. This literary device encourages the target audience to engage with the text, prompting them to uncover layers of interpretation that reflect more significant themes such as identity, morality, and human existence.

It is necessary to acknowledge the fact that symbolism is not merely a “decorative” element of fiction literature, but plays a fundamental role in creating a deep meaning that goes beyond their direct description. Symbolic words have become the subject of study for many famous researchers, who describe various approaches to understanding the essence of symbolism and indicate that the prerequisites for the emergence of symbolism in different eras of literature were the crisis of morality and value orientations. After all, thanks to symbolism, it is possible to feel the emotional state of people who witnessed pivotal historical events.

Among Russian literary scholars, the works of such scientists as Alexander Nikolayevich Veselovsky [1979], who analyzed symbols through their historical evolution, considering their roots in myths, religion, and folklore; Alexander Afanasyevich Potebnya [1989], who believed that a symbol is a means of expressing meanings that are difficult or impossible to convey directly; Alexander Yuryevich Nesterov [2002], who emphasized the need to consider the philosophical, cultural, and historical aspects of symbols in literature; Anastasia Viktorovna Medvedeva [2008], who noted that symbols are not static, their meaning changes depending on the context, era, and cultural environment; and Alexander Valeryevich Alekseev [2016], who studied how contemporary authors reinterpret classical symbols, filling them with new content and meaning, are well-known.

Among foreign researchers, notable works dedicated to the symbolism of artistic works by the following well-known scholars are recognized: Ferdinand de Saussure [1922] considered the symbol in the context of signs and language, emphasizing its arbitrary nature, where a sign consists of the signifier (form) and the signified (content), and a symbol differs from a sign in that its connection with the signified is not entirely arbitrary but based on cultural and historical traditions; Charles Feidelson [1953] studied symbolism as a means of expressing philosophical and aesthetic ideas in works and emphasized that symbols in literature create ambiguity, prompting the reader to ponder hidden meanings; C.S. Lewis [1964] viewed the symbol as an element of myth-making and a tool that helps the author create profound spiritual meanings, emphasizing that symbolism operates on an emotional level, awakening the reader’s intuitive understanding; Umberto Eco [1984] understood the symbol as a complex sign capable of generating multiple

interpretations, where the meaning of the symbol depends on the context and the reader's perception, rather than solely on the intentions of the author of the artistic work; Jonathon Stone [2017] explored symbolism in the context of postmodernism, noting that modern symbols are often devoid of unambiguity and are used to create paradoxical or ironic meanings, and drew attention to how postmodernism dismantles traditional symbols, replacing them with flexible structures that emphasize the instability of meaning.

Literary scholars from the Central Asian region have also contributed to the understanding of the role of symbolism in artistic works. Among them are N.I. Osmanova [2015], who emphasizes that symbols draw their power from cultural memory, thereby awakening an intuitive perception in the reader that does not always require logical reasoning; Gulchira Garipova [2016], who believes that symbols in literature are often used to express ideas that cannot be described directly, making them conduits to transcendental truths and allowing the author to explore the metaphysical aspects of reality, with the reader becoming a co-author as they imbue symbols with individual meanings based on their own experiences and perceptions; and Ulugbek Turgunov [2020], who notes that symbolism, which originated in European literature, has influenced the literature of modern Uzbekistan, fostering creative diversity and the introduction of new artistic techniques, and asserts that traditional symbols were adapted to the spirit of the times, reflecting relevant themes of social change and the aspiration for national awakening.

It is particularly important to note some researchers in this field who have introduced certain concepts into the understanding of symbolism in artistic works. For example, Pavel Dmitrievich Minichkin [2016] introduced the term "lost symbol" in his study, which implies a temporally fragmented spirituality, a disrupted continuity in the development of culture, and its genre diversity. He also continues the thought that the meaning of a symbol in artistic literature can be inscribed in the so-called "semantic triangle": 1) image; 2) the object it denotes; 3) the meaning of the image. A symbol in artistic literature is an image that denotes an object and expresses its essence [P.D. Minichkin, 2017].

Another scholar and thinker, Carl Gustav Jung [1993], when discussing the symbolism of a work of art, introduced the term "archetypal meaning" into the field of literary studies, which is associated with the unconscious abstract collective mind and carries within it the "primordial image" dominant in each individual culture. This idea is further developed in the works of Maria Nikolaevna Gladzinova [2015], who states that "symbolic coherence" is the main property of a text, where what is implied is not so much causal, logical coherence, but rather associative-imagery coherence.

Research methods

For a deeper understanding of symbolism in a work of art, we used a cultural approach, aesthetic analysis of the impact on the reader, the method of interpreta-

tion to explain hidden meanings, the method of categorization to divide symbols into groups for the purpose of systematizing the material and emphasizing the specifics of each type of symbol.

Analysis and results

Exploring the multifaceted role of fiction symbolism in Central Asian context, we examined how it enriches the narrative of the novel, enhances character development, and provides important “messages” about the societal values of the fantasy genre. Analyzing various examples from G.A. Dolgaya’s fantasy novel “Gods of the Middle World” [2013], we identified the intrinsic nature of symbols in shaping the profound impact of the work on the recipient, and differentiated them into four main categories:

1. The symbols of “natural phenomena” include such basic images as:

“The River” is understood as a symbol of the untamed power of time and nature. The description of the spring flood, which crashes onto the shore “with the fury of a hungry beast,” symbolizes the indomitable force of nature. The river destroys the burial mound and carries away an ancient artifact—this could symbolize the cyclicity of time, which erases the boundaries between the past and the present. The Pearl River mentioned in the text symbolizes the flow of life, a history that flows continuously and absorbs elements of the past.

“The Wind in the Steppe” becomes a metaphor for boundlessness, the forces of nature, and the striving for independence. It emphasizes both the strength and the vulnerability of the heroes in the face of fate.

“The Night in the Steppe” symbolizes mystery and the unknown, as well as oppressive loneliness. Tansylu is surrounded by darkness not only physically but also emotionally, feeling out of place in a new environment.

The motif of the “road in the steppe” (the road taken by the expedition) serves as an allegory for the journey towards knowledge and self-discovery. The vastness of the steppe symbolizes the endless possibilities that open up before a person.

The symbol of “dust on the road” represents the path of archaeologists, which becomes a metaphor for the difficulties that must be overcome to achieve their goals. The dust covering the heroes can symbolize their “unity” with history, with the past.

“The transition from night to dawn” symbolizes hope and new beginnings. Ayazgul, ascending to the cave, travels from darkness (the unknown) to light (the hope of saving Tansylu).

“The star in the yurt opening” implies hope for freedom and a connection to past life. The solitary star hints at the light of hope that still flickers in Tansylu’s soul.

“The flames of the bonfires” are symbols of life, traditions, and celebration, which contrast with the heroine’s inner drama. The outside world celebrates, while Tansylu experiences a crisis and humiliation.

2. Symbols expressed in the form of various “objects” from everyday life: “Amulet” as a symbol of fate and memory. The amulet of an ancient warrior, washed out from a burial mound, becomes a link between the past and the present. Its journey through the river, the crow, and the excavator symbolizes the randomness and inevitability of the past’s influence on the present.

“The Knife” becomes a symbol of liberation and the final break with humiliation. The murder of Ulmas is not only an act of revenge but also a metaphor for the struggle against patriarchal norms that suppress individuality.

“Coral beads” are a symbol of protection and connection to the homeland, the mother. The beads given to Tansyl symbolize maternal love, protection, and blessing to preserve the daughter’s soul and body.

“Bags with the bodies of warriors” are a symbol of revenge and the inexorability of traditions. They embody the consequences of violating customs, showing how cruel their disregard can be.

“The second hand of the clock,” observed by Sima, emphasizes the inexorability of time and the desire to make the most of important moments in life.

3. “Animals” are used as symbols in the following context:

“The Raven” as a symbol of mystery and omen. The raven that swallowed the amulet symbolizes the transfer of ancient secrets or powers. In mythology, ravens are often associated with harbingers of fate or guides between worlds.

The image of the “galloping horse” is associated with freedom, strength, and wildness, which contrasts with the restraint and haste of Sima in the city. The “black-maned horse” helps Tansyl gain independence, taking her away from the shackles of tradition and violence.

4. “Abstract images” carry the following meanings:

“The basement” as a symbol of fears and the unknown. The basement where the girl is taken symbolizes unconscious fear, the unknown, and hidden danger. The dark cast-iron boilers enhance this symbolism, acting as “monsters” in the child’s perception.

The sounds, wind, and “white cloud” following the girl emphasize the mystical nature of the basement, making it a symbol of the past or the otherworldly.

“The white cloud” is a symbol of a spirit or an unresolved mystery. The cloud that follows the girl is associated with something otherworldly—a spirit, a trace of the past, or a mysterious energy connected to the amulet.

“The Trolleybus” symbolizes fate and opportunities. The trolleybus, which almost slipped away from Sima but stopped due to a breakdown, represents missed chances that can still be seized with enough persistence.

The symbol of “archaeology” signifies the exploration of the past. Sima’s desire to study antiquities becomes a bridge between the past and the present, connecting the modern girl with ancient heroes and their fates. The archaeologist

hero, Professor Kolesnichenko, represents a mentor figure whose stories awaken in Sima the desire to explore not only historical artifacts but also her roots and purpose.

“Shaman Dances” and “Battle with Demons” are references to the struggle between good and evil within each person, as well as the eternal quest for harmony and balance.

“Circles and squares” - the symbolism of the drawing described by Sima reflects ancient worldview concepts, as well as the striving to organize chaos through knowledge.

Thus, the peculiarity of the symbols in G.A. Dolgaya’s fantasy novel “Gods of the Middle World” lies in the creation of a multi-layered narrative, where natural, historical, and mythological elements intertwine to convey ideas about time, memory, the connection between the past and the present, and human vulnerability before forces that lie beyond their control. Through symbolism, the inner world of the main characters is revealed, highlighting their dreams, fears, and aspirations. Moreover, through symbolic imagery, the internal conflict of the characters, the contrast between the external and internal worlds, as well as the struggle against traditions that simultaneously form the foundation of society and suppress individuality, are emphasized. All the symbols used by the author operate on multiple levels, linking the individual with the universal, the personal with the historical, the internal with the external.

Conclusion

From all of the above, we can conclude that the text of the fantasy novel under study is rich in symbolism, which emphasizes the inner struggle of the characters between dreams and reality, the connection with the past and the aspiration for the future, the eternal theme of freedom and responsibility.

The symbolism of the novel we are examining is expressed through categories of symbols such as natural phenomena (e.g., river, wind, steppe, star), objects (e.g., amulet, knife, beads), animals (e.g., raven, horse), and abstract images (e.g., cellar, white cloud, shaman dances). These elements not only embellish the text of the artistic work but also carry deep meaning, revealing themes of time, memory, inevitability of fate, and the connection between past and present.

Moreover, the systemic-network organization of meanings-symbols in this artistic text represents meanings that are not only elite-cultural for the Central Asian region (e.g., yurt = reliability and tranquility, coral beads = maternal love and blessing) but can also be called collectively archetypical for world culture (e.g., river = time, crow = harbinger of trouble).

All the symbols of the fiction novel we are examining are closely intertwined, creating a rich palette for interpreting the text and revealing deep themes for both the original language and the language of translation.

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俄罗斯史学对 20 世纪 70 年代至 90 年代中国经济改革的贡献
**RUSSIAN HISTORIOGRAPHY ON ECONOMIC REFORMS IN
CHINA IN THE 1970S AND 1990S**

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摘要。本文考察了 20 世纪 70 年代至 90 年代中国经济改革开放史学著作的演变。20 世纪 90 年代末至 21 世纪初,俄罗斯汉学家的著作主要致力于对俄中经济改革的比较分析。随着中国经济增长,研究人员对改革的关注度不断提高。2018 年是中华人民共和国经济改革政策启动 40 周年,成为俄罗斯对这一时期研究的一种总结。现代研究人员已将工作重点转向解释中国经济改革的成功。

关键词: 中国, 20 世纪 70 年代至 90 年代经济改革, 开放政策, 史学评论。

Abstract. *This article examines the transformation of historiographic works devoted to economic reforms and openness in China in the 1970s-1990s. In the late 1990s - early 2000s, the works of Russian sinologists were devoted mainly to a comparative analysis of economic reforms in Russia and China. As China's economic growth progressed, researchers' attention to reforms increased. The date of the 40th anniversary of the start of the economic reform policy in the People's Republic of China in 2018 became a kind of summing up of the research of this period in Russia. Modern researchers have shifted the focus of their work to explaining the success of economic reforms in China.*

Keywords: *China, economic reforms of the 1970s-1990s, openness policy, historiographic review.*

Introduction

The origins of Russian Sinology are connected with the activities of the Russian Ecclesiastical Mission in Beijing in the 17th-20th centuries. The most famous Sinologist of the Russian Ecclesiastical Mission was Iakinf (N. Y. Bichurin), who was in China from 1808 to 1820. "The modern Russian school of Sinologists is quite comparable with the USA in terms of the number of first-class Sinologists and individual

monographs, and the volume and quality of Russian research on modern China are comparable with the achievements of Chinese Russian studies” [1].

The history of China attracts the attention of Russian researchers for a number of reasons, including the presence of a long border between Russia and China, close partnership relations at the present stage, and the experience of successful economic reforms. This paper will review and analyze Russian-language historiography devoted to economic reforms in China in the 1970s-1990s. Since the early 1980s, China has experienced a tremendous economic upswing associated with the implementation of reform and openness policies. The whole world has been observing the rapid upward movement of the Chinese economy for 30 years, briefly stopped by the COVID-19 pandemic.

The renowned sinologist V. Y. Portyakov believes that in the “post-Soviet period, Russian sinology quite adequately described and assessed the processes of modernization, reforms and foreign economic openness of the People’s Republic of China, the evolution of the country’s political system, and the development of Russian-Chinese relations” [1].

Over 100 works have been published covering various aspects of the experience of Chinese reforms and openness policy, including works on the party-political system and law of China, on the development of industry, agriculture, transport, on the legal framework for reform policy and the investment climate, on the place and influence of the Chinese economy in the world economy. “A significant contribution to the development of this area of Sinology was made by A.V. Ostrovsky, V. Y. Portyakov, V.I. Shabalin, E.P. Pivovarova, L.I. Kondrashova, G.D. Sukharchuk, V.G. Gelbras, V.I. Potapov, V.V. Karlusov, M.V. Alexandrova, L.D. Boni, L.P. Deliusin, Z.A. Muromtseva, L.A. Volkova, L.M. Gudoshnikov, N.L. Mamaeva, G.A. Ganshin, A.V. Vinogradov, L.V. Novoselova and others” [2].

Materials and methods

The main method of this article is a historiographical review of the scientific literature devoted to the implementation of economic reforms in China in the 1970s - 1990s and its analysis. It should be noted that most researchers do not pay due attention to the initial period of reforms, focusing more on the analysis of the impressive successes that China managed to achieve. However, we believe that the initial stage was the most important, because there was no ready-made reform program. “The main method of reform was a step-by-step, experimentally tested advancement to the market, the transition from small to large, from particular to general, gradual but decisive expansion of the scale of reform and its deepening. This method was figuratively called “crossing the river, feeling the stones” [3].

Results and discussions

In the 1990s, practically no one was interested in economic reforms in China, and the vast majority of research on the Chinese economy was conducted within

the framework of the Institute of Far Eastern Studies of the Russian Academy of Sciences. In the late 1990s and early 2000s, the main discussion among Russian researchers was a comparative analysis of economic reforms in Russia and China. We highlight the doctoral dissertation of V. Y. Portyakov, one of the leading sinologists in Russia, “Search for Paths of Socioeconomic Development in the People’s Republic of China, Late 1970s – First Half of the 1990s” [4]. V. Y. Portyakov believes that one of Deng Xiaoping’s boldest innovations was the decisive break with the isolationist past and the proclamation of the country’s policy of openness to the outside world.

It should be noted that at the end of the 20th century, most former socialist countries, including Russia, switched to a capitalist mode of production. China, which began reforms in the late 1970s – earlier than others – remained faithful to the socialist economic system, developing the concept of “socialism with Chinese characteristics.”

It should be emphasized that at the end of the 20th century it was still difficult to predict such a stunning success of the Chinese economy. Most politicians and researchers both in Russia and abroad expected that “China, like the USSR and other Eastern European countries, as a result of the collapse of Marxist ideology, would begin to disintegrate into separate territories. This would entail an economic crisis in the country similar to the situation in China in the 1920s after the Xinhai Revolution” [2].

China’s entry into the WTO in 2001, successful overcoming of economic difficulties during the global financial crisis in 2007-2008, reaching 2nd place in the world in terms of economic development and 1st place in the world in terms of export volume, and the strengthening of the Chinese currency have sharply stimulated interest in the situation in the Chinese economy both in the world and in Russia. The world economy has begun to show interest in the reasons and factors that have contributed to such rapid economic growth in China in recent decades.

It is worth noting the works devoted to the economy of China by one of the leading Russian sinologists A.V. Ostrovsky, head of the Center for Economic and Social Research of China at the Institute of Far Eastern Studies of the Russian Academy of Sciences. A.V. Ostrovsky identified the stages of economic reform in the PRC (1978-2019), analyzed the long-term programs of socio-economic development of the country for 1996-2010 and 2011-2030, drawn up by leading economists together with government agencies, as well as amendments made to the Constitution of the country from 1988 to 2004, indicating a structural shift in the economy [5]. A.V. Ostrovsky analyzed the Chinese model of transition from a planned economy to a market economy. He believes that “the experience of Chinese reforms is an experience of a painless transition from a planned economy to a market economy, an exit to a trajectory of high rates of economic growth, which has been going on for more than 30 years” [6].

It is necessary to note the fundamental work “History of China from Ancient Times to the Beginning of the 21st Century”, written by Russian scholars of Sinology, in which the chapters devoted to economic reforms and openness in China were written by V. Y. Portyakov and A. V. Ostrovsky [7]. For the first time in Russian scientific literature, a comprehensive study of the history of China during the reform period was presented, covering domestic policy, law, state system, economy, international relations and culture. And the last quarter of the 20th century and the beginning of the 21st century were called “the most successful period in the history of the PRC and one of the most successful periods in the almost five-thousand-year history of China. Over the course of just one generation, the country was able to solve the eternal problem of “warmth and satiety” and become a leading world power” [7].

It should be emphasized that the date of the 40th anniversary of the start of the economic reform policy in the People’s Republic of China in 2018 became a kind of summing up of the results of research of this period in Russia. V. Y. Portyakov wrote that “summing up briefly the policy of foreign economic openness of China in the post-reform period, it can be stated that it played a critically important, irreplaceable role in the modernization of the country and in its transformation into one of the leading powers of the world, in mastering the norms and rules of functioning of the world market. China became one of the world leaders in terms of trade volumes, attracting foreign investment and investing abroad. Beijing has adapted well to the process of globalization of the world economy and has become one of its main beneficiaries” [8].

A.V. Ostrovsky noted that “the successes of the Chinese economy over 40 years of reforms demonstrate the viability of the Chinese model of transition from a planned to a market economy, associated with a large role of state regulation and a significant volume of investment programs for the development of the country” [9].

Modern researchers from the Higher School of Economics note that in China, “internal decisions on the development of economic institutions, industries and regions played a decisive role in 1992-2023” [10]. The authors of the article use a cluster approach and note that “China’s great market leap between 1992 and 2007 – the transition from the difficult situation of cluster 6 to cluster 4 – took fifteen years, which can be attributed primarily to the liberalization of economic activity, freedom of access to world markets under favorable global conditions and coordinated investment policy” [10].

Conclusion

The Institute of Far Eastern Studies of the Russian Academy of Sciences was a leader in the 1990s in the study of the Chinese economy of the last quarter of the 20th century, and remains so to this day. Modern researchers have shifted

their focus from a comparative analysis of economic reforms in China and Russia to explaining the phenomenon of the success of economic reforms in China and modeling the prospects for the development of the Chinese economy.

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DOI 10.34660/INF.2025.51.42.115

氧化铝纳米复合材料在细菌固定化中的应用
**THE APPLICATION OF ALUMINUM OXIDE NANOCOMPOSITES
IN BACTERIAL IMMOBILIZATION**

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注释。本文介绍了研究各种多孔铝样品性能所获得的数据。利用X射线衍射法研究了所得复合材料的微观结构、孔径分布、多孔铝样品表面的宏观结构、AMg6 (a) 和D16 (b) 合金样品的碎片衍射图以及其表面形成的陶瓷涂层 (b-AMg6, g-D16

)。所得的铝和硅的结晶和非晶态化合物可作为固定生物物体的吸附剂的基础, 特别是细菌大肠杆菌, ATCC 25922。

关键词: 氧化铝、微弧氧化、宏观结构、孔隙率、射线照相术、性能、吸附剂、细菌、固定、细胞、粘附。

Annotation. *The paper presents data obtained from studying the properties of various samples of porous aluminum. The microstructure of the obtained composite, the pore size distribution, the macrostructure of the surface of samples made of porous aluminum, the fragmentary diffraction pattern of samples made of AMg6 (a) and D16 (b) alloys and the ceramic coating formed on their surface (b-AMg6, g-D16) were studied using X-ray diffraction method. The obtained crystalline and amorphous compounds of aluminum and silicon served as the basis for sorbents for the immobilization of biological objects, in particular the bacteria ESCHERICHIA COLI, ATCC 25922.*

Keywords: *aluminum oxide, microarc oxidation, macrostructure, porosity, radiography, properties, sorbents, bacteria, immobilization, cells, adhesion.*

Introduction. Aluminum oxide is one of the most well-known sorption materials due to its mechanical strength, chemical and hydrolytic stability, as well as ease of regeneration and availability [1]. In addition to its use in mechanical engineering and instrumentation, aluminum oxide is successfully applied in filtration devices for water purification from metal ions, as well as for the removal of microbiological contaminants [2]. Aluminum oxide-based filters effectively remove viruses, bacteria, parasites, and reduce water turbidity while preserving beneficial microelements dissolved in the water. Due to the localized positive charges of aluminum oxide nanocomposites and the negative charges associated with the anionic polymers of microbial cell walls, bacteria are firmly retained on the aluminum oxide surface upon contact, thanks to Coulomb forces [3].

It should be noted that aluminum oxide is most commonly used as an adsorbent either in the form of nanoparticles anchored on natural or synthetic supports, or in the form of powders and granules. However, these adsorbents present certain challenges, primarily related to the complex technology of their production, regeneration, and purification, carried out for the purpose of reuse [4,5]. These issues are addressed by creating alumina oxide coatings on aluminum substrates, produced through deep electrochemical oxidation of the aluminum base, with an oxide layer thickness of up to 200 microns [6]. The alumina oxide layer represents a nanostructured composite consisting of aluminum oxide modifications (mainly α - and γ -Al₂O₃), which differ in their adsorption mechanism. The aforementioned properties and the porous structure of the MDO coating make it a technological and promising material for separating multicomponent media, selective adsorption, and isolation of certain microorganisms. The authors of this article previ-

ously studied the sorption of certain forms of microorganisms by various forms of aluminum oxide [7].

The aim of this work was to evaluate certain properties and structures of aluminum oxide nanocomposites (AMg6, D16, Zn-Al) and assess their potential for use as adsorbents in the immobilization of bacteria.

Materials and methods. In this study, aluminum nanocomposite samples of the alloys AMg6, D16, and Zn-Al, obtained by the method of electric arc metallization at the United Institute of Machine Building, National Academy of Sciences of Belarus, were provided by the institute's staff.

The coating was formed on rectangular samples with dimensions of 10×20 mm and a thickness of 1.2 mm. Microarc oxidation (for 80 minutes) was performed with thyristor control, providing anodic-cathodic polarization of the samples at a frequency of 50 Hz (voltage 200–240 V, current strength 55 A). The electrolyte used was an aqueous solution of KOH and liquid sodium silicate (Na₂SiO₃) at concentrations of 2 and 5 g/L, respectively, with the electrolyte temperature maintained between 25–35 °C.

The phase composition of the coating was studied using an X-ray diffractometer DRON-3M with CuK α radiation and secondary monochromatization of the X-ray beam. The structural-phase state of the samples was examined using metallographic analysis on XJM300 and MIM-8 microscopes.

The standard strain of *Escherichia coli* ATCC 25922 was cultivated under shaking conditions in a liquid medium (nutrient peptone broth (NB, HiMedia)) under aerobic conditions at 37°C for 5 hours.

Afterward, bacterial cells were separated from the nutrient medium by filtration under vacuum using nitrocellulose membrane filters (Millipore Corporation, Bedford, MA 01730, USA) with a diameter of 47 mm and a pore size of 0.45 μ m. The bacteria were washed off the filter with sterile saline (0.9% NaCl) and a cell suspension was prepared in saline with a concentration of approximately 1 million cells per milliliter.

Results and discussion

Previously, porous aluminum and its derivatives have shown high sorption capacity in the field of parasitology for the immobilization of *Giardia* cysts and *Ascaris* eggs. The proportion of bound, and subsequently released, *Ascaris* eggs amounted to 86.50%, whereas on fine aluminum oxide granules it was 35.44%, and for *Giardia* cysts, 55.18% and 47.54%, respectively [7]. The volumetric porosity of aluminum oxide ranges from 50–55%, with the majority of the pores, approximately 70%, having a size of up to 650 μ m.

After oxidation, the pore size decreases (Fig. 1), and the peak of the pore size distribution shifts toward smaller sizes.

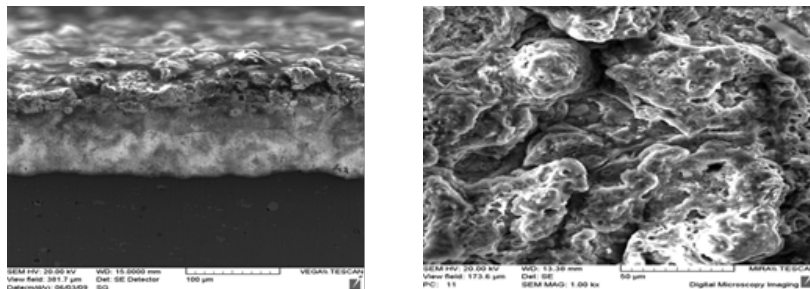


Figure 1. Microstructure of the coating on alloy D16: a – cross section; b – alloy surface

It has been demonstrated that a coating, consisting of well-known electropositive and electronegative sorption materials—aluminum oxide and aluminosilicate—forms on the surface of porous aluminum, including on the surface of the pores of cast samples. By varying the composition of the porous aluminum substrate and the parameters of microarc oxidation, it is possible to control the phase composition of the resulting coating. This is particularly important, as it opens up the possibility of creating selective filtration devices for retaining either anionic or cationic inorganic compounds and microbiological objects, such as bacteria. According to the structure of the outer membrane of most microorganisms, they possess an excess negative charge. Since aluminum oxide is an electropositive adsorbent, microorganisms are retained on its surface due to Coulomb forces [8].

Table.

Efficiency of Escherichia coli Bacteria Sorption on Adsorbents (Number of Cells per 1 mL of Suspension Washed with 0.9% NaCl).

№	Adsorbent Samples	Initial Number of Cells in 50 mL	Number of Cells Remaining After Sorption in 0.9% NaCl	Number of Adsorbed Cells	Number of Non-Adsorbed Cells	Total Number of Adsorbed Cells	Sorption Efficiency, %
1	AMr6	70 312 500	34 375 000	35 937 500	74 800	35 862 700	51
2	D16		33 125 000	37 187 500	47 450	37 140 050	52,2
3	AlZn		26 562 500	43 750 000	47 800	43 702 200	62,15

The aluminum oxide nanocomposites of three types, AMg6, D16, and Zn-Al, were immersed in a 50 mL bacterial cell suspension containing a total of 70,312,500 cells, which were previously washed and diluted with 0.9% NaCl.

The microstructure of the coating on the D16 alloy: a – cross-section; b – surface. The viability of the *Escherichia coli* culture remains between intervals of 1:30 hours. After desorption, no released cells were detected for the ZnAl variant after the 10th washing. The data presented in Table 1 show that the AlZn carrier exhibits the best sorption capacity, with a value of 62.15.

The obtained results demonstrated that all coating samples are effective adsorbents for the selected microorganism culture (*Escherichia coli*), as evidenced by scanning electron microscopy images (Figure 4). However, the structure and composition of the coatings, as expected, have a significant impact on their sorption capacity. According to the research results, the sorption of bacteria on the coating samples made from AMg6 and D16 alloys was 51.0% and 52.8%, respectively, while for the coating on the Zn-Al alloy, this value reached 62.85%.

The studies conducted using scanning electron microscopy methods allowed for the determination of the distribution pattern of adsorbed microorganisms on the surface of the carrier. In all coating samples, *Escherichia coli* cells are distributed randomly; however, for each carrier, specific binding sites can be identified where microorganisms are adsorbed most efficiently (Figures 2-4). This indicates the potential for improving the adsorbent's efficiency through control of its structure and phase composition.

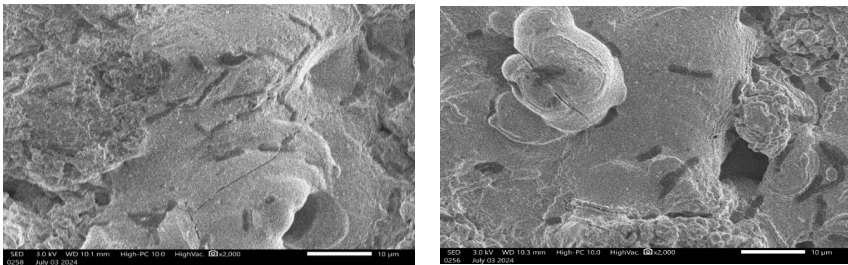


Figure 2. SEM studies of *Escherichia coli* strain ATCC 25922 on the ceramic coating of the composite D16 carrier.

In all coating samples, *Escherichia coli* cells are distributed randomly. However, for each carrier, specific binding areas can be identified where microorganisms are adsorbed most efficiently (Figures 5-7). This indicates the potential to enhance the adsorbent's efficiency by controlling its structure and phase composition.

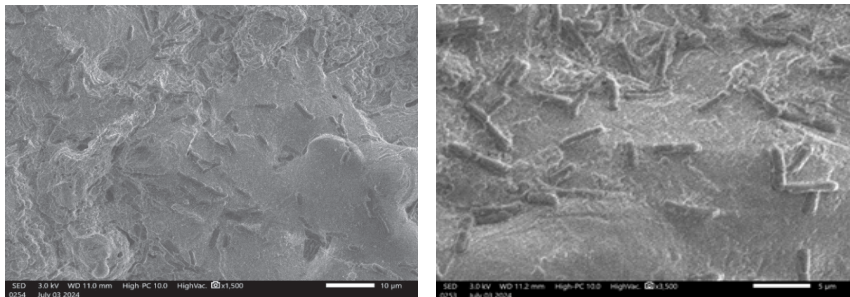


Figure 3. SEM studies of *Escherichia coli* strain ATCC 25922 on the ceramic coating of the composite Zn-Al carrier at different magnifications.

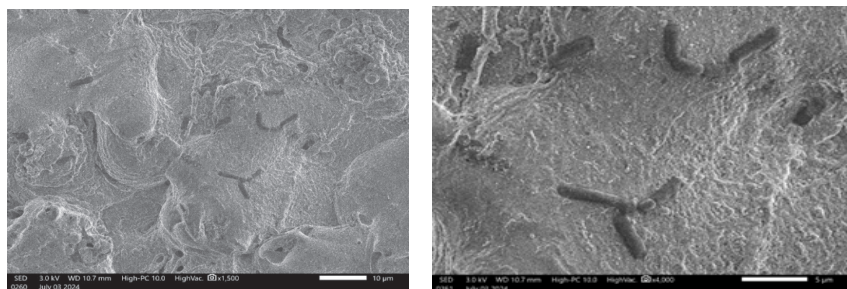


Figure 4. SEM studies of *Escherichia coli* strain ATCC 25922 on the ceramic coating of the composite AMg6 carrier.

The SEM images of the surface of the coatings on D16, Zn-Al, and AMg6 alloys show that the sorption of microorganisms by aluminum oxide in the form of an MDO coating on aluminum alloy substrates demonstrates this material as an effective adsorbent with significant potential for practical use, due to the broad possibilities for controlling its structure, composition, and manufacturability.

Conclusion

Thus, the adsorption immobilization of bioentities is the closest to natural processes of cell attachment in nature and, therefore, represents the simplest and most widely used method for obtaining immobilized microbial cells of industrial significance. The adsorption of microorganisms, particularly *Escherichia coli*, on the surface of a solid body depends on the state of the culture, its developmental phase, and functional condition.

This work was carried out within the framework of the fundamental projects FL-7923051836 (Uzbekistan) and T23UZB-015 (Belarus).

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中国经济鱼类鳞状学分析
SQUAMATOLOGICAL ANALYSIS OF COMMERCIAL FISH IN
CHINA

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注释。描述了中国海域22种鱼类的鳞片结构。编制鱼鳞图谱可解决系统学、古生物诊断和渔业研究中的鱼类分类问题。

关键词: 鱼类, 中国, 鳞类, 鳞片, 显微镜学。

Annotation. *Scale structure of 22 fish species inhabiting the seas of China is described. The compiled atlas of fish scales can solve the problem of fish classification in systematics, paleontological diagnosis and fisheries research.*

Keywords: *fish, China, squamatology, scales, microscopy.*

Ichthyological research is a fundamental branch of biological science that plays a critical role in the conservation and rational use of aquatic biological resources. These studies are of particular relevance in the context of food security in Russia and China, where fish traditionally occupies a significant place in the structure of the population's diet. Fish scales are a unique biological material with significant advantages for research work. The key advantage of this object is the possibility of obtaining representative samples without lethal impact on the studied individuals, which is especially important when working with rare and protected species. The technique of scale sampling is characterized by relative simplicity and minimal invasiveness. Morphological variability of scales provides a wide range of diagnostic features applicable in different areas of fishery research. The sclerite structure of scales serves as a reliable indicator of the age of an individual, which is of paramount importance in assessing population characteristics and determining the optimal parameters of industrial use of fish resources. Microstructural features of scales show a high degree of correlation with habitat conditions, which makes it possible to use this material as a bioindicator for ecological monitoring of aquat-

ic ecosystems. Analysis of morphological modifications of scales is of particular importance in toxicological studies, where structural changes can serve as early markers of negative anthropogenic impact. In the context of palaeontological and archaeological studies, fossil scales acquire special value as a source of information on the historical dynamics of ichthyofauna and the development of fisheries. A high degree of mineralisation ensures the long-term preservation of scales in geological sediments, which makes it possible to reconstruct not only the species composition of ancient water bodies, but also the nature of interaction of human populations with water resources [1].

Morphological characteristics of scales of bony fishes represent a unique complex of diagnostic features with pronounced polymorphism, which causes their wide application in various fields of ichthyological and related studies. The analysis of structural features of scales allows obtaining a significant amount of information of both fundamental scientific and applied fishery importance. In the context of age characterisation of fishes, the scleritic structure of scales plays a key role as a recording component. The formation of annual marks on the scale surface occurs as a result of cyclic changes in the metabolic activity of the organism, which makes it possible to determine the age of individuals with high accuracy. This parameter is critical in assessing the fishery potential of populations, as it correlates with reproductive capacity, growth rate and quality characteristics of the products obtained. Morphometric parameters and microstructure of scales demonstrate a high degree of plasticity depending on habitat conditions. This property makes it possible to use scales as a bioindicator for ecological monitoring of aquatic ecosystems. Of particular importance is the analysis of structural modifications of scales in toxicological studies, where changes in morphological characteristics can serve as a marker of the presence of various pollutants in the aquatic environment. In paleontological and archaeological aspects, fossil scales represent an important source of information on phylogenetic relationships and evolutionary dynamics of taxa. The high degree of mineralisation of scales ensures their preservation in the geological record, which makes it possible to reconstruct historical ranges of species distribution, fish migration routes and, as a consequence, the nature of human population movements associated with fishing activities. Modern research methods include the use of scanning electron microscopy, X-ray structural analysis and other high-tech approaches, which significantly expands the range of information obtained. Integration of classical morphological studies with modern analytical methods allows for a comprehensive assessment of biological and ecological parameters of the studied species. Thus, morphological studies of fish scales represent an interdisciplinary direction that is essential for solving a wide range of fundamental and applied problems in ichthyology, ecology, and fisheries [2].

For the successful application of squamatological methods, it is important to create a complete database on the morphology of fish scales. At present, such stud-

ies have already been carried out for fishes of Europe, North America and western Asia (including Iran)[2-4], the information on Chinese species remains incomplete and scattered. This study aims to collect and organise morphological data on the scales of major commercial fish species of China.

Materials and Methods:

The study samples were obtained from live or frozen fish samples, of different species, purchased from markets or shops in Shenzhen, including both traditional retail outlets and online shops. The sampling methodology involved extracting 20-30 scales from the left side of each individual. The choice of the left side was due to the need to standardize the sampling procedure and to ensure comparability of the results obtained. Scales were selected from different anatomical regions to obtain a representative sample reflecting the morphological variability of the cover structures of the studied species. Sample preparation included chemical treatment of samples using a 1% potassium hydroxide (KOH) solution for 30 minutes. This stage provided partial softening of surface tissues, which significantly facilitated subsequent mechanical cleaning. Removal of epithelial tissues from the surface of the scales was carried out using a specialised fine brush, which allowed to preserve the integrity of the studied structures. Microscopic examination was carried out using a ZEISS Stemi 305 stereomicroscope and a Carl Zeiss Primo Star laboratory microscope. The prepared specimens were placed between slides to ensure optimal focusing and to obtain high-quality micrographs. This technique allowed a detailed analysis of morphological features of scales of the studied fish species.

Results and Discussion:

The results of microscopic study revealed significant differences in the structure of scales of representatives of different families. The analysis of scale morphology showed that representatives of the families *Epinephelidae*, *Sparidae* and *Lutjanidae* are characterised by ctenoid scales with characteristic ossifications in the caudal field forming spike-like structures. At the same time differentiation on character of ctenia is observed, transforming ctenia were identified in *Acanthopagrus latus*, *Sciaenops ocellatus* and *Nemipterus virgatus*, and whole ctenia were characteristic for *Cromileptes altivelis*, *Epinephelus fuscoguttatus* and *Plectropomus leopardus*. Representatives of the families *Gadidae*, *Carangidae* and *Siniperidae* demonstrate the presence of cycloid scales with characteristic smooth caudal margin. Of particular interest are species demonstrating morphological heterogeneity of scales: *Sciaenops ocellatus*, *Sillago sihama* and *Acanthopagrus latus*. These species show differentiation of scale types depending on location on fish body: ctenoid scales cover the main part of the body, while cycloid scales are localized on the operculum.

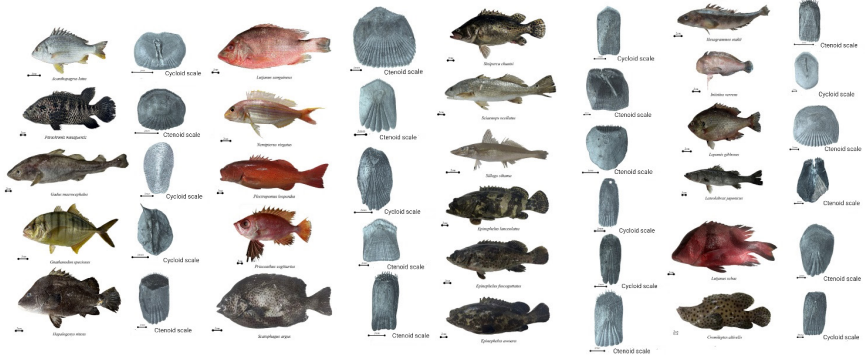


Figure Scale structure of commercial fish species in China

Morphometric analysis revealed considerable variability in the shape of scales, including the following main types - elongated, square, round, polygonal, ovoid. The cranial field of the scale is characterized by the presence of radial rays, the arrangement of which determines the morphological type of the anterior field - wavy, smooth, toothed, striated. The central area of the scale (focal point) shows interspecific variability in shape (round, semicircular, oblong) and degree of expression. Comparative analysis with literature data [5, 6] showed the presence of conservative morphological characters in closely related species inhabiting different water areas. Based on this study, a universal scheme for describing scales was developed, including typological affiliation, morphometric characteristic, features of caudal and cranial fields, and focal characteristic. The proposed system of morphological descriptors provides the possibility of comparative analysis and can serve as a basis for the development of definitive keys for species identification on scales.

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DOI 10.34660/INF.2025.66.20.117

痔切除联合后阴道成形术及前肛提肌成形术治疗直肠膨出的优势
**ADVANTAGES OF HEMORRHOIDECTOMY COMBINED
WITH POSTERIOR COLPORAPHY AND ANTERIOR
LEVATOROPLASTY IN PATIENTS WITH RECTOCELE**

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摘要。痔疮手术治疗的重要性在于其在人群中广泛流行。

目的。改善以阻塞性排便综合征为表现的直肠膨出患者的痔疮治疗效果。

材料和方法。本研究介绍了后阴道缝合术联合前肛提肌成形术与 Milligan-Morgan 开放式痔切除术对 25 例以 SOD 为表现的 3 级中度直肠膨出和慢性 3-4 级痔疮患者（主要组）的结果。对照组还包括 25 例仅接受痔切除术的患者，其病理相同。

结果。主要组患者的术后期更有利：疼痛综合征不太明显，停止得更快。他们出现反射性尿潴留的可能性降低了 24%。手术三天后，主要组中有 20 名（80%）患者有排便行为。对照组有 13 例（52%）。主组患者的伤口过程临床和细胞学标准更好。对照组患者的细胞反应阶段延迟 3-5 天。术后 1.5 个月检查，主组所有患者的伤口均已愈合，形成薄而有弹性的术后疤痕。对照组有 16 例（64%）患者的疤痕粗糙，有肛缘，3 例（12%）患者的伤口在此期间未愈合。

结论。接受痔切除术联合后阴道缝合术和前肛提肌成形术治疗 ODS 的患者在术后和随访中获得了更有利的结果。

关键词：痔疮、直肠膨出、Milligan-Morgan 痔切除术、排便阻塞综合征、后阴道缝合术。

Abstract. *The relevance of surgical treatment of hemorrhoids is due to its widespread prevalence among the population.*

The aim. *Improvement of the results of treatment of hemorrhoid disease in patients with rectocele, manifested by obstructive defecation syndrome.*

Material and methods. *This study presents the results of posterior colporaphy with anterior levatoroplasty in combination with Milligan-Morgan open hemorrhoidectomy in 25 patients with isolated grade 3 medium rectocele, manifested by SOD and chronic grade 3–4 hemorrhoids (the main group). The control group also included 25 patients who underwent only hemorrhoidectomy, for the same pathology.*

Results. *The postoperative period was more favorable in the patients of the main group: the pain syndrome was less pronounced and stopped faster. They were 24% less likely to have reflex urinary retention. Three days after surgery, 20 (80%) patients in the main group had an act of defecation. In the control group, this indicator was 13 (52%). The clinical and cytological criteria for the course of the wound process were better in the patients of the main group. In the control group of patients, there was a delay in the phases of the cellular reaction for 3–5 days. On examination 1.5 months after in all patients of the main group the wounds had healed with the formation of thin elastic postoperative scars. In 16 (64%) patients of the control group, the scars were rough, there were anal fringes, and in 3 (12%) patients the wounds did not heal during these periods.*

Conclusion. *The patients who underwent hemorrhoidectomy in combination with posterior colporaphy and anterior levatoroplasty for ODS had a more favorable results in post-operative period and follow-up.*

Keywords: *Hemorrhoids, Rectocele, Milligan–Morgan hemorrhoidectomy, obstructive defecation syndrome, posterior colporrhaphy.*

Introduction. The widespread prevalence of chronic hemorrhoids, 130–145 cases per 1,000 adults, determines its leading place among coloproctological diseases and a high interest in the problem of treatment [1]. The disease can manifest a variety of symptoms and have varying degrees of severity, which explains the existence of a whole arsenal of ways to treat it: conservative, minimally invasive, surgical. Milligan–Morgan hemorrhoidectomy remains the “gold standard” of surgical treatment of grade III–IV hemorrhoids [2]. The pathogenesis of the disease is based on two main factors, vascular and muscular-dystrophic. In women, the latter is in full agreement with the pathogenesis of pelvic floor prolapse, which is manifested by obstructive defecation syndrome (ODS) [3]. This explains the frequent combination to 34–40 % of hemorrhoids and rectocele, which is most often the cause of obstructive defecation [4]. In this regard, the Department of Hospital Surgery, located on the basis of the Coloproctological Department of

the Belgorod Regional Clinical Hospital of St. Joasaph, conducted a study aimed at a comprehensive solution to the problem of surgical treatment of hemorrhoid disease in women with rectocele, manifested by ODS. The hypothesis of the study was that the correction of ODS simultaneously with hemorrhoidectomy should have a positive effect on the course of the postoperative period and further prevent the recurrence of hemorrhoidal disease.

The aim of the work. Improvement of the results of treatment of hemorrhoid disease in patients with rectocele, manifested by ODS.

Material and methods. This study presents the results of posterior colprography with anterior levatoroplasty in combination with Milligan–Morgan open hemorrhoidectomy in patients with isolated grade 3 medium rectocele, manifested by SOD and chronic grade 3-4 hemorrhoids. Preference was given to the open method due to a less pronounced pain syndrome in the postoperative period and a reduction in the duration of the intervention, compared with closed analogues, which is important when performing combined interventions. The control group also included 25 patients who underwent only hemorrhoidectomy, for the same pathology and in the postoperative period, conservative ODS therapy was prescribed, as they decided to refrain from extended surgical intervention.

Both groups of patients showed similarities in demographic parameters and the presence of pathologies. The participants of both groups belonged to the European race. The average age was 52.4 ± 5.2 years in the main group and 54.6 ± 4.9 years in the control group. The body mass index was 29.5 ± 2.7 kg/m² and 28.9 ± 3.1 kg/m², respectively. The average number of births was 2.4 ± 0.7 and 2.6 . Both groups of patients showed similarities in demographic parameters and the presence of concomitant pathologies. The participants of both groups belonged to the European race. The average age was 52.4 ± 5.2 years in the main group and 54.6 ± 4.9 years in the control group. The body mass index was 29.5 ± 2.7 kg/m² and 28.9 ± 3.1 kg/m², respectively. The average number of births was 2.4 ± 0.7 and 2.6 ± 0.4 . In the main group, 16 (64%) patients had hemorrhoids of the 3rd degree, and 9 (36%) patients had hemorrhoids of the 4th degree; in the control group, 15 (60%) had hemorrhoids of the 3rd degree and 10 (40%) had hemorrhoids of the 4th degree. There were no statistically significant differences between the groups in these parameters. All the study participants had compensated concomitant diseases, which excluded their increased risk during surgical intervention.

The severity of ODS was assessed using a questionnaire proposed by D.F. Altomare et. al. (2008) with a maximum score of “31” [5]. The severity of pain syndrome was assessed on a 10-point scale.

Results. The assessment of the course of the postoperative period in patients of both groups was performed. On the first day after surgery, patients of both groups reported moderate to severe pain in the anus, the intensity of which was

comparable and averaged 4.9 ± 1.3 points, regardless of the volume of surgery performed. On day 2, the pain was less pronounced and did not differ in intensity in the groups, ranging from 3 to 4 points, on average 3.2 ± 0.7 points, and was almost stopped by the end, amounting to 2.3 ± 0.5 points.

Three days after surgery, 20 (80%) patients in the main group had an act of defecation. In the control group, this indicator was 13 (52%). In others, it was caused by prescribing laxatives or microclysting. At the same time, patients in the main group had significantly less pronounced pain syndrome after defecation, on average 4.5 ± 0.6 points, compared with patients in the control group – 6.4 ± 0.8 points ($p = 0.02$). Upon further observation, it was noted that the pain syndrome in the patients of the main group was shorter in duration and generally stopped by the 6th–7th day after surgery. In patients of the control group, it lasted up to 2 weeks, remaining at the level of 3.2 ± 0.7 points after defecation.

In addition to a less pronounced pain syndrome, other advantages of the course of the postoperative period were noted in patients of the main group. Thus, 6 (24%) of the 25 patients in the control group had reflex urinary retention in the early postoperative period. During surgery and during the first day of the postoperative period, patients in the study group underwent bladder catheterization. After removal of the catheter, all patients regained the ability to urinate independently. In the control group, patients with reflex urinary retention recovered later, 3–4 days after surgery. During this period, constant catheterization of the bladder was required. Observations showed that edema of the perianal region after the first act of defecation was more common in patients of the control group. It was recorded in 8 (32%) patients. In the main group of patients, edema was observed in 4 out of 25 (16%) ($p = 0.01$) and resolved 4–6 days earlier than in the control group.

During the study, it was found that in 20 (80%) patients of the main group, blood excretion during defecation stopped within 9–10 days after surgery. In the control group, a similar result was observed only by 16–18 days. In 3 (12%) patients of the control group, blood excretion lasted up to one and a half months. Three weeks after surgery, none of the patients from the main group had blood discharge from the rectum during defecation.

In all patients of the main group, the vaginal wounds healed by primary tension after rectocele repair. The advantages of the combined treatment method in wound healing after hemorrhoidectomy were confirmed by the results of cytological examination of smears from their edges. Cytological analysis of samples taken from the walls of anal canal wounds in patients of both groups (main and control) on 1–2 days after surgery revealed a similar pattern: the predominance of fresh and altered red blood cells in smears, while microbial flora and other cell types were practically absent in most preparations. On the 3rd day of the examination of samples taken from patients of both groups, a significant accumulation

of neutrophils was observed. The microflora is represented by a small number of disparate elements. Phagocytosis in the vast majority of cases is complete, and its average intensity is 85.3%. On the 4th–5th day of follow-up, all patients of the main group showed signs of tissue repair in their cytograms: mononuclear histiocytes, profibroblasts and fibroblasts were detected. There is a gradual decrease in the level of white blood cells, including phagocytes. In some cases, the detection of an increased concentration of microorganisms in the smears during a favorable course of the wound healing process was interpreted as temporary contamination that occurred during the act of defecation. Starting from the 6th–8th day, there is a further decrease in the level of white blood cells. At the same time, there is an increase in the number of fibroblasts, as well as the appearance of mature connective tissue cells – fibrocytes and epithelial cells. The vast majority of patients in the 21 (84%) control group had delayed cellular response at the stage of inflammation. The granulocytic and macrophage reactions persisted for 3–4 days longer, which led to a later appearance of signs of wound repair on the 6th–8th day of the postoperative period.

On examination 1.5 months after, it was noted that in all patients of the main group, the wounds had healed with the formation of thin elastic postoperative scars. In 16 (64%) patients of the control group, the scars were rough, there were anal fringes, and in 3 (12%) patients, the wounds did not heal during these periods.

In order to evaluate the results of surgical treatment of hemorrhoids within 6 months after surgery, patients of both groups were interviewed and examined with a rectal finger examination. So, when filling out the questionnaire to assess the severity of ODS after surgery, the patients of the main group scored, on average, 4.7 ± 0.7 points, the patients of the control group – 24.3 ± 1.2 points ($p = 0.001$).

During this period, all patients in the main group had a complete recovery, confirmed by the absence of any complaints. A finger examination of the rectum did not cause pain. The postoperative wounds have healed well, with the formation of thin elastic scars. The patients in the control group had worse long-term results, which we associate with this group of patients with ongoing ODS. Thus, 8 (32%) patients complained of pain in the anus and blood discharge at the end of defecation. Cicatricial deformity of the anus was diagnosed in 6 (24%) patients. This complication occurred in those patients who had complications in the wound healing process in the early postoperative period. They underwent a course of treatment, including a bougie procedure. Two patients had non-healing postoperative wounds with thickened cicatricial edges resembling chronic anal fissures.

Conclusion. Thus, patients who underwent hemorrhoidectomy in combination with posterior colporaphy and anterior levatoroplasty for ODS had a more favorable course of the wound process, in particular, and the postoperative period in general. Patients in this group showed less pronounced pain symptoms. In ad-

dition, they were less likely to have inflammatory phenomena in the surgical area, and there was also a faster relief of blood discharge during the act of defecation according to the time of observation.

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DOI 10.34660/INF.2025.38.44.118

动脉高血压和腹部肥胖患者的物理康复效果
**EFFICIENCY OF PHYSICAL REHABILITATION IN PATIENTS
WITH ARTERIAL HYPERTENSION AND ABDOMINAL OBESITY**

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摘要。目的。评估门诊长期剂量治疗性体育锻炼 (TPE) 对动脉高血压 (AH) 患者每日血压监测 (DBPM) 参数、血管壁僵硬性和身体结构代谢指标的影响。

材料和方法。研究对象包括 164 名女性。所有受试者分为 3 组。第一对照组由 42 名无高血压女性组成。第二组 - 62 名患有高血压的女性。第三组 - 60 名患有高血压和腹部肥胖 (HTN with AO) 的女性。在所有研究组中进行以下操作：使用俄罗斯 Petr Telegin LLC 生产的 BPLaB 设备进行 24 小时血压监测；使用西门子 Somatom Emotion 螺旋计算机断层扫描评估身体结构代谢指标 (身体质量指数 (BMI kg/m²)、内脏脂肪面积 (sm²)、内脏脂肪体积 (withm³)、全身肌肉百分比 (%)、皮下脂肪面积 (sm³)；使用 Vasera VS-1000 系列 (Fukuda Denishi, 日本) 上的脉搏描记法研究血管壁的弹性特性；实验室血液测试 - 使用 IMMULITE 1000 分析仪 (西门子诊断, 美国) 上的性激素 (雌激素、孕酮、睾酮) 水平。对高

血压患者采用了一种改良的治疗性运动 (TE) 方法 12 个月。

结果。12 个月的长期控制治疗性体育锻炼期可以最佳地控制 DBPM 指标 - SBP (24) 和 DBP (24)、B SBP(24) 和DBP(24), 确保高血压患者内脏脂肪面积、质量和体积参数下降。

结论。长期门诊阶段的体育锻炼, 形成对女性健康有意识控制的稳定动机, 有助于将DBPM的主要参数维持在目标水平。更年期高血压患者身体结构代谢指标的优化需要额外考虑患者的激素状况。

关键词: 动脉高血压, 代谢指标, 长期治疗性体育锻炼。

Abstract. Objective. *To evaluate the effect of long-term dosed therapeutic physical exercises (TPE) at the outpatient stage on the parameters of daily blood pressure monitoring (DBPM), vascular wall stiffness and metabolic indices of body structure in patients with arterial hypertension (AH).*

Materials and methods. *The study included 164 women. All subjects were divided into 3 groups. The first control group consisted of 42 women without hypertension. The second group - 62 women with hypertension. The third group - 60 women with hypertension and abdominal obesity (HTN with AO). In all study groups the following was performed: 24-hour blood pressure monitoring on the BPLaB device manufactured by Petr Telegin LLC, Russia; assessment of metabolic indices of body structure (body mass index (BMI kg/m²), visceral fat area (sm²), volume of visceral fat (withm³), percentage of total body muscle (%), subcutaneous fat area (sm³) on a Siemens Somatom Emotion spiral computed tomography; study of the elastic properties of the vascular wall using the sphygmography method on a Vasera VS-1000 Series (Fukuda Denishi, Japan); laboratory blood tests - levels of sex hormones (estrogen, progesterone, testosterone) on an IMMULITE 1000 analyzer (Siemens Diagnostics, USA). An adapted method of therapeutic exercise (TE) was used for 12 months for patients with hypertension.*

Results. *The period of long-term controlled therapeutic physical exercise for 12 months optimally controls the achievement and maintenance of target levels of DBPM indicators - SBP (24) and DBP (24), B SBP(24) and DBP(24), ensuring a decrease in the parameters of the area, mass and volume of visceral fat in the group of patients with hypertension.*

Conclusion. *The long-term outpatient stage of physical activity, forming a stable motivation for conscious control of women's health, helps maintain the main parameters of DBPM at the target level. Optimization of metabolic indices of body structure in patients with hypertension during menopause requires additional consideration of the state of the hormonal profile of patients.*

Keywords: *arterial hypertension, metabolic indices, long-term therapeutic physical exercise.*

Introduction

The World Health Organization (WHO) considers high blood pressure (BP) to be one of the most important causes of premature death in the world, defining the importance of this problem [1]. The prevalence of arterial hypertension (AH) among the adult population, according to Russian researchers, is 44%. Over the past few years, according to epidemiological monitoring of AH, there has been an increase in treatment coverage to 75% of patients with AH in Russia, although the effectiveness of treatment in the population does not exceed 30% [2]. Obesity and hormonal imbalance during menopause play a major role in the progression of AH and the growth of cardiovascular complications in the female population. In our country, 57.5% of deaths occur due to cardiovascular diseases, one of the main risk factors (RF) of which is excess weight. Unfortunately, the number of obese and overweight people in the world continues to increase, by 2025 almost 20% of the world's population will suffer from obesity. Moreover, according to the ESSE-RF study, the prevalence of obesity in women in the period from 45-54 years is 2 times higher than in men. [3].

Studies on blood pressure control show that existing drug therapy strategies are far from optimal, as the effectiveness of treatment among men is 5.7%, and 13.5% among women [1, 2]. Therefore, the issue of expanding the use of non-drug therapy tactics, which include exercise therapy (ET), the effectiveness of which has been confirmed by a sufficient number of studies, remains relevant [4, 5, 6].

Despite a large number of studies on the use of physical activity in patients with CVD, the problem of using long-term exercise therapy in patients at the outpatient stage of rehabilitation has not been finally resolved. In this regard, we believe that our study, which allowed us to comprehensively assess the effect of long-term dosed therapeutic physical activity at the outpatient stage on the parameters of daily blood pressure monitoring, elastic properties of the vascular wall and metabolic indices of body structure, taking into account the assessment of the state of individual target organs and markers of hormonal status in overweight women in menopause, is a very pressing problem.

Methods and materials of the study. The study included 164 women. All subjects were divided into 3 groups. The first control group consisted of 42 healthy women, average age 44.43 ± 14.26 years. The second group - 62 women with arterial hypertension, average age 60.69 ± 7.91 years, without abdominal obesity (AG without AO). The third (main) group - 60 women with arterial hypertension and abdominal obesity (AG with AO), average age 57.24 ± 7.41 years. A mandatory condition for women in the first control group was the absence of hypertension in the anamnesis and signs of abdominal obesity during an objective examination. Women in groups 2 and 3 had significantly higher age, waist, hip and BMI compared to the control group. Patients in groups 2 and 3 with hypertension were post-

menopausal (82.3% and 80%, respectively). The maximum percentage of women in groups 2 and 3 had stage 2 hypertension (45.2% and 46.7%, respectively). In group 3, women with hypertension and obesity had stage 1 obesity in 63.3%, stage 2 and 3 accounted for 36.7%.

The study protocol was approved by the Ethics Committee of the Tyumen Cardiology Research Center, Tomsk National Research Medical Center of the Russian Academy of Sciences, Tomsk, Russia (protocol No. 7 dated 17.09.2017). Before inclusion in the study, each participant provided written informed consent for the use of the examination results for scientific purposes.

Patients in all study groups underwent DBPM. Blood pressure monitoring was performed using a BPLaB device manufactured by Petr Telegin LLC, Russia. The study of the elastic properties of the vascular wall was performed using sphygmography on a Vasera VS-1000 Series device (Fukuda Denishi, Japan) with an assessment of the following parameters: SPVR (PVW-R, PVW-L) - the velocity of pulse wave propagation in elastic arteries on the right or left. In a laboratory study, the levels of sex hormones (estrogen, progesterone, testosterone) were studied using the IMMULITE 1000 analyzer. An adapted method of therapeutic physical training (LFK) for patients with hypertension was used for 12 months.

Patients with hypertension were divided into groups with and without exercise therapy at the stage of selecting antihypertensive therapy.

The exercise therapy doctor used an adapted method of exercise therapy for patients with hypertension, aimed at activating the functioning of the cardiovascular system in order to normalize motor-vascular reflexes and metabolic processes. Exercise therapy for hypertension was selected taking into account the stage of the disease and the prevalence of any symptoms. Classes were group-based: 2 times a week, classes were held in the gym for 45 minutes with individual selection and correction of the exercise complex; 5 times a week, patients were asked to independently repeat the developed exercise therapy complex at home. At the same time, the homework included a walking complex of 90 steps/min 5 days a week for at least 40 minutes.

The patient's condition was monitored by a cardiologist after 1, 3, 6, 12 months of therapy, including monitoring of general well-being, blood pressure, heart rate, and, if necessary, ECG. Blood pressure and heart rate were monitored by a physical therapy doctor before and after each session in the gym.

The analysis of the obtained data was carried out using the statistical programs SPSS for Windows. Testing of the distribution parameters was carried out using the Kolmogorov-Smirnov criterion. To determine the statistical significance of differences in continuous values depending on the distribution parameters, the unpaired Student's criterion or the Mann-Whitney U-criterion were used with Bonferroni correction. Continuous variables are presented as $M \pm SD$ (mean \pm standard

deviation) regardless of the criterion used. To identify the relationship between variables, the Spearman and Pearson linear correlation coefficient and the logistic regression method were used.

Results and discussion

In order to assess the features of the studied parameters, a comparative analysis of individual DBPM and pulse wave velocity parameters in the studied groups of women was performed at the first stage of the study. According to literature data and the results of our own studies, obese patients have a number of features of the daily blood pressure profile that cause an increase in cardiovascular risk, aggravating damage to target organs, including [7]. In the 3rd group of patients, we recorded a statistically significant excess of the average daily SBP and DBP, daytime SBP, nighttime SBP in comparison with the 2nd group. In addition, a reliable excess of the B SBP indicator at night was found in the 2nd and 3rd groups of patients in comparison with the group of healthy women ($p < 0.017$). No reliable differences were found between the 2nd and 3rd groups in terms of HR, time index and area index.

According to the data of the conducted studies, obesity contributes to the progression of hypertension. Among people with excess body weight, hypertension is observed 5-6 times more often than in people with normal body weight [3]. It was revealed that a clear tendency towards a uniform increase in the absolute values of the SBP parameters with an increase in the degree of obesity persists. In our study, compared with the data in group 2, in the group with hypertension and obesity at the 2nd degree of obesity, a significant increase in the parameter SBP 24 (147.67 ± 22.77 mm Hg and 153.08 ± 22.3 mm Hg, $p = 0.029$), daytime SBP (126.66 ± 14.22 mm Hg and 138.67 ± 13.14 mm Hg, $p = 0.017$), as well as DBP 24 (11.0 ± 2.37 mm Hg and 11.36 ± 2.20 mm Hg, $p = 0.046$) was recorded. The relationship between obesity and hypertension in female patients is reflected in the numerous correlations we obtained between the parameters of DBPM and BMI (SBP (DN), $p=0.002$; B SBP (DN), $p<0.05$); WC (B SBP (24) and at night, $p<0.01$), OC (SBP (DN), $p=0.006$; B SBP (24) and at night, $p<0.05$).

In hypertension, the condition of the arterial vessel wall changes, and above all, the elastic-viscous properties. The REASON study demonstrated that the higher the vascular wall stiffness (according to the PWV indicator), the higher the mortality [7]. In our study, we analyzed the sphygmometry indicators: PWV-R, PWV-L - the velocity of pulse wave propagation in elastic arteries.

It was revealed that the PWV-R, L values in the 2nd and 3rd groups significantly exceeded the standard values (according to WHO criteria of PWV no more than 10 m/s) and the values in the control group. When dividing patients into a subgroup depending on the degree of hypertension and obesity, it was noted that significantly higher values of PWV-R, L in women in the 2nd and 3rd groups

were at the 3rd degree of hypertension. and grade 3 obesity (15.26 ± 2.53 m/s and 13.55 ± 1.68 m/s, respectively).

Registered correlation relationships of PWV-R, L with DBPM parameters and abdominal obesity parameters (PWV-R with visceral fat area $r=0.827$, $p=0.042$; with visceral fat volume $r=0.774$, $p=0.071$; visceral fat mass $r=0.890$; $p=0.018$); FROM s (In the GARDEN (24) and at night, $r=0.687$, $p<0.01$; OB with SAD (DN), $r=0.650$, $p=0.006$) indicate the presence of a close association of the studied markers, which determine favorable conditions for increasing the rigidity of the arterial wall.

At the stage of work on assessing the effectiveness of long-term dosed therapeutic physical exercises (LFK) carried out at the outpatient stage, we analyzed the parameters of DBPM and SPVR in women from the 2nd and 3rd groups with increased weight and AO in subgroups with or without LFK classes.

The blood pressure parameters in the group of patients with exercise therapy during long-term observation against the background of the conducted combination therapy remained within the target values. In the group without exercise therapy, drug therapy also during the observation period allowed achieving the target values of the parameters SBP (24), DBP (24). The remaining parameters of DBPM did not change significantly against the background of therapy in both groups. In addition, in both groups, the absence of significant changes in the parameters PWV-R, L in dynamics was registered, while fluctuations in their values were maintained within the initial levels.

Despite the fact that before the start of exercise therapy, the groups did not differ significantly in all parameters of metabolic indices of body structure, the dynamics of the indicators after a year against the background of long-term exercise therapy in outpatient settings recorded a reliable decrease in the parameters of the area, mass and volume of visceral fat. At the same time, there is no reliable dynamics of the BMI indicators, the total weight of patients, which seems a little strange. However, it should be noted that, firstly, in the exercise therapy group, a significant ($p = 0.033$) increase in the skeletal-muscular body mass index was recorded, and, secondly, our research involved patients of a special age category - in the menopause period, making up to 80% of the women with hypertension included in the study.

When speaking about women aged 50-60 and older, it is always necessary to take into account their hormonal status. The results of our examination confirmed that patients with postmenopausal hypertension have significantly reduced progesterone levels (Group 2 1.056 ± 1.39 ; Group 3 1.46 ± 3.61 , comparison group 7.48 ± 13.7 nmol/l, $p<0.01$), a clear tendency towards a decrease in estrogen and testosterone levels is revealed compared to the control group.

Our data show that long-term 12-month exercise therapy sessions are not always sufficient to control all metabolic indices of body structure. The weak ten-

dency to decrease overall weight and BMI in such groups of patients, on the one hand, may be determined by an increase in skeletal muscle mass against the background of exercise therapy, and on the other hand, may depend on hormonal and water-salt metabolism disorders. This is confirmed by the registered correlations between the estrogen level indicator and the volume and mass of visceral fat ($r=-0.668$, $p=0.025$; $r=-0.711$, $p=0.010$ respectively). In order to achieve the target results of metabolic body indices, such patients, in addition to following a rational diet, should be recommended to continue regular exercise therapy in an outpatient setting and to conduct scheduled consultations with an endocrinologist and gynecologist for personalized selection of therapy in terms of correcting hormonal disorders.

Conclusion

Based on the conducted study, it can be concluded that, despite the lack of a significant effect on the rigidity of the vascular wall, the presented method of non-drug therapy helps maintain the achieved DBPM parameters at the target level and, by forming a strong motivation for conscious control of health status, can be recommended to patients for wider implementation in clinical practice at the outpatient stage of observation and treatment. Optimization metabolic indices of the body require additional correction of the profile of hormonal disorders.

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DOI 10.34660/INF.2025.42.49.119

通用基台在种植牙修复中的临床应用
**CLINICAL APPLICATION OF UNIVERSAL ABUTMENTS IN
PROSTHETICS ON DENTAL IMPLANTS**

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简介。现代假牙是治疗的主要和最成功的方法。假牙的成功标准已大大扩展，不仅包括客观的临床和放射学数据，还包括美学和生物学指标。

关键词：万能基台、牙周炎、牙种植体。

Introduction. *Modern prosthetics on dental implants is the leading and most successful method of treatment. The criteria for the success of orthopedic prosthetics have expanded significantly, including not only objective clinical and radiological data, but also aesthetic and biological indicators.*

Keywords: *universal abutment, periodontitis, dental implant.*

The introduction of universal abutments (“Flat Abutment”) in dental implantation is an effective method of prosthetics, as it reduces the loss of peri-implant soft and hard tissues in patients with chronic generalized severe periodontitis. The use of such abutments improves the integration of implants, preserves the height of the bone ridge and the health of soft tissues. The “all-on-one” concept in orthopedic rehabilitation reduces the number of surgical stages and treatment time, which has a positive effect on the quality of life of patients and treatment outcomes. The introduction of these abutments in the future will contribute to improving the standards of dental care and rehabilitation.

Objective: To study the clinical effectiveness of using universal abutments (“Flat Abutment”) in dental implantation in patients with severe chronic generalized periodontitis.

Materials and methods: The clinical case presented was a 44-year-old male patient diagnosed with severe chronic generalized periodontitis, where significant bone loss was observed. The treatment included extraction of teeth on the lower jaw, reduction of the alveolar ridge, and installation of 6 dental implants using

universal abutments in the anterior areas and standard multi-units in the posterior areas.

The postoperative period was assessed on a 10-point scale with a focus on pain, aesthetics and discomfort for 7 days. Bone loss was monitored one year after prosthetics.

Results: One year after prosthetics, it was found that the bone loss was only 0.14 mm, which is significantly lower than the physiological level of loss according to the literature (up to 1.18 mm in the first year). This indicates that universal abutments can provide a more stable connection between the implant and the abutment, helping to maintain the level of soft and hard tissues. In addition, patients did not report any esthetic discomfort, which emphasizes the importance of using low-neck abutments and a connective tissue collar to achieve high esthetic indicators. The results are consistent with the data of other authors indicating the benefits of using universal abutments, especially in esthetically significant areas, and emphasize their role in successful prosthetic rehabilitation on dental implants.

Conclusions: The use of “Flat” abutments in combination with spherical abutments provided a positive clinical result for a patient with chronic generalized severe periodontitis. This was manifested in the absence of postoperative swelling, pain and discomfort, as well as high aesthetic indicators and minimal loss of marginal bone tissue.

DOI 10.34660/INF.2025.13.55.120

通过数学建模证实“扁平”多单元的有效性
**SUBSTANTIATION OF THE EFFECTIVENESS OF THE USE OF
“FLAT” MULTIUNITS BY MATHEMATICAL MODELING**

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简介。在外科牙科中，与牙种植体颈部区域骨吸收相关的问题仍然很重要。这是由于磨牙症、种植体定位不当等功能因素以及生物学方面（生物膜形成）造成的。在这方面，牙科中出现了数学建模，这使得在骨科康复框架内更准确地预测生物力学过程成为可能。在这项工作中，有限元法（FEM）用于分析“扁平”多单元的有效性，它提供了结构中负载和应力的详细分布，有助于减少种植体周围区域的骨质流失。

关键词：扁平上部结构、锥形上部结构、扁平基台、稳定性、应力、设计、机械特性、应力、数学建模

目的：评估在牙种植体患者骨科康复过程中使用“扁平”多单元的有效性，使用有限元法（FEM）分析生物力学过程并预测种植体结构中的应力。

Introduction. *In surgical dentistry, issues related to bone resorption in the cervical zone of dental implants are still relevant. This is due to functional factors such as bruxism, inadequate positioning of implants, as well as biological aspects (biofilm formation). In this regard, mathematical modeling has appeared in dentistry, which allows more accurate prediction of biomechanical processes within the framework of orthopedic rehabilitation. In this work, the finite element method (FEM) was used to analyze the effectiveness of “Flat” multi-units, which provides a detailed distribution of loads and stresses in structures, helping to reduce bone loss in the peri-implant area.*

Keywords: *flat superstructures, conical superstructures, flat abutments, stability, stress, design, mechanical characteristics, stress, mathematical modeling*

Objective: To evaluate the effectiveness of using “Flat” multi-units in the process of orthopedic rehabilitation of patients on dental implants, using the finite

element method (FEM) to analyze biomechanical processes and predict stresses in the implant structure.

Materials and methods: In this study, the finite element method (FEM) was used for mathematical modeling of orthopedic bridge structures with planar and conical superstructures supported by IRIS dental implants. The models included three-dimensional representations of components and implants and took into account parameters such as implant dimensions (length 10 mm, diameter 4 mm) and mechanical characteristics of materials (elastic modulus and Poisson's ratio). To analyze the distribution of equivalent von Mises stresses and micro deformations in the structures, an assessment was made of the number of finite elements, their dimensions, and loading conditions, including tightening of superstructures and fixing screws with specified forces. These processes were implemented in the ANSYS 20.0 software package, which made it possible to obtain highly accurate results for assessing the mechanical behavior of orthopedic systems.

Results: Analysis of load distribution in two models shows that the first model - conical superstructures or universal multi-units with high stresses (up to 789.65 MPa) and uneven distribution (with 10% of the surface experiencing critically high stresses) demonstrates less stable behavior, while the second model - flat abutments with lower maximum stresses (up to 679.13 MPa) has a more uniform load distribution, indicating potentially greater strength and durability of the structure as a whole.

Conclusions: Thus, the conducted research proves the importance of determining the mechanical properties of materials and structures to avoid damage and microcracks. Also, understanding deformations, information about how different structures behave under stress, allows us to more accurately predict the behavior of the entire product.

DOI 10.34660/INF.2025.97.21.121

全身血流动力学变化对循环障碍性脑病患者慢性缺血性视神经病变形成的影响

**THE CONTRIBUTION OF CHANGES IN SYSTEMIC
HEMODYNAMICS TO THE FORMATION OF CHRONIC
ISCHEMIC OPTIC NEUROPATHY IN PATIENTS WITH
DYSCIRCULATORY ENCEPHALOPATH**

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摘要。人类寿命的延长必然导致脑血管病患者数量的增加，包括慢性脑缺血-脑血管功能不全 (CVI)。后者病程的特殊性不仅在于这种病理的“年轻化”，而且在于神经功能缺损的转变，以及视神经缺血损伤的征兆，使 CVI 的“典型”症状更加明显，导致这些患者的生活质量下降。确定这些患者视觉障碍发展的病因和发病机制，不仅可以在早期诊断这些疾病，还可以针对这些疾病进行有针对性的治疗。在没有视力下降症状的 ED 患者中，全身血流的变化和随后的视网膜电生理紊乱表明最初潜在的视觉障碍的形成，血流重构的进展导致这些患者出现临床表现的慢性缺血性视神经病变。

关键词。循环障碍性脑病、慢性缺血性视神经病变、颈部血管超声多普勒图、脑血流图、视网膜电图、视觉诱发电位、视野检查。

Abstract. *The extension of human life expectancy invariably leads to an increase in the number of patients with cerebrovascular diseases, including chronic cerebral ischemia - cerebrovascular insufficiency (CVI). The peculiarity of the course of the latter is not only the “rejuvenation” of this pathology, but also the transformation of neurological deficit with the addition of signs of ischemic damage to the optic nerve to the “typical” picture of CVI, which leads to a more pronounced decrease in the quality of life in these patients. Identification of the etiological factors and pathogenetic mechanisms of the development of visual disorders in these patients will allow not only to diagnose these disorders at earlier stages, but also to carry out targeted treatment of these conditions. The revealed changes in systemic blood flow and the subsequent electrophysiological disturbances in the retina in patients with ED without complaints of decreased vision indicate the formation of initially latent, visual disturbances, and the progression of blood flow restructuring leads to the debut of clinically expressed chronic ischemic optic neuropathy in these patients.*

Keywords: *Dyscirculatory encephalopathy, chronic ischemic optic neuropathy, ultrasound Dopplerography of neck vessels, rheoencephalography, electroretinography, visual evoked potentials, perimetry.*

Relevance

Progressive neurological deficit caused by ischemic damage to the white matter of the brain due to chronic cerebral blood flow deficiency gradually leads to a decrease in working capacity and impairment of self-care in an increasing number of people suffering from hypertension and atherosclerotic changes in the cerebral vessels. Ischemic-hypoxic damage affects not only the central nervous system, but also various analyzers, including the visual one, which leads to the emergence and progression of vascular pathology of the eye [2,3,4,5], one of the forms of which is chronic ischemic optic neuropathy. It is known that the main pathogenetic mechanism of cerebral ischemia is the reduction of cerebral blood flow as a result of atherosclerotic and hypertensive changes in the vascular wall [1,3,4,5]. Despite the huge number of different studies of atherogenesis processes and associated vascular diseases, changes in regional blood flow and its impact on visual impairment have not yet been fully studied [5,6,7].

The purpose of the work.

To study the indices of regional blood flow based on the data of ultrasound Dopplerography of the brachiocephalic vessels of the neck (USDG BCA) and rheoencephalography (REG), as well as the results of electroretinography, visual evoked potentials and perimetry in patients with “isolated” cerebrovascular insufficiency and in combination with chronic ischemic optic neuropathy.

Materials and methods.

The study included 85 patients (48% men, 52% women) who were under observation at the Institute of the Federal State Autonomous Institution “National Medical Research Center “Microsurgery of the Eye” named after Academician S.N. Fedorov” of the Ministry of Health of the Russian Federation and the Federal State Budgetary Healthcare Institution “Clinical Hospital of the Scientific Research Center of the Siberian Branch of the Russian Academy of Sciences”. Patients were divided into 3 groups according to the presence/absence of eye and cerebral pathology: the first group (34 people) consisted of patients with a combination of DE and chronic ischemic optic neuropathy, the 2nd group (30 people) - patients only with chronic cerebral ischemia and the third group (20 people) - healthy patients without signs of ischemic damage to vision and the brain. The diagnosis of DE was made to patients based on complaints, anamnesis (confirmed cerebral atherosclerosis, hypertension, the relationship of decompensation of neurological syndromes with the increase in atherosclerotic lesions of the neck vessels, unstable blood pressure), neurological examination, and brain neuroimaging

data. The diagnosis of chronic ischemic optic neuropathy is established on the basis of complaints, characteristic course of the disease (gradual onset, steady progression, bilateral lesions of varying severity), ophthalmoscopy of the fundus (the optic disc is pale with clear boundaries, monotonous, the vessels are moderately narrowed, in some patients - peripapillary atrophy of the choroid, in the macular zone - depigmentation phenomena), the presence of similar background diseases (atherosclerosis of the vessels of the neck, hypertension). The observation group did not include patients with macular dystrophy, diabetic retinopathy complicated by myopia, consequences of inflammatory diseases of the retina and optic nerve, as well as patients with consequences of TBI, meningoencephalitis and demyelinating lesions of the central nervous system.

All patients underwent a series of studies: USDG of the brainstem, REG, electroretinography in various modes (ERG), registration of visual evoked potentials (VEP) and perimetry. Ultrasound scanning was performed on the Aplio XG device, Toshiba (Japan), where hemodynamic and structural parameters of the carotid and vertebral arteries were assessed. REG research was conducted on the rheographic complex “Reo-Spectrum”, Neurosoft, Russia, with determination of the degree of blood filling and tone of the vessels of the brain. To assess the state of the visual analyzer, a number of examinations were performed: scotopic 0.01 and 3.0 ERG with oscillatory potentials, photopic ERG, pattern ERG, where the amplitude and time indices of a- and b-waves, ischemic or transretinal index, oscillatory index, as well as the amplitude indices of N35-P50, P50-N95 and the corresponding time indices of latency P50 and N95 according to pattern ERG were taken into account; as well as perimetry with determination of the indices of retinal sensitivity to light and the magnitude of visual field defects.

Statistical processing was performed using the STATISTIKA10 package.

Results and discussion.

As a result of the studies, a number of hemodynamic disorders were revealed, both at the level of the brachiocephalic vessels and at the level of the arteries inside the brain (Table 1 and Table 2).

*Table 1.
Parameters of USDG of the brachiocephalic vessels (M±σ).*

Index	Group 1 DE + CHION	Group 2 DE	Group 3 norm	Mann-Whitney test
Common carotid artery, blood flow velocity, m/s	0,63±0,13	0,80±0,11	0,86±0,11	P1-2 0,0001 P1-3 0,003 P2-3 0,9
Internal carotid artery, blood flow velocity, m/s	0,56±0,11	0,74±0,13	0,78±0,15	P1-2 0,0001 P1-3 0,0007 P2-3 0,33

Vertebral artery, blood flow velocity, m/s	0,41±0,09	0,45±0,07	0,45±0,03	P1-2 0,02 P1-3 0,003 P2-3 0,34
Stenosis in bifurcation, %	25,7±12,82	10,9±5,07	8,3±4,9	P1-2 0,0001 P1-3 0,0007 P2-3 0,32
Intima-media complex, cm	0,08±0,02	0,07±0,02	0,06±0,01	P1-2 0,03 P1-3 0,01 P2-3 0,64

Table 2.
Comparative characteristics of rheoencephalography indicators ($M \pm \sigma$).

Indicator	Group 1	Group 2	Group 3	Mann-Whitney test
Frequency response index, frontomastoid lead	1,53±0,12	1,94±0,21	1,98±0,08	p1-2 0,08 p1-3 0,01 p2-3 0,87
Frequency response index, occipito-mastoid lead	1,25±0,21	1,55±0,15	1,61±0,1	p1-2 0,09 p1-3 0,01 p2-3 0,74
Dicrotic index, frontomastoid lead	72,9±10,1	68,85±18,91	59,44±12,03	p1-2 0,55 p1-3 0,007 p2-3 0,05
Maximum rapid vessel filling velocity, occipito-mastoid lead, m/s	1,50±0,52	1,65±0,58	1,95±0,14	p1-2 0,98 p1-3 0,008 p2-3 0,01
Average slow vessel filling velocity, occipito-mastoid lead, m/s	0,64±0,3	0,74±0,25	0,98±0,27	p1-2 0,23 p1-3 0,01 p2-3 0,02
Venous outflow index, occipito-mastoid lead, %	10,35±6,99	11,15±3,65	11,1±3,2	p1-2 0,23 p1-3 0,01 p2-3 0,5

Thus, in patients with isolated DE without complaints of decreased vision, a reliable change in only one indicator was recorded - a decrease in the maximum rate of rapid blood filling of vessels by 15%, indicating the presence of angiospasm of large cerebral arteries. It should be noted that this parameter responds to changes in blood flow even when other hemodynamic indicators are still within normal limits. Due to the fact that other reliable disorders of regional and intraorgan blood circulation were not detected, it can be assumed that spasm of large cerebral arteries with subsequent disorganization of blood flow can cause the debut of visual disorders due to initial ischemic damage to the conduction pathways of the visual analyzer. The subsequent addition of spasm of medium and small caliber

arteries (a reliable decrease in the average rate of slow filling of vessels by 1.5 times compared to the control group), accompanied by a decrease in systolic blood flow to the brain (a reliable decrease in the amplitude-frequency index by 20%, mainly in the carotid basin), a sharp loss of elasticity of large arteries (an increase in the dirotic index by more than 20%, $p < 0.01$), as well as a violation of venous outflow, against the background of progressive stenosis in the bifurcation area of the common carotid arteries with a decrease in the blood flow velocity in them, are the causes of the progression of visual disorders and the appearance of clinically pronounced chronic ischemic neuropathy of the optic nerve.

Reduction of blood flow inevitably leads to the appearance of hypoxic-ischemic changes in the cells of the brain and the visual analyzer. In order to identify these changes, the above-mentioned electrophysiological studies were carried out. Based on the ERG results under various conditions of light stimulation, the following ($p < 0.01$) pathological functional changes in retinal electrogenesis were determined in patients of the first group: a 20-40% decrease in the amplitude of a- and b-waves, with a simultaneous prolongation of latency up to 30%, a 1.3-fold decrease in the b/a index, and a 3.5-fold decrease in the oscillatory potential index with a simultaneous decrease in the amplitude of the latter by almost 2 times. Based on the pattern ERG results, a violation of neuroconduction was revealed at the level of the 3rd retinal neuron: a 2-fold decrease in the amplitude of N35-P50 and P50-N95 ($p < 0.01$). These changes indicate ischemic damage to all retinal layers and explain a more than 10-fold decrease in retinal light sensitivity and a more than 2-fold increase in the area and depth of visual field defects, identified during perimetry. In patients with isolated DE, a number of disorders were also revealed: a decrease in the b/a index by 15% ($p < 0.01$), a slowdown in the speed of nerve impulse conduction in the form of an increase in the latency of the b-wave by 10% ($p < 0.01$) and the amplitude of the b-wave by 11% ($p < 0.01$).

In order to clarify the presence of relationships between regional blood flow disorders and structural and functional changes in the visual analyzer in patients with combined pathology, a correlation analysis was carried out, which revealed the following:

1. An increase in the degree of stenosis of the common carotid arteries with a concomitant decrease in blood flow velocity in the ICA is associated with a deepening of ischemic processes in the inner layers of the retina (a decrease in the amplitude of P2 oscillatory potentials).
2. Thickening of the intima-media complex correlates with:
 - worsening of neuroconduction in the visual analyzer inside the brain (decreased amplitude of P100 visual evoked potentials),
 - occurrence and progression of degenerative changes in the retina in the nerve fiber layer (decrease in the thickness of the nerve fiber layer of the lower half of the retina),

- increase in the area and depth of visual field defects (increase in the square of the dispersion of retinal photosensitivity).
3. A decrease in the level of systolic blood flow to brain tissue (decrease in the amplitude-frequency indicator) is consistent with:
- worsening of neuroconduction in the central part of the visual analyzer (decrease in the amplitude of P100 visual evoked potentials) and in the peripheral part of the visual analyzer (increase in the latency of the b-wave of the scotopic 3.0 ERG).
1. Increased tone of large vessels of the neck and brain (decreased maximum rate of rapid filling of vessels) correlates with worsening of neuroconduction between the first two neurons of the retina (increased latency of b-wave of scotopic 3.0 ERG).
2. Increased total peripheral vascular resistance (increased dirotic index of REG) correlates with increased area and size of visual field defects (increased square of dispersion of retinal photosensitivity).
- Thus, changes in regional blood flow at the level of brachiocephalic vessels and vessels of the brain may be one of the reasons for the occurrence and progression of chronic ischemic optic neuropathy in patients with DE.

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北极地区桥台附近土路堤渗透结果

THE RESULTS OF THE SOIL EMBANKMENT PENETRATION IN THE ARCTIC ZONE FOR SITE NEAR BRIDGE ABUTMENT

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摘要。本文致力于利用动态锥形探入仪对北极某座桥梁结构引桥路堤的土壤进行勘测。简要介绍了该设备及其工作原理。

关键词：穿透、动态探测、锥形探入仪、引桥路堤。

Abstract. *This article is devoted to the survey of the soils of the approach embankment to a bridge structure in the Arctic using a dynamic cone penetrometer. A brief description of the device and its operating principle are given.*

Keywords: *penetration, dynamic probing, cone penetrometer, approach embankment.*

Introduction

In the summer of 2024, a research internship was held, in which employees, postgraduate students and students of the Russian University of Transport (RUT (MIIT) took part.

One of the objects of the study was the approach embankments to the railway bridge.

Dynamic probing (penetration) of the embankment

According to GOST 19912-2012, dynamic probing is the process of immersing a probe into the soil under the action of an impact load or shock-vibration load with the measurement of the soil resistance to the penetration of the probe. Probing is performed using a dynamic cone penetrometer [1-7].

Methods of field testing of soils by probing are used in combination with other types of engineering-geological work or separately for:

- identifying engineering-geological elements (thickness of layers and lenses, boundaries of distribution of various types of soils);
- assessing the spatial variability of the composition, condition and properties of soils;
- determining the depth of the roof rocky, coarse-grained and frozen soils;
- quantitative assessment of physical and mechanical characteristics of soils (density, deformation modulus, angle of internal friction and adhesion, etc.);
- determination of the degree of compaction and strengthening of soils in time and space;
- as well as other tasks [1].

In the context of practice, the tasks of determining the depth of frozen soils and the degree of strengthening of embankment soils were the main ones.

An example of the use of soil penetration data is:

- plotting graphs of penetrometer tip resistance (soil) versus penetration depth;
- plotting a graph of the DCPI (Dynamic Cone Penetrometer Index) [?] parameter versus probing depth. DCPI is a parameter characterizing the depth of immersion of the penetrometer probe per 1 hammer blow;
- plotting the dependence of the relative density parameter (D_r) on penetration depth. The correlation between the DCPI parameter and the relative density (D_r) is expressed by the formula [2], [3]:

$$D_r(\%) = 189.93/DCPI^{0.53} \quad (R^2=0.98) \quad (1)$$

The description of sandy soil using DCPI and D_r parameters is presented in Table 1.

Table 1
Classification for assessing relative density using DCPI [2], [3].

DCPI, mm/stroke	Relative density, %	Soil condition
>42	<25	Very loose
42-23	25-35	Loose
23-12	35-50	Average
12-5	50-75	Dense
<5	>75	Very dense

Soil testing by dynamic probing is regulated by regulatory documents in different countries.

In Russia, this is GOST 19912-2012 “Methods of field testing by static and dynamic probing”.

French standard NF P 94-105 - this standard is referred to by the creators of the “Panda” penetrometer, which was used by the participants of the internship on the trip to Yamal.

Operating principle of the dynamic cone penetrometer “Panda”

The device comes with rods (50 cm each), a conical tip with an angle of 60 degrees and a cross-section of 2 cm², a microprocessor with a screen for data output, a cord for measuring data, a hammer with a known mass. The rod is connected to an “anvil”, which is struck with a hammer, due to which the rod penetrates the soil. The blows on the anvil should be of the same force and (ideally) with an interval of 2 seconds [4].

When the hammer strikes, the device records two values: the depth of penetration of the tip upon impact – the same DCPI, and the speed with which the hammer strike was made. Then the cone resistance and the total penetration depth are calculated and displayed on the screen (Figure 1). The general form of the “Dutch” formula (2) is suitable for penetrometers with a fixed hammer drop height. For the “Panda” device, in which hammer strikes are made manually, a modified form of formula (3) is used. The first is expressed through potential energy, the second – through kinetic energy. For this purpose, the device records the hammer strike speed.

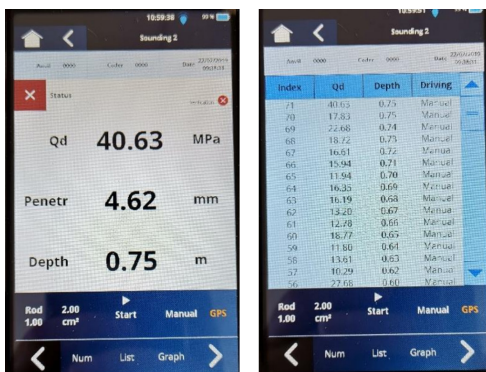


Figure 1. Interface of the “Panda” device

The resistance of the cone is calculated using the “Dutch” formula [4,5,6]:

$$Q_d(z) = \frac{1}{S+\epsilon} * m * g * H * \frac{m}{m+p} \quad (2)$$

$$Q_d(z) = \frac{1}{S+\epsilon} * \frac{mV^2}{2} * \frac{m}{m+p} \quad (3)$$

where Q_d – resistance of the cone tip;

S – cross-section of the cone;

ϵ – depth of penetration of the tip at each blow;

m – mass of the hammer;

H – height of the hammer fall;
 V – speed with which the hammer strikes the “anvil”;
 p – mass of the penetrometer; g – acceleration of gravity.

Processing of approach embankment penetration data

The result of processing the penetration data is probing diagrams, clearly showing the cone resistance at a certain depth. The vertical axis of the graph shows the penetration depth (m). The horizontal axis shows the cone resistance (MPa).

The penetration was performed along the contour of three transverse embankment profiles, as well as on the high river bank. A total of 39 diagrams were constructed. Some of them show sharp deviations of the graph line to the right (towards higher cone resistance values) and equally sharp returns (Figure 2). These deviations can be explained by the penetration of the geotextile layer in the embankment.

The cone tip resistance values during penetration were recorded within the range from 40 to 85 MPa at a depth of 0.5-0.8 m. In almost all cases, it was not possible to drive the rod below 1.3 m. On average, across all the probes, solid soils begin at a depth of 0.9-1.2 m. However, there were places where the depth of the penetrometer penetration reached 3 m (Figure 3) and more.

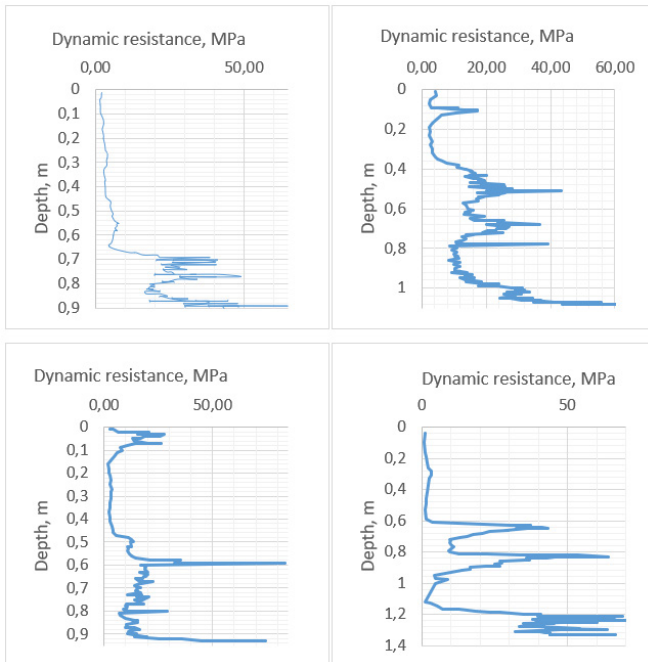


Figure 2. Soil probing diagrams of a railway embankment

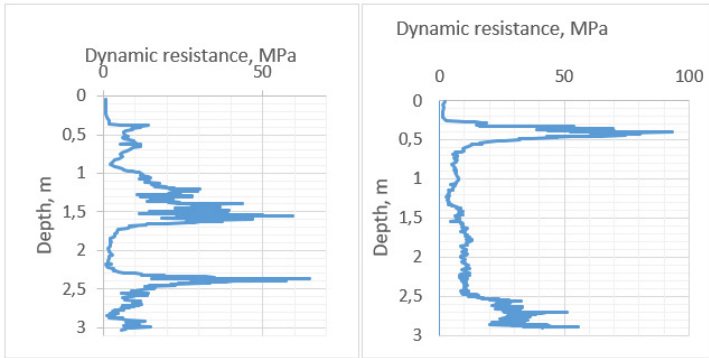


Figure 3. Railway embankment soil probing diagrams. Soil penetration at 3 m

Probing of the embankment on the high (eroded) river bank was also carried out (Figure 4).

Three probings were made at a distance of 12 m and 25 m from the bridge with a step of 5 m. Using probing, it was established that the depth of soil thawing on the bank is about 0.75 m, below which the frozen soil begins.

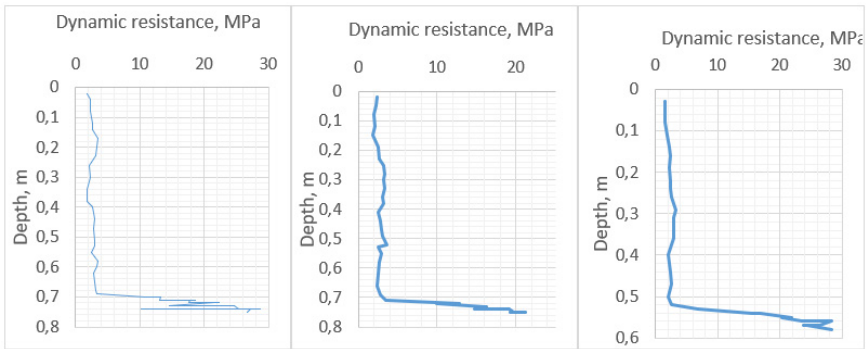


Figure 4. Soil probing diagrams of a high river bank

Conclusions. The dynamic cone penetrometer is an easy-to-use device that is used to study soil to a depth of up to 3 m, including in difficult conditions with limited access.

Using a cone penetrometer and the dynamic probing method on an approach railway embankment in the Arctic, probing diagrams were obtained that made it possible to estimate the depth of soil thawing, its density and resistance in space.

Geotextile layers in the embankment were also detected and the resistance of these layers was determined.

Further development of the research is aimed at laboratory testing of the penetration of a soil massif reinforced with high-strength geotextiles.

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褐煤粉尘润湿效果研究

STUDY OF THE EFFECTIVENESS OF WETTING BROWN COAL DUST

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摘要。煤炭开采和加工过程中产生的粉尘对环境和工业构成重大挑战，对工人健康和环境产生负面影响。本研究重点关注褐煤粉尘颗粒的沉积，这是煤炭开采过程中的一个关键方面。正确使用润湿剂不仅可以提高工艺效率，还可以降低职业健康风险。褐煤颗粒的沉降对采矿和化学工业以及环境保护至关重要。本文研究了沉降机理、影响颗粒沉积速率和有效性的因素以及提高褐煤悬浮液稳定性的方法。这个问题的相关性源于需要改进煤层开采时的抑尘方法，因为煤层开采会产生大量的粉尘和排放。本文描述了褐煤颗粒沉降的机理。研究发现，当润湿剂 SP-01 浓度为 0.3% 至 0.5% 时，褐煤粉尘细颗粒的润湿时间急剧减少。

关键词：粉尘、褐煤、重力、表面活性剂、润湿剂浓度、临界胶束浓度。

Abstract. Dust generated during coal mining and processing poses significant environmental and industrial challenges, negatively affecting worker health and the environment. This study focuses on the deposition of brown coal dust particles,

a critical aspect of the coal mining process. Proper use of wetting agents not only enhances process efficiency but also reduces occupational health risks. The sedimentation of brown coal particles is vital in the mining and chemical industries, as well as in environmental protection. This article examines the mechanics of sedimentation, factors influencing the rate and effectiveness of particle deposition, and methods to improve the stability of brown coal suspensions. The relevance of this issue stems from the need to improve dust suppression methods when mining coal seams, which involve significant dust generation and emission. The mechanism of brown coal particle sedimentation is described. It was found that a sharp reduction in the wetting time of fine fractions of brown coal dust occurs at a wetting agent SP-01 concentration ranging from 0.3% to 0.5%.

Keywords: dust, brown coal, gravity, surfactants, wetting agent concentration, critical micelle concentration.

Introduction

In today's world, occupational safety and environmental protection are increasingly important. A key problem in this domain is dust control, particularly during the processing of materials like brown coal. Dust generated during brown coal processing is a critical issue in the coal industry. Such dust not only worsens working conditions but also poses a serious threat to human health and the environment. Therefore, developing effective methods to control and reduce dust formation is becoming increasingly essential [2, 4].

One promising approach to addressing this problem is the use of wetting agents, which can significantly reduce the amount of dust released into the atmosphere. Wetting agents applied during coal processing help suppress dust by retaining particles and preventing their dispersal. This can improve working conditions and reduce the risk of occupational diseases among coal industry workers [1].

Theoretical and Experimental Studies

The processing of brown coal involves mining, transportation, and processing operations, during which dust is a significant byproduct. This dust, containing fine particles of coal and other minerals, can adversely affect both worker health and the environment. Inhalation of coal dust may lead to respiratory diseases, allergic reactions, and other severe health issues. Wetting agents provide an effective method for controlling dust formation [3, 6].

Wetting agents work based on adsorption, adhering to the surface of dust particles and altering their properties. Consequently, the particles become more hydrophilic and more easily wetted by water. This causes the dust particles to agglomerate and settle under the influence of gravity. Wetting agents can be anionic or cationic, with the choice depending on the specific conditions of coal processing. Anionic agents are generally more effective in hard water conditions, while cationic agents perform better in acidic environments [5].

When wetting agents are added to water used for coal moistening, the following effects occur:

- *Reduction in Surface Tension:* Wetting agents lower the surface tension of water, allowing it to penetrate coal pores and coat its particles more effectively;
- *Particle Flotation:* Wetting agents form a film around coal particles, increasing their mass and aiding their sedimentation [4, 7];
- *Dust Reduction:* Moisturized coal particles are less susceptible to mechanical impacts, reducing the likelihood of their disintegration and dust formation.

Integrating wetting agents into the technological processes of brown coal processing can significantly decrease dust levels. Studies indicate that wetting agents can reduce dust formation by 30-50%, depending on the type of coal and processing conditions. This not only enhances working conditions but also ensures compliance with environmental standards [7].

For sedimentation studies, coal samples of the following technical grades were selected: B (brown coal), 3B (third-grade brown coal), and 3BV (third-grade brown vitrinitic coal). These samples, characterized by medium ash content and high susceptibility to oxidation and explosiveness, were divided into three fractions based on particle size: less than 0.04 mm, 0.04–0.071 mm, and 0.1–0.25 mm. The experiments employed SP-01 wetting agent solutions with concentrations ranging from 0.05% to 4.5%. Particle sedimentation was conducted under laboratory conditions, and the sedimentation time for each fraction was measured.

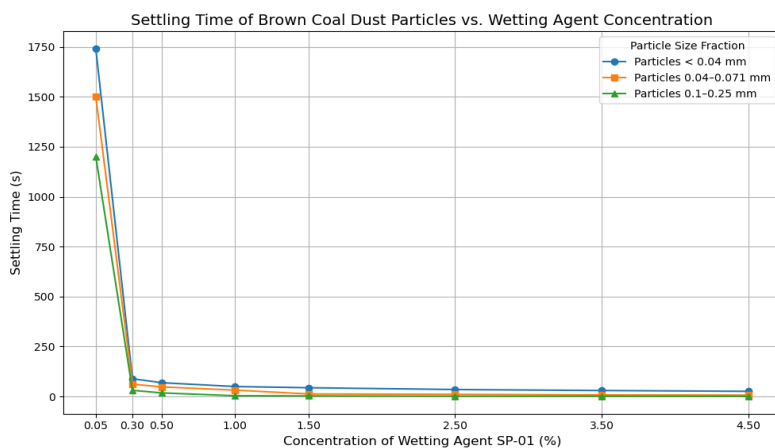


Figure 1. Dependence of sedimentation time of coal dust particles on wetting agent concentration

The sedimentation times are presented in Figure 1. Analysis shows a sharp reduction in sedimentation time within the concentration range of 0.05% to 0.3%. For particles smaller than 0.04 mm, the sedimentation time decreased from 1740 seconds to 89 seconds (a 19.6-fold reduction); for the 0.04–0.071 mm fraction, from 1500 to 62 seconds (a 24.2-fold reduction); and for the 0.1–0.25 mm fraction, from 1200 to 31 seconds (a 38.7-fold reduction). This indicates a critical wetting agent concentration at which maximum process efficiency is achieved.

Based on the measured sedimentation times, particle sedimentation velocities for each fraction were calculated, depending on the wetting agent solution (Table 1).

Table 1.
Brown Coal Dust Particle Sedimentation Velocity

No.	Wetting Agent Concentration (%)	Particle Size Fraction (χ , mm)					
		$x < 0,04$		$0,04 \leq x < 0,071$		$0,1 \leq x < 0,25$	
		Velocity (cm/s)	Time (s) per 1 cm	Velocity (cm/s)	Time (s) per 1 cm	Velocity (cm/s)	Time (s) per 1 cm
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>
1	0,05	$5,7 \cdot 10^{-3}$	174,0	$6,67 \cdot 10^{-3}$	150,0	$8,33 \cdot 10^{-3}$	120,0
2	0,3	$11,24 \cdot 10^{-2}$	8,9	$16,13 \cdot 10^{-2}$	6,2	$32,26 \cdot 10^{-2}$	3,1
3	0,5	$14,49 \cdot 10^{-2}$	6,9	$20,83 \cdot 10^{-2}$	4,8	$55,56 \cdot 10^{-2}$	1,8
4	1,0	$20,0 \cdot 10^{-2}$	5,0	$31,25 \cdot 10^{-2}$	3,2	2,5	0,4
5	1,5	$22,73 \cdot 10^{-2}$	4,4	$76,92 \cdot 10^{-2}$	1,3	3,33	0,3
6	2,5	$28,57 \cdot 10^{-2}$	3,5	$90,91 \cdot 10^{-2}$	1,1	5,78	0,173
7	3,5	$33,33 \cdot 10^{-2}$	3,0	1,25	0,8	6,41	0,156
8	4,5	$38,46 \cdot 10^{-2}$	2,6	1,43	0,7	10,0	0,1

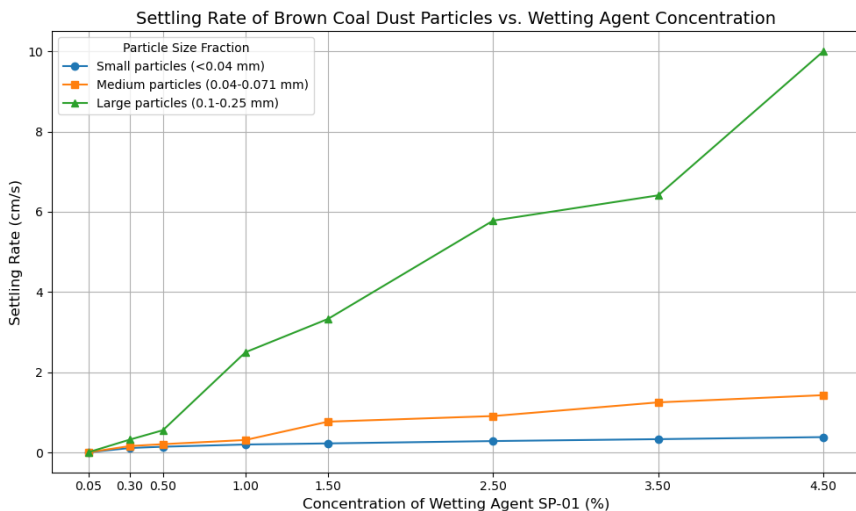


Figure 2. Dependence of sedimentation velocity of coal dust particles on wetting agent concentration

Figure 2 illustrates the relationship between sedimentation velocity and wetting agent concentration. The data indicate a substantial increase in sedimentation velocity up to a 0.5% concentration, especially for medium and large fractions, suggesting this concentration corresponds to the adsorption capacity of the wetting agent by coal dust.

During the study, the ratios of particle masses and sedimentation velocities were also calculated. Assuming spherical particle shapes, the mass ratios for fine, medium, and large fractions were 1:6:199.08, respectively. However, the velocity ratios between these fractions were 1:3.7:26. This demonstrates that increasing particle mass does not lead to a proportional increase in sedimentation velocity. These findings highlight that the sedimentation process is complex and depends not only on gravity but also on frictional forces, buoyancy, and other factors.

Conclusion

The study of sedimentation processes for brown coal dust particles using wetting agents revealed the necessity for more detailed investigations to enhance dust suppression efficiency. Additionally, a clear dependency was observed between sedimentation velocity and wetting agent concentration, alongside the effects of gravitational forces on particles. For each particle size range, the process is characterized by a balance of these forces, with certain forces dominating under specific conditions. The use of wetting agents significantly reduces sedimentation time,

lowering airborne dust levels. Optimal wetting agent concentrations, corresponding to the adsorption capacity of coal dust, should be employed for effective dust suppression.

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多模态可解释人工智能的分层方法：解释的增量集成

HIERARCHICAL APPROACH TO MULTIMODAL EXPLAINABLE ARTIFICIAL INTELLIGENCE: INCREMENTAL INTEGRATION OF EXPLANATORY

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摘要。本文介绍了一种多层多模态可解释人工智能 (XAI) 框架, 该框架专为跨学科研究而设计, 其中人工智能驱动的见解的透明度至关重要。我们的方法包含五个关键模块:

1. 深度神经网络 - 提取特征并提供初始分类或聚类。
2. XAI 工具 (例如 Grad-CAM、SHAP) - 生成局部归因, 突出显示对神经网络决策影响最大的显着区域或特征。
3. 软模型 - 应用启发式阈值和特定领域的分割来进一步细化和解释原始解释信号。
4. 中间模型 - 将预测、启发式输出和相关元数据整合到结构化的“草稿”解释中。
5. 最终生成模型 - 通过使用大型语言模型将中间发现情境化, 生成全面、人类可读的报告。

提出的级联本质上是多模态的, 集成了图像、表格数据和文本。通过引入“软”启发式层, 领域专家可以调整敏感度阈值, 以更好地捕获不同数据源中的异常或关键变化。最终的生成组件通过创建将模型预测与基础证据联系起来的叙述式解释, 进一步丰富了可解释性。环境监测、地质学、工程学和社会科学等不同领域的实验和用例表明, 该框架促进了高水平的透明度、适应性和用户信任。

关键词: 多模态可解释人工智能 (MXAI)、分层架构、软描述符、生成语言模型、领域适应性。

Abstract. *This paper introduces a multilayered multimodal Explainable Artificial Intelligence (XAI) framework designed for interdisciplinary research,*

where the transparency of AI-driven insights is paramount. Our approach incorporates five key modules:

1. *Deep Neural Network* – Extracts features and provides initial classification or clustering.
2. *XAI Tools* (e.g., Grad-CAM, SHAP) – Generate localized attributions, highlighting the salient regions or features that most influence the neural network’s decisions.
3. *Soft Model* – Applies heuristic thresholds and domain-specific segmentation to further refine and interpret the raw explanatory signals.
4. *Intermediate Model* – Consolidates predictions, heuristic outputs, and relevant metadata into a structured “draft” explanation.
5. *Final Generative Model* – Produces a comprehensive, human-readable report by contextualizing the intermediate findings with large language models.

The proposed cascade is inherently multimodal, integrating imagery, tabular data, and text. By introducing a “soft” heuristic layer, domain experts can adjust sensitivity thresholds to better capture anomalies or critical variations in different data sources. The final generative component further enriches interpretability by creating narrative-style explanations that link model predictions to underlying evidence. Experiments and use cases across diverse fields—including environmental monitoring, geology, engineering, and social sciences—demonstrate that this framework fosters high levels of transparency, adaptability, and user trust.

Keywords: Multimodal Explainable Artificial Intelligence (MXAI), hierarchical architecture, soft descriptors, generative language models, domain adaptability.

Acknowledgments: The research was carried out within the state assignment of Ministry of Science and Higher Education of the Russian Federation (theme No. 124092700007-4)

Introduction

The exponential growth and complexity of data across diverse fields—such as environmental monitoring, geology, engineering, and social sciences—demands sophisticated analytical systems capable of producing transparent results. Traditional deep learning methods, although powerful in extracting features from large datasets, are frequently treated as “black boxes,” limiting trust and interpretability for domain experts. To address this challenge, explainable artificial intelligence (XAI) techniques have gained significant momentum, as they offer insights into the decision-making process of AI models [1–5].

Recent advances underscore the importance of multimodality in XAI systems: instead of analyzing only one type of data (e.g., images or text), a multimodal

architecture can simultaneously process images, tabular data, and textual information [7–8]. By combining multiple data sources, the AI system can provide richer, more comprehensive explanations. Moreover, the interpretation of deep neural network outputs can be facilitated by methods such as Gradient-Weighted Class Activation Mapping (Grad-CAM) [9] and SHAP (SHapley Additive exPlanations) [6], which highlight the most influential features or regions responsible for a model’s decision.

The proposed approach in this paper is a multilayered “cascade” designed to seamlessly integrate multimodal data streams and explanatory modules (see Figure 1).

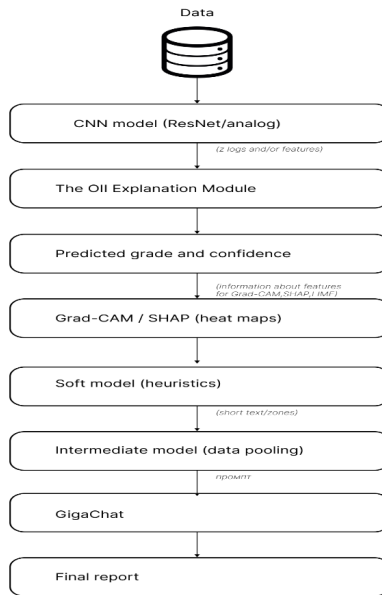


Figure 1. Multilayered Cascade for Integrating Multimodal Data Streams and Explainability Modules

The central idea is to fuse:

1. A Deep Neural Network for initial feature extraction and classification,
2. XAI Tools (Grad-CAM, SHAP) for highlight-based explanations,
3. A Soft Model that applies heuristic thresholds and domain-specific segmentation,
4. An Intermediate Model that consolidates these explanatory cues into coherent text or structured descriptors,

5. A Final Model (a large language model) that generates a comprehensive report, understandable to non-technical stakeholders.

This cascade offers multiple benefits. First, it handles various data types (images, text, and tabular data) in parallel, which itself can be considered a form of multimodality: at each stage, the relevant explanations and features from different sources are combined. Second, the existence of a “soft” interpretive layer ensures that domain-specific heuristics can be flexibly adjusted, thereby improving the transparency and reliability of the system’s recommendations. Third, the final generative model enriches the explanation by contextualizing the discovered patterns, providing detailed human-readable reports.

Implementation Details: Block Diagram Overview

1. CNN Model (e.g., ResNet50):
 - Outputs a vector of logits $z \in R^2$.
 - Defines:

$$\text{predClass} = \text{argmax}(z), \text{Confidence} = \text{max}(\text{softmax}(z)).$$
2. XAI Tools (Grad-CAM and SHAP):
 - Generate heatmaps ($\text{CAM}(x)$) and feature importance maps ($\text{shapValues}(x)$) as the primary sources of explanations.
3. Heuristic Segmentation («Soft» Model):
 - Identifies “hot” regions in the heatmap:

$$\text{Hot}(\text{HeatMap}) = (i, j) | \text{HeatMap}[i, j] > \tau.$$
 - Calculates the proportion of “hot” regions in predefined zones (e.g., central or peripheral areas for images) and formulates a brief textual description.
4. Intermediate Model and GigaChat:
 1. Inputs:
 - Predicted class (predClass)
 - Confidence score (Confidence)
 - Brief descriptors from Grad-CAM and SHAP generated by the heuristic module.
 - Additional text-based metadata, if applicable.
 2. Outputs a comprehensive text draft that integrates multimodal data segments. This draft is then fed into GigaChat as a structured prompt:

$$\text{Prompt} \leftarrow (\text{predClass}, \text{Confidence}, \text{softDescr}, \text{metaData})$$
 3. GigaChat generates the final report (e.g., “Signs of surface contamination in a water body detected. Further analysis recommended.”).

Conclusion

The proposed approach was previously tested on medical data and published in article [10]. This study presents a methodology for creating hierarchical multimodal explicable AI systems. The proposed system starts with a single type of

data, such as images, and gradually adds explanatory layers using special modules. The architecture combines five key components: a deep neural network for primary processing, explainability tools for visualization, a soft descriptor model based on heuristics, an intermediate pooling layer, and a language model for creating detailed text reports. Combining various explanatory materials, including visualizations such as heat maps and segmentation maps, numerical data, and detailed descriptions, provides a holistic and comprehensive view of the system's performance. The adaptability of the presented system makes it possible to apply it in multidisciplinary fields. Customizable heuristic methods and the creation of user-friendly data improve the accuracy of the system, as well as its credibility. The described hierarchical structure lays the foundation for bridging the gap between complex AI algorithms and the practical requirements of domain experts, providing a deeper understanding of the results obtained using AI.

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DOI 10.34660/INF.2025.76.44.125

UDC 58.02:631.524.01

克里米亚柿子品种的种植, 考虑抗寒能力和气候条件

**PLACEMENT OF PERSIMMON VARIETIES IN CRIMEA,
TAKING INTO ACCOUNT FROST RESISTANCE AND CLIMATIC
CONDITIONS**

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摘要。 柿子是克里米亚流行的亚热带作物。一项评估三种柿子（高加索柿子、弗吉尼亚柿子和东方柿子）抗霜冻性的研究表明，弗吉尼亚柿子更适应该地区的气候条件，并且抗霜冻。为了培育更稳定的品种，使用处女柿子作为砧木。根据抗霜冻数据，优化了柿子种植地点的选择，创建了霜冻风险地图：红色表示风险高，绿色表示没有重大损害。克里米亚南部海岸适合种植东部柿子，黑海地区和中部地区适合种植抗霜冻能力较弱和中等的品种，这些品种能够承受低至零下 19 °C 的温度。由于其生物和环境特性，抗霜冻的处女柿子品种可以在整个克里米亚种植，而不会产生重大的作物损失风险。这些研究有助于为克里米亚特定地区选择柿子品种，提高其在半岛和大陆南部地区的种植效率。

关键词： 柿子、抗霜冻、品种、果实种植、产量、克里米亚。

Abstract. *Persimmon is a popular subtropical crop in Crimea. A study assessing the frost resistance of three types of persimmon – Caucasian, Virginian and oriental – showed that the Virginian persimmon is better adapted to the climatic conditions of the region and is resistant to frost. To create a more*

stable assortment, Virgin persimmon is used as a rootstock. Based on the data on frost resistance, the choice of persimmon locations was optimized, maps with the risk of frost damage were created: red indicates a high risk, green indicates the absence of significant damage. The southern coast of Crimea is suitable for eastern persimmons, the Black Sea regions and the central part are suitable for weak and medium frost-resistant varieties capable of withstanding temperatures up to minus 19 °C. Frost-resistant varieties of Virgin persimmon can be grown throughout the Crimea without significant risk of crop loss due to their biological and environmental characteristics. These studies help to select persimmon varieties for specific areas of Crimea, increasing the efficiency of their cultivation both on the peninsula and in the southern territories of the mainland.

Keywords: *persimmon, frost resistance, varieties, fruit growing, yield, Crimea.*

Introduction

Three main types of persimmons are grown in Crimea, which are of great importance for fruit growing – Caucasian, Virginian and Oriental persimmons. Each of these species has its own characteristics, which were formed in different centers of origin. The Oriental persimmon originated in China, the Virginian in North America, and the Caucasian in the territory adjacent to the southern and central Caucasus. These persimmon species differ from each other in their ecological and biological characteristics. [9].

Among the many varieties of persimmon, according to the results of numerous studies, the Virginian persimmon is the most resistant to various climatic and soil conditions [5, 6]. It is often used as a basis for grafting many varieties of oriental persimmon and is highly resistant to low temperatures. This species is able to withstand cold temperatures up to minus 25 °C and below, depending on the region of growth.

Unlike oriental persimmon, which can withstand frosts up to minus 12 °C, and Caucasian persimmon, which can withstand up to minus 20 °C, this species demonstrates higher frost resistance [7, 20, 21]. In the southern regions, varieties are often grown, the fruits of which are eaten fresh. They are rich in vitamins and nutrients [16]. The fruits of this plant can be used not only fresh. Compotes, jams, pastilles, dried fruits and much more are made from them [1, 18]. In addition, other parts of the plant can be used in persimmons. For example, the leaves and young shoots are suitable for making tea. Virginia persimmon is mainly used for this purpose [15].

Unfortunately, there are no extensive industrial persimmon plantations in Crimea yet, as is observed in the main countries of its cultivation and in the southern regions of the country. In places such as the Caspian Sea, the Kuban region, Southern Dagestan and the Caucasus, the cultivation of this subtropical crop has

been developed since the Soviet Union [2, 4, 14]. Until recently, persimmons could only be found on private homesteads. However, recently the first farm was founded in the Bakhchisarai district, which decided to establish an industrial garden of oriental persimmon on an area of 4 hectares [10].

As a result of climate change on the peninsula in recent years [3], this culture has been able to spread to northern and previously unsuitable regions, as well as inland to a temperate zone.

This is possible only with the use of frost-resistant varieties and hybrids of oriental and Virginian persimmons, which, due to their biological characteristics, can withstand low winter temperatures.

Fruit breeders from various breeding institutions strive to improve and preserve these characteristics [12].

By creating new and exploring existing varieties and hybrids that have an attractive appearance, excellent consumer properties and sufficient frost resistance, scientists thereby contribute to increasing industrial production of persimmons in suitable regions, following the example of their foreign colleagues [8,11,13].

In order to successfully grow persimmons in conditions of negative temperatures, it is necessary to carefully select varieties and optimize their placement on the territory. Fruit scientists from Romania conducted a study on subtropical crops such as figs, persimmons and unabi. They studied how climate change in their country affects these plants, and created a map on which they identified regions suitable for their cultivation [17]. Areas with a high risk of frost damage to generative and vegetative parts of the aboveground part of plants, as well as low-risk regions where the crop will not suffer much from frost, were marked on the map.

The purpose of the study is to optimize the location of persimmon varieties on the territory of Crimea, depending on their resistance to low temperatures during a period of deep (organic) rest.

Research materials and methods

The research was carried out within the framework of the initiative on the basis of the Department of Fruit and Vegetable Growing and Viticulture of the Institute “Agrotechnological Academy” of the V.I. Vernadsky Crimean Federal University, as well as at the Federal State Budgetary Institution “Center of Agrochemical Service “Krymsky”. The main direction of the work was a comparative analysis of data on minimum air temperatures obtained from weather stations with the international classifier “WMO_ID” using the open databases of the Federal Hydrometeorological Service and the resource <https://rp5.ru/> for the period from 2005 to 2023. 22 weather stations were included in the analysis.

Persimmon varieties were selected both from the State Register of Breeding Achievements and from amateur horticulture with known frost resistance indicators. All varieties are conditionally divided into five groups depending on their

frost resistance, ranging from frost-resistant to extremely frost-resistant, with different indicators of extreme frost resistance.

Persimmon varieties were conditionally divided into five groups according to the degree of frost resistance:

– Non Frost-resistant varieties (Alexey Chelombit, Zvezdochka, Zolotaya, Zuhra, Chamomile and others similar to them in frost resistance) - withstanding up to minus 15.0 °C.

– Low Frost-resistant varieties (Nikitskaya Burgundy, God’s gift, Dream, Souvenir of autumn, Ukrainka and others) – minus 17.8 °C.

– Medium frost-resistant varieties (Rossiyanka, Dar Sofiyevsky, Chuchupaka, John Rick, Deer, Magnet, Lehman Deligt and others) – minus 20.6 °C

- Frost-resistant varieties (Bull’s Heart, Prok, Barbara’s Rouge, Sosnovskaya, Korolek and others) – minus 23.3 °C.

– Extremely frost-resistant varieties (Mider, H-120, Mohler, Yates, Juhl, Wonderful, Belogorye, Szukis, Weber and others similar in frost resistance) – minus 26.1 °C.

To achieve this goal, an analysis of winter temperatures at rest was carried out, based on data from official meteorological stations located in Crimea (22 stations in total). For this task, variational statistics were used, which involves predicting deviations of minimum temperatures. To do this, the probabilities of temperatures that will exceed the set level were summed up, with maximum resistance to low temperatures for each group of varieties.

For any specific date between 2005 and 2023 that is available for analysis, it is possible to trace how the minimum air temperature changed. It fluctuates relative to the average value, and these fluctuations can be described using statistical methods. Using the Student’s method, two types of minimum air temperatures were identified. The first type is comparable to the average long-term minimum temperatures (the probability of their occurrence is 95%, in the t-analysis - the “confidence interval”). The second type is comparable to absolute minima (probability 5%, in the t-analysis – the “scope of variation”). These indicators reflect the minimum air temperatures that occur with a certain probability on certain days. A 5% probability means that such a minimum is observed once every twenty years, and temperatures will be milder in the remaining nineteen years.

For other days, there is also a possibility of minima that can damage generative and vegetative tree formations. To determine the probability of frost damage to varieties, the sums of all transitions of the minimum air temperature by each calendar date of the cold period (autumn-winter-early spring) through the boundary level of stability of groups of varieties with different frost resistance were calculated.

When determining the optimal placement of persimmon varieties in the territory of Crimea, the principle was applied that for agricultural producers, the

permissible yield losses should not exceed 20%. At the same time, the probability of fruit damage in the winter months, ranging from 21 to 50%, may be acceptable only for amateur gardening of certain groups of varieties. If the total probability of damage exceeds 50%, such conditions become critical for the stable cultivation of cultivated perennials. The results of predicting the probabilities of damage to varieties with different levels of winter hardiness were visualized on a specialized map, where the color scheme changed in 10% increments from green (indicating suitable conditions for growth in accordance with climatic and environmental requirements of varieties) to dark red, indicating a high risk of loss of plant reproductive organs during deep winter dormancy.

Results

All varieties and hybrids of oriental and Virginian persimmons differ in their ecological and biological adaptability. As already mentioned, all varieties can be divided into five groups depending on their resistance to adverse conditions. Each group is able to withstand certain temperature minima during deep rest, and these values were determined after studying the scientific literature.

The analysis shows that the risk of damage to persimmon varieties from low temperatures is extremely low — the probability is 95%. However, the absolute minimum temperatures, which can be observed with a probability of 5%, exceed the following values:

- minus 20.6 °C — repeats in a year for 3 calendar days;
- minus 17.8 °C — repeats 7 calendar days during the year;
- minus 15.0 °C — 15 calendar days;
- minus 12.0 °C — 34 calendar days.

This fact clearly demonstrates how the number of days with low temperatures can affect damage to both generative and vegetative structures of persimmons, which are classified according to various levels of frost resistance.

Since severe damage can occur with a sharp decrease in temperature, which can lead to crop death even with a single exposure, it is possible to calculate the average annual probability of crop loss.

For medium frost-resistant varieties, this probability is: $3 \text{ days} \times 0.05 = 0.15 = 15\%$. For low frost resistance — $7 \text{ days} \times 0.05 = 0.35 = 35\%$. The level of threat to the crop is considered acceptable if such cases occur no more than once every five years. This means that the overall probability does not exceed 20%. If the probability of damage reaches 50%, it can be considered as a zone of risky agriculture. Values from 50% to 90% already belong to the category of extreme conditions, where it is unreasonable to expect economic benefits from agriculture. When the probability of damage to plants from frost exceeds 90%, this indicates the complete futility of growing in this area [19]. As a result of the study, persimmon varieties were grouped and divided into frost resistance groups, thanks to which they were distributed throughout the territory of the Crimean peninsula.

Varieties of oriental persimmon, which can withstand temperatures up to minus 12.0 °C, are not suitable for most territories of the Republic of Crimea, due to the high risk of damage to the aboveground part of the trees, with the exception of the southern coast and the city of Sevastopol.

For persimmon varieties that are not frost-resistant and can tolerate temperatures up to minus 15.0 °C, in addition to the southern coast of the Crimean Peninsula, Sevastopol and its district, such areas as the Sudak urban district and the Leninsky district can also be distinguished, where industrial cultivation of this crop is possible. Frost-resistant varieties such as Nikitskaya maroon, God's Gift, Dream, Souvenir of autumn, Ukrainka and others, which are able to withstand temperatures up to minus 17.8 °C, can be successfully cultivated in the Saki district, as well as in the urban districts of Feodosia and Kerch. In the Black Sea, Bakhchisarai, Kirovsky, Razdolnensky, Krasnoperekopsky and Pervomaisky districts, slight damage to plants is possible. Nevertheless, it is important to emphasize that this group of varieties is not optimal for those regions where the probability of crop loss and damage to generative organs remains significant, such as Nizhnegorsky, Sovetsky, Belogorsky and Krasnogvardeysky districts.

Medium frost-resistant varieties of persimmon, such as Rossiyanka, Dar Sofiyevsky, Chuchupaka, John Rick, Deer, Magnet, Leman Deligt and others, are able to withstand temperatures up to minus 20.6 °C. This makes it possible to almost completely develop the territory of the peninsula, with the exception of the Nizhnegorsky, Sovetsky and Krasnogvardeysky districts. In these areas, due to difficult climatic conditions, persimmon cultivation is possible only for personal subsidiary farming. The cultivation of frost-resistant varieties of persimmon, such as Bull's Heart, Prok, Korolek, Barbara's Rouge, Sosnovskaya and others, which are able to withstand temperatures up to minus 23.3 °C, is no longer an obstacle to the creation of industrial persimmon gardens. Nevertheless, in some years, damage to the aboveground part of plants in the Nizhnegorsky and Sovetsky districts may occur.

The selection of varieties of Virgin persimmon, which has a level of frost resistance up to minus 26.1 °C, makes the entire territory of Crimea suitable for obtaining a stable harvest. When using these varieties of Virgin persimmon, there are no longer climatic restrictions in its cultivation. These varieties are ideal for processing into dried fruits, compotes, jams and jams. However, if they are grown in small amounts for personal use, they can also be consumed fresh.

This analysis of the probabilities of damage to persimmon varieties can be used to select and optimally place these varieties not only in the southern, but also in the temperate regions of the continent.

Conclusions

1. During the study, the varieties of eastern and Virgin persimmons were analyzed, conditionally divided into five groups according to frost resistance, with the

determination of the threshold minimum of winter critical temperatures for each of them. Based on the research data, the probabilities of damage to various varieties of persimmon in conditions of low winter temperatures in Crimea were calculated.

2. According to the results of the analysis of climatic conditions, it was found that the most suitable territories for the industrial cultivation of eastern persimmon are the southern coast of Crimea and the Black Sea regions: Yalta, Alushta, Sevastopol, Feodosia, Kerch, as well as the Saki, Black Sea and Leninsky districts. Simferopol, Bakhchisarai, Kirovsky, Razdolnensky, Krasnoperekopsky and Pervomaisky districts stand out from the central part of Crimea. Krasnogvardeysky, Nizhnegorsky and Sovetsky districts are recognized as the most unsuitable and can only be developed by frost-resistant varieties of Virgin persimmon.

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UDC 638.123.52

巴什科尔托斯坦共和国北部地区蜜蜂形态发生评估
**MORPHOGENETIC ASSESSMENT OF HONEY BEES IN THE
NORTHERN REGIONS OF THE REPUBLIC OF BASHKORTOSTAN**

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摘要。本文介绍了对巴什科尔托斯坦共和国北部森林草原农业区养蜂场的蜜蜂进行形态学和遗传学分析的结果。综合研究所得数据表明，在所研究的 29 个养蜂场中仍存在原始蜜蜂，巴什基尔蜜蜂 *Apis mellifera mellifera* 种群的纯度在阿斯金地区为 47.5%，在亚纳尔地区为 42.3%。

关键词：蜜蜂 *Apis mellifera mellifera*、品种、蜜蜂形态学、线粒体 DNA、核 DNA。

Abstract. *The article presents the results of studies of honey bees in apiaries of the northern forest-steppe agricultural zone of the Republic of Bashkortostan by morphometric and genetic analysis. The obtained data from a comprehensive study indicate that the aboriginal bee remained in the studied 29 apiaries, the purity of the Bashkir population of the honeybee *Apis mellifera mellifera* was 47,5 % in the Askin district and 42,3 % in the Yanaul district.*

Keywords: *honeybee *Apis mellifera mellifera*, breed, morphometry of bees, mtDNA, nuclear DNA.*

Introduction. *Import of queen bees and bee packages to the Republic of Bashkortostan (RB) from other regions of Russia and foreign countries leads to cross-breeding of local bees, which leads to deterioration of economically useful traits*

of families and decrease in marketability of apiaries. Therefore, monitoring the state of the gene pool of the Bashkir population of the Central Russian bee breed and identifying maternal families for breeding reproducers are important tasks [1–11]. Since 2022, comprehensive studies of the breed composition of bee families by administrative districts have been conducted in the RB for the first time. They include a questionnaire survey of beekeepers, a study of morphometric and genetic indicators of bees [4–6]. This work contains the results of studies of bees in apiaries of the northern forest-steppe agricultural zone of the RB, which will be useful to beekeepers.

The purpose of the work is to study the breed composition of bees in apiaries of the northern forest-steppe agricultural zone of the RB based on morphometric and genetic indicators.

Materials and methods of research. To assess the breed of bees by the main wing indicators - the cubital index (C_i) and the discoidal displacement (DsA) - 40-50 individuals were selected from each bee colony and fixed in 96% ethanol. The breed of bees was determined using the computer program by A. B. Kartashev "Breed by Wings" (version 2.5, 2016). It used the coordinates of eight points of the right front wing, which were generated by the tpsDig2 program. According to the program, bee colonies were assessed as follows: no less than 17 points - as the founder of the line; no less than 15 points - as one of the families of the reproducer of queens; no less than 10 points - for further selection; no less than 5 points - for breeding queens. In parallel with the morphometric studies, the variability of the intergenic locus COI-COII of mitochondrial DNA (mtDNA) and 9 microsatellite (SSR) loci of nuclear DNA (nDNA) were studied in bees from the same samples using the molecular genetic method. If the Q variant (characteristic of southern breeds) was detected in the COI-COII locus of mtDNA, then nDNA was not studied. To assess the purity of bee colonies, the level of introgression of genes of the evolutionary line C (southern bees) into the line M (Central Russian bees) was determined. Bee colonies in which the proportion of M exceeded 0.88, the cubital index C_i was $\geq 60\%$, and the discoidal shift DsA was negative, were classified as purebred. Families with similar indicators, but not included in the purebred group, were rejected due to the discrepancy between the morphometric feature dumbbell index ($Hi \leq 0.77$ or ≥ 0.93) and the data of the prevailing breed (not *Apis mellifera mellifera*), which were determined by the Breed by Wings program.

Research results. In the northern forest-steppe agricultural zone of the Republic of Bashkortostan, bees from 29 apiaries of the Askinsky and Yanaulsky municipal districts were examined. The total area of these districts is 4718 km², 111 bee samples were examined, 3552 wings were analyzed for morphometric indicators.

In the Askinsky district, 40 bee samples were taken from 8 apiaries, with a total of 456 bee families, 1280 wings were analyzed for morphometric indicators. The results of the morphometric and genetic analysis of bees are presented in Table 1.

Table 1
Comprehensive assessment of bees in the apiaries of the Askinsky district of the Republic of Bashkortostan, 2023.

№	Cubital index (Ci), %		Discoidal displacement (DsA)	The level of introgression of genes of subspecies of evolutionary branches M and C		
				mtDNA	nDNA	
	M±m	Cv,%	M±m	COI-II	share C	share M
v. Kigazy, apiary 1						
12	60,5±1,61	17,8	0,12±0,01	PQQ	0,16	0,84
32	59,2±1,59	15,2	-1,53±0,46	PQQ	0,02	0,98
66	59,1±1,54	14,7	-3,54±0,34	PQQ	0,40	0,60
57	64,2±1,73	15,3	-1,52±0,35	PQQ	0,03	0,97
38	65,3±1,40	12,1	-1,43±0,44	PQQ	0,01	0,99
v. Kigazy, apiary 2						
1	72,9±1,72	13,2	-2,08±0,43	PQQ	0,03	0,97
2	64,6±1,69	14,6	-2,58±0,31	PQQ	0,01	0,99
4	68,3±1,26	10,4	-1,09±0,40	PQQ	0,07	0,93
5	66,9±1,78	15,2	-2,90±0,40	PQQ	0,07	0,93
52	66,2±1,98	16,6	-3,40±0,38	PQQ	0,02	0,98
v. Askino, apiary 1						
4	76,3±2,05	15,2	-1,63±0,33	PQQ	0,19	0,81
1	65,5±1,19	10,1	-2,50±0,43	PQQ	0,20	0,80
2	66,8±1,71	14,5	-2,48±0,52	PQQ	0,01	0,99
3	61,2±1,17	10,8	0,21±0,36	PQQ	0,07	0,93
5	68,4±1,66	13,7	-0,90±0,35	Q	-	-
v. Askino, apiary 2						
2	68,8±1,49	12,1	-0,99±0,37	PQQ	0,14	0,86
17	74,7±1,56	11,6	-1,79±0,48	PQQ	0,36	0,64
23	60,4±1,87	17,6	0,83±0,26	PQQ	0,07	0,93
47	71,3±1,93	15,3	-3,01±0,42	PQQ	0,48	0,52
51	80,6±1,31	9,2	-4,90±0,44	PQQ	0,02	0,98
v. Kashkino						
1	64,7±1,84	15,6	-0,67±0,36	PQQ	0,35	0,65
2	73,0±1,94	14,5	-1,62±0,49	PQQ	0,14	0,86
3	66,2±1,31	10,9	0,28±0,51	PQQ	0,36	0,64
4	71,1±2,08	16,3	-2,87±0,48	Q	-	-
5	77,4±2,03	14,3	-2,81±0,36	Q	-	-
v. Amirovo						
53	60,7±1,89	17,6	-1,60±0,43	PQQ	0,02	0,98

43	72,2±1,76	13,6	-1,97±0,31	PQQ	0,06	0,94
12	68,7±1,44	11,6	-1,64±0,45	PQQ	0,03	0,97
4	64,9±1,59	13,9	-0,83±0,40	PQQ	0,44	0,56
3	72,2±1,18	9,3	-2,64±0,51	PQQ	0,07	0,93
v. Novaya Burma						
1	77,3±1,89	13,6	-1,24±0,27	PQQ	0,05	0,95
4	70,7±1,69	13,3	-3,35±0,32	PQQ	0,23	0,77
2	65,2±2,32	20,1	-2,10±0,53	PQQ	0,51	0,49
3	78,4±2,14	14,9	-2,46±0,72	PQQ	0,21	0,79
5	65,6±1,20	10,4	-2,47±0,40	PQQ	0,02	0,98
v. Kubyazi						
3	78,9±1,86	12,9	-1,20±0,50	PQQ	0,10	0,90
4	65,2±1,90	16,0	-2,66±0,49	PQQ	0,11	0,89
5	73,1±2,30	17,2	-3,28±0,42	PQQ	0,21	0,79
2	69,6±1,81	14,2	-3,33±0,67	PQQ	0,10	0,90
1	65,6±1,54	13,1	-2,99±0,39	PQQ	0,10	0,90
Note: the sign «-» - not researched, highlighted - purebred family						

Based on the results of the morphometric study, three bee colonies suitable for further selection and reproduction of queens were selected from the Askinsky District. These are colony #4 from the apiary in the village of Novaya Burma (13 points), colony #51 from apiary #2 in the village of Askino (16 points), and colony #43 from the apiary in the village of Amirovo (10 points). The following 10 bee colonies are recommended for use in breeding queen bees: #1 and #5 (apiary in the village of Novaya Burma); #2 and #5 (apiary in the village of Kubyazy); #1 (apiary 1 in the village of Askino) and colony #47 (apiary 2 in the village of Askino); #3 (apiary in the village of Amirovo); No. 4 and No. 5 (apiary in the village of Kashkino); No. 52 (apiary 2 in the village of Kigazy). In the apiaries of the Askinsky district, the average value of the cubital index (Ci) exceeded 60%, and the discoidal displacement (DsA) was negative in 38 bee colonies. This was observed in the following apiaries: the village of Kigazy (apiary 1) - colonies No. 12, 38, 57; (apiary 2) - No. 52, 2, 4, 5, 1; the village of Askino (apiary 1) - No. 1, 4, 5, 3, 2; (apiary 2) - No. 47, 2, 51, 23, 17; the village of Kashkino - No. 4, 2, 1, 3, 5; Amirovo village - No. 4, 12, 43, 53, 3; Novaya Burma village - No. 5, 2, 4, 1, 3; Kubyazy village - No. 5, 3, 4, 1, 2. Thus, these individuals, according to morphometric parameters, met the requirements of the Bashkir population of the Central Russian breed of honey bees. According to the results of molecular genetic studies, 3 bee colonies out of 40 studied in the Askinsky district originate from the evolutionary branch C on the maternal line (allelic variant Q of the COI-COII locus): No. 5 from Askino village (apiary 1), No. 4 and 5 from Kashkino village.

The remaining families belong to the evolutionary branch M. On average, the proportion of hybridization in the sample from branch M (37 families) was 15%. Samples from the following families belong to the subspecies *Apis mellifera mellifera* (the proportion of $M > 0.88$): No. 2 and 3 from the village of Askino (apiary 1); No. 51 and 23 from the village of Askino (apiary 2); No. 1, 2, 3 and 4 from the village of Kubiyazy; No. 1 and 5 from the village of Novaya Burma; No. 2, 12, 43, 53 from the village of Amirovo; No. 32, 38, 57 from the village of Kigazy (apiary 1); No. 1, 2, 4, 5 and 52 from the village of Kigazy (apiary 2). According to the comprehensive study, including morphometric and molecular genetic analysis, 19 bee colonies of the Askinsky district (47.5%) were classified as purebred bees of the Bashkir population of the Central Russian breed, including No. 38 and 57 (apiary 1 in the village of Kigazy), all 5 studied families of apiary 2 in the village of Kigazy, No. 2 (apiary 1 in the village of Askino), No. 51 (apiary 2 in the village of Askino), No. 3, 12, 43, 53 (village of Amirovo), No. 1 and 5 (village of Novaya Burma), No. 1, 2, 3 and 4 (village of Kubiyazi). In the Yanaulsky district, 71 samples were taken from 21 apiaries, with a total of 1,225 bee colonies. The results of the morphometric and genetic analysis of bees are presented in Table 2.

Table 2
Comprehensive assessment of bees in the apiaries of the Yanaulsky district of the Republic of Bashkortostan, 2023.

№	Cubital index (Ci), %		Discoidal displacement (DsA)	The level of introgression of genes of subspecies of evolutionary branches M and C		
				mtDNA	Я/ДHK	
	M±m	Cv,%	M±m	COI-II	M±m	Cv,%
v. Cheraul						
27	62,8±1,61	14,5	-4,29±0,32	PQQ	0,03	0,97
43	62,7±1,31	11,8	-1,79±0,48	PQQ	0,20	0,80
83	59,6±1,26	11,9	-1,55±0,27	PQQQ	0,02	0,98
87	64,2±1,31	11,5	-2,52±0,41	PQQ	0,01	0,99
100	58,5±1,48	14,4	-1,65±0,34	PQQ	0,03	0,97
v. Salihovo, apiary 1						
1	64,0±1,63	14,4	-1,31±0,33	PQQ	0,06	0,94
38	64,5±1,36	11,9	-3,30±0,38	PQQQ	0,02	0,98
44	59,1±1,45	13,9	-1,45±0,44	PQQ	0,06	0,94
80	58,3±1,38	13,4	-0,74±0,45	PQQ	0,04	0,96
v. Salihovo, apiary 2						
13	64,4±1,89	16,3	-2,64±0,39	PQQ	0,01	0,99
22	67,5±1,69	13,9	-1,93±0,21	PQQ	0,01	0,99

v. Zaitsevo, apiary 1						
1	62,0±1,56	14,2	-2,89±0,43	PQQ	0,01	0,99
2	64,4±1,54	13,5	-1,41±0,44	PQQ	0,04	0,96
3	65,2±1,86	16,1	-4,97±0,47	PQQ	0,40	0,60
4	62,6±1,31	11,8	-3,17±0,39	PQQ	0,04	0,96
5	54,6±1,17	12,1	-2,30±0,35	PQQ	0,01	0,99
v. Zaitsevo, apiary 2						
108	55,9±1,71	17,3	-3,03±0,36	PQQQ	0,07	0,93
112	57,2±2,00	19,8	-1,64±0,39	PQQQ	0,03	0,97
A	60,0±1,54	14,5	-2,53±0,46	PQQQ	0,01	0,99
B	51,3±1,11	12,3	-1,25±0,41	PQQ	0,03	0,97
C	54,3±1,17	12,2	-1,85±0,35	PQQQ	0,30	0,70
v. Novyi Artaul, apiary 1						
10	62,0±1,64	15,0	-3,30±0,38	PQQ	0,79	0,21
31	54,3±1,57	16,4	-1,43±0,32	PQQ	0,17	0,83
43	60,9±1,52	14,1	-1,82±0,49	PQQ	0,01	0,99
59	63,9±1,43	12,7	-1,51±0,29	PQQ	0,08	0,92
v. Novyi Artaul, apiary 2						
1	60,0±1,50	14,2	-2,26±0,33	PQQ	0,03	0,97
2	59,2±1,10	10,5	-2,29±0,51	PQQ	0,02	0,98
v. Novyi Artaul, apiary 3						
A	60,1±1,61	15,1	-1,93±0,55	PQQ	0,02	0,98
B	51,8±1,22	13,3	0,99±0,40	PQQ	0,01	0,99
v. Sibady						
1	67,8±1,54	12,8	-2,70±0,38	-	-	-
2	52,2±1,34	14,6	2,05±0,51	-	-	-
v. Varyashbash						
1	59,6±1,50	14,3	-2,55±0,31	PQQQ	0,01	0,99
2	56,3±2,07	20,8	-1,43±0,32	PQQQ	0,01	0,99
3	58,0±1,36	13,3	-2,31±0,32	PQQ	0,01	0,99
д. Урал						
12	61,9±1,63	14,9	-1,65±0,33	PQQ	0,02	0,98
16	62,6±1,64	14,9	-1,74±0,34	PQQ	0,02	0,98
v. Izhboldino						
118	40,1±1,79	25,2	3,65±0,42	-	-	-
A	61,9±1,15	10,5	-2,26±0,33	-	-	-
B	67,3±1,59	13,4	-2,42±0,34	-	-	-
v. Isanbay						
1	62,6±1,41	12,8	-3,69±0,31	PQQ	0,37	0,63
2	60,2±1,34	12,6	-3,18±0,38	PQQ	0,23	0,77

3	56,7±1,24	12,7	-0,81±0,35	PQQ	0,07	0,93
4	57,4±1,57	15,5	0,64±0,40	PQQ	0,38	0,62
5	60,8±1,22	11,4	-2,31±0,39	PQQ	0,01	0,99
v. Yamada						
1	57,3±1,29	12,7	-0,99±0,29	PQQ	0,09	0,91
2	62,3±1,62	14,3	-1,97±0,54	PQQ	0,02	0,98
3	62,1±1,40	12,7	-3,18±0,36	PQQ	0,19	0,81
4	60,5±1,26	11,7	-2,14±0,33	PQQ	0,02	0,98
5	55,5±1,41	14,4	-1,43±0,32	PQQ	0,08	0,92
v. Yanbaris						
1	61,2±1,43	13,2	-3,89±0,36	PQQ	0,01	0,99
2	68,0±1,71	14,3	-3,87±0,36	PQQQ	0,02	0,98
v. Atlegach						
11	60,9±1,29	12,0	-1,39±0,46	PQQ	0,02	0,98
A	55,2±1,04	10,7	-2,09±0,29	PQQ	0,01	0,99
B	57,0±1,50	14,9	-1,55±0,52	PQQ	0,03	0,97
C	59,3±1,03	9,8	-3,42±0,33	PQQ	0,01	0,99
D	62,5±1,38	12,5	-3,12±0,52	PQQ	0,01	0,99
v. Andreevka						
5	63,7±1,54	13,7	-3,02±0,34	PQQ	0,02	0,98
8	62,9±1,33	11,9	-0,12±0,44	PQQ	0,11	0,89
23	59,5±1,24	11,8	-1,04±0,40	PQQ	0,01	0,99
A	60,6±1,59	14,9	-0,57±0,55	PQQ	0,22	0,78
B	64,9±1,54	13,4	-1,58±0,44	PQQQ	0,01	0,99
v. Cheraul						
7	61,4±1,34	12,4	-2,16±0,44	PQQ	0,03	0,97
15	61,0±1,84	17,0	-0,99±0,46	PQQ	0,02	0,98
34	60,1±1,56	14,6	-2,02±0,46	PQQQ	0,02	0,98
v. Kichikir						
8	47,3±1,63	19,4	2,85±0,41	-	-	-
25	59,5±1,41	13,4	-0,58±0,41	-	-	-
v. Karmanovo						
A	62,4±1,40	12,7	-3,89±0,36	PQQ	0,36	0,64
B	58,7±1,22	11,7	-2,38±0,31	PQQ	0,14	0,86
v. Bulat-Elga						
10	59,2±1,68	16,1	0,77±0,42	PQQ	0,03	0,97
95	66,3±1,47	12,5	-1,67±0,30	PQQ	0,01	0,99
110	58,7±1,33	12,8	-1,98±0,49	PQQ	0,02	0,98

Based on the results of morphometric studies, it was established that 19 bee colonies are suitable for breeding queens and further selection. These colonies

belong to apiaries in the following settlements: v. Yussukovo, No. 27 (9 points); v. Salikhovo, apiary 1, No. 38 (7 points) and apiary 2, No. 13 (9 points), No. 22 (8 points); v. Zaitsevo, apiary 1, No. 3 (5 points); v. Sibady, No. 1 (3 points); v. Isanbay, No. 1 (7 points), No. 2 (9 points), No. 5 (6 points); s. Yamada, No. 3 (3 points), No. 4 (4 points); v. Andreyevka, No. 5 (3 points); Yanbaris village, No. 2 (11 points); Karmanovo village, No. A (5 points). As a result of the study, 41 bee colonies were identified that meet the standards of the Bashkir population of the Central Russian breed. These colonies live in apiaries in the following populated areas: Yussukovo village (No. 27, 43, 87); Salikhovo village, apiary 1 (No. 1, 38) and apiary 2 (No. 13, 22); Zaitsevo village, apiary 1 (No. 1, 2, 3, 4) and apiary 3 (No. A); New Artaul, apiary 1 (No. 10, 43, 59), apiary 2 (No. 1) and apiary 3 (No. A); With. Sibady (No. 1); Ural village (No. 12, 16); With. Izhboldino (No. A, B); Isanbay village (No. 1, 2, 5); With. Yamada (No. 2, 3, 4); With. Atlegach (No. 11, G); With. Andreevka (No. 5, 8, A, B); village Yanbaris (No. 1, 2); With. Cheraul (No. 7, 15, 34); With. Karmanovo (No. A); village Bulat-Elga (No. A, 95). Bees of these families have an average cubital index (Ci) value above 60% and negative DsA. Molecular genetic studies of 71 bee families from the Yanaul district showed the following: 56 families have the allelic variant PQQ of the mtDNA COI-COII locus; 11 families have the PQQQ variant; 4 families have the Q variant. All bee families of beekeepers from the villages of Varyashbash, Ural and Yanbaris, Bulat-Yelga, as well as the villages of Cheraul, Novy Artaul (apiary 2 and 3), Atlegach, Salikhovo (apiary 1 and 2) belong to the subspecies *Apis mellifera mellifera* (proportion $M > 0.88$). Bee families No. 3 and 5 of the beekeeper from the village of Isanbay, No. 1, 2, 4 and 5 from the village of Yamada, No. 100, 87, 83 and 27 from the village of Yussukovo, No. 5, 23, 8 and B from the village of Andreyevka and families No. 1, 2, 5 from apiary 1 in the village of Zaitsevo. Also, families No. 59 and 43 from apiary 1 in the village of Novy Artaul belong to the subspecies *Apis mellifera mellifera*. The remaining families are of hybrid origin. Based on the results of a comprehensive assessment (morphometric and molecular genetic analyses) in the Yanaulsky district, 30 bee colonies (42.3%) were classified as belonging to the Bashkir population of the Central Russian breed, including No. 27, 87 (Yussukovo village), No. 1, 38 (apiary 1, Salikhovo village), No. 13, 22 (apiary 2, Salikhovo village), No. 1, 2, 4 (apiary 1, Zaitsevo village), No. A (apiary 2, Zaitsevo village), No. 43, 59 (apiary 1, Novyi Artaul village), No. 1 (apiary 2, Novyi Artaul village), No. A (apiary 3, Novyi Artaul village), No. 12, 16 (village Ural), No. 5 (Isanbay village), No. 2, 4 (Yamady village), No. 11, G (Atlegach village), No. 5, 8, B (Andreevka village), No. 1, 2 (Yanbaris village), No. 7, 15, 34 (Cheraul village), No. 95 (Bulat-Elga village). Thus, the results of the study confirmed the conservation of the array of native bees in the apiaries of the Yanaul region.

The results of complex studies, including morphometric and molecular genetic analyses of bee colonies, showed that in the regions of the northern forest-steppe

agricultural zone of the Republic of Bashkortostan, 45% of the bee colonies in the 29 apiaries studied (with a total of 1,680 bee colonies from 111 samples taken) belong to the Bashkir population of the Central Russian breed.

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上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2025 年 1 月 15 日，中国北京

编辑 A. A. Siliverstova

校正 A. I. 尼古拉耶夫

2025 年 1 月 15 日，中国北京
USL。沸点：98.7。 订单253. 流通500份。

在编辑和出版中心印制

无限出版社



