



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

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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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关于中国和俄罗斯的粮食安全问题
ON THE ISSUE OF FOOD SECURITY IN CHINA AND RUSSIA

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摘要: 文章分析了中国和俄罗斯主要粮食作物的生产指标。根据中国年人均谷物消费量数据,计算了中国水稻、小麦、玉米、大豆等作物的自给率指标。由于大多数俄罗斯人的营养传统(“面包是万物之首”),分析选择了小麦、黑麦、大麦和燕麦作为主要谷物作物。得出的结论是,中国和俄罗斯都确保了主要谷物作物的粮食独立性。考虑到价格因素,两国在主要谷物作物方面的相互贸易发展在于生产高质量和环保型产品。这将有助于粮食的实际和经济供应,并确保各国的粮食安全。

关键词: 粮食安全、粮食独立、主要谷物、自给自足、人口对谷物的需求。

Abstract. *The article analyzes the production indicators of major grain crops in China and Russia. Based on data on annual per capita grain consumption in China, self-sufficiency rates for rice, wheat, corn, and soybeans are calculated. Due to the dietary traditions of the majority of the Russian population (“Bread is the head of everything”), the analysis focuses on wheat, rye, barley, and oats as key grain crops. The study concludes that both China and Russia maintain food independence in terms of their primary grain crops. The development of mutual trade between these countries in key grain crops should prioritize the production of high-quality and environmentally friendly products while considering pricing factors. This approach will enhance the physical and economic availability of food and ensure food security for both nations.*

Keywords: *Food security, food independence, key grain crops, self-sufficiency, population grain demand.*

The production of grain crops plays a key role in ensuring food security and sustainable economic growth in any country.

In Russia, “food independence” is understood as the self-sufficiency of the country in terms of key types of domestic agricultural products, raw materials, and foodstuffs [1]. For the purposes of this study, this concept is also applied to China, where “food security” is achieved through maintaining domestic production, ensuring quality and product safety, and managing grain reserves [2].

In both China and Russia, agriculture, particularly grain crop production, serves as a vital pillar of the national economy.

Significant differences in the natural and economic conditions of China’s four major regions (Eastern, Central, Western, and Northeastern) lead to variations in agricultural trends and challenges faced by these regions. Table 1 provides comparative data on agricultural development conditions and the main crops cultivated in these four regions of China [3].

Table 1
Comparative analysis of agricultural development conditions and main crops cultivated in four regions of China.

Region	Characteristics of Natural Conditions	Characteristics of Economic Conditions	Cultivation of Main Agricultural Crops
Eastern	Warm and humid climate, fertile soils	Developed economy, high level of urbanization, advanced agricultural modernization, shortage of land resources	Rice, wheat
Central	Moderate climate, sufficient precipitation, flat terrain	Balanced economy, good agricultural infrastructure, but uneven distribution of water resources, labor outflow	Wheat, rice, corn
Western	Complex terrain, variable climate	Underdeveloped economy, weak agricultural infrastructure, reliance on government support	Corn, wheat, fruits
Northeastern	Fertile lands, cold climate	High level of mechanization, stable grain production, but population outflow, significant impact of climate change	Corn, soybeans

Due to dietary traditions in China, rice is the primary grain crop. Its production in the Central region is the highest, with the Northeastern region steadily increasing output over time. In the Eastern and Western regions, rice production remains relatively stable. The Northeastern region, with its fertile black soil, is known for producing the highest quality rice.

Wheat production is concentrated mainly in the Eastern and Central regions, particularly in provinces such as Henan and Shandong, which contribute significantly to the total output. In the Western region, wheat production is significantly lower due to constraints related to terrain and climate, while in the Northeastern region, wheat production is minimal due to limited arable land.

Corn production is primarily concentrated in the Northeastern region, where climatic conditions are extremely favorable for its cultivation, ensuring high annual yields. The Western and Central regions also produce substantial amounts of corn, which is mainly used in livestock farming and industry.

Soybean production is predominantly concentrated in the Northeastern region, with Heilongjiang Province being the largest producer of soybeans in China. In the Eastern, Central, and Western regions, soybean production volumes are significantly lower, with most of the crop being used for food and industrial purposes. Although domestic soybean production can meet the needs of direct consumption, it does not satisfy demand in areas such as soy sauce production, animal feed, and vegetable oil. Consequently, China continues to rely on imports to address shortages in these specific sectors.

The production volumes of major grain crops in China are presented in Figure 1.

In 2022–2023, the primary grain crops were wheat, rice, and corn. China’s agricultural sector met 95–98% of the total domestic food demand, with grain crops accounting for 85–90% of the total food consumption demand [4].

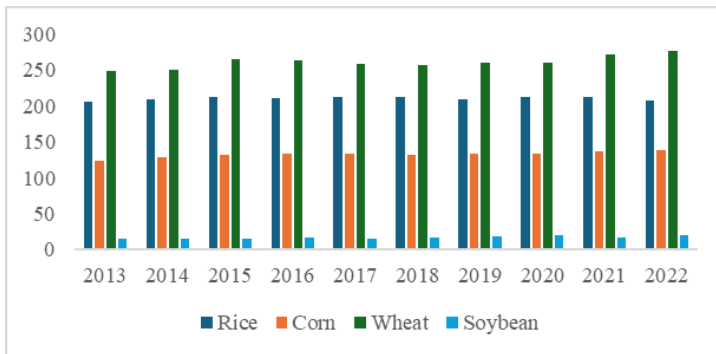


Figure 1. Production of Major Grain Crops in China (million tons), 2013–2022 [5]

An analysis of the data in the figure shows that from 2013 to 2022, the production of rice, wheat, corn, and soybeans in China generally demonstrates an upward trend. Rice and wheat production remain relatively stable, with wheat production

exhibiting gradual growth, reflecting the impact of technical improvements and increased levels of mechanization. Corn production is characterized by significant volatility; however, recent years have seen noticeable growth. Since 2007, the government has purchased corn from farmers at a fixed price, ensuring stable incomes for producers. However, this policy was abolished in 2016, after which the price of corn transitioned to a market-based pricing system. This shift led to reduced incomes for some farmers and a decrease in motivation to grow corn, causing fluctuations in production volumes.

The calculation of self-sufficiency levels for rice, wheat, corn, and soybeans in China's four major economic regions in 2022 is presented in Table 2.

Table 2
Self-Sufficiency Levels of Major Grain Crops in China, 2022 [5]

Crop	Production (million tons)	Consumption (million tons)	Self-Sufficiency Rate (%)
Rice	208.48	126.88	164.31
Corn	277.2	77.49	357.72
Wheat	137.72	126.88	108.54
Soybean	20.29	14.1	143.9

The self-sufficiency rate for rice stands at 164.09%, indicating that China's rice production fully meets domestic demand and generates surpluses. Approximately 95% of the total rice production is allocated for consumption and storage, while only 5% is used as animal feed, in alcoholic beverage production, and for other purposes.

The self-sufficiency rate for wheat is 108.39%, reflecting stable production levels, the majority of which are directed toward meeting domestic demand. Around 80% of the total wheat output is used for the production of flour-based products, about 12% for industrial processing, including starch, beer, and other products, and approximately 8% is used as animal feed in the livestock sector.

The self-sufficiency rate for corn is 357.01%, far exceeding domestic requirements, demonstrating a high production capacity. Between 60% and 70% of the total corn output is utilized as animal feed in livestock production, 20% to 30% is allocated for industrial processing, primarily for starch, alcohol, ethanol, and other products, while only 1% to 2% of corn is used for human consumption, mainly in the production of cornmeal and other food products.

The self-sufficiency rate for soybeans is 143.67%, indicating sufficient production levels to meet domestic needs and generate surpluses. However, approximately 85% of soybeans are used for oil production, with by-products from pressing serving as animal feed. Only 15% of soybeans are utilized for direct consumption

or food processing. Despite sufficient production levels, soybean yield remains relatively low compared to other crops, necessitating continued imports to meet demand, particularly for vegetable oil production and animal feed.

The primary grain crops in Russia are wheat, rye, barley, corn, and oats (Fig. 2). This selection reflects the export orientation and resource advantages of Russian agriculture. The vast territory and fertile black soils of Russia are ideally suited for cultivating high-yield crops. The production of wheat, rye, and barley not only fully satisfies domestic demand but also plays a critical role in international markets. At the same time, corn and oats are primarily used for domestic purposes, including feed production, industrial processing, and the food industry.

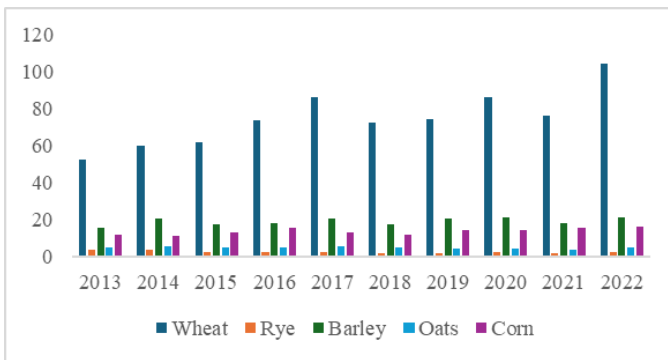


Figure 2. Production of Major Grain Crops in Russia (million tons), 2013–2022 [6]

Wheat, as the most important food crop in Russia, shows consistent production growth, increasing from 52.14 million tons in 2013 to 104.23 million tons in 2022, with a record high achieved in 2022. This growth has been made possible by the widespread adoption of modern agricultural technologies, including advanced mechanized sowing equipment, precision irrigation technologies, and the use of high-quality, high-yield wheat varieties, which have significantly boosted productivity. Additionally, key wheat-growing regions such as the Volga region, the West Siberian Plain, and the North Caucasus, with their fertile black soils and favorable climatic conditions, ensure stable yield growth [7].

Rye production demonstrates moderate stability with some decline, dropping from 3.36 million tons in 2013 to 2.18 million tons in 2022. The peak value was recorded in 2014 at 3.28 million tons. Despite reduced production volumes, rye remains an important crop for bread production, animal feed, and other food products. Major growing regions include the Central Federal District and the Volga region, where favorable climatic conditions support its cultivation.

Barley production is characterized by significant volatility, rising from 15.39 million tons in 2013 to a peak of 21.00 million tons in 2022. Barley is primarily used for feed and brewing purposes, and its production largely depends on changes in international demand. In Russia, farmers tend to grow more profitable crops like wheat or corn, so when market prices or economic profitability of barley decrease, there may be a reduction in planted areas, leading to lower production volumes. Nevertheless, the recovery observed in 2022 reflects favorable market conditions [8].

Oat production shows a recovery trend after a period of decline, decreasing from 4.95 million tons in 2013 to 4.53 million tons in 2022. The peak value was reached in 2017 at 5.46 million tons. As a secondary grain crop, oats are gradually losing planted areas to more profitable crops like wheat and corn. However, oats' resilience to harsh climatic conditions and high nutritional value make them valuable for livestock farming and the food industry.

Corn production demonstrates steady growth, increasing from 11.61 million tons in 2013 to 15.80 million tons in 2022. The peak value was recorded in 2016 at 15.28 million tons, driven by growing demand for corn for feed and industrial purposes, such as starch and ethanol production. The broad adoption of modern agricultural technologies, including high-yield seeds, precision irrigation, and pest control methods, has contributed to stable yield improvements.

The self-sufficiency levels for key agricultural crops in Russia are presented in Table 3.

Table 3
Self-Sufficiency Levels of Major Grain Crops in Russia, 2022 [6]

Crop	Production (million tons)	Consumption (million tons)	Self-Sufficiency Rate (%)
Wheat	104.23	13.23	787.85
Rye	2.18	1.47	148.23
Barley	21	3.68	571.43
Oats	4.53	1.47	307.96
Corn	15.8	8.82	179.14

The self-sufficiency rate for wheat stands at 787.85%, emphasizing Russia's immense production potential. Of the total production, approximately 60–70% is allocated for domestic consumption, primarily for flour production and other food products, while the remainder is exported to international markets, positioning Russia as one of the largest global wheat suppliers. Additionally, a small portion of wheat is used as animal feed and for industrial processing.

The self-sufficiency rate for rye is 148.23%, reflecting sufficient production volumes to meet domestic demand. Rye is mainly used for producing rye flour,

bread, and other food products, as well as partially serving as a forage crop. This indicator highlights the stable supply of rye-based products in the domestic market.

The self-sufficiency rate for barley is 571.43%, indicating significant production exceeding domestic demand, with the surplus primarily exported. Around 70–80% of the total barley output is used as animal feed, particularly in livestock farming, while the remaining portion is utilized in the brewing industry (e.g., for beer production) and, to a lesser extent, in food processing.

The self-sufficiency rate for oats stands at 307.96%, also highlighting substantial production volumes that exceed domestic demand. About 50–60% of the total oat production is used as feed due to its frost resistance and adaptability, making it ideal for livestock farming. The rest is processed into food products such as oatmeal and other cereals to meet domestic demand, with a portion also exported.

The self-sufficiency rate for corn is 179.14%, indicating that production not only covers domestic demand but also leaves surpluses for export and reserves. Approximately 60–70% of the total corn output is used for feed production, particularly as a high-energy feed in livestock farming; 20–30% is allocated for industrial processing, including starch, alcohol, and ethanol production; less than 5% of corn is used for food processing.

Overall, Russia demonstrates a high level of self-sufficiency in key grain crops, ensuring the country's food security and strengthening its position as one of the leading global exporters of grains, particularly wheat. Meanwhile, barley and oat production is more dependent on international demand and adjustments to sown area structures, whereas corn production shows steady growth.

In China, the production of rice, wheat, corn, and soybeans is generally increasing, with stable performance in rice and wheat, rapid growth in corn production, and a rise in soybean output in recent years due to government support.

In summary, Russia is focused on grain exports, emphasizing high-revenue export crops, while China, considering its large population, concentrates on ensuring food security by prioritizing domestic demand, supply stabilization, and yield improvement.

The development of foreign trade between China and Russia in key grain crops, given their high self-sufficiency levels, is feasible through the production of high-quality and environmentally friendly products, considering pricing factors. This would enhance the physical and economic accessibility of food and contribute to the overall food security of both countries.

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2021–2022 年宏观经济平衡被打破，全球通胀加速

**ACCELERATION OF GLOBAL INFLATION IN 2021–2022 AS A
RESULT OF DISRUPTION OF MACROECONOMIC EQUILIBRIUM**

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注释。本文分析了2010–2020年期间世界各国的货币、金融和预算政策，这些政策导致了总需求和总供给的不平衡。描述了新冠疫情之后对通胀过程产生积极影响的危机的具体情况。探讨了发达国家央行未能预测通胀异常飙升并迟迟未出台反通胀措施的原因。

关键词：通胀、通胀冲击、央行、基准利率、目标制、货币政策、财政政策。

Annotation. *The article analyzes monetary, financial and budgetary policies in various countries of the world in the period 2010–2020, which led to an imbalance in aggregate demand and aggregate supply. The specifics of the crisis that followed the coronavirus pandemic and had an active impact on inflationary processes are characterized. The reasons why central banks of developed countries could not predict the abnormal surge in inflation and were late in introducing anti-inflationary measures are considered.*

Keywords: *inflation, inflation shock, central bank, key rate, targeting, monetary policy, fiscal policy.*

During 2010–2020, despite constant fiscal stimulus, inflation in developed countries remained below target, averaging 1.8% in the US and 1.3% in the European Monetary Area. In 2021 and 2022, this figure reached 7.0 and 6.5% in the US, and 5.0 and 9.2% in the eurozone. At the peak of inflation in the US, it approached 10%, and even exceeded this mark in European countries [1].

While high inflation is common in emerging market countries, it has not been seen in developed economies since the early 1980s. High inflation poses numerous risks to the global economy and creates a difficult dilemma for monetary authorities. Maintaining a soft monetary policy could lead to a loss of control over prices

and a stagflation trap. Stabilizing inflation by raising interest rates helps avoid stagflation, but risks destabilizing government budgets and the financial system, which have adapted to low rates over the past decade. In addition, tightening monetary policy slows economic growth, which is already low.

For a decade, central banks in developed countries have sought to raise inflation to target levels and move to positive key rates, but price growth has remained low. Therefore, the acceleration of inflation in 2021 came as a surprise to policy-makers. Even when the inflation shock became obvious, they continued to implement quantitative easing programs by inertia and kept rates at a minimum level.

Let us analyze the causes and mechanisms of the inflation shock. In 2010–2019, the leading countries pursued a stimulating economic policy, under which key rates in the United States and Canada did not exceed 2.0–2.5%, and in other countries did not rise above 1.25% [2]. At the same time, central banks implemented various bank refinancing and asset purchase programs to increase the money supply and boost economic activity. A soft budget policy was pursued. After the global financial crisis of 2008–2009, government budget deficits significantly expanded, and the volume of public debt began to increase. By the mid-2010s, the fiscal situation had normalized, but governments did not seek to reduce the debt to the pre-crisis level. Despite the soft macroeconomic policy, it did not cause overheating or destabilization of the economy. The budget crisis appeared only in certain countries of the eurozone. Inflation remained well below target levels even in countries where unemployment fell below pre-crisis levels.

There were concerns that the leading countries' economies would develop according to the Japanese scenario, in which low growth rates and the threat of deflation persisted for more than 10 years. The slowdown in economic development was attributed to structural factors [3-7]. In a state of “secular stagnation”, the risks of deflation become much higher than the risks of inflation, so economic policy must be oriented toward stimulating growth. The task of returning inflation to target values and avoiding a situation of zero rates and deflation came to the fore.

As a result, the concept of the “new normal” emerged in the expert community in the 2010s, meaning a combination of low inflation, high employment, and moderate economic growth rates [8]. Before the global crisis of 2008–2009, macroeconomic regulation was aimed at smoothing out cyclical fluctuations in the economy, preventing the acceleration of inflation, and maintaining budget stability. In this regard, much attention was paid to maintaining budgetary and monetary discipline. However, the post-crisis period has shown that in conditions of low demand and close to zero inflation, even soft fiscal and monetary policies do not cause inflationary consequences or destabilize the budget. Therefore, during the economic crisis caused by the pandemic that began in 2020, governments of developed countries switched to ultra-soft monetary and fiscal policies.

In 2020, global output contracted by 3.3%, with GDP dynamics varying significantly across countries. OECD and emerging market countries lost an average of 4.5% of GDP, in the EU GDP fell by more than 6%, in the US by 3.4%, in Japan by 4.5%, and in Latin American countries by an average of 6.7%. The exceptions were China and Turkey, where growth of 2.4% and 1.8%, respectively, was observed in 2020. Subsequently, by the end of 2021, most countries had reached pre-crisis production levels. In the first half of 2020, during the period of the rapid spread of the pandemic across the world and the highest uncertainty, economic activity declined sharply, and inflation slowed down along with it [9].

In this situation, central banks have cut rates everywhere to support economic activity, prevent a

liquidity crisis in financial markets, and provide stability to the banking sector. The US Federal Reserve, the Bank of Canada, the Bank of England, the Reserve Bank of Australia, and the Central Bank of Norway have cut key rates to almost zero. In the eurozone, Japan, Sweden, and Switzerland, rates were already zero or even negative by the beginning of 2020 and remained at the same level during the crisis [10].

In addition to lowering rates, monetary authorities resumed asset purchases, and no limits were set on their amount. During the acute phase of the crisis, central banks in emerging market countries also lowered rates, that is, they pursued countercyclical monetary policy, despite record capital outflows and a sharp weakening of national currencies. In 2021, a steady global inflationary wave began, which weakened only in the second half of 2022. Due to the significant synchronization of inflationary processes in developed countries, consumer price growth was observed everywhere.

The 2021–2022 inflation wave was the strongest inflation shock since the so-called “Great Inflation” of the 1960s–1980s, when consumer price growth rates in developed countries were expressed in double digits. One inflation peak occurred in the first half of the 1980s, and the second in the early 1980s. In 2021–2022, inflation rates in developed countries significantly exceeded the average rates for the previous decade and target levels, but still turned out to be lower than the peak inflation rates of the 1970s and 1980s. [11]

The main factor behind the 2021–2022 inflation was the imbalance between aggregate demand and aggregate supply that emerged on a global scale. In 2020, demand temporarily declined as a result of quarantine restrictions imposed by governments, but as the lockdown was eased, it not only recovered, but also grew significantly due to the implementation of an unprecedentedly large-scale budget aid package. This aid had many goals: support for private consumption, additional funding for the healthcare system, subsidies and assistance for servicing the debt of the most vulnerable enterprises under the lockdown, tax holidays, and unem-

ployment benefits. In 2020, the volume of budget support in the United States exceeded 22% of GDP, in Australia - 17% of GDP, in the UK and Japan - 14% of GDP [12].

As for aggregate supply, it showed a significant lag behind aggregate demand due to the destruction of global supply chains and cooperative production links under quarantine restrictions. The production of many types of products decreased.

Another factor in abnormal inflation was the rise in food and fuel prices on world markets. In OECD countries, food and energy accounted for about 1/3 of the increase in the consumer price index in 2021 and 2022, and in developing countries this contribution was even greater. Two waves can be distinguished in the increase in commodity prices. The first wave affected mainly food prices. It began in the second half of 2020 and was caused by the resumption of economic activity after a pause at the beginning of the year. The growth in prices for cereals and vegetable oil was especially rapid. From June 2020 to July 2021, these prices increased by almost 50%.

The second wave is associated with increased geopolitical tensions and the aggravation of the international situation at the beginning of 2022, which caused large-scale changes in the energy market. The sanctions war against Russia, the undermining of the Russian Nord Stream and Nord Stream 2 gas pipelines, which provided 32% of all Gazprom exports to foreign countries, and the cessation of Russian gas supplies to European countries have led to a sharp increase in global energy prices. Thus, the average price of coal in 2022 has increased by 4 times compared to 2020, and the price of natural gas - more than 7 times. The rise in natural gas prices had the greatest impact on the countries of Central and Eastern Europe: on average, the price of gas for households in the EU and the eurozone increased by 33%, including in Latvia - by 55%, in Lithuania - by 110%, in Estonia - by 154%. In other CEE countries, the situation was similar to the Baltic countries [13].

Another factor in the acceleration of global inflation was the change in the structure of consumer demand, namely, a decrease in demand for services and an increase in demand for goods. This shift occurred in many countries, including both developed and developing ones. It is known that prices of goods are generally more flexible than prices of services. Due to this, an increase in demand for goods and a decrease in demand for services leads to the fact that goods become more expensive quickly, and services become cheaper slowly. As a result, the overall price level rises. A similar effect was observed in 2021-2022, when the implementation of deferred demand caused an increase in prices for goods, and there was no decrease in prices for services. In the context of reduced production capacity of the global economy, this led to an increase in the overall level of consumer prices.

The effect of this inflationary mechanism was significantly enhanced by three factors: uneven recovery of demand in different sectors of the economy, difficul-

ties in production and supplies, and active stimulating policies. In the context of rising inflation, the first to move to a tight monetary policy were monetary authorities in Latin American countries. Brazil, Chile, Mexico, Colombia, and Peru began to raise key rates in the third quarter of 2021. In the fourth quarter of 2021, rates were raised in the CEE countries - Poland, the Czech Republic, Hungary, and Romania. The countries of the Pacific region and Southeast Asia (Thailand, the Philippines, Malaysia, India, and Indonesia) began a policy of “expensive money” in the second and third quarters. 2022 Monetary tightening by central banks in developed countries began only in 2022. Thus, the US Federal Reserve rate was raised to 0.25–0.5 per annum in March 2022 for the first time in 4 years, when inflation reached 8%. The ECB raised the rate from 0 to 0.5% in July 2022, with inflation at 8.6% [14].

Experts identify several reasons why regulators were unable to predict the abnormal surge in inflation and were late in raising key rates [15,16].

Firstly, the rapid return of demand to pre-crisis levels was extremely unexpected and atypical. Usually, it takes much longer for demand to recover after a crisis. However, the 2020 economic crisis is unique in that it arose primarily due to a supply shock under the influence of a non-economic factor – the coronavirus pandemic. Therefore, demand recovered very quickly after a short-term decline during the acute phase of the crisis, and significant budget injections led to overheating of the markets. China’s experience has shown that lockdown is a strong anti-inflationary factor. In this country, strict quarantine restrictions were maintained until the end of 2022, holding back demand, as a result of which the global wave of inflation did not affect the Chinese economy.

The second reason for the delay in anti-inflationary measures is that central banks are not inclined to suppress price shocks caused by rising commodity prices, since their pro-inflationary effect is short-lived. Experts at leading central banks believed that the acceleration of inflation was caused only by short-term factors, the effect of which would quickly cease, so there was no need to raise key rates. As a result, the possibility of long-term high inflation was not even considered.

The third reason is the erroneous conclusions of the monetary authorities about the situation in the labor market. With the onset of the crisis, employment declined and returned to its original level only by the beginning of 2022. The relatively high unemployment rate seemed to indicate that the economy was not overheating and there was no threat of inflation. However, in reality, in 2021, many developed countries already experienced a labor shortage as a result of the consequences of the pandemic, although this manifested itself differently in different segments of the labor market. In fact, by 2021, there was a simultaneous increase in actual unemployment and its natural rate. However, experts did not notice the increase in the natural rate of unemployment and therefore underestimated the degree of labor

shortage in many areas and the general tension in the labor market. As is known, unemployment and inflation are in antiphase. The appearance of high unemployment was perceived as the absence of risks of increased inflation.

The fourth reason for maintaining low key rates of central banks is that the connection between inflation and real economic activity has weakened in developed countries. In the second half of the 20th century, an increase in inflation was usually observed during such a phase of the economic cycle as an upswing. In the 21st century, the correlation between inflation and indicators of the phases of the economic cycle has practically ceased to be evident. Despite active fiscal stimulus from 2010 to 2019, the price level in developed countries remained stable and responded weakly to changes in aggregate demand. For several years, inflation remained below the target level. In this situation, in the United States, since 2020, they came to the conclusion that short-term increased inflation is quite acceptable, compensating for the low inflation of past years, since its final average value will be close to the target level. Tight monetary policy, as was recognized, will hinder the recovery of the economy after a severe crisis.

Finally, the fifth reason for keeping rates low by regulators was their desire to maintain the stability of public finances. It was the budgets that bore the brunt of the crisis. In 2020, general government budget deficits in developed countries exceeded 10% of GDP. In 2021, deficits decreased but did not return to relatively safe levels. In these conditions, raising rates would have been a strong shock to the budget. The threat of budget destabilization inclined monetary authorities to decide in favor of low rates.

Conclusion. The inflation shock of 2021–2022 was one of the consequences of the 2020 pandemic crisis. The main reason for the inflation wave that began in 2021–2022 was the rapid recovery of aggregate demand in the context of a reduction in aggregate supply as a result of quarantine restrictions and disruptions in supply chains during the coronavirus pandemic. The growth in demand was due to soft monetary and fiscal policies during the pandemic. Monetary authorities in developed countries failed to foresee the inflation shock, as they failed to take into account the increase in costs due to breaks in production chains during the lockdown, as well as the dysfunctionality of some markets. This is largely due to the abnormal, atypical nature of this crisis, the high uncertainty of its consequences and their impact on the economy.

In addition, governments and central banks underestimated the inflationary impact of budget support measures. This is due to their reliance on the experience accumulated in the pre-crisis period, when ultra-soft monetary policy combined with strong fiscal stimuli did not lead to inflation. Thus, the inflation shock of 2021–2022 was caused by both monetary policy miscalculations and deviations from strict adherence to fiscal discipline during the crisis. The example of devel-

oped countries, including the United States, shows that inflationary surges are possible even if price stability is maintained for several decades, budget authorities have the ability to borrow at low rates and with a high debt burden, and the currency is a reserve currency. Excessive demand stimulation is associated with the risks of destabilization of the monetary sphere, so the use of monetary policy instruments and fiscal support measures should be well thought out.

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俄罗斯法律中公寓地块法律制度的特点

**FEATURES OF THE LEGAL REGIME OF LAND PLOTS FOR
APARTMENT BUILDINGS UNDER RUSSIAN LEGISLATION**

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摘要。本文探讨了俄罗斯立法中公寓楼用地块法律制度的特点。探讨了公寓楼用地块法律制度的主要原则，以及俄罗斯联邦发展这一法律框架的挑战和前景。

关键词：法律制度、地块、公寓楼、公寓业主、土地权。

Abstract. *This article examines the features of the legal regime for land plots designated for apartment buildings under Russian legislation. It explores the main principles governing the legal regime of land plots for apartment buildings, as well as the challenges and prospects for the development of this legal framework in the Russian Federation.*

Keywords: *legal regime, land plot, apartment building, apartment owners, land rights.*

The legal regime of land plots for apartment buildings is a relevant topic in the field of real estate. The construction and maintenance of apartment buildings require clear legislative regulation of the relationships between apartment owners, management companies, and government authorities. In this article, we will discuss the key aspects of the legal regime of land plots designated for apartment buildings.

According to paragraph 3 of Article 6 of the Land Code of the Russian Federation [1], a land plot as an object of property rights and other rights provided for by the Code is considered an immovable thing, representing a part of the earth's surface with characteristics that allow it to be identified as an individually defined item [2]. Land plots associated with apartment buildings have specific characteristics.

The main principles governing the legal regime of land plots for apartment buildings regulate the relationships between apartment owners and the land plot on which the building is situated:

1. Principle of Delimitation of Legal Relations: This principle stipulates that apartment owners have the right to use the common land plots on which the building is located, in accordance with the charter or rules for the use of these plots.

2. Principle of Ensuring Common Use of Land Plots: Under this principle, apartment owners cannot dispose of land plots individually, only collectively through a management company or a homeowners' association. This ensures the protection of the collective interests of all owners and establishes rules for land use in line with the set regulations.

3. Principle of Preserving Common Ownership of the Land and Building Structures: This principle guarantees the stability and sustainability of relationships between apartment owners and the land on which the building stands, while also excluding the possibility of privatizing the land under the apartment building.

The boundaries, areas, and usage regimes of land plots for apartment buildings are determined by urban planning documentation, taking into account the legislation of the Russian Federation and the regulatory legal acts of the subjects of the Russian Federation [3].

Regulating the legal status of land plots for apartment buildings constitutes an important aspect of ensuring legality and upholding the rights of owners. The land plot on which an apartment building is located is viewed as part of the common property of apartment owners.

According to Article 37 of the Housing Code of the Russian Federation [4], each apartment owner in an apartment building has a share in the ownership of the land plot. This shared ownership is usually determined in proportion to the area of each owner's apartment.

The primary objective of regulating the legal status of such land plots is to ensure unhindered access for owners to exercise their land rights, as well as to maintain common property in proper condition. As per clarifications in the letter from the Ministry of Economic Development of Russia dated May 18, 2016, Division No. ОГ-Д23-6115 [5], it is concluded that it is not possible to divide a land plot on which an apartment building located, which belongs to the common property of the owners of the premises in the apartment building.

In accordance with Part 3 and 4 of Article 16 of the Federal Law dated December 29, 2004, No. 189-FZ "On the Introduction of the Housing Code of the Russian Federation" [6] the owner is not entitled to dispose of the land in the part where the land plot under the apartment building must be formed. In turn, owners of premises in the apartment building have the right to own and use this land plot

to the extent necessary for their operation of the apartment building and the objects that make up the common property within such a building.

In determining the scope of the rights of premises owners in the apartment building regarding the ownership and use of the specified land plot, it is necessary to refer to Part 1 of Article 36 of the Housing Code of the Russian Federation. In such cases, the owners' premises act as legal owners of the land plot on which the building is located and which is necessary for its operation, according to Article 305 of the Civil Code of the Russian Federation. They have the right to demand the cessation of any violations of their rights, even if those violations do not involve deprivation of ownership, and the right to defend their possession, including against the land owner.

Thus, the regulation of the legal status of land plots for apartment buildings plays a crucial role in ensuring owners' rights, maintaining legality, and supporting order in the management of common property.

According to Article 244 of the Civil Code of the Russian Federation, owners of apartments in apartment buildings hold ownership rights to a share of the common property and, correspondingly, to a share of the land plot [7]. Management of the land plot is carried out collectively through a general owners' meeting in accordance with Article 44 of the Housing Code of the Russian Federation.

An essential aspect is the coordination of land use among apartment owners, as the actions of one co-owner can impact the interests of others. It is also important to consider that any work that needs to be carried out on the land plot requires agreement with the other co-owners.

Another critical aspect is ensuring safety and the effective use of the land plot. The legal regime imposes the obligation on owners to monitor the preservation and safety of the plot, carry out its improvement, and ensure access to necessary engineering communications.

The relevance of studying the problems and prospects for the development of the legal regime of land plots for apartment buildings arises from the constant changes in legislation, judicial practice, and societal needs [8].

As noted in the academic literature, the issue of the relationship between the rights of land plot owners and owners of buildings, structures, and premises as independent objects of real estate, as well as determining an effective method of defending the violated rights of such owners, is one of the most complex in modern civil law. Scholars propose a concept of a unified real estate object, which suggests defining the legal regime for developed land plots. Recognizing a developed land plot as a civil rights object requires clarifying the characteristics under which such an object arises as a real estate item. It should be emphasized that a unified approach to defining the criteria for the capital nature of a building as a component of a unified object (the developed land plot) must include public (urban planning)

legislation. Civil legislation should define the legal regime of such an object (the developed land plot) and the features of its turnover.

Furthermore, within the framework of the developed land plot regime, the issue of identifying an object of rights, such as a room, may arise. An apartment building as part of a developed land plot contains multiple rooms [8]. However, registering individual rooms for cadastral purposes does not imply a transformation of their legal regime into an independent object of civil rights. The right to occupy a room as an object of capital construction should be viewed as a share of the common ownership rights to the developed land plot.

There are prospects for developing the legal regime of land plots. One such prospect is the improvement of mechanisms for monitoring compliance with laws in the area of land relations. The introduction of electronic management and monitoring systems will enhance transparency and effectiveness in managing land plots in apartment buildings.

Another prospect is the expansion of citizens' rights to participate in decision-making regarding the management of land plots. Creating mechanisms for the direct inclusion of homeowners in the management process fosters more harmonious relationships between residents and management companies. Overall, active interaction among all stakeholders and ongoing legislative improvement will help resolve existing issues and create favorable conditions for the development of the legal regime of land plots for apartment buildings.

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远程签订买卖协议的特点
**PECULIARITIES OF CONCLUDING A PURCHASE AND SALE
AGREEMENT REMOTELY**

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摘要。本文致力于远程签订货物买卖合同的具体内容。作者定义了远程货物买卖方式的特点，这些特点与传统的贸易组织有显著区别，以及这种签订买卖合同方式的法律监管问题。提出了完善这一法律关系领域立法的建议。

关键词：远程销售货物，卖方，买方，签订合同的时刻，买卖协议的条款。

Abstract. *The article is devoted to the specifics of concluding a contract for the sale and purchase of goods remotely. The author defines the features of the remote method of buying and selling goods, which significantly distinguish it from the traditional organization of trade, as well as the problems of legal regulation of this method of concluding a contract for the sale and purchase. Proposals are formulated to improve the legislation in this area of legal relations.*

Keywords: *distance selling of goods, seller, buyer, moment of conclusion of the contract, terms of the purchase and sale agreement.*

The COVID-19 pandemic, which has affected countries worldwide, has resulted in a significant increase in the volume of e-commerce both globally and specifically in Russia. This trend indicates a shift in consumer preferences towards a gradual growth in online shopping and a decrease in purchases from traditional retail chains. However, the existing legal challenges related to the regulation of distance sales significantly hinder the development of e-commerce, which possesses considerable potential for bolstering the domestic economy and integrating Russia into global information and economic processes. In this context, examining the legislative nuances surrounding the conclusion of remote sales contracts is particularly relevant.

According to Article 497 of the Civil Code of the Russian Federation [1] and Article 26.1 of the Law “On Protection of Consumer Rights” [2] a retail sales contract can be concluded using a distance method. This means that the contract can be finalized based on the buyer’s review of the seller’s description of the goods through catalogs, pamphlets, brochures, photographs, and communication channels such as television, mail, radio, and others, or via any other means that exclude the possibility of direct examination of the goods or a sample of the goods at the moment of contract conclusion.

Let us highlight the key characteristics of the remote method of selling goods, namely the lack of the possibility of physical familiarization with the goods at the time of concluding the contract, as well as the need for an offer, which serves as the basis for creating obligations between the seller and the buyer.

The importance of the offer is that it defines the terms on which the seller is willing to sell the goods. An offer is a public offer containing all the essential terms of the transaction, such as the cost of the goods, their characteristics, delivery and payment methods. However, it is worth noting that the offer must be clear and understandable for the buyer to avoid possible misunderstandings and disputes in the future.

In addition, there is an obligation for the seller to provide the buyer with the necessary information about the goods, which is especially relevant in distance selling, where the buyer does not have the opportunity to physically check the quality of the goods before purchasing. The law requires sellers to provide reliable information about the goods, including, for example, their characteristics, composition, operating rules and service life. It should also be taken into account that if the product does not correspond to the description provided in the offer, the buyer has the right to return or exchange the product in accordance with consumer protection standards. This further emphasizes the importance of transparency and honesty in distance selling. Distance selling is becoming increasingly popular, but it is not without risks for both consumers and sellers. Therefore, it is important not only to ensure compliance with the law, but also to create a trusting atmosphere in the relations between the parties, which can be achieved through competent legal regulation and active protection of consumer rights. Thus, the successful development of distance selling in Russia requires a comprehensive approach to legal regulation that will take into account the interests of all market participants and promote the growth of trust in this form of trade.

Another feature of concluding a distance purchase and sale agreement, which distinguishes it from a traditional sales contract, is the moment of its conclusion. According to paragraph 13 of the Rules for the Sale of Goods under Retail Sale Agreements [3], the moment of conclusion is recognized as both the moment when the seller issues a document confirming the payment for the goods to the buyer and

the moment the seller receives the buyer's message expressing the intention to enter into a retail sale agreement. At the same time, these provisions contradict the existing civil legislation, which defines distance selling as a method of concluding a retail sale agreement that, according to the legislative classification, is both a real and consensual contract. This means that for the agreement to be considered concluded, both payment and delivery of the goods are required. However, this requirement cannot be applied to a contract concluded at a distance, as such a contract is deemed concluded upon the seller's receipt of the buyer's acceptance.

The presence of these contradictions has been pointed out repeatedly in the works of Y.A. Sukhanov [6]. Furthermore, it seems that this legislative wording regarding the moment of concluding a distance purchase and sale agreement does not meet the criteria of certainty, as it is unclear under what circumstances the agreement is considered concluded from the moment the seller issues the document confirming the payment for the goods, and in which cases it is from the moment the seller receives the buyer's message.

The essential terms of a distance purchase and sale agreement are the subject of the contract and its price [5]. However, certain items cannot be the subject of such an agreement, specifically alcoholic beverages, tobacco products, and goods for which trade is prohibited or restricted by Russian legislation. Thus, regarding the subject matter of retail purchases, the subject of a distance sale agreement is quite limited. The price is fixed at the moment the contract is concluded, and the seller is not entitled to unilaterally alter it. Payment for the goods is conducted through cashless transactions.

O.A. Belova highlights another critical condition for an online retail sales agreement, without which the contract cannot be deemed concluded: the delivery condition [4]. In accordance with the Rules for the Provision of Goods via Distance Selling, the seller is required to deliver the goods to the buyer within the timeframe established in the contract; if no timeframe is specified, delivery must occur within a reasonable period. Nonetheless, while the legislation outlines the concept of a reasonable period, it does not specify the criteria for calculating it.

When utilizing a distance selling method for products, the seller is obliged to provide the buyer with confirmation of the retail sales agreement based on the terms of the offer. This confirmation must include an order number or another method for identifying the order, which enables the consumer to access information about the concluded retail sales agreement and its specific conditions.

The termination of a distance sales contract follows a unique procedure due to the buyer's ability to evaluate the quality and characteristics of the product solely based on the information provided by the seller. As the less protected party in this transaction, the buyer has the right to withdraw from the agreement both prior to and after receiving the goods.

Additionally, it is important to note that the Civil Code of the Russian Federation allows for the conclusion of retail sales contracts via distance means through the exchange of electronic messages between participants. However, it lacks distinct provisions specifically governing these contracts or particular obligations of the parties that arise from the unique nature of this method of entering into a sales agreement.

Although the current legislation recognizes distance selling as one of the methods for entering into retail sales agreements, these relationships possess distinct characteristics that warrant their classification as a separate category of contracts. This distinctiveness allows for specific regulations regarding the conclusion of such agreements, as well as the rights and obligations of the parties involved, to be articulated in various provisions of the Civil Code of the Russian Federation (RF Civil Code). Therefore, it is imperative to introduce amendments and additions to the section concerning “Specific Types of Obligations.”

To eliminate legal ambiguity regarding the moment a distance selling contract is formed, it is necessary to amend paragraph 2 of point 13 in the Rules for Selling Goods Under Retail Sale Agreements, as approved by the Government Resolution No. 2463 dated December 31, 2020. The revised wording should read as follows:

“The retail sale agreement concluded through distance selling is deemed to be established at the moment the consumer pays for the goods.”

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反极端主义的价值语义技术
**VALUE-SEMANTIC TECHNOLOGY OF COUNTERING
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摘要。对表征年轻人参与极端主义活动的犯罪学指标的统计数据进行分析表明，尽管当局密切关注这一威胁，但情况仍在继续恶化。特别是，2022年，年轻人犯下的与极端主义活动有关的犯罪数量与2019年相比增加了2.7倍，2022年的恐怖主义犯罪数量是2018年同类犯罪数量的1.3倍。这一趋势可能表明，俄罗斯联邦对引入国内社会技术重视不够，这些技术不仅可以高质量地预防公民参与极端主义恐怖主义活动，还可以积极转变那些道德健康受到破坏性意识形态影响的个人的世界观。本文致力于反极端主义的价值语义技术，该技术已成功通过了20年的国家测试。

关键词：极端主义、恐怖主义、活动、青年、参与、技术、价值观、意义、转变、系统、管理。

Abstract. *Analysis of statistical data characterizing criminological indicators of involvement of young people in extremist activities shows that despite the close attention paid to this threat by the authorities, the situation continues to*

deteriorate. In particular, in 2022, the number of crimes related to extremist activities committed by young people increased by 2.7 times compared to 2019, and the number of terrorist crimes in 2022 was 1.3 times higher than the number of similar crimes in 2018. This trend may indicate that insufficient attention is paid in the Russian Federation to the introduction of domestic social technologies that allow not only high-quality prevention of citizens' involvement in extremist terrorist activities, but also a positive transformation of the worldview of individuals whose moral health has been damaged by the influence of destructive ideology. The article is devoted to the value-semantic technology of countering extremism, which has successfully passed 20-year state testing.

Keywords: *extremism, terrorism, activity, youth, involvement, technology, values, meanings, transformation, system, management.*

Tendencies of the spread of youth extremism in Russia have been in the center of attention of researchers for a long time due to the fact that they pose a threat to national security and the integrity of the state. A particular danger lies in the fact that many citizens perceive extremism as an acceptable tool of confrontation in resolving political contradictions. In the context of ideological diversity established by Article 13 of the Constitution of the Russian Federation, the perception of extremism as an acceptable means of resolving interideological, interfaith, interethnic and intercultural relations becomes a factor in the destabilization of public life and state activity [1]. Socio-economic reforms and socio-political transformations developing in the Russian Federation since the late eighties of the last century contributed to the emergence of informal communities and subcultures among young people gravitating toward extremist activities. One of the reasons for this phenomenon should be considered the objective unpreparedness of the personnel policy in education, culture and the media to ensure high quality spiritual, moral and patriotic education in the conditions of ideological diversity and constitutional prohibitions on state ideology and censorship. In the USSR, education in state institutions was understood as the formation of a worldview corresponding to the state ideology, that is, the builder of communism. However, even when solving this simpler task, supported by state censorship, the main problem was recognized as the personnel shortage and low qualification of personnel. Therefore, the new situation of the need to implement spiritual and moral education in the conditions of ideological diversity and freedom of conscience, as well as the announcement that the highest values of the Constitution are “man, his rights and freedoms”, and the duty of the state is “recognition, observance and protection of the rights and freedoms of man and citizen”, caused shock among specialists who are not ready to solve such problems. Thus, the relevance of this problem has been noted by state leaders for more than forty years, but the situation is becoming increas-

ingly tense. The official assessment given in Article 20 of the Fundamentals of State Policy for the Preservation and Strengthening of Russian Spiritual and Moral Values states: “In the future, the situation may develop according to a positive or negative scenario” [3]. It is no coincidence that General Secretary of the CPSU Central Committee Yu. V. Andropov noted in his report to the June Plenum of the CPSU Central Committee in 1983 that “our main opponents on this path are formalism, stereotypes, timidity, and sometimes even laziness of thought” [2]. Unfortunately, these shortcomings have not been eradicated even today, in 2025, so it seems natural that on December 28, 2024, the President of the Russian Federation V. V. Putin signed Decree No. 1124 “On Approval of the Strategy for Counteracting Extremism in the Russian Federation” (hereinafter referred to as the Strategy) [4]. It should be noted that the main problem causing the growth of extremism is the personnel shortage, which was mentioned in the Address of the President of the Russian Federation to the Federal Assembly in February 2024, and the difficulties with the implementation of “sovereign technologies”, despite the fact that the Head of State insists on using their potential, and personally “Putin held a brainstorming session on satisfying the personnel shortage” [5, 8].

In accordance with Article 8 of the Strategy, counteraction to extremism is recognized as activity aimed at forecasting, preventing, identifying, warning, suppressing extremist manifestations, minimizing and eliminating their consequences, as well as identifying and eliminating the causes and conditions that contribute to the commission of crimes of an extremist nature [4].

Intensive development of fundamentally new methods for solving the above-mentioned problems was organized after the June Plenum of the Central Committee of the CPSU in 1983. In accordance with the instructions of the Head of the USSR Yu. V. Andropov, whom modern media call “Soviet Putin”, exact humanitarian sciences were developed that make it possible to reliably predict manifestations of extremism based on quantitative assessments of the characteristics of the worldview of citizens and their ability to comprehend new information [7]. The application of exact humanities to the problem of forecasting extremist manifestations using the analysis of value-semantic dynamics and numerical indicators that determine its quality has made it possible to guarantee the success of preventing all forms of extremism [6, 13, 14, 19]. The ability to guarantee the achievement of a given result has made it possible to develop a specialized cluster of value-semantic technologies for countering extremism. In other words, with the help of value-semantic technologies based on the application of exact humanities: value-semantic philosophy, value-semantic psychology, value-semantic sociology, value-semantic propaedeutics, value-semantic pedagogy, it is possible to guarantee the successful implementation of not only forecasting and prevention, but also the identification, prevention and suppression of extremist manifestations [9,

11, 12, 16, 18]. Applied aspects of exact humanities allow not only to adequately assess the specific characteristics of the worldview and the ability of citizens to comprehend new information, but also to develop a precisely calibrated positive impact that eliminates the causes of social tensions that cause processes leading to various manifestations of extremism [13, 15].

Thus, within a society, the constant monitoring of the state of which is carried out with the help of value-semantic technologies of counteracting extremism, the emergence and development of processes leading to manifestations of extremism becomes impossible. Therefore, in order to completely eliminate manifestations of extremism, it is necessary to pay special attention to the processes of interaction of society, controlled by value-semantic technologies of counteracting extremism, with the external environment. For example, the problems of the growth in the number of crimes committed by migrants in Russia can be solved as a preventive measure if the value-semantic technology of counteracting extremism is adopted by employees of the services that monitor migration processes. Minimization and elimination of the consequences of extremist manifestations are also most successfully carried out with the help of value-semantic technologies, which allow not only qualitatively but also quantitatively to accurately determine the state of the worldview of persons who have suffered damage from various manifestations of extremism, and to accurately determine the nature and strength of the impact necessary to minimize and eliminate undesirable consequences. Value-semantic technologies for countering extremism have demonstrated unique effectiveness in identifying and eliminating the causes and conditions that contribute to the manifestations of extremism, thanks to the discovery of new phenomena - the pain threshold of comprehension and methods of accurate numerical assessment of the level of unacceptable damage, after which destructive processes can become irreversible.

The testing of value-semantic technologies was carried out during a twenty-year state experiment organized in the most crime-prone area of Moscow, with systematic quarterly monitoring of the indicators of value-semantic dynamics, health, intelligence, education, learning ability, creativity and communication skills of the participants. During twenty years of observation, all indicators changed only in a positive direction [13, 17, 20]. The abnormally high intensity of extremism manifestations observed before the start of the application of value-semantic technologies to counter extremism decreased annually by 25% of the starting indicator, and after four years all manifestations of extremism completely ceased. It should be noted that the main condition for the successful application of value-semantic technologies to counter extremism is the qualification of personnel who possess original methods of using applied aspects of exact humanities to manage the quality of value-semantic dynamics. The training of personnel imple-

menting the application of value-semantic technologies for countering extremism, during the 20-year state experiment, was carried out for three years before the start of the experiment under the author's supervision. The system of continuous value-semantic education, including a package of value-semantic technologies for countering extremism, was called the "Anti-crisis education system" and was recognized as the winner of the All-Russian professional competition "Innovations in Education" in 2009, receiving the status of "Pearl of Russian Education" [10, 12, 13]. The main difference of specialists trained using the author's technology is the ability to accurately assess the quantitative indicators of the pain threshold of comprehension and unacceptable damage when managing value-semantic dynamics. This feature ensures the guarantee of safety and effectiveness of the application of value-semantic technologies for countering extremism in any conditions, opening up unlimited prospects for achieving the goals of sustainable development of civilization.

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激光技术在牙科领域的作用及其对牙科学生教育培训的意义

**THE ROLE OF LASER TECHNOLOGIES IN DENTISTRY AND
THEIR SIGNIFICANCE IN THE EDUCATIONAL TRAINING OF
DENTAL STUDENTS**

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摘要。本文探讨了激光技术在牙科中的应用，并论证了在牙科学生教育培训中研究其物理性质的必要性。重点是与临床实践中使用激光相关的实践和理论方面。

关键词：激光、牙科、教育培训、物理学、激光干预、临床应用。

Abstract. *This article examines the application of laser technologies in dentistry and justifies the necessity of studying their physical nature in the educational training of dental students. The focus is on the practical and theoretical aspects associated with the use of lasers in clinical practice.*

Keywords: *laser, dentistry, educational training, physics, laser interventions, clinical application.*

In recent decades, laser technologies have been applied in various fields of medicine, and dentistry is no exception. Lasers provide dentists with innovative tools for performing minimally invasive treatments, reducing healing time, and enhancing the overall efficiency of procedures. Due to their ability for high-precision work and minimal damage to surrounding tissues, lasers have become an integral part of modern dental practice, allowing for the resolution of a wide range of clinical tasks from therapeutic to surgical interventions.

With the advancement of laser technologies, there is a growing need for their comprehensive integration into educational programs for future dentists. Under-

standing the physical principles of laser operation, such as wavelength, emission power, and modes of operation, is critically important for comprehending their interaction with biological tissues. Understanding these aspects will help future specialists optimally utilize laser equipment, prevent potential complications, and ensure a high level of safety and comfort for patients.

A physics course that includes the study of laser technologies not only enhances the training of dental students but also provides insight into how the latest technologies merge with traditional medicine [1-3].

Application in Dentistry (Therapy)

Herpes Treatment. Herpetic stomatitis is a viral disease characterized by the appearance of painful and itching blisters on the mucous membrane of the oral cavity. Symptoms of the disease include pain during eating, swelling of the mucous membranes, inflammation of the lymph nodes, and sore throat when the palate is affected. No specific factors are required for infection as the virus is widespread, and contact with it occurs during childhood. The virus remains in a “dormant” state and becomes active when a person’s immune system weakens. The disease can last up to two weeks, but the use of lasers for treatment can reduce this period to just a few days [4].

During treatment, pain subsides, and a feeling of numbness occurs, but the next day, the situation may worsen as the biostimulation process begins [5]. The affected area must be treated in such a way that the patient does not feel heat. For this, the optical fiber is held at a distance of 5 mm from the lesion (or moved quickly and non-contactly by hand). The treatment begins on the periphery and then moves to the center. The treatment lasts 60 seconds, followed by a 10-15 second break. The total treatment time is 3 minutes, and it can be repeated up to 5 times in one session! As a result, within the first 24 hours, itching and burning disappear, and within two days, the lesion disappears completely without forming scabs (Fig. 1) [6]. It should also be noted that after laser treatment of herpes, the lesion does not recur in that spot.



Figure 1. Laser Treatment of Herpes [6]

Treatment of Aphthous Stomatitis (Aphthous Ulcer) of the Oral Mucosa. Aphthous stomatitis is a condition characterized by the appearance of ulcers covered with a gray necrotic plaque. Unlike herpetic ulcers, aphthous ulcers are not contagious; however, the symptoms remain similar: itching and burning at the site of the inflammation, and enlargement of the lymph nodes. The disease course is about 10 days, and the immune system plays a leading role in its development, with patients exhibiting decreased T-lymphocyte activity.

Irradiation of the area with aphthous ulcers using a diode laser is performed non-contact. The mucous area is first processed with brushing motions, moving towards the center of the ulcer, with an exposure duration of 60 seconds, followed by a 20-second break. The procedure of non-contact laser irradiation is then repeated for 40 seconds, followed by another 20-second break, then the area is exposed again for 20 seconds. The surface should be moist, for which we use 3% hydrogen peroxide. Ulcer treatment is conducted 5-8 times to achieve the best effect. As a result, immediate pain relief occurs, and healing is accelerated (within 3 days).

Antiseptic Treatment of Carious Cavity and Tooth Canal. Antiseptic treatment is a crucial step in caries therapy as it helps reduce the risk of secondary caries after filling. Laser irradiation does not affect nerve endings, thus it does not require anesthesia. After treatment, the cavity is covered with an agent that enhances adhesion to the filling material and prevents infection.

For this treatment, a laser is used in continuous mode for 2 minutes at a power of 0.5 W. The treatment is conducted for 45 seconds using a non-contact labile technique — with stroking movements along the walls of the carious cavity, followed by 15 seconds using a contact-labile method, gently touching and scraping the fiber optic on the surface of the carious cavity. To clean the tooth canals, the laser is held at a distance of 5 mm, using a power of 1 W for 60 seconds. Before laser treatment, the canal must be widened, rinsed with 1% sodium hypochlorite, and dried with paper points. Do not push deep into the canal as the fiber optic may break at bends; however, it can still reach the depths of the canal regardless of its curvature.

The use of the laser promotes the achievement of sterility in the carious cavity and tooth canal, preventing the occurrence of secondary caries and infection of the root canal.

Treatment of Tooth Hypersensitivity. Tooth hypersensitivity is a common issue leading patients to visit a dentist, characterized by increased sensitivity of teeth to external stimuli (such as acidic food, hot/cold temperatures, etc.). Using a laser to eliminate hypersensitivity is the most optimal method for addressing this issue, as it focuses on narrowing the dentin tubules and relaxing the internal receptors.

The procedure is performed with a replaceable optical fiber at a power of 0.5 W for 1 minute. The treatment is conducted over two visits, with an interval of 1-2 days: the first visit for treatment and the second for reinforcement. Sensitivity is removed after the first visit and does not recur. The Bulgarian treatment method is used: a 3M (softness) pencil is rubbed into the tissue and treated with the laser for 1 minute on each tooth. Then, the area is wiped with 3% hydrogen peroxide and treated again with the laser (sealing the canal), without changing the tooth color after treatment [1]. This method is highly effective in a short time, providing the greatest analgesic effect compared to other methods of treating tooth hypersensitivity.

Treatment of Acute Catarrhal Gingivitis. Catarrhal gingivitis is a periodontal disease characterized by serous inflammation of the gums. The main symptoms include swelling, pain, and bleeding of the gum margin. The primary causes of the disease are cervical caries, abnormal bite, and inadequate oral hygiene.

Laser treatment of gingivitis is completely painless and aims at reducing inflammation and strengthening the gums. The method involves a contact-stable application at a power of 0.5 Watts for 60 seconds. A total of 3-5 procedures should be performed, with an interval of 1-2 days between them. As a result, immediately after the procedure, the condition of the gums improves, redness and swelling subside, and the gums become firmer.

Application in Periodontology

Reduction of Gingival Hypertrophy. Gingival hypertrophy is a condition characterized by excessive overgrowth of the gums on the upper and lower jaws, leading to the formation of false periodontal pockets. Hypertrophied gums bleed, are painful to touch, and are swollen. Patients complain of bad breath and itching of the gum mucosa. The inflamed edematous tissue is excised, which helps to block the spread of infection. The procedure facilitates the restoration of periodontal tissues and minimizes the progression of the disease.

After several sessions, periodontal pockets, which can harbor a large number of bacteria, are completely eliminated. The result of the entire procedure is a bactericidal effect, and a reduction in pain and swelling.

Treatment of Periodontitis. Periodontitis is an inflammatory disease that results in the destruction of both soft and hard bone tissues, which can lead to the atrophy of the tooth socket and eventual tooth loss. The disease is often caused by poor oral hygiene, an improper diet dominated by soft foods, and a lack of vitamins in the body. Laser treatment techniques ensure the excision of dead tissue, eradication of bacteria, and cessation of bleeding.

The method involves inserting an optical fiber along the pocket: without anesthesia, using a scratching (or labile) technique or a stable one (inserted pointwise with tangential motions). Each technique yields similar results—the choice is up

to the dentist. If the optical fiber gets initialized, it should be removed, trimmed by 0.5 mm, and reinserted, or an impulse mode can be used, though this reduces effectiveness. Follow-up visits every other day with 3-4 procedures in total. Initially, the tooth pocket is treated for 30 seconds, and the time can be increased to 60 seconds on the second visit. The tooth pocket is sealed with tissue from the bottom up, and once the pockets are closed, a mechanical contact of the laser with the gum is performed for 30-60 seconds [6].

The laser procedure promotes restorative processes in periodontal tissues (stimulating the formation of new connective tissue bundles of the gums, attachment of the periodontal ligament to the cement surface of the root, in the absence of a long junctional epithelium).

Application in Surgery

Excision of the Gingival Hood during Wisdom Tooth Emergence, Inflammation Reduction. The difficult eruption of wisdom teeth is characterized by inflammation of the gum mucosa, creating a favorable environment for pathogenic bacteria between the gum and the tooth crown. This is accompanied by pus discharge, leading to an unpleasant odor from the eruption area, as well as pain. Excision of the gingival hood using a laser helps avoid severe pain and swelling.

The tissue is pierced at a power of 0.9 W, then the power is reduced to 0.7 W to excise the hood, followed by treatment with 3% hydrogen peroxide. After the procedure, the power is set to 0.5 W, and the wound is treated non-contact. As a result, within 4-5 days, the tissue heals, and swelling and inflammation subside.

Gingivoplasty in the Area of One Tooth (Crown Lengthening). Gingivoplasty is a dental procedure aimed at improving the appearance of the gum contour and maintaining oral aesthetics. The operation is necessary when a patient has an uneven gum contour, deep periodontal pockets, or tooth root exposure (Fig. 2) [6]. Laser interventions prevent bleeding, reduce the risk of infection under the wound, and ensure maximum precision in tissue excision.

A thread of size 000 or 00 is placed in the gingival sulcus. The gum is excised along this thread (without heating or breaking it), followed by treatment with 3% hydrogen peroxide. The tooth restoration is performed, and the thread is removed [7]. As a result, post-operative pain is absent or minimal, there is no post-operative swelling, and recovery occurs quickly.



Figure 2. Gum Contouring [6]

Excision of the Lingual Frenulum. The proper size of a child's frenulum in the oral cavity significantly influences bite formation. The procedure to trim the lingual frenulum in children is often necessary, as otherwise, it can cause discomfort during eating or speaking. Laser equipment intervention is a quick and painless procedure that can even be used in preschool-aged children.

The operation involves the use of local anesthesia, after which laser plastic surgery is performed over 3 minutes as the laser beam excises the tissue fold, contributing to its shortening. The use of the laser does not require additional suturing of the tissue cuts, which almost eliminates discomfort during the recovery period. As a result, within a couple of days, the patient no longer feels the wound, and complications are rare in most cases.

Despite the many advantages of lasers, it is essential to highlight the main contraindications for using this method in patient treatment [8]: cardiac and vascular pathologies in a stage of decompensation; nervous system diseases characterized by marked, severe excitability; hyperthyroidism; severe stages of emphysema; functional renal failure; severe diabetes mellitus; profuse bleeding; oncological diseases and predisposition to them; and photodermatoses.

Lasers have found widespread application in dentistry and have provided a plethora of nearly painless treatment methods for various oral diseases. The advantages of lasers over traditional dental methods can be observed through the methods of laser use described in this work.

Considering the growing interest and clinical demand for new technologies, it is anticipated that the use of lasers will become a standard in dental practice in the future.

Education in physics is becoming an integral part of the educational program, preparing specialists capable of utilizing the latest medical advancements to maximize benefits for their practice, as well as for the comfort and health of patients. This will contribute to further progress in the field of dentistry, ensuring more effective and safer treatment methods [1-3, 9].

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单亲家庭对儿童社会化进程的影响
**THE IMPACT OF SINGLE-PARENT FAMILIES ON THE PROCESS
OF CHILD SOCIALIZATION**

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摘要。本文论证了单亲家庭对儿童社会化过程的影响。揭示了单亲家庭的类别；在离婚危机时期以及离婚后危机时期对儿童心理发展产生负面影响的因素；与父母双方沟通的重要性程度，家庭政策。

关键词：家庭，单亲家庭，儿童，家庭危机，家庭关系危机，离婚过程，儿童社会化，家庭政策。

Abstract. *The article provides a justification for the impact on the process of socialization of a child from a single-parent family. The categories of single-parent families are revealed; factors negatively affecting the mental development of a child in both the crisis period of divorce, as well as in the crisis period after the divorce; the degree of importance of communication with each parent, family policy.*

Keywords: *family, single parent family, child, family crisis, family relations crisis, divorce process, child's socialization, family policy.*

Family is a value that every child needs, regardless of age. In a family, a child receives full, positive development. In recent years, the number of children raised in single-parent families has increased sharply, and in most cases, they are raised by their mother. Sociologists explain the divorce process or the abandonment of family by a pan-European trend.

Research supports the assumption that as adults, children of divorced parents are more likely to divorce themselves, since raising a child in a single-parent family affects his or her future marital and family relationships.

Three categories of single-parent families should be distinguished:

- families who have lost their father as a result of his death;
- families with a child born out of wedlock;
- after divorce families.

First category constitutes a special group of single-parent families, since the breakup of the family due to the death of the father is unintentional.

The psychological characteristics of children brought up in such families are determined by the fact of experiencing grief, and not by being brought up in a single-parent family. However, this category of families cannot avoid three consequences common to all broken families:

- emotional security is affected;
- the effectiveness of the family decreases due to the loss of the father with his specific role and responsibilities;
- deviations from the normal family model appear from the point of view of others.

Second category single-parent families are characterized by the birth of an illegitimate child. In this situation, the mother experiences a feeling of loneliness and increased responsibility for him, which turns into overprotective behavior. Excessive dependence on the mother is often combined in children with a feeling of hostility and idealization of the absent father.

The third category of families characterized by divorce proceedings.

Let us dwell on this category of families in more detail. The attitude of scientists to the problem of the influence of divorce on the development of the child's personality is not unambiguous. Thus, supporters of the "attachment theory", who pay special attention to the relationship between the child and the mother, believe that divorce does not have much significance for children, since a significant share of child care in complete families is provided not by the father, but by the mother. The role of the father, as a rule, is limited to play and entertainment.

Accumulating evidence not only confirms the impact of parental divorce on children's subsequent development and behavior, but also suggests that this impact may be even greater than the death of a parent. Research data indicate that the incidence of delinquency among boys in divorced families is approximately twice that of boys in intact families.

Divorce is usually understood as the moment when spouses stop living together. However, divorce should be viewed as a process that unfolds over time, which begins long before the separation. In many cases, this is a fairly long period of conflict between spouses. It is the conflicts and disharmony in the family, and not its disintegration as such, that is the source of the negative impact on the child.

The impact of chronic family conflicts on the emotional well-being of a child in a pre-divorce situation is analyzed in the studies of B.A. Titov and L.T. Mashkova. According to the authors, in conflict families, the main conditions for the full development of a child are violated - protection, love and care of loved ones, an atmosphere of cordial affection and goodwill towards each other. The lack of security, experienced by the child as a feeling of fear, anxiety and worry, suppresses his

activity, deforms feelings and thoughts, gives rise to depression or aggressiveness as the leading features of personal and social behavior. Under unfavorable conditions, according to the authors, the situational emotional reaction of fear can turn into a persistent character trait. Fear of one of the parents often causes a neurotic attachment to the other in search of the missing warmth. All this forms a distorted “self-image” and low self-esteem of the child [3].

Children involved in their parents’ quarrels find themselves in a severe internal conflict. They love their parents and fear that they will not live up to their expectations and lose the love of one of them. As a result of divorce, the child’s emotional connections and interactions with one or both parents are disrupted, the need for love, parental warmth, attention and care is not satisfied, that is, emotional deprivation is observed.

J. Wallerstein and J. Kelly testify that the decision of parents to divorce is often preceded by a long period of uncertainty of the child, leading to a sharp interruption of the process of his development, which can contribute to a significant disruption of the psychological and social functioning of the child.

Thus, the development of a child’s personality is influenced not only by divorce and upbringing in a single-parent family, but also by his life in the family before the divorce, since a divorced family is no longer a prosperous family long before the separation of the parents.

Another factor that has a negative impact on a child’s mental development is the divorce itself and the crisis period that follows it. The news of their parents’ divorce is a shock for most children, since parents usually do not talk about the approaching divorce until the last moment. According to J. Wallerstein and J. Kelly, young children are not ready to accept this news even in families where the parents did not hide their quarrels and were “openly” at odds. Preschool children are usually stunned and frightened. Girls aged 2-5 and boys aged 5-7 are especially sensitive to the breakup of the family. They believe that they have done something very bad and feel guilty for their parents’ divorce. Such a feeling of guilt leads to a loss of a sense of self-worth, fear of separation and loss of love, fear of retribution, and fear of losing their mother after their father. This fear is based on the shocking discovery of the transient nature of love [3].

At primary school age, according to J. Wallerstein and J. Kelly, most children understand that they are not to blame for the divorce, but they are also worried about their future. A distinctive feature of this age group is an acute sense of shame. Children are ashamed to admit that their father’s departure implies rejection of them, which means that they are unworthy of love. This situation has a direct negative impact on the development of the child’s self-awareness.

Only at the age of 13-18, according to J. Wallerstein, children, while experiencing a sense of resentment, becoming embittered and blaming one or both

parents for what happened, are at the same time able to form an adequate idea of the reasons for the divorce and their relationship with their parents.

In the short term, divorce always traumatizes children. Its long-term consequences have been studied much less, but there is an opinion that an incomplete family under certain circumstances is a significant factor in the deformation of the child's value orientations, behavior, and lifestyle in general.

Violation of emotional relationships with the immediate family environment and a high degree of conflict of former relatives increase the risk of the formation of pathological character traits and the emergence of neurotic disorders in children from broken families, which manifests itself in society. According to M.S. Bedny, 70% of childhood neuroses have their source in family conflicts. According to M.I. Buyanov, half of teenagers aged 16-18 who have attempted suicide are from single-parent families.

A.I. Zakharov notes that after divorce, conflicts with children in single-parent families are observed 2.5 times more often than in full families, which is an additional factor in the neuroticism of children, especially boys. Mothers who stay with girls, on the contrary, conflict with them 2.5 times less often. This is explained by the fact that in a mother, unlike a father, a decrease in neuroticism occurs not in a conflict with her husband, but in a conflict with the child. Taking on the role of a father and, in connection with this, the general emotional and physical overload of mothers further increases their nervous tension, increases the frequency of conflicts with the child, and thereby accelerates the process of his neuroticism [4].

Teenagers who have experienced their parents' divorce are characterized by greater emotional instability and personal immaturity, less strength of the "I", increased emotional sensitivity and passivity, timidity, fearfulness, and indecisiveness. This is largely determined by the personal changes in the parents themselves, which explain the conflict structure of the family and deviations in the educational approach to children.

A number of authors claim that due to the absence of a father in the family, adolescent children (especially boys) from single-parent families have difficulty with gender identification. Long intervals in meetings with the father can give rise to the effect of "family strangers". Such a father may be more attractive to the child than the mother.

E. Fromm emphasizes that a child needs a father throughout his entire development. However, he especially needs paternal love, authority and guidance after the age of 6.

G. Figdor notes that for the development of the child in most families the father performs the following important functions: representation of the "external world"; to a greater extent "invulnerability" in relation to the actions and attacks

of the child; representation of the properties: “big”, “strong” or the resulting “competitive”, “capable of self-affirmation”, and finally, in later life, representation of professional success and social status.

Sharing the opinion of E. Fromm on the importance of the father’s influence on the child’s development, Y. M. Antonyan and E. G. Samovichev believe that the absence of a father in a child aged 4-5 years has a greater negative effect than for a child at a later age. They argue, for example, that boys who lost their father before the age of 4-5 years have a weak male sexual-role orientation and more sexual-role conflicts than children who had a father or lost him at a later age. These conflicts are very often associated with an inadequate assessment of oneself as functioning in a male role, with the lack of formation of the corresponding forms of behavior [3].

Close to the previous opinion is the point of view of R. Muksinov, who claims that in children abandoned by their fathers in preschool childhood, behavioral deviations are observed in 44% of cases, at 7-8 years old - in 13% of cases, at 12 years old - in 24%, and at 13-18 years old - in isolated cases.

According to the same authors, the child’s attraction to the father and the father’s ability to fully accept his child stimulates his intellectual development. At the same time, 60% of students who lag behind in school are raised without fathers.

Research shows that fatherless upbringing has the most obvious impact on gender identity for both boys and girls. The less opportunity for real experience with their father that boys have, the more likely they are to identify with a distorted image of their father, which may include both idealization and disdain for him. Idealized fathers make it difficult for boys to have a realistic self-assessment. The absence of a male behavioral model prevents boys from adopting male gender roles and the corresponding behavioral style. In order to avoid suspicion of feminine behavior, they more often than others exaggerate their masculinity, display aggressiveness, rudeness, and pugnacity.

The experience of a relationship with a father is important for girls, first of all, for the formation of the “image of a man”. They can form an idealized image of a father, and the search for a love object will be associated with this image.

At the same time, scientists believe that a well-functioning divorced family has the potential to guide the child’s sexual identity. First, the children’s relationship with the divorced father should have a certain everydayness in order to make it difficult to idealize or disdain him. Second, it is desirable for the mother to feel good and lead an extra-family social life, to facilitate her children’s contacts with men (grandfather, uncle, coach, teacher, etc.).

G. Figdor believes that divorced mothers are often inclined to “pedagogize” their relationships with their children. They subordinate all their interests to their

children, give them more rights than children in two-parent families have, but also limit the child more with their inflated expectations, which largely contradict the needs of the child's development. The woman uses the role of mother as a chance for self-affirmation after her defeat in the role of wife. Another reason is the feeling of guilt, since she believes that she has caused harm and pain to her child with the divorce. Such "pedagogization" is a great burden for both the mother and the child.

The formation of personality begins very early and continues throughout life. The development of the child's personality and his upbringing are inextricably linked with the process of his socialization. In the works of L.S. Vygotsky, L.I. Bozhovich, V.S. Mukhina, D.B. Elkonin, the fundamental factor influencing the development of the child's personality is social experience embodied in objects of material and spiritual production, which is internalized by the child. The initial and only bearers of this social experience for the child up to a certain age are the parents. And since the primary socialization of the child occurs in the sphere of interpersonal relations with the immediate environment, harmonious relations within the parental family are important for the formation of a healthy personality [5].

This fact is vividly illustrated by the words of L. I. Bozhovich: "The mental development of a child and the formation of his personality can be understood only within the framework of his socialization, that is, his assimilation of the products of people's accumulated social experience. But the patterns that a child encounters in the course of his development are ambiguous. They can be products of creative, constructive activity of people, contributing to the progress of society, but they can be a product of negative experience, represent false views and principles, negative personality traits, etc." [2].

Family, according to the classification of A.V. Mudrik, is related to microfactors of human socialization. But of all existing factors, the parental family is the most important and influential. The child experiences the influence of the family first of all, when he is most receptive and deprived of a critical attitude. Family conditions, including social status, occupation, material level and level of education of parents, largely predetermine the life path of the child. In addition to the conscious, purposeful upbringing that parents give him, the child is influenced by the entire intra-family atmosphere, and the effect of this influence accumulates with age, refracting in the structure of the personality [5].

Research in recent years shows that single-parent families face a number of difficulties in fulfilling the function of socializing children. The presence of problems is evidenced, in particular, by the increase in the number of juvenile offenders from single-parent families. It is noted that juvenile offenders are twice as likely to come from a single-parent family. Another indicator is the high incidence of illness in children: studies conducted by medical specialists indicate a higher

susceptibility of children from single-parent families to acute and chronic diseases (N. Akkerman, O.V. Molokhovskaya) [1].

Family policy, in accordance with the Decree of the President of the Russian Federation “On the Main Directions of State Family Policy” dated May 14, 1996 (No. 712), is an integral part of the social policy of the Russian Federation and represents an integrated system of principles, assessments and measures of an organizational, economic, legal, scientific, informational, propaganda and personnel nature, aimed at improving the conditions and improving the quality of life of the family.

In addition, according to the Decree of the applicant Russian Federation dated November 9, 2022 No. 809 “On approval of the principles of state policy for the preservation and strengthening of traditional Russian spiritual and moral values”, a strong family as a “social institution” is laid down as the basis of state policy.

Family policy is the activity of the state, political parties, public organizations, interest groups, etc., aimed at the revival of the family, the family way of life, the culture of society lost over the long historical path, the return to the family of its organically inherent social functions, aimed at preserving and strengthening the family.

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19 世纪与 20 世纪之交俄罗斯帝国各省东正教神职人员的日常生活（基于《奔萨教区日记》）

THE DAILY LIFE OF THE ORTHODOX CLERGY IN THE PROVINCES OF THE RUSSIAN EMPIRE AT THE TURN OF THE 19TH AND 20TH CENTURIES (BASED ON “THE PENZA DIOCESAN JOURNAL”)

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摘要。本文介绍了 19 世纪和 20 世纪之交农村东正教神职人员日常生活的特点。研究的资料来源是奔萨教区公报的材料，其中包含神职人员自己的出版物，这使我们能够从那个时代日常生活的目击者的角度研究这个问题。神职人员生活的特点是牧师的收入依赖于地主和教区居民，需要将服务与农业工作或贸易相结合，以及贫困。作者得出结论，东正教神职人员代表的出版物是需要对社会进行深刻改革的信号。

关键词：日常生活史、日常生活、东正教神职人员、俄罗斯教会、俄罗斯帝国。

Abstract. *The article presents the characteristics of the everyday life of the rural Orthodox clergy at the turn of the 19th and 20th centuries. The source base of the study is the materials of the Penza Diocesan Gazette, which contains publications of the clergy themselves, which allows us to study the issue from the point of view of eyewitnesses of everyday life of the era. Characteristic features of the life of the clergy were the dependence of priests' income on landowners and parishioners, the need to combine service with agricultural work or trades, and poverty. The author concludes that the publications of representatives of the Orthodox clergy were a signal of the need for a deep reform of society.*

Keywords: *history of everyday life, everyday life, Orthodox clergy, Russian Church, Russian Empire.*

Until the mid-19th century, the daily life and daily routine of the clergy and peasantry had much in common [12, p. 1027]. “In their everyday home life, the former clergymen differed little from commoners: the same clothes, the same food

and the same activities...” wrote priest N. Dokuchaev of the village of Vyrypaevo, Saransk district, Penza province [6, p. 938].

In carrying out their special duties, all members of the clergy were the same farmers as their parishioners. Priest K. Stolypin from the village of Blokhino in Saransk district recorded the recollections of his parishioners: “They all lived, including the priests, in ordinary smoky huts; they went out to do field work – plowing and harvesting – just like the parishioners; they hauled and threshed grain just like them; during haymaking they could be found in any mowers’ team” [12, p. 1027].

In most parishes of the Penza Diocese, clergy did not receive *rugi*,¹The salary of the clergy began to be paid only during the church reform of Alexander II. The main source of income for the clergy was the voluntary payment of parishioners for the performance of religious services [2, p. 123]. However, due to their poverty, the parishioners paid the clergy very poorly for their work and often asked to perform religious services on credit, and then few repaid this debt [4, p. 277].

Priest Yevgeny Derzhavin from the village of Kotel in the Kerensky district of the Penza diocese shared his observation: “The majority of the clergy have long been of the opinion that parishes with a population of state-owned peasants are much better for them in material terms than parishes with a population of serfs or former serfs. We will not dispute this view of things, although it is true that in those harsh years of serfdom, general oppression and silence, the clergy could breathe a little more freely morally in parishes with state-owned peasants, but in material terms it was much worse than in the lordly villages” [8, p. 613].

Why did the clergy prefer to serve in villages on state lands? Apparently, because of possible complications in relations with landowners. According to the priests themselves, the situation of the clergy in villages with serfs “was sad”. Life in someone else’s manor house, the master’s heating, insignificant income, poor land forced the entire clergy to bow down not only to the landowner, but also to the burgomaster, clerks and “the rest of the servants [1, pp. 752-753]. Priest Yevgeny Derzhavin referred to the recollections of old-timers from the village of Znamenskoye (Bolshoy Burtas) in the Kerensky district: “The office allocated arable land, hayfields, somewhere in a ravine - a place for an apiary, cattle in the summer walked on the master’s fields, it was possible to somehow beg for a line for construction, and then, look, in the winter a kind burgomaster will be generous - and give a cart - or rye straw for heating and, perhaps, oatmeal for feed. All this for family people, poor, not provided with either a decent mug income or a salary from the treasury, was a big calculation” [4, p. 277].

¹ Ruga (from the Greek “salary”) - payments to the clergy, “*ruzhniki*”, usually issued from the state treasury or from the personal funds of a large landowner. Ruga originally meant the grain given to the clergy instead of a salary. Unlike the tithe, the amount of the *ruga* was set arbitrarily.

The clergy felt their dependence on the landowners even when replacing clerical positions, which, with rare exceptions, were inherited: a father would give them to his son, a father-in-law to his son-in-law for his daughter, etc. However, the replacements did not take place without the knowledge and consent of the local landowners: “The latter, as church builders and lifelong ktitors, viewed the parish church as property and therefore treated the clergy as their employees. If a landowner took a liking to a priest or a clergyman, the latter became his own man and enjoyed the lord’s favor on an equal basis with the favorite burgomaster” [11, p. 591].

The relations of the clergy with the landowners developed in different ways. For example, in the village of Abashevo, Narovchatsky district, Penza diocese, according to the recollections of old-timers, the landowners showed little interest in the lives of the clergy and church servants, with whom they had to meet very rarely, only during the performance of some services and the celebration of holiday prayers. There were no quarrels or disputes between them [7, p. 414]. But this was not the case everywhere. For example, in the village of Nikolskoye-Bornuki, Gorodishchensky district, Penza diocese, Deacon Uspensky was transferred to another parish because he had answered rudely to the master at the market when the latter was admonishing him. Priest Yagodin left the parish, having lost the master’s favor because of the priest’s cap. The young mother, instead of a modest headscarf, dressed herself in exactly the same cap as the lady had, and, despite the latter’s comments, stubbornly continued to flaunt it [11, p. 591].

Priest A. Rosnitsky from the village of Nikolskoye-Bornuki in the Gorodishchensky district, where these events took place, wrote: “If the clergy kept a distant and respectful distance from the landowner, they lived on an equal footing with the peasants: they partied together, and they grieved together. He had nothing to boast about in front of the peasants. The same plough and harrow, the same poverty and general serfdom brought him very close to the peasants” [11, p. 593].

Before the introduction of state salaries, the clergy could receive the main means for their own maintenance only from church land [2, p. 123]. Therefore, all members of the clergy “cultivated the land with their own labor - they themselves plowed, reaped, mowed, in general, performed all the peasant work” [1, p. 752-753].

The clergy could carry out their service only on condition of personal physical labor [5, p.173-174]. All members of the clergy, not excluding the priest, were engaged in cultivating the land only with their own hands. At a certain time of the year, on working days, parishioners, in case of need for the clergy, went straight to the field or meadows and there found the members of the clergy they needed.

Content with a small allowance, the clergy were very modest in their demands for life and in their home life differed little from the peasants. They ate very poor-

ly. They drank tea occasionally, as a delicacy. Some of the clergymen lived even worse than the peasants [3, p. 714].

The house of the village priest looked like this: “A wooden, three-windowed room, a cold entryway and a ‘black hut’ with sleeping platforms made up the priest’s entire dwelling. The furniture in the room was very simple: in the front corner, under the icons, there was a table covered with a white tablecloth made of thin linen; the tablecloth was woven and chosen in a simple pattern by the nun herself. Benches and painted chests were arranged along the walls. A rug was spread out on the cleanly washed floor. There was a bed behind the partition. The black hut was no different from a peasant’s house” [10, p. 137]. The priest’s house, as a rule, belonged to a church, while the deacon and the psalm-reader had their own [9, p. 791].

In relation to the peasants, the clergy behaved very simply: “Some of the clergy did not disdain to intermarry with peasants; they gave their daughters in marriage to peasants or enrolled uneducated children into the peasant class.”

“They lived simply, and behaved simply with their parishioners, taking part in their family joys and misfortunes,” wrote priest N. Dokuchaev from the village of Vyrypaevo in the Saransk district. “Therefore, just as a wedding or christening could not take place without a priest and matushka, so they could also be seen at a funeral. “Becoming godparents” and becoming related to the clergy was not uncommon in the old days” [6, p. 938].

The clergy’s clothing was almost entirely homemade. On weekdays, the priest wore a woven shirt, bast shoes, and a “polkaftanye” made of dyed fabric with a colored belt, and on holidays he wore boots and a cassock made of purchased material [1, p. 752-753]. Only priests and some deacons had boots, but they wore them when they went to perform the Divine Service; in ordinary times, priests also wore bast shoes [3, p. 714].

In the village of Blokhino in the Saransk district, many stories have been preserved about the priest Adrian Iosifov. He was, in the full sense of the word, a “priest in bast shoes.” He had boots, but they were kept in the church. He wore them on great holidays for the liturgy - Easter, Christmas, etc. He celebrated matins in bast shoes. At home, his favorite pastime was weaving bast shoes. Priest K. Stolypin wrote down the recollections of old-timers: “He was a great master in this regard. He would sometimes weave a whole heap of bast shoes - large and small - and give them to his numerous godparents and godchildren. Often, he could be found wandering into some village and certainly fully armed: in a caftan, tightly pulled together with a sash; on one side, behind the sash, a “kochedyk” was fastened, on the other - a bunch of bast; on his back are bast shoes, taken off for economy during the journey; in his bosom is a prayer book, and sometimes a baptismal box. He comes to a village and lives there for three or four days: he

walks under the windows and asks: “Are there any prayers?” Wherever it happens, he baptizes a baby, or gives a prayer to a woman in labor, blesses a new well; if a woman doesn’t watch closely enough, some evil spirit gets into a tub of cabbage, he climbs into the cellar himself and blesses the defiled food” [12, p. 1027].

The scarcity of means for existence forced many members of the clergy to open inns at their homes (the village of Aksel is known for its rich bazaars); some took on the role of cabbies and, having collected, for example, a party of seminarians after the holidays, took them to Penza - for a correspondingly meager fee, and from there, in order not to return with an empty cart, they carried salt in the winter, and watermelons, apples or onions from Bessonovka in the summer. Such “side activities” increased the meager budget of the clergy for feeding the family. Some members of the clergy sometimes even set up commercial establishments (millet or cereal “dranki”, butter churns, etc.). Priest I. Golubinsky from the village of Aksel, Krasnoslobodsky district confirmed: “Some members were downright profiteers: they bought the catch of fish from fishermen at a certain time and sold the fish themselves, receiving a few pennies in profit for their troubles” [2, p. 1203].

In the second half of the 19th century, the clergy began to live with greater conveniences than before. Priests and psalm-readers no longer wore bast shoes, and if some deacons and sextons wore bast shoes, it was only for work - plowing, mowing, reaping, etc. Priest F. Pokrovsky noted: “The home life of priests began to be distinguished by a better environment. They no longer smelled of tar, and they were received by landowners not in the reception room or pantry, as before, but in their personal quarters, as welcome guests and interlocutors. And from that time on, landowners did not shy away from visiting priests” [10, p. 137].

Since 1857, the clergy itself began to own church-clergy land. In some places, the clergy hired peasants for a small fee [10, p. 136], or leased land for a short term. As a rule, the rent for a tithe was 10-12 rubles per year [9, p. 791]. However, the rural clergy failed to overcome the problem of mass poverty in this way.

When studying the everyday life of the province, it became clear that the clergy and peasantry suffered unfavorable historical circumstances together. Insufficient technical equipment of farms; lack of effective land cultivation practices, mass poverty, low crop yields and recurrences of famine, etc. became widespread and everyday phenomena. The clergy fully shared the hardships of the everyday life of the peasantry, experiencing a disastrous financial situation. Characteristic features of the life of the clergy were the dependence of priests’ income on landowners and parishioners, the need to combine service with agricultural work or trades, poverty. Publications of representatives of the Orthodox clergy on the pages of the Penza Diocesan Gazette were a signal of the need for a profound reform of society.

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美术作品中的宪法共生意象
SYMBIOTIC IMAGES OF THE CONSTITUTION IN WORKS OF
FINE ART

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摘要。本文分析了一种特殊类型的宪法图像的作用和意义。艺术家为其艺术作品选择的大多数宪法图像都受到书籍、卷轴、碑文、建筑物、女性、机械等明确图像的启发。除此之外，还有一小部分宪法图像，本文将它们称为共生体，因为它们结合成一个整体，两个宪法图像的原型取自不同的生活领域。本文给出并分析了此类图像的示例。值得注意的是，共生宪法图像主要以卡通为特征，同时也尝试创作此类纪念性艺术作品。以 1978 年西班牙加的斯宪法纪念碑为例，就说明了这一点。最后，作者得出结论，共生体图像中两个图像特征的结合使我们能够更深入地揭示国家宪法在该国特定政治局势中的作用和意义，以及总体上的历史意义。

关键词：宪法形象、美术、宪法可视化、原型、漫画中的共生体、共生体纪念碑。

Abstract. *The article analyzes the role and significance of a special type of images of the constitution. Most of the images of the constitution that artists choose for their works of art are inspired by the unambiguous images of the book, scroll, tablets, buildings, women, mechanisms, etc. Along with this, there is a small group of images of the constitution, which in the article is designated as symbionts, since they combine into a single whole, two images of the constitution, prototypes of which are taken from different spheres of life. Examples of such images are given and analyzed. It is noted that symbiotic images of the constitution are characteristic primarily of cartoons, at the same time there are attempts to create such monumental works of art. This is shown by the example of a monument dedicated to the 1978 Spanish Constitution in Cadiz. In conclusion, the author concludes that the combination of the features of the two images in the symbionte image allows us to deeper reveal the role and significance of the national constitution in the specific political situation of this state and, in general, its historical significance.*

Keywords: *image of constitution, fine art, visualization of the constitution, prototypes, symbionts in caricature, symbionts-monuments.*

The Constitution as the most important law of the state in works of fine art is represented by various images: books, scrolls, tablets, humans, animals, architectural objects, culinary masterpieces, mechanisms, puzzles, umbrellas, etc. [1, pp. 119-129]. Each of these images contains certain characteristics of the constitution as a legal act or reveals the attitude of politicians and officials of this state to the constitution.

The Constitution as a legal act is a set of fundamental rules established in this state, it is a rather complex and abstract category, the transmission of which in verbal form requires the use of special legal terminology and immersion of the listener in the world of constitutional doctrine. In contrast, the artistic image of the constitution allows the viewer to understand at least the whole idea of the artist without special legal knowledge. Some images of the national constitution are so common in works of fine art that they have become steadily associated with this act (for example, images such as the constitution-book, constitution-scroll, constitution-woman). This facilitates the recognition of the constitution in the work of fine art. These images were analyzed by the author of this article in a number of works [2, 3, 4].

However, the imagination of artists is not limited to turning the constitution into only one visual object, along with this, there is a combination in the image of the constitution of two heterogeneous visual objects, due to their peculiar artistic symbiosis.

Use of the term «symbiont» in science and culture

The term and concept of «symbiosis» (Greek συμ - βίωσις – «life together») appeared in scientific terminology thanks to the achievements of biology, in which «symbiosis is an obligate or optional form of cohabitation of two dissimilar organisms» [5]. Accordingly, a symbiont is a participant in symbiosis.

These terms are also used in the development of scientific models of «symbiotic associations of natural and artificial intelligence systems included in organized and organized technical environments» [6].

The term «symbiont» turned out to be so successful in conveying the phenomenon it describes that it began to be used in other areas of life. He is present in cinematic works, as, for example, in the film «Venom» (USA, 2018) and «Venom-2» (USA, 2021), in fiction, especially in science fiction in the style of cosmo-operas¹ and found embodiment in performances. For example, in the performance «Symbiont» by Nikolai Golikov and Vladimir Ermachenkov, a person becomes part of a musical instrument that obeys the machine's algorithm².

¹ In particular, it is represented by a whole direction on the samizdat sites Litres, Litnet, Knigoed by the works of Ekaterina Rovskaya «Symbiont» URL: <https://litnet.com/ru/book/symbiont-b148988> (accessed 30.12.2024); Oleg Divov «Symbionts» URL: <https://www.litres.ru/book/oleg-divov/symbionty-437105/> (accessed 30.12.2024); Vladimir Abramov «Symbiont and laziness» URL: <https://knigoed.net/84-symbiont-i-len.html> (accessed 30.12.2024), etc.

² Performance «Symbiont» by Nikolai Golikov and Vladimir Ermachenkov URL: <https://garagemca.org/event/prepared-surroundings-festival-of-experimental-sound/materials/symbiont-symbiont> (accessed 30.12.2024).

Features of images of the constitution in the form of symbionts

It seems that the introduction into scientific circulation of the use of this term to characterize this type of constitution images is permissible and is optimal from the point of view of reflecting their characteristics. At the same time, it should be noted that the images of the constitution - symbionts «function» differently from the way alien predators-invaders in science fiction films do, seeking to change humanity for their own purposes, or like many real-life biological symbionts in which the symbiont parasitizes on the host organism.

By creating symbiotic images of the constitution, artists aim to more fully and simultaneously reflect different sides of the implementation of the constitution. At the same time, various artistic techniques are used. There are three main ones.

The first technique is to «merge» the well-known artistic image of the constitution with another, often unexpected artistic way, usually not correlated with the constitution. Let us also illustrate this with the example of the image of the constitution in the form of a book. Usually in works of fine art, the constitution is depicted in the form of a book without any features, more or less similar to the original text of the national constitution. This is how it looks in works about taking the oath of allegiance to the constitution, promoting its ideas, reflecting the negative processes occurring with it, or to show the difficulties of its interpretation (for more details, see: [2]).

The symbiotic connections of the constitution-book image can be different. One of the most complex cultural codes is laid by an unknown artist in the symbiotic image of the constitution, depicted in a caricature, which is an illustration of the article by Italian author Monica Capo «Constitutional Referendum» [7] (Fig. 1).



Figure 1. Unknown author. Cartoon illustration of the article by M. Capo «Constitutional referendum» [7].

The cartoon presents the referendum as a rodeo. As you know, rodeo is a sport common among Mexican and American cowboys and has existed since the 19th century. This is a sport of brave and risk-taking people who tame a strong bull (Fig. 2).



Figure 2. Rodeo (Wikipedia photo).

The cartoon depicts the Italian Constitution as a symbiont combining a book and a bull saddled with a cowboy. The image of the bull and rider reflects clearly the influence of American culture and the American way of life. At the same time, this image reflects one of the aspects of the Italian cultural code, although it arose under American influence, but transformed in the Italian spirit thanks to the achievements of real Italian cowboys from Maremma, from the 19th century. to the present day [8], as well as spaghetti westerns. The image of a cowboy is the result of the mythologization and romanticization of the Wild West in Italian culture (see about this: [9]). The cartoon depicts a bold cowboy (this is indicated by his hat, cowboy boots, apparently denim suit), who pacified the bull at the rodeo and raised his hand in a victorious gesture. This symbiont includes an image of a book with the inscription «Constitution of the Italian Republic», which is also a «bull», but this is not a living bull, but an image of an adjustable and controlled simulator for training cowboys in the form of a bull. So both the rodeo and the cowboy victory are not real, this is a kind of game, a preliminary training for real competitions. The cartoon illustrates the ideas of an article calling for a vote against the amendments to the 1947 Italian Constitution proposed by the government of Matteo Renzi as negatively affecting the constitutional order, worsening the situation of citizens, reducing the importance of the Senate and weakening control over the government (for more details on this reform, see [10]). This government initiative

ultimately did not receive support in the referendum. Summarizing the conclusions of Italian researchers regarding the results of the constitutional referendum, T.A. Vasilyeva writes: «The results of the 2016 referendum showed that in Italy the time for serious constitutional changes, obviously, has not yet come and such ideas have not been identified that could seriously compete with the solutions proposed in the Constitution» [11, c. 98].

The second technique used to create the image of the symbiotic constitution is that it is based on a recognizable object that is an important part of the national cultural code in a given country, for example, an original monument to the constitution or a picture dedicated to the constitution with famous characters, and on the basis of this object symbiotic images of the constitution are created. In Spain, for example, such an object was a monument to the 1978 Constitution, located in the center of the Spanish capital Madrid at the intersection of Vitruvia Street and Paseo de la Castellana (Fig. 3). Since the «cube» of the Constitution stands steadily on one of the edges, this monument symbolizes the stability of the constitutional order based on this constitutional act. This kind of idea of a firmly standing cube has rather ancient roots in art: it was on it that Faith and Wisdom were traditionally depicted, as opposed to the changeable Fortune, depicted standing on a ball [12, pp. 322, 571]. The Constitution Monument is clad with 60 tons of the same marble that clad such masterpieces of Spanish architecture as the Alhambra and Escorial, underscoring the value of the 1978 Constitution and with it the connection of centuries. The monument has an esoteric meaning, since it was originally created as a tesseract (a four-dimensional cube, an analogue of a three-dimensional cube in four-dimensional space), i.e. as the geometric equivalent of the fourth dimension of space-time. There are highly symbolic and even cosmogonic interpretations of this monument, including those derived from the mathematical features of the cube used for it³. Inside the marble cube there is also an empty space of a cubic shape, to which steps lead, inviting the viewer to enter the «core» of the cube, thereby, as it were, completing and activating it, which can be seen as symbolizing the movement of Spanish citizens in the democratic era.

³ They are reflected even in Wikipedia in the article «Monumento a la Constitución 1978». URL: [https://es.wikipedia.org/wiki/Monumento_a_la_Constituci%C3%B3n_de_1978_\(Madrid\)](https://es.wikipedia.org/wiki/Monumento_a_la_Constituci%C3%B3n_de_1978_(Madrid)) (accessed 30.12.2024).



Figure 3. Spanish Constitution Monument 1978 in Madrid (Wikipedia)

This monument is widely known, associated by the population with the Constitution, gave rise to other «cubic» monuments of the Spanish Constitution, in which the authors otherwise play up the theme of the cube, for example, hanging it on cables, as in Cuenca, and thereby emphasizing complex political ties that ensure the stability of the Constitution. The «cube» of the Constitution serves as an object of image by artists, including in the form of symbiotic images. So, the Spanish cartoonist H.M. Nieto created the image of the Spanish Constitution in the form of a cube puzzle (Fig. 4).

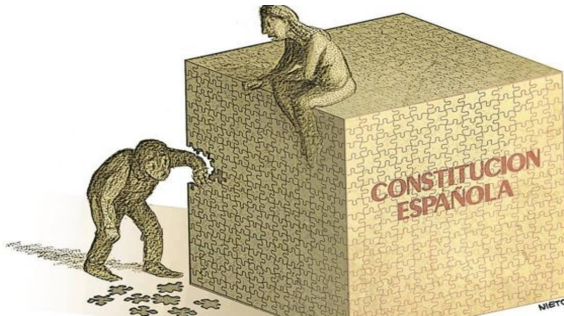


Figure 4. By Nieto. Article illustration [13].

This cartoon combines into a symbiotic two images of the constitution that are found in Spanish fine art, namely a cube and a puzzle. In the image of the Spanish Constitution, the idea of the aforementioned monument is played out as a cube. However, in this case, it is just a three-dimensional cube, the integrity of which is clearly encroached upon by one of the characters. The image of the puzzle in relation to the constitution arises from this cartoonist when creating works addressing

the problems of nationalism and the secessionist movement. This is evidenced by his other caricature, in which the Spanish Constitution of 1978 is a complex puzzle from which one of the elements, «nationalism» (Fig. 5). He was clearly less than the space left for him. The characters who are next to the constitution and collected the big picture of the constitution are at a loss, they clearly did not expect this. In this case, the artist focuses on the complex problem of nationalism, which is directly related to the status of autonomies, in particular Catalonia, however, the general assessment of the Constitution in the form of a puzzle largely coincides with the ideas of some Spanish lawyers that this is not a very holistic act requiring reforms (see more on this [14, p. 171]).

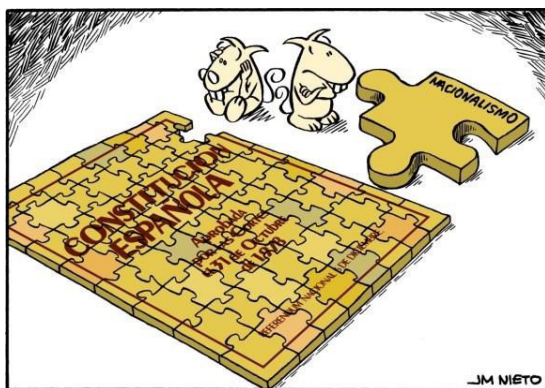


Figure 5. By J.M. Nieto [15, p. 69].

Returning to the caricature of the constitution in the form of a cube-puzzle, it can be noted that, combining two images, the image of a cube and a puzzle, the artist emphasized the complexity of the implementation of this Constitution and a certain discrepancy between the plan of the constitutional legislator, who sought to create a solid legal basis for the state and society and the implementation of this plan in modern rapidly changing conditions. In fact, the caricature raises the question: is the «cube» of the constitution so reliable if at the same time it is a «puzzle» of heterogeneous elements? This vision of the country's Constitution reflects the fact that at the time of its creation it represented the result of a consensus of diverse political forces in order to overcome the consequences of dictatorship. Вместе с тем художественными средствами показано, что процесс изъятия элементов пазла подрывает целостность и прочность самого «куба» конституции.

At the same time, it is shown by artistic means that the process of removing puzzle elements undermines the integrity and strength of the «cube» of the constitution itself.

The third technique used to create symbiotic images of the constitution is to create a new image that has no connection with the usual, established images of the constitution, or with other original objects dedicated to the national constitution. So, sculptors often find new symbiotic images of the national constitution, in search of a more complete and expressive embodiment of the multidimensionality of the constitution. Images of the constitution of a symbiotic nature are found not only in cartoons dedicated to the constitution. At the same time, sculptors can find new images for symbionts that are not related to common images of the constitution.. In order to show the multidimensionality of the theme of the constitution, this technique is also used by sculptors. So, one of the most complex sculptural symbiont images dedicated to the Spanish Constitution of 1978 was created by the Spanish sculptor L. Kentero. The monument is located in Cadiz, in the city where the country's first constitution was adopted. This image of the 1978 Constitution combines the image of a cage and a bird (Fig. 6).



Figure 6. Spanish Constitution Monument 1978 in Cádiz⁴.

The author of the monument, Spanish artist Luis Kentero, explained his artistic design as follows: «When I am assigned to work on freedom, I work with opposite elements. Thus, the idea of a bird is endless freedom, without restrictions, and the cage symbolizes its absence, oppression. I think this is a more positive image of the 78 Constitution» [16].

This image-symbiont of the constitution is unusual and does not include common images of the constitution as an integral part, unlike other previously given

⁴ URL: <https://www.lavozdigital.es/cadiz/20071018/local/cadiz/monumento-constitucion-1978-cadiz-200710181250.html> (accessed 30.12.2024)

examples, but its purpose is the same as that of other images-symbionts of the constitution: to reveal the complexity and originality of the moment of creation of this act during the transitional period for the state movement from dictatorship to democracy.

Conclusion

The analysis of the combination of the features of two images of the national constitution in a symbiont image is a fruitful artistic device for showing the features of this legal act. The immersion of the usual, traditional images of the constitution into a new cultural environment by including an additional image in the symbiont creates a «doubling» of the angle of perception of the national constitution, giving rise to another, more saturated associative figurative series. This technique allows you to more deeply reveal in artistic form the role and significance of the national constitution in the specific political situation of a given state and its historical significance.

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风景画中的贝加尔湖主题
BAIKAL MOTIFS IN LANDSCAPE PAINTING

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摘要。本文致力于在描绘贝加尔湖主题的背景下描述贝加尔湖地区的风景画，对贝加尔湖主题的解读可能非常多样化。这取决于特定艺术家的概念和想法。因此，呈现了艺术家的风景画作品以供研究：V. S. Rogal“贝加尔湖主题”，1966年，在国家预算文化机构“伊尔库茨克地区艺术博物馆以 V. P. Sukachev 命名”中；V. F. Zagonek“贝加尔湖主题”，20 世纪末，在阿斯特拉罕地区国家预算文化机构“阿斯特拉罕国家美术馆以 P. M. Dogadin 命名”中；V. A. Kuzmina“贝加尔湖主题”，2008 年，在国家预算文化机构“伊尔库茨克地区艺术博物馆以 V. P. Sukachev 命名”。

关键词：贝加尔湖主题、贝加尔湖、风景情绪、风景画家。

Abstract. *This article is devoted to the description of landscape painting of the Baikal region in the context of the depiction of Baikal motifs, the interpretation of which can be very diverse. It depends on the concept and idea of a particular artist. Thus, landscape works of the artists are presented for study: V. S. Rogal “Baikal Motif”, 1966, is in the State Budgetary Cultural Institution “Irkutsk Regional Art Museum named after V. P. Sukachev”; V. F. Zagonek “Baikal Motif”, late 20th century, is in the State Budgetary Cultural Institution of the Astrakhan Region “Astrakhan State Art Gallery named after P. M. Dogadin”; V. A. Kuzmina “Baikal Motif”, 2008, is in the State Budgetary Cultural Institution “Irkutsk Regional Art Museum named after V. P. Sukachev”.*

Keywords: *Baikal motive, Lake Baikal, landscape-mood, landscape artists.*

The relevance of this topic is beyond doubt, since the appeal of modern man to the image of nature is a kind of cultural code that has been relevant throughout all centuries of human existence. This is the same as a person’s appeal to his origins. Nature is eternal, it gives strength to live on and find answers to all questions that

arise in people. The nature of Baikal is unique and the appeal in this case to this body of water allows artists to create unique works of fine art.

The purpose of this article is to examine the landscape works of artists V. S. Rogal, V. F. Zagonek, V. A. Kuzmina, having a common name “Baikal Motif” and dedicated to the depiction of Lake Baikal, to determine the similarities and differences in the author’s concept.

To achieve the stated goal the following tasks need to be solved:

- provide a list of literature on the designated topic;
- indicate the methods used in the course of this study;
- give a general description of the “Baikal motif”;
- in the context of the above points, consider the landscape works of artists V. S. Rogal “Baikal Motif”, 1966; V. F. Zagonek “Baikal Motif”, late 20th century; V. A. Kuzmina “Baikal Motif”, 2008.

The materials obtained as a result of the analysis of the presented paintings can be used in further scientific pedagogical activities as a basis for research into regional landscape painting.

The practical application of the findings will facilitate a more in-depth and comprehensive examination of this issue.

During the preparation of this material, the following was studied: scientific and specialized literature, which can be conditionally divided into two groups.

The first group of sources is devoted to the landscape genre as a whole. This includes: work Panarina E. I. “Classification of the landscape genre” [4] and scientific article Syromyatnikova E. V. “Methods of conveying the light and air environment in landscape painting” [6], which provides a general description of the landscape genre, lists its types, and provides features of the image.

The second group also includes landscape painting, but of a certain place. Siberia on the example of specific artists. This includes: the publication of a candidate of philosophical sciences, associate professor Simanzhenkova T.K., candidate of art history, associate professor Serikova T.Y. “Genius of the place: representation of the image of the native land in painting (based on the work of A.M. Znak, A.V. Kazansky, and A.N. Osipov)” [5]; work of an art critic Lareva T. G. “History of fine art of the Baikal region of the 20th – early 21st centuries” [3]; publication by Doctor of Arts, Professor Vasilyeva-Shlyapina G. L. “Siberian Romanticism in the Works of Krasnoyarsk Artist Elvira Motakova” [2]; scientific work senior lecturer Bekisheva A.V. “Landscape in the painting of Transbaikalian artists of the second half of the twentieth century” [1]; article Shepnyakova I. V., Vostryakova T. Y., Novikova G. A. “Siberian Levitan: landscape in the works of V. V. Tetenkin (from the collections of the Tulun Museum of Local History)” [7].

In the above-mentioned works, the theme of depicting Siberian nature is presented very vividly. “Landscape (from the French paysage– locality, country) is

one of the most emotional, most lyrical genres of fine art, the subject of which is the depiction of pristine or human-modified nature” [4, 242]. Baikal as a source of inspiration runs through the works of many artists. Therefore, Baikal motifs are one of the key themes of the works of local artists.

The presented scientific works provide an opportunity to delve deeper into the landscape painting of the Baikal region and comprehensively reveal the theme of this study “Baikal Motifs in Landscape Painting”, being, in addition, its specific methodology, along with general scientific methods such as: description, comparison, generalization, systematization.

Baikal is unique and inimitable in its diversity. Therefore, each of the artists finds something personal and individual in this natural phenomenon. “The artist’s idea of the place where he lives, and the image of which he embodies in his works, is exclusively personal, subjective. This subjectivity is multi-layered: it is divided into time, place, choice of object and its condition and determination of means of artistic embodiment” [5, 62]. Baikal is also an artistic image of the entire region. Contemplating the severe beauty of the lake, a person comes into contact with eternity, conducts a dialogue with time, which is endless on Baikal. In the context of the modern world of digital technologies and the Internet, turning to the beauty of this natural phenomenon, a person thereby preserves the cultural and spiritual traditions of many generations living before him, for whom Baikal was not only an object of observation, but a means of survival in a harsh reality.

Baikal motives— is a very broad topic for interpretation, united only by Baikal itself. This definition includes everything that excites a person and is connected with Baikal: from the image of the people living on it, to simply the mood inspired by the lake or thoughts about it. In this case, there is no clear definition of what should be depicted in accordance with such a name. However, it can be stated with confidence that along with the real landscape of a certain area, the artist also really depicts his feelings and inner experiences, giving the landscape an emotional coloring and the background of his mood. “Among all the genres of fine art, perhaps one of the most emotional is landscape” [6, 175].

Looking at the presented works of artists united by this common name, it is clear how different the plot of this work can be.

Let’s consider the landscape by V. S. Rogal “Baikal Motif”, 1966:

The composition of the work is horizontal. It depicts the snow-covered shore of Lake Baikal. The shore is very steep, completely covered with snow, and it is difficult to get to the edge. In the upper part of the work and the depicted shore, there are several trees standing separately from each other. The trees are coniferous. One tree has a slope to the right. Its lower part is shown as icy, with stalactites of icicles hanging down to the ground. The kingdom of ice and snow. The surface of Lake Baikal is very dark, going up to the sky. The whole work exudes cold and

frost. The painting seems frozen and motionless. The depicted landscape is very realistic, as evidenced by the entire composition of the work [3]. In addition, the scale of the depicted objects corresponds to reality, the color scheme is close to natural colors. The artist's "Baikal motif" is expressed through the image of the wild winter shore of Lake Baikal, gloomy and cold.

A completely different "Baikal motif" is presented by the artist V. F. Zagonek in his work of the end of the 20th century. The composition of the painting has a rectangular position close to a square. The whole work exudes a spring mood. The color scheme is very bright, blue, white, light-yellow colors prevail. In the foreground of the work, the shore of Lake Baikal is also depicted, on which there are bushes of plants that are covered with white and light-yellow blossoming buds, like the revival of a new life. The surface of the lake is bright blue and calm, along which a steamboat is moving in the distance. The air is transparent and clean. In the background are the tops of the hills, the tops of which are covered with white snow. The hills are the same color as the water surface of the lake, blue. Because of the emphasized bright straight colors, the elements of the work seem decorative somewhere [1]. The whole work exudes calm joy and peace. The day is just beginning. It will be bright and warm. Unlike the previous work, in this case the "Baikal Motif" is completely different, bright and festive.

Unlike the two previous motifs (cold and harsh and festive, minus and plus), the third "Baikal Motif" by artist V. A. Kuzmin can be described as neutral. The composition of the work is horizontal. In the middle of the lake's water surface, there is an island. The shore of the island is rocky, it seems deserted and unsociable. The cliffs are very steep and inaccessible, there is no vegetation. In front of the island, fragments of rocks protrude from the water. The entire work is done in gray-brown colors. And only in the sky in the work does the blue color appear, depicting running clouds. The landscape evokes calm and thoughtfulness [3]. The absence of bright accents helps the viewer immerse himself in his inner world. In himself. The leisurely splash of the waves stops time, forcing thoughts to flow calmly and evenly. This is the "Baikal Motif" that the artist presented.

Analyzing the presented works, it can be stated that, having a common name, the content of the works is completely different, united only by Baikal itself.

Therefore, having examined all the presented works of the artists V. S. Rogal, V. F. Zagonek, V. A. Kuzmina the following conclusions can be drawn:

- all the artists' works are done in the landscape genre;
- all the artists' works have a common title "Baikal motif";
- all the artists' works depict the nature of Lake Baikal;
- all the artists' works are absolutely different in content and mood (different in the time of year depicted) [7];
- works of artists V. S. Rogal and V. A. Kuzmina have features of the realism style;

- the artist's work V. F. Zagonek has decorative elements;
- works of artists V. S. Rogal and V. A. Kuzmina have a horizontal composition; the work artist V. F. Zagonek has a rectangular composition, which highlights the author's position and emphasizes the personal focus of the plot [2];
- all the presented works of the artists, each individually, represent a unique Baikal motif.

Thus, in the course of the conducted research:

- a list of literature on the designated topic was presented;
- the methods used in the present study were indicated;
- a general description of the "Baikal motif" was given;
- in the context of the above points, landscape works of artists were considered V. S. Rogal "Baikal Motif", 1966; V. F. Zagonek "Baikal Motif", late 20th century; V. A. Kuzmina "Baikal Motif", 2008.

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耶尔森氏菌致病性的未公开潜力
**THE UNDISCLOSED POTENTIAL OF YERSINIA
PATHOGENICITY**

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注释。耶尔森氏菌的致病性已被研究。研究表明，所谓的耶尔森氏小肠结肠炎样微生物具有致病因素，并可能引起人类和动物的疾病。这些耶尔森氏菌的表型鉴定很困难，因此有必要使用分子遗传学和光谱分析方法

关键词：耶尔森氏菌、耶尔森氏菌病、致病因素、耶尔森氏小肠结肠炎样菌、毒素、耶尔森氏假结核菌、鲁氏耶尔森氏菌。

Annotation. *Pathogenicity of Yersinia has been studied. It has been shown that the so-called Y. enterocolitica-like microbes possess pathogenicity factors and can potentially cause diseases in humans and animals. Phenotypic identification of these Yersinia is difficult, so it is necessary to use molecular genetics and spectral methods of analysis*

Keywords: *Yersinia, yersiniosis, pathogenicity factors, Y. enterocolitica, Y. enterocolitica-like, toxins, Y. pseudotuberculosis, Y. ruckeri.*

The genus *Yersinia* belongs to the recently separated family *Yersiniaceae* of the order *Enterobacteriales* [8]. This genus includes three known pathogens of humans and animals: *Yersinia pestis* (the causative agent of plague), *Yersinia pseudotuberculosis* (the causative agent of pseudotuberculosis) and *Yersinia enterocolitica* (biotypes 1B, 2, 3, 4 and 5) – the causative agent of intestinal yersiniosis,

as well as a large number of *Yersinia* species that are controversial in terms of pathogenicity – the so-called *Y. enterocolitica-like* microbes.

The aim of this study was to investigate the pathogenicity of *Yersinia* based on literature data and our own research, with an emphasis on *Y. enterocolitica-like* microorganisms.

The pathogenicity factors of *Yersinia* include surface proteins Yop, toxins, yersiniabactin, etc. The intracellular effectors of Yop include YopE, YopH, YpkA/YopO, YopP/YopJ, YopM and YopT. TO translocator apparatus - YopB, YopD and LcrV, which deliver effectors into cells. *Y. pseudotuberculosis* has a much more pronounced invasive activity, which causes frequent cases of generalization of this infection. In *Y. enterocolitica*, invasiveness, with the exception of serovar O:9, is not expressed. Enterotoxin of *Y. enterocolitica* plays a leading role in the development of diarrhea. The possibility of developing immunopathological disorders is associated with the YPM toxin. The pathogenicity factors also include flagella, which determine the ability of *Yersinia* to reversion, and VW antigens, which regulate the production of effector proteins, etc. [10].

All pathogenic *Yersinia* contain a 70-kilobase plasmid required for virulence expression. Currently, thirteen polypeptides encoded by this plasmid have been identified [13]. Two of them have been identified as true outer membrane proteins, and at least ten are secreted into the culture medium. The pathogenic functions mediated by plasmids include survival in blood serum, resistance to phagocytosis, cell adhesion, and cytotoxicity. Plasmid-encoded proteins are more effective for serological diagnostics of Yersiniosis than whole bacterial antigens. According to the mechanism of action, all *Yersinia* pathogenicity factors are divided into several functional groups. One of them combines determinants that promote adhesion (YopA) and invasion (Ail), as well as porin, a lipopolysaccharide-protein complex, and special organelles - pili, filamentous structures. The ability of *Yersinia* to adhere to and invade intestinal epithelial cells is encoded by the chromosomal *inv* gene and does not depend on the presence of plasmids [1,9,14].

YST (*Yersinia* Stable Toxin) is a heat-stable enterotoxin produced by *Y. enterocolitica* bacteria. There are several subtypes of these toxins: YST A (gene *ystA*), characteristic of pathogenic representatives of *Y. enterocolitica* (1B, 2–5 biotypes), YST B (gene *ystB*) and YST C (gene *ystC*). YST B has a strong toxic effect and causes diarrhea. More than 80% of *Y. enterocolitica* 1A strains have the gene *ystB* in their chromosomes [2,19].

Of particular interest are the so-called *Y. enterocolitica-like* microbes. The latter include: *Y. kristensenii*, *Y. intermedia*, *Y. frederiksenii*, *Y. hibernica*, *Y. ruckeri* and a number of others. *Y. enterocolitica-like* microbes are a group of pathogens that cause diseases similar to infections caused by *Y. enterocolitica*. When using traditional methods of phenotypic identification, these bacteria are difficult to differentiate from *Y. enterocolitica* due to their similarity.

It has been proven that at least two species *Y. enterocolitica-like* cause infectious diseases only in animals. The causative agent of infection in salmon fish is *Y. ruckeri*, which leads to their mass death in artificially raised conditions. *Y. entomophaga* causes an infectious disease in the New Zealand grass larva *Costelytra zealandica* [15].

The role of these microbes in human pathology is ambiguous. However, there are more and more reports of the isolation of these microbes from patients with intestinal infections and other pathological processes. However, the isolated *Yersinia* are not studied as a possible etiologic factor in these infections. Therefore, it is so important to study the pathogenicity factors of rarely isolated *Yersinia*. In recent years, certain types of *Yersinia* with pathogenicity determinants have been increasingly isolated. Most often, these types include the “troika” of *Yersinia*: *Y. kristensenii*, *Y. intermedia*, *Y. frederiksenii*. The clinical significance of these *Yersinia* remains unclear and will be clarified as a result of improving etiologic diagnostics.

In the species *Y. kristensenii* and *Y. frederiksenii*, the gene of the heat-stable toxin *ystB* was found in the chromosome, encoding a heat-stable enterotoxin similar to that of enterotoxigenic *E. coli*, but 8 times more toxic [18].

Y. ruckeri isolated from human wound discharge after an injury sustained while swimming. Being an absolute pathogen for fish, often consumed by humans not only in thermally processed but also raw form, the question arises about their possible etiological significance. Representatives of *Y. ruckeri* have pathogenicity factors and have the ability to form biofilms [5]. The overwhelming majority of epizootics in salmon are caused by serovar O1a.

In Russia, the *Y. ruckeri* strain was first isolated from humans by E. A. Bogumilchik et al. [3] during a bacteriological analysis of the feces of a gastroenterological patient. The results of the study for other infections of viral and bacterial etiology were negative. A characteristic feature of *Y. ruckeri* is the absence of the urease enzyme, as a result of which the colonies on elective nutrient media were not stained blue-green, as in another *Yersinia*. Further studies using the MALDI ToFMS method and determination of biochemical activity using the API 20E test system showed that the bacteria belong to the *Y. ruckeri* species. Sequencing of the 16S rRNA gene was used as an additional method for determining the genus and species affiliation of the strain under study.

A single bacterial isolate of *Y. kristensenii* (EPLC-04T) was isolated from human feces and identified based on phenotypic characteristics, mass spectrometry, and partial 16S rRNA gene sequencing. The phenotypic profile of the isolate differed from that described for the most closely related species, *Y. kristensenii*, by increased lipase production and lack of pyrazinamidase activity. However, unique phenotypic features and phylogenetic analysis indicate that it represents a new

subspecies of *Y. kristensenii*. The subspecies *rochesterensis* subsp. nov. (type strain EPLC-04T=ATCC BAA-2637T, DSMZ 28595T) is proposed for this new taxon [11].

A case of isolation of *Y. canariae* from clinical material in Denmark is described [17]. *Y. artesiana*, *Y. proxima*, *Y. alsatica*, *Y. vastinensis*, *Y. thracica* and *Y. occitanica* were isolated from humans and animals as a result of multilocus typing of the core genome sequence [16].

Y. kristensenii and *Y. frederiksenii* contain a gene of a heat-stable toxin in the chromosome [21]. The isolation of such strains from patients with intestinal infections may indicate that these types of *Yersinia*, previously considered non-pathogenic microorganisms, can cause human diseases. In this regard, material from patients with acute intestinal infections of unknown etiology and from patients with prolonged abdominal pain (of unclear origin) should be examined for intestinal yersiniosis.

According to A. Sulakvelidze, virtually all *Y. enterocolitica*-like species (except *Y. aldovae*) have been isolated from humans worldwide, including humans with gastrointestinal disorders. The exact prevalence of these species in humans is unclear but should be better determined, at least in the United States, since the Centers for Disease Control and Prevention's active foodborne surveillance network is beginning to monitor *Y. enterocolitica*-like species in that country. At the same time, some observations suggest that currently available data on the prevalence of *Y. enterocolitica*-like species in clinical specimens are not accurate. For example, very few microbiology laboratories perform tests to differentiate *Y. enterocolitica* from *Y. enterocolitica*-like bacteria; therefore, some *Y. enterocolitica*-like species are likely to be misidentified. In this context, it has been shown that automated bacterial analyzers are not always able to identify these species [12,20].

Y. enterocolitica-like microbes have certain biological properties that make them similar to *Y. enterocolitica*, including their ability to cause symptoms typical of diseases caused by this pathogen. These microorganisms can be found in various environments, from soil to water, and can get into food products, which increases the likelihood of human infection. The facts of their detection in material from sick people require further research in this area, especially in acute diarrheal infections of unknown etiology and wound complications.

Since *Yersinia* that are not classified as plague or pseudo-tuberculosis pathogens may be the cause of food poisoning, their etiological role must be confirmed by the absence of other pathogens in the biomaterial. Repeated detection of such *Yersinia* or their isolation from "sterile" tissues of the body, massive seeding of the material with them, signs of an immune response to antigens of the suspected pathogen (seroconversion) are mandatory. In this regard, material from patients with intestinal infections of unknown etiology and from patients with prolonged

abdominal pain (of unclear origin) must be examined for the presence of such yersinia.

The use of multi-primer PCR is a promising direction for the detection of *Y. enterocolitica*-like *Yersinia*. Detection of the genetic material of non-pathogenic *Y. kristensenii*, *Y. frederiksenii*, *Y. intermedia*, *Y. bercovieri*, *Y. mollaretii*, *Y. rohdei* in biological samples of a sick person may indicate that the clinical manifestations of an infectious disease may be caused by *Yersinia* species previously considered non-pathogenic [7]. The *ykst* gene has also been identified in 4 strains of *Y. kristensenii* [4,6].

There is a need to develop more accurate diagnostic methods to differentiate *Y. enterocolitica* from similar microbes to enable more effective management of infections caused by these organisms. Additional research and analysis are required to better understand the pathogenic properties of *Y. enterocolitica*-like microbes and their impact on human health. Therefore, *Y. enterocolitica*-like microbes are of interest to human and veterinary care, as their role in human and animal infections requires further study and attention.

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肿瘤微环境中性粒细胞与早期腔内HER2阴性乳腺癌临床及形态学参数的关系及预后价值

RELATIONSHIP AND PROGNOSTIC VALUE OF TUMOR MICROENVIRONMENT NEUTROPHILS WITH CLINICAL AND MORPHOLOGICAL PARAMETERS OF EARLY LUMINAL HER2-NEGATIVE BREAST CANCER

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摘要。该研究为回顾性研究。对 2021 年 1 月至 2022 年 12 月在莫斯科卫生部 S.P. Botkin 市临床医院接受治疗的 60 例早期乳腺癌女性的病史和手术材料进行了分析。所有患者均被诊断为管腔 A 或管腔 B 乳腺癌、HER2 阴性乳腺癌、pT1-2pN0-1M0、散发性（非遗传性）癌症；未检测到 BRCA1/BRCA2 和 CHEK2 基因突变。使用抗 CD15 抗体在全自动系统（BenchmarkXT、Roche 的 ICH Slide Stainer、Ventana）中对肿瘤相关中性粒细胞的存在进行免疫组织化学检查。使用 Jamovi 软件（版本 2.2.5）进行统计数据处理。

关键词：中性粒细胞，管腔，临床和形态学数据特征，单变量逻辑回归分析，ROC分析，淋巴管侵犯。

Abstract. *The study was retrospective. An analysis of 60 case histories and surgical material of women with early breast cancer who were treated at the S.P. Botkin City Clinical Hospital of the Moscow Health Department from January 2021 to December 2022 was performed. All patients were diagnosed with luminal A or luminal B breast cancer, HER2-negative breast cancer, pT1-2pN0-1M0, sporadic (non-hereditary) cancer: mutations in the BRCA1/BRCA2 and CHEK2 genes were not detected. Immunohistochemical examination of the presence of tumor-associated neutrophils was performed using anti-CD15 antibodies in a fully automated system (BenchmarkXT, ICH Slide Stainer by Roche, Ventana). Statistical data processing was performed using Jamovi software (version 2.2.5).*

Keywords: *neutrophils, luminal, characteristics of clinical and morphological data, univariate logistic regression analysis, ROC analysis, lymphovascular invasion.*

Introduction

Breast cancer (BC) is one of the most common oncological diseases among women. Also, according to the International Agency for Research on Cancer GLOBOCAN (Cancer Today), BC ranks first in the structure of mortality from cancer among women. The absolute number of detected BC worldwide in 2022 reaches 2.5 million with the number of deaths exceeding 600 thousand [1]. Given the steady increase in the incidence of BC, it is expected that by 2040 the number of deaths will exceed 1 million [2]. Treatment of early breast cancer is regularly improved, increasingly moving towards a multidisciplinary approach, including: neoadjuvant drug therapy (chemo-, hormonal, targeted therapy), radical surgery and radiation therapy when indicated. However, despite the constant improvement of antitumor treatment, more than 20% of patients experience relapse and progression of the disease, even with early luminal breast cancer of good prognosis [3]. In routine clinical practice, breast cancer is classified into the main molecular subtypes depending on the presence of prognostic and predictive biomarkers, including estrogen receptors (ER), progesterone receptors (PR), tumor cell proliferation marker Ki67 and human epidermal growth factor receptor HER2/neu. Based on various combinations of these biomarkers, luminal A and luminal B HER2 negative (they have the most favorable prognosis), luminal B HER2-positive and triple-negative molecular subtypes of breast cancer are distinguished, each of which is characterized by its own tumor microenvironment, which, thus, allows us to talk about the pronounced heterogeneity of this oncological disease [4].

The tumor microenvironment includes a wide range of both non-immune cells, including fibroblasts, and immune cells: natural killers, macrophages, various subpopulations of lymphocytes [5]. As studies show, immune system cells in the tumor microenvironment of breast cancer play a key role in the prognosis of the

disease [6]. In this case, standard morphological examination routinely evaluates only the presence of lymphocytic infiltration (TILs), while the presence of myeloid hematopoietic cells, which include tumor-associated neutrophils, is relegated to the background.

Tumor-associated neutrophils are cells that have migrated from the systemic bloodstream into the tumor stroma [7]. Depending on the cytokines secreted by the tumor microenvironment, 2 neutrophil phenotypes are formed: antitumor anti-inflammatory N1 and proinflammatory N2 [8,9]. Data on the relationship between tumor-associated neutrophils and clinical and morphological features of breast cancer are extremely limited, and existing studies focus mainly on non-luminal forms with heterogeneous patient samples [10,11], while relatively “favorable” forms are not actively studied.

In this regard, we set the following goal: to compare the clinical and morphological features of early luminal HER2-negative breast cancer with the presence of neutrophils in the tumor microenvironment. Materials and methods

Characteristics of patients included in the study and evaluated parameters

The study was retrospective. An analysis of 60 medical records and surgical material of women with early breast cancer who were treated at the S.P. Botkin City Clinical Hospital of the Moscow Health Department from January 2021 to December 2022 was conducted. All patients were diagnosed with luminal A breast cancer or luminal B, HER2-negative breast cancer, pT1-3pN0-1M0. Mutations in the BRCA1/BRCA2 and CHEK2 genes were not detected in all patients.

The assessed clinical characteristics of patients included: age, body mass index (BMI), presence and number of births, presence of menstruation, breast trauma, family history, breast cancer stage.

The assessed morphological parameters included: molecular subtype of breast cancer, degree of tumor differentiation (G), presence of lymphovascular (LV) and perineural (Pn) invasion, presence of lymphocytic infiltration (TILs), level of expression of estrogen receptors (ER) and progesterone receptors (PR), Ki67, presence of metastases in lymph nodes (stage pN), size of the primary tumor (stage pT).

Assessment of the presence of tumor-associated neutrophils

Immunohistochemical study of the presence of tumor-associated neutrophils was performed using anti-CD15 antibodies. Immunohistochemical staining was performed in a fully automated system (BenchmarkXT, ICH Slide Stainer by Roche, Ventana). Sections were deparaffinized in xylene and ethanol. Then anti-CD15 antibodies were applied to the sections. The preparations were stained with hematoxylin. The finished immunohistochemical glass slides were scanned using the Pannoramic Desk (3DHitech) apparatus. The scanned slides were used to quantify CD15+ neutrophils in the CaseViewer software. The total number of

CD15+ neutrophils in close contact with tumor cells was counted in 10 high-power fields of view. Intravascular and perivascular neutrophils were not included in the count. Infiltration of the tumor with CD15+ neutrophils was considered positive if there were ≥ 1 neutrophils in close contact with tumor cells in 10/HPF, and negative, respectively, if there were no neutrophils among the tumor cells.

Statistical analysis of data

Statistical data processing was performed using the Jamovi software (version 2.2.5). When assessing the normality of distribution, all the studied quantitative parameters had a distribution different from normal, therefore these variables were presented as a median, 25 and 75 quartiles (Q1-Q3).

Comparison of quantitative non-normally distributed variables in two independent samples was carried out using the Mann-Whitney test. Differences were considered statistically significant at $p < 0.05$.

Absolute values (n) and frequency characteristics (%) were used to describe nominal variables. Comparison of nominal variables was carried out using the Chi-square test, Chi-square with Yates correction and Fisher’s exact test. Differences were considered statistically significant at $p < 0.05$.

Logistic regression analysis was used to analyze potential predictors. Predictors were considered statistically significant at $p < 0.05$. To compare the quality and visualize statistically significant regression logistic models, we used ROC analysis with the construction of ROC curves and calculation of ROC-AUC metrics.

Results

The median age of patients included in the study was 62.0 years (Q1-Q3 = 57.8-68.3). The average BMI by median was 27.1 kg/m² (Q1-Q3 = 24.4-33.0).

CD15+ tumor-associated neutrophils were detected in 51.7% of patients (31 people), while in 48.3% (29 people) CD15 expression was not observed. Depending on the presence of expression of CD15+ tumor-associated neutrophils, a comparative analysis of the clinical and morphological parameters of patients was carried out. The results are presented in Table 1.

Table 1.

Comparative characteristics of clinical and morphological data of patients with early luminal HER2-negative breast cancer depending on the level of CD15 expression

Parameter	No expression CD15 n=29	There is expression CD15 n=31	p
Clinical parameters			
Age, years, median (Q1-Q3)	64,0 (59,0-70,0)	61,0 (49,5-66,0)	0,060
BMI, kg/m ² , median (Q1-Q3)	27,1 (24,2-32,6)	27,9 (25,6-34,0)	0,511

Stage of disease:			0,006*
• I, % (n)	79,3% (23)	35,5% (11)	
• II-III, % (n)	20,7% (6)	64,5% (20)	
Burdened hereditary history % (n)	31,0% (9)	19,4% (6)	0,456**
Presence of menstruation % (n)	10,3% (3)	25,8% (8)	0,225**
Presence of childbirth % (n)	72,4% (21)	67,7% (21)	0,910**
Injuries to the mammary glands % (n)	6,9% (2)	16,1% (5)	0,426***
Morphological parameters			
Stage pT:			0,018**
• 1, % (n)	86,2% (25)	54,8% (17)	
• 2, % (n)	13,8% (4)	45,2% (14)	
Stage pN:			<0,001**
• N0, % (n)	93,1% (27)	45,2% (14)	
• N+, % (n)	6,9% (2)	54,8% (17)	
G:			<0,001**
• G1-G2, % (n)	96,6% (28)	51,6% (16)	
• G3, % (n)	3,4% (1)	48,4% (15)	
ER, points, median (Q1-Q3)	8,0 (8,0-8,0)	8,0 (7,5-8,0)	0,058
PR, points, median (Q1-Q3)	7,0 (4,0-8,0)	8,0 (6,0-8,0)	0,243
Ki67, %, median (Q1-Q3)	12,0 (10,0-22,0)	27,0 (18,0-45,0)	<0,001
Molecular subtype:			0,008*
• Luminal A, % (n)	75,9% (22)	41,9% (13)	
• Luminal B, % (n)	24,1% (7)	58,1% (18)	
TILs, %, median (Q1-Q3)	1,0 (1,0-3,0)	5,0 (3,5-10,0)	<0,001
LV, % (n)	17,2% (5)	58,1% (18)	0,001***
Pn, % (n)	13,8% (4)	32,3% (10)	0,166**

Note. *Chi-square, **Chi-square with Yates correction, ***Fisher's exact test

According to the results of the comparative analysis, it turned out that the only clinical factor that statistically significantly differed between patients with and without CD15 was the stage of the disease: stage I was more common in patients with no CD15 expression, while II-III - with CD15 expression ($p = 0.006$). The age of patients also had a borderline level of significance, with a tendency for older age in the absence of CD15 expression.

Statistically significant differences between the groups were obtained for the following morphological parameters: stage pT, stage pN, differentiation degree G, molecular subtype, Ki67 expression, lymphocytic infiltration of TILs and lymphovascular invasion of LV. It was found that patients with CD15+ tumor-associated

neutrophils are characterized by high pN and pT stages, G3 differentiation degree, luminal B subtype, the presence of LV, higher Ki67 and TILs. Detailed results, as mentioned above, are presented in Table X. At the next stage, clinical and morphological parameters that statistically significantly differ in the groups depending on the expression of CD15, as well as parameters with a borderline significance level, were selected as potential predictors determining the chance of the presence or absence of expression of CD15+ tumor-associated neutrophils. The level of expression of Ki67 and TILs for ease of perception and interpretation were presented as a binary value. Univariate logistic regression analysis was performed for these parameters, the results of which are presented in Table 2.

Table 2.
Univariate logistic regression analysis for morphological predictors of CD15 expression in patients with early luminal HER2-negative breast cancer

Parameter	OR	95%CI	p
Age	0,947	0,898-0,999	0,046
Stage of the disease			
• I	Reference	-	-
• II	6,970	2,182-22,261	0,001
Stage pT:			
• 1	Reference	-	-
• 2	5,147	1,445-18,340	0,011
Stage pN			
• N0	Reference	-	-
• N1	16,393	3,306-81,275	<0,001
• Degree of differentiation G1-G2	Reference 26,250	-	-
• G3		3,165-217,680	0,002
ER	0,876	0,598-1,280	0,497
Ki67			
• 20% and less	Reference	-	-
• More than 20%	4,156	1,399-12,350	0,010
Molecular subtype			
• Luminal A	Reference	-	-
• Luminal B	4,352	1,434-13,210	0,009
TILs			
• 5% and less	Reference	-	-
• More than 5%	9,750	1,961-48,470	0,005
LV	6,646	2,004-22,040	0,002

In the course of univariate analysis, statistically significant predictors increasing the chance of having CD15+ tumor-associated macrophages were the patient age, stage II of the disease (6.97 times), stage pT2 (5.15 times), pN1 (16.39 times), degree of differentiation G3 (26.25 times), luminal B subtype (4.35 times), the level of Ki67 expression more than 20% (4.15 times), lymphocytic infiltration of TILs more than 5% (9.75 times) and the presence of lymphovascular invasion LV (6.65 times), while the expression of estrogen receptors ER did not show a statistically significant relationship.

For a visual comparison and assessment of the quality of the above-proposed univariate models for assessing the CD15 status based on clinical and morphological parameters, we performed ROC analysis. ROC curves are shown in Figure 1.

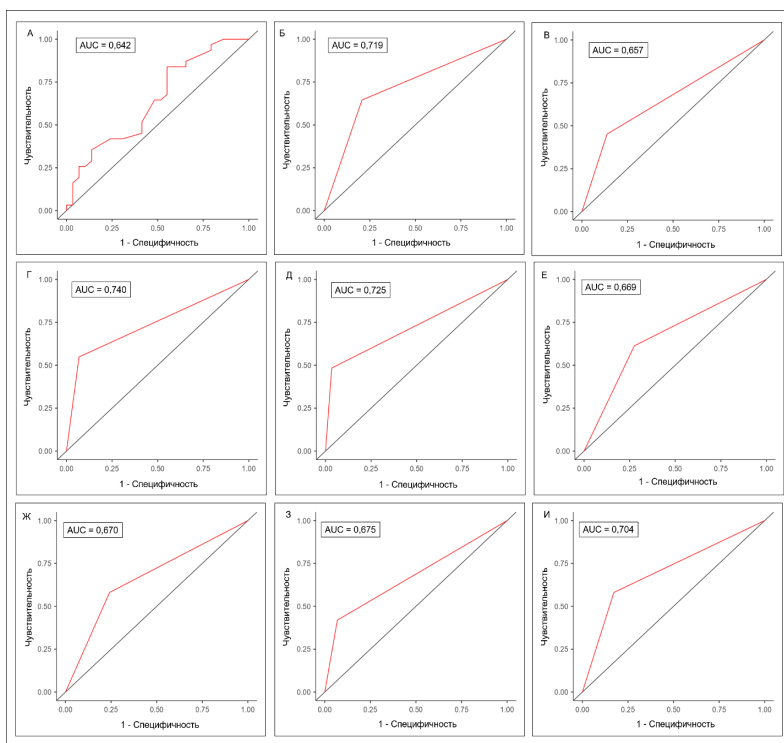


Figure 1. ROC curves for univariate logistic regression models for assessing CD15+ status based on age (A), disease stage (B), pT stage (C), pN stage (D), differentiation grade (E), Ki67 expression (E), molecular subtype (G), lymphocyte infiltration (H), and LV (I)

Note. The vertical axis is sensitivity, the horizontal axis is specificity.

The ROC-AUC metrics values are presented in Table 3. Based on the data presented in the table and the figure, it is clear that the best predictor for assessing the CD15 status in patients with early luminal HER2-negative breast cancer, which has the highest ROC-AUC value, is the pN stage (0.740). Then comes the degree of differentiation G, for which the area under the ROC curve was 0.725. The third place in terms of significance of predictors is occupied by the stage of the disease with a ROC-AUC value of 0.719. Detailed results with values for all predictors are presented in Table 3.

Table 3.
ROC-AUC metrics values for univariate logistic regression models for assessing the CD15+ status

Parameter	Value ROC-AUC
Age	0,642
Disease stage	0,719
Stage pT	0,657
Stage pN	0,740
Degree of differentiation G	0,725
Expression Ki67	0,669
Molecular subtype	0,670
Lymphocyte infiltration TILs	0,675
Lymphovascular invasion LV	0,704

Discussion of results

In this study, it was shown that more than half of patients (51.7%) with early luminal HER2-negative breast cancer have CD15+ neutrophils in the tumor microenvironment. It was found that the presence of CD15+ tumor-associated neutrophils is associated with a number of known factors of a more unfavorable prognosis of early breast cancer, such as: stage pT2-3, stage pN+, low degree of tumor differentiation and luminal B molecular subtype, Ki67 greater than 20% and lymphovascular invasion (LV). Similar data for early luminal HER2-negative breast cancer are currently absent, patient samples in existing studies are heterogeneous, and the methods for detecting tumor-associated neutrophils also differ.

In the work of Enrique Soto-Perez-de-Celis et al. (2017), the clinical and morphological characteristics of the patient sample were similar to ours, but did not completely correspond to it [12]. Thus, the vast majority of patients had a clinical stage T1-T2 (79.0%), but the HER2 status in patients was different. The work showed that tumor-associated neutrophils, counted during the revision of hematoxylin and eosin-stained preparations, were found in 27% of samples. Among patients with luminal ER+ PR+ HER2-negative breast cancer (n = 72), tumor-

associated neutrophils were detected in only 5.6% of cases (4 out of 72 samples), which was significantly lower than in the present study. Neutrophils were significantly more common in patients with HER2-positive and triple-negative cancer (53.3% and 88.9%, respectively). When comparing the clinical and morphological characteristics of patients depending on the presence of tumor-associated neutrophils, it was shown that age, menstruation, clinical stage T and clinical stage N did not differ statistically significantly between the compared groups, while the degree of tumor differentiation was often higher in the presence of neutrophils. Thus, G3 tumors were detected in 12% and 57% of patients with the absence and presence of tumor-associated neutrophils, respectively [12], which corresponded to the results of the present study. Thus, we have shown that G3 breast cancer was determined in 3.4% and 48.4% of patients also with the absence and presence of tumor-associated neutrophils, respectively ($p < 0.001$). During the regression analysis, it was found that G3 tumors increase the chance of having CD15+ tumor-associated neutrophils by 26.25 times (95% CI = 3.165-217.680; $p = 0.002$). As well as Enrique Soto-Perez-de-Celis et al. (2017), we found that the presence of menstruation is not associated with the presence of neutrophils in the tumor tissue, however, unlike the described study, in the present work, the pT stage and pN in patients with the presence of neutrophils were higher. The chance of the latter's presence with pT2 increased by 5.15 times (95% CI = 1.45-18.34; $p = 0.011$) compared to pT1 tumors and by 16.39 times with pN1-3 compared to pN0 (95% CI = 3.31-81.28; $p < 0.001$). In the work of Akinari Kakumoto et al. (2024), including 196 people with breast cancer of various stages, the relationship between the number of tumor-associated neutrophils, counted during the revision of hematoxylin and eosin-stained preparations, and the clinical and morphological features of the disease course was assessed [13]. In ER+ PR+ breast cancer, it was found that with a low number of neutrophils in the PZ (below the average value for the studied sample) both in the stroma and in the tumor nests, G1-G2 degree of tumor differentiation is more often noted and G3 is less common, metastatic lesions of the lymph nodes are less common, and stages III-IV of the disease are less common. At the same time, no association with the age of patients was found [13]. Similar data were obtained in the present work, but the number of neutrophils, as mentioned above, was assessed using antibodies to CD15 during further visual assessment. In the absence of tumor-associated neutrophils, BC G1-G2 was determined in 96.6% of cases, while in their presence - in 51.6% ($p < 0.001$). Stage I in the studied groups occurred in 79.3% and 35.5% of patients, respectively ($p = 0.006$).

According to Jasmin Zeindler et al. (2019), tumor-associated neutrophils, assessed using myeloperoxidase expression, were found in 16% of patients with breast cancer (150 of 928), with the majority of the sample (60.4%) including patients with luminal HER2-negative breast cancer, but the stage was different [11].

When comparing the morphological characteristics of patients with and without tumor-associated neutrophils, it was found that in the presence of the latter, metastases in the lymph nodes are less common (pN0 stage is detected in 64% and 49.9% of patients, respectively, $p = 0.002$). Moreover, the degree of differentiation G1-G2 is more often detected in patients with the absence of neutrophils, while G3 is detected in patients with their presence. Thus, G3 breast cancer was detected in 52.7% of patients with the presence of tumor-associated neutrophils and only in 35.9% without them ($p < 0.001$). A similar pattern was noted for the expression of Ki67, which was higher in the group with the presence of neutrophils 90.6% and 80.6%, respectively ($p = 0.005$) [11]. Such results are partially consistent with the data obtained in the framework of the present work. Thus, G3 tumors, as mentioned above, are more common in the presence of tumor-associated neutrophils, as well as metastatic lesions of the lymph nodes. Expression of Ki67 in the present work in the presence of neutrophils also turned out to be statistically significantly higher (27.0% and 12.0%, $p < 0.001$). We also found that CD15+ tumor-associated neutrophils are associated with the presence of lymphovascular invasion. Thus, the chance of having neutrophils in the tissue of patients with early HER2-negative breast cancer in the presence of lymphovascular invasion increases by 6.65 times (OR = 6.646; 95% CI = 2.004-22.040; $p = 0.002$). Similar data are absent in the literature, which makes it difficult to compare them. Additionally, we showed the relationship between tumor-associated neutrophils in the structure of the tumor microenvironment and TILs. Thus, with TILs over 5%, the chance of having CD15+ tumor-associated neutrophils increased by 9.75 times, which was also confirmed based on the analysis of two large databases – The Cancer Genome Atlas (TCGA) and Genotype-Tissue Expression (GTEx), however, CD66 was used as a neutrophil marker. The researchers found that with increased expression of tumor-associated neutrophils, the expression of almost all subpopulations of immune cells in the TILs structure also increases, both in tumor tissue and in the mesenchymal region of breast cancer [14].

Conclusion

In patients with early luminal HER2-negative breast cancer, tumor microenvironment neutrophils are associated with such parameters as pT2-3, the presence of metastatic lesions of the axillary lymph nodes (pN+), Ki67 greater than 20%, a low degree of tumor differentiation and lymphovascular invasion, which in themselves are factors of a more unfavorable prognosis in early breast cancer. Also, in the presence of these factors of progression, the chance of the presence of neutrophils in the tumor microenvironment increases significantly.

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人体上肢形态测量方法分析

**ANALYSIS OF METHODS FOR MORPHOMETRY OF THE HUMAN
UPPER LIMB**

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摘要。本研究探讨了与现代解剖学和人类学实践相关的上肢形态测量方法。反映了解剖学和人类学研究过程中发现的上肢形态测量参数的主要变异模式。对这些方法的回顾将有助于更全面地了解目前已知的测量参数的年龄-性别动态，这将为未来开展更多具体的研究提供便利。

关键词：上肢解剖学、上肢形态测量、上肢长度、肩长、前臂长度、手的几何形态测量、参考线、上肢体积的参考诊断。

Abstract. *The work considers the methods of morphometry of the human upper limb that are relevant in modern anatomical and anthropological practice. The main patterns of variability of morphometric parameters of the upper limb, revealed in the course of anatomical and anthropological studies, are reflected. The review of the methods will help to form a more complete picture of the currently known age-gender dynamics of the measured parameters, which will allow for a number of more specific studies in the future.*

Keywords: *anatomy of the human upper limb, morphometry of the human upper limb, length of the human upper limb, shoulder length, forearm length, geometric morphometry of the hand, reference lines, reference diagnostics of the volume of the upper limb.*

Introduction. The human upper limb is one of the most complex structures from an anatomical point of view. Such anatomical organization is associated with a long and complex process of phylogenesis. Thus, three sections of the upper limb of tetrapods develop from homologous sections of the fins of fleshy-lobed fishes (sarcopterygians): stylopodium (shoulder), zeugopodium (forearm) and autopodium (hand). In this case, two proximal segments (stylopodium and zeu-

gopodium) are homologs of the mesomeres of the central axis of the biserial fin, and the hand, in turn, is formed as a result of the bending of the distal part of the fin, where the first finger is a derivative of the last preaxial radial of the fin, and II-V fingers are similar derivatives of the radials of the already postaxial ones [1]. The anatomy of the soft tissues of the human upper limb is also quite complex. The migration of myocytes and motor neurons occurs under the guiding action of specific tendon rudiments [2]. Currently, biomechanical and neurophysiological aspects of the basic motor mechanism of the links of the free upper limb, its distal section are actively studied [3,4]. The goal is to find structural and functional patterns of the radial and bilateral organization of the finger mechanism and, on this basis, develop perfect cybernetic analogues of the hand and its links [5,6]. The morphological basis for establishing these patterns is very modest today and includes isolated works. This work directly examines the methods used by anthropologists and anatomists for the morphological and functional characteristics of the human upper limb.

Aim. The aim of the article is to review and analyze the currently existing anthropometric methods and functional tests used to measure and determine the anatomical and functional parameters and characteristics of the human upper limb.

Methods. Various methods and the results obtained with their help were studied and analyzed by the authors of original articles, scientific papers, dissertations.

Results. The most obvious and simple anthropometric characteristic of the human upper limb is its length, which in turn consists of the length of the shoulder, the length of the forearm and the hand. This indicator reflects the growth processes of an individual as a whole at a specific point in time. However, its determination in a specific individual does not make sense until similar indicators are determined in a large number of people belonging to different age and sex groups, so that the obtained indicators can be compared with the average values for a specific sex and age. The most complete age and sex dynamics of the length of the segments of the upper limb is considered in the studies of E.V. Safonenkova [7]. Longitudinal studies have shown that shoulder growth has two ages of increase. In the period between the first and second crossing, the growth curve of females is ahead of that of males. Reliable differences in the length of the arm between the sexes are observed after the age of 16. From 4 to 11 years, there are no gender differences in the size of the arm and the intensity of its growth. During adolescence, the growth of the intensity of the arm in males increases to 6.2 cm, followed by fading until reaching maturation. When comparing the growth curves of the increase in forearm length in males and females, it was found that there are no reliable differences. Despite the uniformity of the increase in forearm length, gender differences in the intensity of its growth are nevertheless noted. In females from 4 to 8.5 years, a period of accelerated forearm growth is noted with an average annual increase of 1.4

cm. According to the results of the study of the length of the hand, certain patterns were also found. In the period from 9 to 14 years, girls are ahead of boys in hand length development by an average of 1.5 years, from 4 to 9 years and from 14 to 15 years the differences in both sexes are insignificant. From 15 to 18 years, men are ahead of women in hand size. The most rapid increase in the hand, in relation to body length, was observed in males from 4 to 10 years and from 17 to 20 years, in females - in the period from 4 to 9 years. The intensity of hand length growth was uneven, three periods of accelerated and two slow growth were distinguished. In males, the first period of accelerated growth was from 4 to 8.5 years. Hand length increased by 3.24 cm, the average annual increase was 0.6 cm. A decrease in the intensity of growth occurred between 8.5 and 13 years. From the age of 13, a repeated increase in the length of the hand was observed, by 0.5 cm per year. In females from 4 to 8 years old, the length of the hand increased by 3.74 cm, the average annual increase was 0.7 cm. The growth rate reached a maximum at the age of 6 - 11.4%, the increase per year is equal to 2 cm, or 11.3% of the final value.

As for the hand, in the vast majority of studies its morphofunctional features are studied in the context of body type and are based on classical morphometry, that is, measuring the longitudinal and transverse dimensions of the hand or its sections. The study of the hand as a geometric object remains underestimated due to conceptual difficulties in assessing such an abstract concept as shape. The hand as a whole is considered as a shape by the authors of the study A.S. Ermoolenko, E.S. Selivanova. The study [8] uses the method of geometric morphometry of the hand developed by them. Landmark points are applied to the contour of the dactylogram, then the file with the coordinates is entered into the MorphoJ 1.07a program, with the help of which the subsequent geometric morphometry is carried out. To create an optimal average configuration of landmarks, as well as to exclude from the subsequent analysis data that are not related to the shape of the hand (isometric size, position and orientation in space), Procrustean alignment was performed [9]. The size of the examined hands was expressed as the centroid size, which is the most common indicator in geometric morphometry. To determine the effect of size on shape (allometry), a multivariate regression was performed using the centroid size as an independent variable and the Procrustes distance as a dependent variable of shape. The fact of a weak relationship between the shape of the hand and the somatotype was established, which is consistent with the data that during ontogenesis, despite the fact that the size of the hand changes by several orders of magnitude (from several tenths of a millimeter to several millimeters), its proportionality, including shape, does not change significantly. It is also of interest to consider the method of measuring the volume of the segments of the upper limb. The author of the study, E.V. Safonenkova, considers the method of measuring the volume of the segments of the upper limb by drawing reference lines [7]. The

reference diagnostics of body masses allowed to determine the expression of the main muscle groups of the limbs on the basis of six measurements and calliperometry [10]. The following landmarks were made on the upper limb: the outer vertical of the shoulder, the outer vertical of the forearm, the girth of the shoulder flexors, the girth of the shoulder extensors, the girth of the forearm flexors, the girth of the forearm extensors, the inner vertical of the shoulder, the inner vertical of the forearm. The study showed that the shape of the links of the upper limb changes with age. Conical, cylindrical and intermediate forms of the links of the upper limb are distinguished. They correlate with age-related increases in muscle strength. From 7 to 10 years old, the cylindrical shape predominates in children, from 17 to 20 years old the intermediate shape of the limb predominates. The shapes of the links of the limb, their girths in males increase by 3.2 times, in females - by 2.9 times. The variability of the shape of the links at the age of 4 to 8 and from 18 to 20 years is higher in males, at the age of 8 to 18 years - in females, which is mainly due to the increase in fat mass. The girth dimensions of the shoulder in all age groups are a consequence of the increase in muscle mass as an increase in spontaneous motor activity. This is most clearly manifested in the dynamics of the upper shoulder girth, increasing due to the growth of the triceps muscle mass. In the forearm, a similar correlation does not reach the level of significance. Changes in the girth dimensions of the forearm in relation to its maturation maturity show that in all age groups, females have more “mature” forms that reach maturity by 17-18 years. The girth dimensions of the forearm in males increase most intensively in the period of 17-20 years, i.e. in the period when the intensity of growth of the elongated dimensions ceases, and the amount of physical activity increases.

Conclusion. As we have already considered, the existing methods of morphometry of the human upper limb are quite diverse and, for the most part, require processing the data obtained during direct measurements using specially developed mathematical programs. In this regard, promising studies are those that rely not only on methods of direct measurement of anatomical parameters, but also improve the software apparatus that allows working with large arrays of data, facilitating their subsequent analysis. The review data presented in the article can be useful not only for anatomists and anthropologists, but also for sports doctors, medical rehabilitation specialists, coaches of game and strength sports. They can also be used in searching for ways to optimize the design of bionic prostheses of the upper limb, developing more ergonomic controller devices.

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正常情况下牙弓的牙列测量分析
**ODONTOMETRIC ANALYSIS OF THE DENTAL ARCH IN
NORMAL CONDITIONS**

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摘要。了解正常牙列的牙列测量参数对于诊断和治疗牙病至关重要。准确的基线测量为识别磨牙症、错颌畸形和发育异常等情况的偏差提供了关键基准。这些参数还可以指导修复和正畸治疗，确保功能和美观的和谐 [1] [3] [5]。

尽管 3D 扫描等现代技术增强了诊断能力，但传统的硅胶技术仍然具有很高的实用性，因为它们易于获取、成本效益高且精度高 [2] [6]。硅胶印模可以对牙齿尺寸进行详细分析，在临床和研究环境中仍然是可靠的选择 [2][6]。

本研究评估了 60 名牙列健康的个体，以建立下颌和上颌牙齿的规范牙列测量参数。研究结果将为未来的研究提供参考，特别是用于研究磨牙症形态影响的比较研究 [3] [5] [9]。

关键词：牙齿测量参数，牙齿形态，下颌牙齿，上颌牙齿，磨牙症，牙齿形态变化。

Abstract. Understanding the odontometric parameters of normal dentition is essential for diagnosing and treating dental pathologies. Accurate baseline measurements provide critical benchmarks for identifying deviations in conditions such as bruxism, malocclusions, and developmental anomalies. These parameters also guide restorative and orthodontic treatments, ensuring functional and aesthetic harmony [1] [3] [5].

Although modern technologies like 3D scanning have enhanced diagnostic capabilities, traditional silicone-based techniques remain highly relevant due to their accessibility, cost-effectiveness, and proven precision [2] [6]. Silicone impressions allow for detailed analysis of tooth dimensions and continue to be a reliable option in clinical and research settings [2][6].

This study evaluates 60 individuals with healthy dentition to establish normative odontometric parameters for mandibular and maxillary teeth. The results will serve as a reference for future research, particularly for comparative studies examining the morphological impacts of bruxism [3] [5] [9].

Keywords: *Odontometric parameters, Dental morphology, Mandibular teeth, Maxillary teeth, Bruxism, Tooth morphology variations.*

Introduction

Understanding the odontometric parameters of normal dentition is critical for diagnosing and treating dental pathologies. While advanced methods like 3D scanning are increasingly popular, traditional silicone-based techniques remain relevant for their accessibility and precision [2][6]. This study evaluates 60 healthy individuals to establish a normative baseline for future comparative studies on bruxism-affected dentition [3] [9].

Materials and Methods

This study utilized a cross-sectional design involving 60 participants, including 28 females and 32 males, to establish baseline odontometric parameters for normal dentition. Participants were carefully selected to ensure balanced sex representation and a controlled age range of 18–25 years with an average of 21.5 years.

Inclusion Criteria:

- Healthy dentition without occlusal abnormalities, as confirmed by clinical examination.
- No history of orthodontic or prosthodontic treatment.
- Absence of systemic conditions affecting oral health.
- Voluntary participation with signed informed consent.

Dental measurements were performed using high-precision, certified classical calipers (accuracy: ± 0.01 mm) to ensure reliable and reproducible results. Silicone impressions of both the mandibular and maxillary arches were taken using standard dental procedures. The impressions were cast into dental stone models to facilitate accurate measurements under controlled laboratory conditions.

The following odontometric parameters were measured:

1. **Crown Height** (from the cusp tip to the cemento-enamel junction).
2. **Mesiodistal Diameter** (the widest horizontal dimension between the mesial and distal contact points).

3. Buccolingual Diameter (the widest horizontal dimension from the buccal to the lingual surface).

All measurements were conducted thrice per tooth to minimize variability, and mean values were calculated for analysis.

Data Management and Analysis:

The collected data were meticulously organized into a structured Microsoft Excel spreadsheet. Advanced functions in Excel were employed to compute descriptive statistics, including means, standard deviations. These data formed the baseline for normative odontometric parameters and are intended for comparative studies involving patients with bruxism or other dental conditions.

Results and discussion

The following findings summarize the odontometric parameters:

For the **mandibular central incisor**, the median (μV) crown height is 7.48 mm (6.93–8.18), the mesiodistal crown diameter is 5.3 mm (5.0–5.6), and the vestibulolingual crown diameter is 6.1 mm (5.7–6.6). For the **lateral incisor**, the median (μV) crown height is 7.5 mm (6.9–8.1), the mesiodistal crown diameter is 5.8 mm (5.4–6.0), and the vestibulolingual crown diameter is 6.3 mm (5.9–6.8). The **canine** shows a median (μV) crown height of 8.7 mm (8.2–9.6), a mesiodistal diameter of 6.48 mm (5.98–6.9), and a vestibulolingual diameter of 7.5 mm (7.0–8.0). The **first premolar** has a median (μV) crown height of 7.8 mm (7.3–8.4), a mesiodistal diameter of 6.8 mm, and a vestibulolingual diameter of 7.9 mm (7.5–8.4). For the **second premolar**, the median (μV) crown height is 6.7 mm (6.3–7.4), the mesiodistal diameter is 6.54 mm (6.2–7.0), and the vestibulolingual diameter is 8.6 mm (8.0–9.1). The **first molar** exhibits a median (μV) crown height of 6.36 mm (6.0–6.72), a mesiodistal diameter of 10.8 mm (10.2–11.14), and a vestibulolingual diameter of 10.7 mm (10.1–11.0). The **second molar** has a median (μV) crown height of 5.5 mm (5.3–6.0), a mesiodistal diameter of 9.8 mm (9.44–10.23), and a vestibulolingual diameter of 11.1 mm (10.61–11.6).

For the **maxillary central incisor**, the median (μV) crown height is 8.1 mm (7.5–8.84), the mesiodistal diameter is 8.2 mm (7.7–8.6), and the vestibulolingual diameter is 6.9 mm (6.2–7.3). The **lateral incisor** shows a median (μV) crown height of 7.1 mm (6.5–7.8), a mesiodistal diameter of 6.2 mm (5.6–6.64), and a vestibulolingual diameter of 6.2 mm (5.6–6.7). For the **canine**, the median (μV) crown height is 8.3 mm (7.7–9.2), the mesiodistal diameter is 7.26 mm (6.8–7.76), and the vestibulolingual diameter is 8.1 mm (7.5–8.54). The **first premolar** has a median (μV) crown height of 7.18 mm (6.7–7.9), a mesiodistal diameter of 6.5 mm (6.0–7.0), and a vestibulolingual diameter of 9.2 mm (8.74–9.9). For the **second premolar**, the median (μV) crown height is 6.18 mm (5.6–6.68), the mesiodistal diameter is 6.4 mm (5.9–6.8), and the vestibulolingual diameter is 9.5 mm (8.9–10.1). The **first molar** exhibits a median (μV) crown height of 5.9 mm (5.16–6.3),

a mesiodistal diameter of 10.2 mm (9.8–10.7), and a vestibulolingual diameter of 11.3 mm (10.6–11.8). Finally, the **second molar** has a median (μV) crown height of 5.5 mm (5.025–6.0), a mesiodistal diameter of 9.8 mm (9.025–10.23), and a vestibulolingual diameter of 11.1 mm (10.61–11.6).

Discussion

The morphometric characteristics of mandibular and maxillary teeth highlight key functional and structural differences, which are critical for clinical applications such as orthodontics, prosthodontics, and forensic odontology. In the mandibular arch, the central incisor demonstrates a median crown height of 7.48 mm, with mesiodistal and vestibulolingual diameters of 5.3 mm and 6.1 mm, respectively, indicating its role in cutting and maintaining uniformity in size. The lateral incisor is slightly larger, with a crown height of 7.5 mm, mesiodistal diameter of 5.8 mm, and vestibulolingual diameter of 6.3 mm, reflecting its transitional role towards the canines. The canine stands out with its significant crown height of 8.7 mm and robust mesiodistal and vestibulolingual diameters of 6.48 mm and 7.5 mm, underscoring its importance in tearing and guiding occlusion.

The first and second premolars exhibit a shift towards grinding functionality, with the first premolar showing a crown height of 7.8 mm, mesiodistal diameter of 6.8 mm, and vestibulolingual diameter of 7.9 mm, while the second premolar has a slightly reduced crown height of 6.7 mm but larger vestibulolingual diameter of 8.6 mm. The molars, designed for heavy mastication, demonstrate the largest dimensions, with the first molar having a crown height of 6.36 mm, mesiodistal diameter of 10.8 mm, and vestibulolingual diameter of 10.7 mm, while the second molar has a crown height of 5.5 mm, mesiodistal diameter of 9.8 mm, and vestibulolingual diameter of 11.1 mm. The variability in molar dimensions reflects their adaptation to diverse occlusal patterns and significant functional loads [1] [3] [7] [8].

In the maxillary arch, the central incisor exhibits a median crown height of 8.1 mm, with mesiodistal and vestibulolingual diameters of 8.2 mm and 6.9 mm, highlighting its aesthetic prominence and cutting function. The lateral incisor, smaller in size, has a crown height of 7.1 mm, mesiodistal diameter of 6.2 mm, and vestibulolingual diameter of 6.2 mm, serving as a transitional tooth. The canine, with a crown height of 8.3 mm and robust dimensions of 7.26 mm (mesiodistal) and 8.1 mm (vestibulolingual), reinforces its anchoring role in the maxillary arch. The first and second premolars show a gradual increase in dimensions suited for grinding, with the first premolar having a crown height of 7.18 mm, mesiodistal diameter of 6.5 mm, and vestibulolingual diameter of 9.2 mm, while the second premolar displays similar trends with a crown height of 6.18 mm and a vestibulolingual diameter of 9.5 mm.

The molars in the maxillary arch exhibit the largest dimensions, with the first molar having a crown height of 5.9 mm, mesiodistal diameter of 10.2 mm, and

vestibulolingual diameter of 11.3 mm, and the second molar a crown height of 5.5 mm, mesiodistal diameter of 9.8 mm, and vestibulolingual diameter of 11.1 mm. The larger dimensions of maxillary teeth compared to mandibular teeth, particularly in the mesiodistal and vestibulolingual planes, emphasize their role in occlusal overlap for effective mastication [3] [8] [7].

Understanding odontometric parameters is a cornerstone in diagnosing and treating dental pathologies, as these dimensions provide insight into the functional and structural characteristics of dentition. This study emphasizes the importance of establishing a reliable normative baseline using traditional silicone-based techniques, which, despite the rise of advanced methods such as 3D scanning, remain relevant for their accessibility, affordability, and proven precision.

The traditional method of obtaining silicone impressions, followed by measurement with high-precision certified calipers, provided a robust dataset of odontometric parameters. These methods have stood the test of time, offering a dependable alternative when advanced technologies are either unavailable or impractical in routine clinical settings. Silicone-based techniques also allow for the physical archiving of impressions, which can be revisited for further analysis or verification.

The dataset collected in this study establishes critical baseline parameters for normal dentition, including crown height, mesiodistal diameter, and buccolingual diameter for mandibular and maxillary teeth. Such data is indispensable for comparative studies, particularly in conditions like bruxism, where morphological changes such as enamel wear, flattening of cusps, and altered dimensions are common. By providing a benchmark, this research supports clinicians and researchers in identifying deviations that signify pathology, aiding in early diagnosis and treatment planning.

While this study employed traditional techniques, it also highlights the potential for integrating these methods with advanced technologies like 3D scanning and digital modeling. The digitalization of odontometric data enhances precision and offers opportunities for longitudinal studies, enabling clinicians to monitor changes in tooth morphology over time. However, the financial and technical barriers associated with these methods underline the continuing relevance of traditional approaches, particularly in resource-limited settings.

Establishing a normative baseline is not only critical for diagnosing conditions like bruxism but also for evaluating the outcomes of restorative and orthodontic treatments. The precise dimensions of teeth serve as a guide for restoring occlusal harmony, whether through direct restorations, prosthetic replacements, or orthodontic interventions. Additionally, understanding the parameters of healthy dentition provides insights into the progression of wear, helping to differentiate between physiological and pathological changes.

This study's reliance on a standardized process—silicone impressions combined with precise measurement tools—ensures reproducibility and reliability. However, minor distortions in the impression or casting process may introduce variability. Future research could explore ways to refine these traditional methods or validate them against digital techniques to further enhance accuracy.

Conclusion

This study establishes baseline odontometric parameters for both maxillary and mandibular teeth using traditional methods. The findings of this study set the stage for further exploration of how dental pathologies, particularly bruxism, impact tooth morphology. Comparative analyses of bruxism-affected dentition against the normative dataset will provide critical insights into the extent and nature of odontometric deviations. Additionally, the incorporation of technologies like electromyography and craniofacial imaging could complement odontometric data, offering a holistic view of bruxism's effects on the stomatognathic system.

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COVID-19 分叉淋巴结的形态学变化
**MORPHOLOGICAL CHANGES IN BIFURCATIONAL LYMPH
NODES IN COVID-19**

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摘要本文探讨了COVID-19感染时支气管肺淋巴结的形态学变化。分析了宏观和微观变化，比较了正常淋巴结和新型冠状病毒感染改变的形态学参数。讨论了影响淋巴结结构的致病机制。

关键词：淋巴结，冠状病毒，COVID-19，形态学，支气管肺淋巴结。

Abstract. *This article examines the morphological changes in bronchopulmonary lymph nodes in COVID-19 infection. Macroscopic and microscopic changes are analyzed, and a comparison is made between the morphometric parameters of normal lymph nodes and those altered by the novel coronavirus infection. The pathogenetic mechanisms affecting the structure of lymph nodes are discussed.*

Keywords: *Lymph nodes, coronavirus, COVID-19, morphology, bronchopulmonary lymph nodes.*

Introduction

The COVID-19 pandemic, caused by the SARS-CoV-2 coronavirus, has become one of the most significant global health threats in recent decades. According to the World Health Organization (WHO), by the beginning of 2023, over 750 million cases of the disease were registered, and the number of deaths exceeded

6 million people worldwide. [1] The virus continues to mutate, which affects the clinical picture of the disease and complicates epidemiological control. An important area of scientific research is the study of morphological changes occurring in human organs and tissues in COVID-19, which provides a deeper understanding of pathogenesis mechanisms and helps to develop effective treatment and prevention strategies.

Epidemiological data on COVID-19 morbidity indicate that the disease poses the greatest danger to older adults and individuals with comorbidities such as hypertension, diabetes, and heart disease. The incidence of complications and mortality is also high among patients with weakened immune systems. In countries with highly developed healthcare systems, high morbidity and mortality are observed due to more accurate diagnosis and case registration. At the same time, in developing countries, the prevalence of the disease is also high, but mortality data may be incomplete due to limited medical resources. [3]

The etiology of COVID-19 is caused by the SARS-CoV-2 virus, which is transmitted via airborne droplets and enters the body through the mucous membranes of the respiratory tract. The virus actively interacts with body cells by penetrating them via ACE2 receptors, leading to cell and tissue damage. [2] The most affected organs include the lungs, heart, kidneys, and the central nervous system. [3] However, systemic complications are often observed, including changes in the lymphatic system. Lymph nodes, particularly bronchopulmonary lymph nodes, play a key role in the immune response, making their morphological state an important subject of research.

The aim of this study is to examine the macroscopic and microscopic changes in bronchopulmonary lymph nodes in COVID-19.

Materials and Methods

The study used lymph nodes obtained during autopsies of 20 patients (12 women, 8 men) who died from laboratory-confirmed severe forms of COVID-19. The second group consisted of comparison patients whose deaths were not related to the SARS-CoV-2 virus.

The material was fixed in a 10% neutral-buffered formalin solution, and standard histological processing was performed with subsequent staining using hematoxylin and eosin. Macroscopic evaluation included the assessment of size, shape, and consistency.

Microscopic analysis was conducted using light optical microscopy and morphometric analysis.

Results and Discussion

The bronchopulmonary lymph nodes from the comparison group were macroscopically oval or bean-shaped, light gray-pink in color, with a smooth and even surface. Each node was surrounded by a dense capsule, and the size ranged from

0.5 to 1 cm in length. Microscopically, a clear division into cortical and medullary substances was observed, with lymphoid follicles containing germinal centers, and free sinuses (Fig. 1).

In COVID-19, lymph nodes were enlarged, averaging 1.4 cm in length, with a firm consistency. On sectioning, hemorrhagic inclusions, edema, and areas of necrosis were noted. Microscopically, the structure of lymphoid follicles was disrupted, with accumulation of macrophages and monocytes in the sinuses, deposition of fibrin, and thrombus formation in vessels. The cortical and medullary substances showed significant depletion, and lymphoid follicles were no longer visible (Fig. 2).

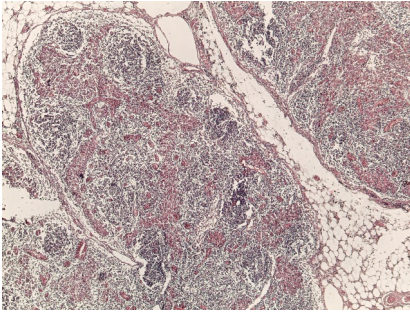


Figure 1. Lymph Node from the Comparison Group.

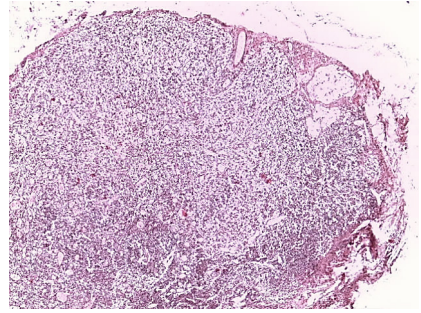


Figure 2. Lymph Node in COVID-19.

Morphometric analysis revealed a significant thickening of the capsule of bifurcational lymph nodes in COVID-19 patients, up to 200–250 μm , associated with the development of fibrosis and inflammatory edema. This value in the comparison group was 120–150 μm on average. The area of the lymph nodes increased by 30–40% compared to normal. In the comparison group, the area of the nodes was about 5–8 mm^2 , while in COVID-19 patients, the area increased to 7–12 mm^2 .

Normally, the width of the sinuses ranged from 20 to 50 μm . In COVID-19, there was a significant expansion of the sinuses to 70–90 μm due to the accumulation of exudate and macrophage-like cells. The number of lymphoid follicles decreased on average by 2.5 times. In normal lymph nodes, the average number of lymphoid follicles was 10–15, while in COVID-19 patients, this number decreased to 4–8 follicles.

In the comparison group, the average area of the cortex was about 60% of the total node volume. In COVID-19, this value decreased to 40–50% due to necrosis and the loss of germinal centers. At the same time, the area of the medullary substance in the comparison group was about 40% of the total volume, while in

COVID-19, the area of this layer increased to 50–60%, associated with vascular element hyperplasia and macrophage infiltration.

Conclusion

The morphological changes in bifurcational lymph nodes in COVID-19 highlight the important role of these organs in the immune response to the infection. The studies show that in response to SARS-CoV-2 viral damage, lymph nodes undergo activation, accompanied by structural changes. In COVID-19 patients, signs of hyperplasia, lymphocyte infiltration, and follicular destruction were observed, which may indicate disruption of normal immune system function. At the same time, damage to bifurcational lymph nodes may be linked to the development of systemic inflammatory processes, reflecting the pathogenesis of the disease.

The analysis of morphological changes in lymph nodes is crucial for better understanding the mechanism of infection spread and for identifying potential risk factors for severe disease progression. These findings could assist in the development of new approaches to treating and preventing COVID-19, as well as improving disease diagnostics. Future research in this area should focus on further exploring the pathophysiological processes occurring in the lymphatic system during coronavirus infection.

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正常腰椎磁共振断层图像的纹理特征
**TEXTURAL CHARACTERISTICS OF MAGNETIC RESONANCE
TOMOGRAMS OF THE NORMAL LUMBAR VERTEBRAE**

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摘要。介绍。引入新的医学成像方法需要新的方法来评估获得的结果，减少诊断者的主观影响，并充分选择感兴趣的区域。纹理分析方法满足这些要求。阻碍纹理分析投入实践的因素包括：缺乏处理医学图像的标准算法，缺乏纹理指标规范的量化标准，缺乏“通用”的纹理特征集。

目的。确定正常情况下第三和第四腰椎骨组织某些纹理特征的数值指标。

材料和方法。在中矢状面上对 52 名男女在成熟期第一和第二期的磁共振断层扫描中，确定了位于第三和第四腰椎体中的感兴趣区，并确定了信号强度水平和灰度值等纹理分析指标。

结果。无论是在整个样本中，还是在不同性别和不同年龄组的人群中，第三和第四腰椎中指定变量的值之间均没有统计学上的显著差异。Spearman 非参数相关性分析表明，所研究的特征之间存在很强的正线性相关性，这允许选择其中一个进行纹理分析。

结论。鉴于所研究变量的一致性水平相当高，仅使用其中一个变量即可评估腰椎图像的纹理，这可以大大简化诊断医生对图像的评估。**关键词：**纹理分析、椎骨、骨组织、医学成像、磁共振成像。

关键词：纹理分析、腰椎断层图、信号强度水平、灰度值水平。

Abstract. *Introduction. The introduction of new methods of medical imaging requires the new approaches to assessing the results obtained, reducing the subjective influence of the diagnostician, and adequately selecting the area of interest. The texture analysis method meets these requirements. The factors hindering the introduction of texture analysis into practice include: the lack of a standard algorithm for processing medical images, the lack of quantitative criteria for the norm of texture indicators, the lack of a “universal” set of texture features.*

Purpose. Determination of numerical indicators of some textural characteristics of the bone tissue of the third and fourth lumbar vertebrae in the norm.

Materials and methods. On magnetic resonance tomograms of 52 people of both sexes, in the first and second periods of mature age, performed in the midsagittal plane, the zone of interest located in the bodies of the third and fourth lumbar vertebrae was identified, and such texture analysis indicators as the signal intensity level and gray value were determined.

Results. No statistically significant differences were found between the values of the specified variables in the third and fourth lumbar vertebrae either in the total sample or separately in people of different sexes and different age groups. Spearman's nonparametric correlation analysis showed a strong, positive, linear correlation between the studied characteristics, which allows choosing one of them for texture analysis.

Conclusion. Given the fairly high level of consistency of the studied variables, only one of them can be used to assess the texture of the lumbar vertebrae image, which can significantly simplify the assessment of the image by a diagnostician. Keywords: texture analysis, vertebrae, bone tissue, medical imaging, magnetic resonance imaging.

Keywords: *textural analysis, lumbar vertebrae tomograms, signal intensity level, gray value level.*

Introduction. The introduction of new digital methods of medical imaging requires new approaches to assessing the results obtained, reducing the subjective influence of the diagnostician, and adequately selecting the area of interest [1]. The method of texture analysis of medical images meets these requirements, which involves assessing the image as a set of its constituent pixels and voxels, each of which has its own numerical characteristics [2,3]. Despite the fact that the texture analysis method is a relatively new research tool, it has already proven its effectiveness in diagnosing focal diseases of various organs, such as: hepatocellular cancer, pancreatic tumors, osteolytic and osteoblastic bone metastases, etc. [4-7].

What is holding back the introduction of texture analysis into the practical activities of a diagnostician? Firstly, there is no standard algorithm for pre- and post-processing of medical images; secondly, there is no quantitative criteria for the norm of indicators characterizing the texture characteristics of the area of interest; thirdly, there is no "universal" set of texture features that could accurately characterize images created on different equipment and processed in different software products, both paid and open source, currently developed for assessing the texture of medical images [8,9].

Of significant interest is the question of how much the texture analysis indicators determined in different software environments correlate with each other; is it

possible to use different software products to assess the texture of medical images or is a “universal” program necessary for all cases of using texture analysis in medicine?

In addition, the results of texture analysis can largely depend on the area of interest chosen by the diagnostician, which directs not only the search for algorithms for the analysis itself, but also the development of universal approaches that allow for the maximum objectification of the choice of the area of interest [10]. Determination of quantitative criteria of the norm of textural features of various organs and tissues will help to significantly simplify the application of this method not only in the diagnosis of focal changes, but also in the assessment of tissue texture, which will help not only subjectively, but also quantitatively assess diffuse changes that may not be noticeable during visual assessment of the image.

The purpose of the study – is to determine the numerical indicators of some textural characteristics of the bone tissue of the third and fourth lumbar vertebrae in the norm in individuals of the first and second periods of mature age.

Material and methods. The material for this study was magnetic resonance imaging of the lumbar spine, performed in the midsagittal plane, according to which no signs of structural damage to the vertebrae were detected. The subjects were divided into two age groups: the first period of mature age - 25 people (including 12 men, 13 women), the second period of mature age - 27 people (including 12 men, 15 women). The study did not include patients with diseases of the musculoskeletal system, endocrine pathology, as well as complaints from the bone or muscle systems. The choice of the study area is due to the fact that this area, along with the femur, is most often used in the diagnosis of osteoporosis. It is believed that it is in the bodies of the lumbar vertebrae that a decrease in bone mineral density occurs first [11]. In addition, the spongy substance of the lumbar vertebrae is well visualized and convenient for the diagnostician to select and highlight the area of interest. When determining the texture characteristics, the area of interest was identified in the bodies of the third and fourth lumbar vertebrae.

The question remains open as to which set of texture analysis parameters can be considered “universal”, whether it is necessary to use all available characteristics for an objective texture assessment or whether it is possible to identify only a number of them that will allow one to evaluate a medical image without significant time resources.

The choice of the specified age group is due to the fact that mature age is the age of relative stability of the body, when growth processes are already completed, and the processes of age-related restructuring have not yet begun [12].

The following were determined as texture analysis parameters: the signal intensity of the selected area, its minimum and maximum values, and the standard square deviation of the studied indicator. The determination of these parameters

was carried out in the interactive environment of the RadiAnt Dicom program (Medixant, Poland) after identifying the area of interest. Also, using the open-source software product for the Windows environment ImageJ (National Institutes of Health, USA), statistical characteristics of the gray level value of the selected area were determined: average value, minimum and maximum values, standard square deviation, asymmetry and excess.

Evaluation of the presence and strength of the correlation between the signal intensity indicators determined in the RadiAnt Dicom program interface and the values of the gray scale intensity values determined using the ImageJ utility was performed using Spearman's nonparametric correlation analysis. The strength of the relationship between the values of the specified variables was estimated using the Chaddock scale.

Statistical processing of the obtained data was carried out using the licensed computer program Statistica10 (StatSoft, USA).

Results. At the first stage of the work, statistical characteristics of the signal intensity index were determined, including depending on the age group, which can be used as a standard of the norm when assessing changes occurring in the spongy bone tissue of the lumbar vertebrae. The average value of the volume of the selected area of interest in the third lumbar vertebra was 2.89 cm², in the fourth lumbar vertebra - 3.1 cm². Since the frequency distribution of the values of the studied variables characterizing the signal intensity corresponded to the normal distribution law of the frequencies of the values or was different from it, both parametric and non-parametric criteria were used as criteria for statistical processing. The average value of the specified variable in the area of interest, selected in the body of the third lumbar vertebra, was 1626.17+22.36 absolute dimensionless units (a.d.u. here and below in the text) (in men - 1574.43+25.38 a.d.u., in women - 1572.18+23.28 a.d.u.). The average value of the signal intensity in the fourth lumbar vertebra was equal to 1626.15+21.32 a.d.u. (in men, the signal intensity in the selected area was 1648.73+23.26 a.d.u., in women - 1651.34+23.34 a.d.u.). In the first period of mature age, the median values of the specified variable were 1721.42+21.30 a.d.u. in the third lumbar vertebra and 1696.40+24.24 a.d.u. in the fourth lumbar vertebra; in the second period of mature age, they were 1698.45+21.34 a.d.u. and 1702.45+23.21 a.d.u. in the third and fourth vertebrae, respectively. When conducting paired comparisons, no statistically significant differences were found between the signal intensity values from the spongy substance of the bodies of the third and fourth lumbar vertebrae ($p > 0.05$, where p is the significance level for the Student's coefficient, here and below in the text). No statistically significant differences were found between the signal intensity values in men and women in either the third or fourth lumbar vertebrae ($p > 0.05$). There were also no statistically significant differences between the signal intensity values

of the zone of interest in the third and fourth lumbar vertebrae in either men or women ($p > 0.05$). When conducting paired comparisons, the values of this variable in individuals of different age groups also did not differ significantly in either the third or fourth lumbar vertebrae ($p^* > 0.05$, where p^* is the significance level for the Wilcoxon's coefficient, here and below in the text).

Thus, the signal intensity value from the spongy substance of the bodies of the third and fourth lumbar vertebrae does not depend on gender, age group, and vertebral number, which means that the same reference value can be used to assess the structure of bone tissue.

The minimum value of the variable under study ranged from 1186.63 a.d.u. to 1273.43 a.d.u. in the third lumbar vertebra, from 1195.32 a.d.u. up to 1316.32 a.d.u. – in the fourth lumbar vertebra. The range of maximum signal intensity values was 2045.43 – 2139.38 a.d.u. in the third lumbar vertebra and 2110.27 – 2254.34 a.d.u. – in the fourth lumbar vertebra.

The average value of the gray level of the selected area of interest in the third lumbar vertebra was 121.36 ± 2.35 (in men, the value of this indicator was 122.43 ± 3.28 , in women - 120.23 ± 4.21), in the fourth lumbar vertebra - 118.24 ± 2.78 (in men: 117.35 ± 3.69 , in women: 120.88 ± 4.04). At the same time, in individuals of the first period of maturity, this indicator was equal to 119.72 ± 2.82 and 121.52 ± 2.59 in the third and fourth lumbar vertebrae, respectively, in individuals of the second period of maturity - 123.65 ± 3.08 and 122.54 ± 3.18 , respectively. There were no statistically significant differences between the gray level values in the bodies of the third and fourth lumbar vertebrae, nor were the values of this variable significantly different in the first and second periods of mature age ($p > 0.05$). There were no statistically significant differences between the gray level values in the third and fourth lumbar vertebrae, including separately in the group of males and females ($p > 0.05$). Like the previous studied indicator, the gray level value is least dependent on such factors as vertebra number, gender and age, which makes it quite convenient for practical use.

The minimum value of this indicator ranged from 69 to 104 in the third lumbar vertebra, from 71 to 107 in the fourth lumbar vertebra. When conducting nonparametric correlation analysis, it was found that the significance level for the Spearman's coefficient was $r = 0.836$, which characterizes the relationship between the values of signal intensity and gray level in the selected area of interest as linear, strong, positive, when changing the value of one indicator, the second changes in direct proportion, with a high level of consistency. Thus, given the fairly high level of consistency of the studied variables, only one of them can be used to assess the texture of the lumbar vertebrae image, which can significantly simplify the assessment of the image by a diagnostician.

Conclusion. In the course of the work, the values of the signal intensity indicators and the gray values of the images of the spongy substance of the bodies of the third and fourth lumbar vertebrae were determined, which can be used as a quantitative standard of the norm in individuals of the first and second periods of mature age when conducting texture analysis. The absence of statistically significant differences between the values of these variables in the third and fourth lumbar vertebrae, in the first and second periods of maturity, in individuals of different sexes allows using the same normative values. A high level of consistency between the values of these variables allows choosing one of them for texture analysis, without losing its quality, which can save time and material costs.

Further determination of the values characterizing the texture of the image of various organs and tissues in the norm will allow in the near future to introduce the texture analysis method into the practical activities of a diagnostician for an objective quantitative assessment of medical images.

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术后胸骨纵隔炎: 问题和现代治疗方法

**POSTOPERATIVE STERNOMEDIASTITIS: PROBLEMS AND
MODERN APPROACHES TO TREATMENT**

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摘要。正中胸骨切开术仍然是心脏外科手术中最常见的方法；然而，术后胸骨纵隔炎是与胸骨入路相关的最严重并发症之一。本文探讨了发生这种并发症的术前风险因素，包括合并症、体质特征、不良习惯、住院时间和手术的紧迫性。它还强调了术中风险因素，例如手术过程中的技术错误、手术干预的具体特征、心肌血运重建移植物的选择以及手术的最后阶段。术后风险因素与心脏外科患者术后管理有关，这可能导致胸骨纵隔炎的发展。本文进一步介绍了治疗这种并发症的现代方法。

关键词：心脏外科手术、风险因素、正中胸骨切开术、胸骨纵隔炎。

Abstract. Median sternotomy remains the most common approach in cardiac surgery; however, postoperative sternomediastinitis is one of the most severe complications associated with transsternal access. This article examines the preoperative risk factors for developing this complication, including comorbidities, constitutional features, harmful habits, duration of hospital stay, and the urgency of the procedure. It also highlights intraoperative risk factors, such as technical errors during surgery, specific characteristics of the surgical intervention, the choice of graft for myocardial revascularization, and the final stages of the operation. Postoperative risk factors are associated with the management of the postoperative period in cardiac surgery patients, which may contribute to the development of sternomediastinitis. The article further describes modern approaches to the treatment of this complication.

Keywords: cardiac surgery, risk factors, median sternotomy, sternomediastinitis.

Introduction.

Over the past decade, there has been a significant increase in the volume of cardiac surgery interventions in the Russian Federation. More than 70 thousand operations on the heart and major mediastinal vessels are performed annually.

Cardiovascular diseases remain the leading cause of morbidity and mortality in the Russian Federation. Mortality from cardiovascular diseases reaches 50%, which is approximately 700 deaths per 100,000 people. Among cardiovascular diseases, coronary heart disease (CHD) accounts for more than 50% of cases. Approximately 30% of patients with CHD require open surgical treatment.

Postoperative complications such as septic infections of the anterior chest wall after sternotomy occur in 0.6–6.0% of cases. Postoperative sternomediastinitis (PSM), first described by Y. Fabiani (1976) and N.I. Kolesnikov (1986), is one such complication. Although isolated sternal infections are rare, PSM often involves adjacent tissues, including the chest wall muscles, costal cartilages, ribs, clavicles, and anterior mediastinum [1,2]. Deep tissue damage of the chest wall with the development of poststernotomy mediastinitis after cardiac surgery occurs with a frequency of up to 5%. Internationally, this type of complication is accompanied by an extremely high mortality rate, which ranges from 14% to 50% [1,2,6].

Materials and methods.

Classification of poststernotomy mediastinitis.

PSM can be classified into three categories based on duration: Acute: up to 3 weeks, Subacute: 3 to 6 weeks, Chronic: more than 6 weeks. Chronic PSM is the most challenging to manage due to extensive tissue damage, recurrence, and a higher risk of complications leading to patient disability [1].

Risk Factors for Postoperative Sternomediastinitis.

Numerous prospective and retrospective studies highlight a wide range of predictors influencing the development of inflammatory postoperative sternal complications. These risk factors are typically classified into preoperative, intraoperative, and postoperative categories [2,5].

Preoperative Risk Factors. Comorbidities: The presence of comorbid conditions is significant, with diabetes mellitus being particularly impactful, increasing the risk of infectious complications by 0.21–3.02 times. Obesity: One of the most common risk factors, obesity elevates the likelihood of developing postoperative sternomediastinitis by 2.0 to 3.2 times, depending on its severity in cardiac surgery patients. Chronic Obstructive Pulmonary Disease (COPD): COPD contributes to complications due to generalized tissue hypoxemia and the perioperative use of glucocorticosteroids, which negatively affect tissue repair processes. Additionally, severe postoperative coughing associated with COPD often leads to sternal instability, suture fatigue, and suture failure [1,2].

Intraoperative Risk Factors. Surgical Access: Asymmetrical sternal incisions increase the risk of postoperative sternomediastinitis by 3.6 times. According to A.A. Vishnevsky (2012), asymmetrical incisions were a predictor in 33.3% of patients who developed this complication [2]. Duration of Cardiopulmonary Bypass (CPB): Prolonged use of CPB exacerbates the risk of sternomediastinitis and negatively impacts postoperative recovery. Bone Wax Usage: While effective in controlling sternal bleeding, bone wax inhibits osteoblast activity and bone regeneration, hindering the healing of cancellous bone. Sternal Closure: Standard steel wire ligatures, commonly used due to their low cost, have limitations. These include ischemia at fixation sites, inadequate alignment of sternal edges, potential suture cut-through, wire breakage, or knot loosening in the postoperative period. Reliable sternal fixation plays a critical role in reducing the incidence of sternomediastinitis by preventing suture failure and instability [1,2].

Postoperative Risk Factors. Postoperative Bleeding: Increases the risk of complications by 3.1–5.4 times [16, 31]. Prolonged ICU Stay: Extended intensive care significantly elevates the risk of inflammatory complications. Reoperations: According to L.A. Bokeria (2014), repeat surgeries due to bleeding prolong hospitalization and triple the mortality risk from inflammatory complications [1,2].

These findings underscore the importance of individualized approaches to managing each patient's unique risk factors to minimize complications and improve outcomes.

Treatment Approaches

Modern treatment of postoperative PSM combines systemic therapies such as antibiotics, infusion therapy, and immunostimulation with local treatment methods. Local treatment strategies can be broadly divided into two categories: open and closed techniques.

Open Techniques. Open methods involve thorough debridement of necrotic tissue followed by wound packing with medicated dressings or gauze soaked in antiseptics. Wound closure is performed only after the site is fully cleansed, bacterial cultures return negative, and granulation tissue forms [3]. Advantages: Effective drainage and wound cleansing. Disadvantages: Prolonged hospitalization with restricted mobility. Open chest wounds with exposed vessels, heart, and grafts, increasing the risk of bleeding and secondary infection. Impaired chest wall stability, potentially affecting respiratory function. Advanced open treatments include vacuum-assisted closure (VAC) therapy or localized negative-pressure wound therapy (NPWT). This involves applying a polyurethane sponge with micropores (400–2,000 micrometers), adhesive dressing, a drainage tube, and a vacuum device. Dressings are changed every 2–3 days. VAC therapy accelerates wound healing, shortens hospital stays, improves patient quality of life, reduces the duration of mechanical ventilation, and facilitates early mobilization[3,4,7].

Closed Techniques. Closed methods focus on simultaneous debridement and wound closure, often using re-osteosynthesis of the sternum or reconstructive plastic surgery with tissue flaps. Depending on the extent and depth of tissue damage, options include: Local tissue flaps, such as pectoralis major muscle flaps. Omental flaps or abdominal muscle flaps. These techniques may be performed in stages to ensure optimal outcomes, including enhanced tissue repair and reduced risk of complications. Prolonged Local Antibacterial Therapy (PLAT). PLAT utilizes antibiotic-impregnated matrices that release high concentrations of antibacterial agents over extended periods. Collagen-based matrices have shown additional benefits for tissue repair and regeneration[3,4,6,8].

Results and Conclusion.

Sternomediastinitis remains one of the most severe and potentially life-threatening complications in cardiac surgery, despite advancements in modern medicine. Analyzing risk factors highlights the importance of a multidisciplinary approach to the prevention and treatment of this condition.

Preoperative risk factors, such as comorbidities like diabetes mellitus, obesity, and chronic lung diseases, underscore the need for thorough preoperative preparation. Intraoperative factors, including the precision of sternotomy, graft selection, and methods of sternal fixation, emphasize the critical role of adherence to surgical techniques and protocols. Postoperative factors, such as prolonged stays in intensive care units and repeat surgeries, require close patient monitoring and timely intervention at the earliest signs of complications.

Modern treatment methods, including VAC therapy, localized and systemic antibacterial therapy, and reconstructive techniques for wound closure, significantly improve the chances of successful recovery. However, their effectiveness largely depends on early detection and appropriate management.

Thus, the prevention and treatment of sternomediastinitis demand an individualized approach based on a thorough assessment of risk factors and the selection of the most effective therapeutic strategies. Strengthening preventive measures and incorporating advanced techniques into clinical practice can substantially reduce morbidity and improve treatment outcomes for this condition.

Comprehensive guidelines for the prevention and management of postoperative PSM have been developed to reduce complications and improve outcomes. However, the significant variability in the disease's presentation necessitates an individualized approach for each patient.

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鸦片战争对中医的影响：社会文化和历史的回顾
**THE IMPACT OF THE OPIUM WARS ON TRADITIONAL
CHINESE MEDICINE: A SOCIO-CULTURAL AND HISTORICAL
RETROSPECTIVE**

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摘要。文化空间的划分标准有很多，我们习惯于不仅根据地理和政治边界来区分地域，还根据语言、宗教信仰、共同的历史记忆和其他方面来区分地域。最古老的方法之一是划分东方和西方。

本文以大英帝国和美国作为欧洲文明（西方）的代表，以中国（包括清朝最后几十年和中华民国时期）作为亚洲文明（东方）的代表。选择这一时期作为分析鸦片战争社会文化影响的最具说明性的时期，鸦片战争的影响至今仍在中国产生。

关键词：中医、鸦片战争、文化圈、西方医学。

Abstract. *There are numerous criteria for differentiating cultural spaces, and we are accustomed to distinguishing territories not only by their physical and political boundaries but also by the languages spoken, religions practiced, shared historical memory, and other aspects. One of the oldest methods is the division into East and West.*

This article examines the British Empire and the United States as representatives of European civilization (the West) and China (encompassing the final decades of the Qing Empire and the years of the Republic of China) as a representative of Asian civilization (the East). This period was selected as the most illustrative for analyzing the sociocultural impact of the Opium Wars, the echoes of which are still felt in the country today.

Keywords: *Traditional Chinese Medicine, Opium Wars, Cultural Sphere, Western Medicine.*

Introduction

The 19th century was pivotal for the histories of both empires. For Victorian Britain, it was the century of reaching the height of its power and expanding its colonial presence. Alongside extensive expansion, the country underwent a period of intensive development: the construction of new railways facilitated trade and improved communication; the ambitious project of London's sanitary sewer system; the introduction of antiseptics and anesthesia, which saved thousands of lives¹; as well as advancements in art and literature.

Meanwhile, the Qing Empire sank into a systemic crisis, remaining defenseless against the technological and military achievements of Europeans. The bureaucratic system was too corrupt and inflexible to respond swiftly and effectively to the challenges of the era or to mitigate the consequences of foreign invasions. The Industrial Revolution, which had permanently transformed Europe, never reached China. In fact, even the mere idea of building railroads encountered fierce resistance from conservative officials. The economy was stagnant and no longer capable of meeting the country's needs².

How did a country that had been considered the most advanced and culturally sophisticated in its region for millennia fail to stand up to British ships?

To answer this question, one must consider not only the historical but also the sociocultural perspective. China perceived itself, as its name suggests — 中国 (*Zhōngguó*), the “Central State.” Its role was akin to that of the Roman Empire, which gave the world Latin as a lingua franca and served as a center of intellectual and scientific development. Thanks to China, not only Asia but humanity as a whole gained paper, the compass, silk, gunpowder, and refined porcelain.

However, a critical mistake occurred during the reign of Emperor Qianlong³ in the mid-18th century when he ordered the country to isolate itself from foreigners. China did not anticipate that another power could exist in the world that would surpass the great Asian imperial center or have anything to teach it, let alone excel in any field of knowledge. This mindset marked the beginning of the end for China, which underestimated the “barbarians” and was unable to respond appropriately to the transformations taking place in Europe.

¹ Penner, L. *Victorian Medicine and Social Reform: Florence Nightingale among the Novelists* (Nineteenth-Century Major Lives and Letters) 2010th Edition. Palgrave Macmillan; 2010 edition (May 14, 2010)

² Wang, Zhen'guo.P.258

³ Buckley Ebrey, Patricia. *Cambridge illustrated history of China. Second Edition.p.225*

The Concept of Chinese Medicine: Paradigmatic Differences

Chinese medicine traces its origins to two legendary sages — Huangdi (the Yellow Emperor) and Shen Nong (the Divine Farmer), who, according to legend, lived around 3000 BCE⁴. These sages passed down extensive knowledge to the Chinese, including the concept of **qi** (气), the theory of the five elements, and a comprehensive pharmacopoeia. This knowledge was documented during the Han Dynasty (206 BCE–222 CE). Two foundational works, the *Yellow Emperor's Inner Canon* (黄帝内经) and the *Divine Farmer's Classic of Materia Medica* (神农本草经), became the cornerstones of ancient Chinese medicine.

It is important to note that, unlike the medical theories of ancient Greece and Rome, which evolved over time, the foundations of traditional Chinese medicine remained largely unchanged up to the 21st century. This consistency also applies to related aspects such as feng shui, geomancy, the Chinese zodiac, the balance of yin and yang energies, and the theory of the five elements. As a result, the fundamental principles of the existential paradigm in Asian cultures remain a significant part of their daily lives to this day.

In Chinese medicine, illness is seen as a manifestation of an imbalance in energies. Each internal organ is associated with one of the five elements, which form a cycle of interdependence. Each element enhances the energy of the next and can be weakened by another⁵. Consequently, the treatment of a patient involves using herbs and substances that help restore the lost balance, as well as practicing **qigong** (气功), a form of exercise designed to maintain the healthy flow of **qi** (气) through the meridians of the human body.

Although these methods of treating illnesses may seem extravagant to Europeans, the average life expectancy in China and Europe before the Opium Wars was roughly the same. However, significant differences became noticeable starting in the latter half of the 19th century, when Europe achieved major advancements in public health and Western medicine.

Socio-Cultural Aspects of the Opium Wars: Pioneers of Western Medicine in China

The first Europeans arrived in China in the 16th century, seeking the freedom to trade. The immediate cause of the First Opium War was the destruction of a shipment of opium owned by British merchants in Guangzhou. Following the conclusion of hostilities (1840–1842), the war ended with a British victory, and on August 29, 1842, the Treaty of Nanking was signed. This agreement marked the first unequal treaty in modern Chinese history⁶.

⁴ Jackson, Mark. The history of medicine

⁵ Ted J. Kaptchuk. The web that has no weaver.

⁶ Ward Fay, Peter. Opium War, 1840-1842: Barbarians in the Celestial Empire in the Early Part of the Nineteenth Century and the War by Which They Forced Her Gates. The University of North Carolina Press; Revised ed. edition (March 16, 1998)

From this point on, the Qing Empire began its decline, gradually transforming into a humiliating state of semi-colonial and semi-feudal dependency, losing its role as the undisputed regional leader. Despite the historical distance, the study of the Opium Wars remains a relevant topic today. Contemporary Chinese people remember this war, viewing it as both shameful and unjust. In 1945, Professor Fan Wen-lan wrote in his book: “Even now, we recall with pain and indignation the suffering endured by the Chinese people under the oppression of foreign invaders in the context of a semi-colonial, semi-feudal society”⁷.

Five ports were opened for international trade, providing the British with a legal market for selling opium. The following year, the British also secured the right to establish their own settlements in these open ports, further solidifying their influence in China.

The Russian historian M.I. Sladkovsky emphasized the significance of these events, noting, “Studying the events of past centuries helps to better understand the current state and prospects of relations between China and England”.

A year later, France, the United States, and other European countries joined these unequal treaties. Thus, China was forced to open its borders to Western countries, marking the beginning of its semi-colonial subjugation. This process, accompanied by economic and political pressure, had long-term consequences for the country, both in its international relations and internal development.

Due to the increased presence of the British in the country, there arose a need for medical assistance for foreigners. The first hospitals practicing Western medicine were established in the open ports. However, the forced nature and historical circumstances under which European medicine entered China did little to ease tensions or establish harmonious coexistence. This was reflected in the widespread use of the term “洋鬼子” (*yangguizi*, literally “devil from across the ocean”) to refer to foreigners, showcasing hostility and disdain.

The vast majority of the Chinese population ignored Western medicine, placing their trust in traditional healers. Interestingly, at the onset of the Opium Wars, the state of Western and Chinese medicine was roughly on par. However, within a short period, Western medicine achieved revolutionary breakthroughs that began to significantly change the situation:

In 1846, American dentist William Morton first used ether as anesthesia, introducing the world to its application as a painkiller during surgeries.

In 1847, Scottish obstetrician and surgeon James Young Simpson was the first to use chloroform for pain relief during childbirth and is rightfully considered the founder of obstetric anesthesia.

In 1853, John Snow used chloroform anesthesia to relieve pain during the childbirth of Queen Victoria of England, when she gave birth to her eighth child.

⁷ Fan, W. (1955). The new history of China: 1840–1901

A report that the Queen was satisfied with the procedure was published in *The Lancet*. This broke the resistance of skeptics, both medical and religious, who opposed the use of anesthesia during labor⁸.

In 1867, Joseph Lister, an English surgeon and scientist, developed a comprehensive approach to combat surgical infections. Lister's method was based on the use of carbolic acid. His scientific research marked the beginning of a new era of antiseptic surgery.

These achievements provided Western medicine with strong arguments in its favor, which the Chinese could no longer ignore. The introduction of these innovations, although in the context of dominance and conflict, marked a turning point in the perception and acceptance of Western medicine in China.

Traditionally, the area of contact between the Qing Empire and foreigners was the southern coast and ports. It is clear that it was there, in Guangzhou, in 1835, that the first Western-style hospital was opened, and it was also there that missionaries had the strongest presence. In addition to religious propaganda, they established schools, taught English and natural sciences, worked as translators, and engaged in translations.

It is difficult to overstate the significance of John Glasgow Kerr for the development of Western medicine in China and for China itself. In 1898, he opened the first institution for the treatment of mental illnesses in Guangdong Province, in Canton (Guangzhou), where he worked until his death. Kerr's asylum for the mentally ill operated until 1937.

Kerr made a significant contribution to the anti-opium campaign; he opened a department at the Canton Hospital to treat patients with opium addiction and participated in the work of the Permanent Committee for the Development of Societies to Fight Opium. John Kerr promoted medical education in China, translated more than 34 volumes of medical works into Chinese, and was involved in training the first Chinese students of Western medicine, including Dr. Sun Yat-sen.

The position of Traditional Chinese Medicine (TCM) began to change in 1911, when the Qing Empire fell and the Republic of China was established with Sun Yat-sen as its first president. In the early 20th century, the Chinese population suffered from epidemics of cholera, smallpox, diphtheria, malaria, and tuberculosis, which claimed thousands of lives. The government leaders' inclination towards Western medicine was likely influenced by a combination of factors, such as the dreadful state of public hygiene and the general political atmosphere. However, it is important to note that the "father of modern China," in addition to being an ideologue and revolutionary, had a medical education. At both institutions where he

⁸ Penner, L. *Victorian Medicine and Social Reform: Florence Nightingale among the Novelists (Nineteenth-Century Major Lives and Letters)* 2010th Edition. Palgrave Macmillan; 2010 edition (May 14, 2010)

studied—the Hong Kong Hospital and the Medical College for Chinese in Hong Kong—his instructors were foreigners who taught him according to European medical concepts.

The need for change was urgent for a country that had fallen behind Europe by a whole century. In 1881, the first Western medicine college, founded by the Chinese themselves, was opened in Tianjin. In 1903, a Western medicine college was established in Beijing⁹. Western medicine began to gain popularity and receive government support to such an extent that by the 1920s, nationalists were considering the possibility of banning Traditional Chinese Medicine (TCM)¹⁰.

In a sense, TCM, which is based on the same principles as Chinese civilization, was rejected and considered a symbol of backwardness that hindered China's path to modernization. Many leaders of the Republic received European education and personally encountered the achievements of modern medicine. Their dream of a strong and rejuvenated China began with raising a new generation that trusted science more than “dragon horn powders.” The humiliation that the nation experienced in its confrontation with the British made it reject its cultural heritage and created an imbalance between traditional Chinese medicine and Western medicine.

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⁹ Zhen'guo Wang. History and Development of Traditional Chinese Medicine p.260

¹⁰ Alan K L Chan. Historical Perspectives on East Asian Science, Technology and Medicine, p.199

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燃气轮机组的结构特点

CONSTRUCTIVE FEATURES OF GAS TURBINE UNITS

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摘要。人们已经注意到，对于发电而言，利用型蒸汽燃气机组是最高效、最有效和最经济的选择。这种电站效率最高，燃料消耗较少，因此，排放到大气中的废气量减少，最大限度地减少了对生态的影响。

关键词：蒸汽轮机、燃气轮机、利用锅炉、燃料、有用功系数。

Abstract. *It has been noted that for generating electricity, the utilization-type steam-gas unit is the most efficient, effective, and economical option. Such stations have the highest efficiency, consume less fuel, and therefore, the amount of exhaust gases released into the atmosphere is reduced, minimizing the ecological impact.*

Keywords: *Steam turbine, gas turbine, utilization boiler, fuel, useful work coefficient.*

The perspective direction of energy development is related to the use of gas turbine and steam-gas turbine energy systems in thermal power plants. These systems have a specific structure for main and auxiliary equipment, with differences in operating modes and management. In recent years, interest in applying steam-gas systems in power plants has significantly increased. A steam-gas system using gas fuel in a condensation mode operates with a net efficiency of 58%. In steam-gas systems, the heat from the exhaust gases of the gas turbine is used to generate electricity through the steam turbine. The schematic diagram of a simple utilization-type steam-gas system is shown in Figure 1.

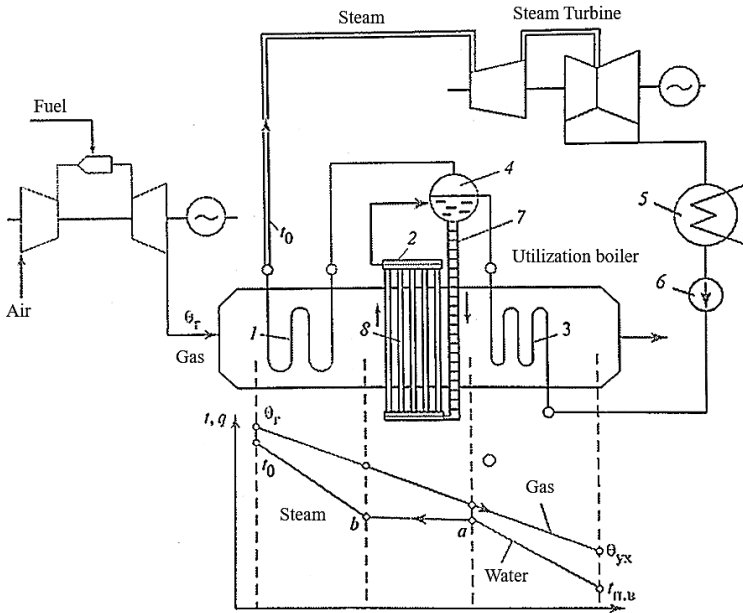


Figure 1. Scheme of a simple utilization-type steam-gas system:
 1 - Steam superheater; 2 - Evaporator; 3 - Economizer; 4 - Drum; 5 - Condenser
 of the steam turbine; 6 - Feed pump; 7 - Downcomer pipes of the evaporator;
 8 - Riser pipes.

The exhaust gases from the gas turbine enter a counter-flow heat exchanger, where the heat of the gases generates high-parameter steam in the utilization boiler, which is then supplied to the steam turbine. The utilization boiler has a rectangular cross-section and contains ribbed pipes in which the supplied water turns into steam and is delivered to the steam turbine. The utilization boiler consists of an economizer (3), an evaporator (2), and a steam superheater (1). The evaporator is located in the middle and includes a drum (4) (its cylindrical part is filled with water up to halfway), several downcomer pipes (7), and vertical riser pipes (8).

The evaporator is situated in a zone with higher temperatures compared to the downcomer pipes. Therefore, the water heats up and evaporates in the evaporator, becoming lighter and rising upward into the drum. The empty spaces in the drum are filled with water supplied through the downcomer pipes. The saturated steam accumulates in the upper part of the drum and then flows into the steam superheater (1). Cool water from the economizer flows into the drum to replace the

outgoing steam. Thus, the water undergoes multiple cycles through the evaporator for complete vaporization, that's why the utilization boiler is called a natural-circulation boiler.

In the economizer, the feedwater heats up to the boiling temperature (below 10-20 °C saturation temperature corresponding to the pressure in the drum) and the dry saturated steam from the drum enters the evaporator. There it is converted into superheated steam and delivered to the steam turbine. The temperature of the superheated steam is 25-30 °C lower than the temperature of the gases exiting the gas turbine. In Figure 1, the temperature changes of the gases and the working fluid (steam, water) during counterflow movement are shown. The temperature of the gases Θ_g gradually decreases to Θ_{ex} temperature.

In the economizer, the temperature of the feedwater reaches the boiling point (point a). At this temperature, the water enters the evaporator, where it evaporates at a constant temperature (*a-b* process), and at point *b*, it turns into saturated steam, which is then converted into superheated steam with temperature t_0 in the superheater and delivered to the steam turbine, where the steam expands and performs work. The used steam from the turbine enters the condenser (5), where it condenses and, with increased pressure through the feed pump, is returned to the utilization boiler. [3].

Thus, the main difference between the steam-gas system and the traditional thermal power plant (TPP) lies in the fact that no fuel is burned in the utilization boiler; heat is obtained from the gases exiting the gas turbine. Additionally, several technical differences need to be noted:

1. The temperature of the gases exiting the gas turbine (Θ_g) is practically the same as the temperature of the gases entering the gas turbine and ensures a consistent performance of the turbine's improved cooling system. The temperature of the gases exiting the gas turbine is 530-580 °C, while in the steam-gas turbine, it is 640 °C. For reliable operation of the economizer tube system, if gas fuel is used, the temperature of the feedwater entering the utilization boiler ($T_{f.w.}$) should not be below 60 °C. The temperature of the gases exiting the utilization boiler (Θ_{ex}) should always be higher than the temperature of the feedwater ($T_{f.w.}$).

2. The efficiency coefficient of the steam turbine in the steam-gas system is significantly lower than that of the steam turbine in the TPP. This is due to the lower parameters and quantity of steam exiting the utilization boiler, as well as the absence of a regeneration system in the steam turbine of the steam-gas system. This is by design because if the temperature of the feedwater is increased, the efficiency coefficient of the utilization boiler would decrease significantly.

Based on the composition of the working fluid used in the steam-gas system, it can be divided into two types:

reheating to maintain the moisture content of the steam entering the last stages of the steam turbine within acceptable limits (12-14%).

By employing optimized pressure regulation in conjunction with intermediate reheating, the station's efficiency indicators are significantly improved. [4] Figure 3 illustrates the schematic of a two-circuit utilization-type steam-gas system.

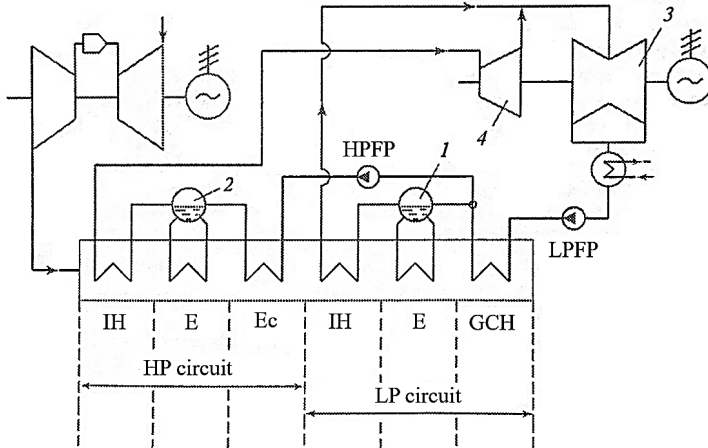


Figure 3. Scheme of a two-circuit SGU (steam-gas unit)

1. Drum of the low-pressure circuit; 2. Drum of the high-pressure circuit; 3. Low-pressure cylinder; 4. High-pressure cylinder.

Low-pressure feed pump (LPFP), gas condensate heater (GCH), high-pressure feed pump (HPFP), evaporator (E), steam heater (SH), economizer (EC), low-pressure circuit (LP circuit), high-pressure circuit (HP circuit).

A portion of the condensate (25-30%) from the steam turbine condenser is directed to the GCH through the LPFP, from where it is sent to the LP drum. The dry saturated steam from the drum enters the heater, and the heated steam is supplied to the low-pressure turbine section. Similarly, the remaining feedwater is sent to the high-pressure circuit through the HPFP. The high-pressure steam obtained there is sent to the high-pressure turbine section, where, after expansion, it mixes with steam from the low-pressure circuit and is sent to the low-pressure turbine section.

Such a steam-gas unit has an efficiency of 50-52%, while a three-circuit steam-gas unit achieves an efficiency of up to 58-60%. The steam-gas unit has many different designs. These units are characterized by simplicity and high economic performance.

The advantages of the steam-gas unit are as follows:

1. The steam-gas unit is the most efficient, convenient, and cost-effective system for generating electricity.
2. Steam-gas turbine is the cleanest engine from an ecological point of view. This unit is highly efficient in electricity production, consuming less fuel. As a result, the amount of harmful gases released into the atmosphere decreases, reducing the ecological load.

Therefore, when comparing the gases released into the atmosphere by steam-gas turbines and the steam turbine block, the amount of fuel required to produce electricity is taken into account.

On the other hand, the amount of nitrogen oxides (NOx) emitted by steam-gas turbines is relatively low. This is not related to gas combustion in SGU (Steam-Gas Unit) since the steam turbine works with hard fuel. Although there is nitrogen in SGU emissions, the amount is reduced due to the operation of some energy boilers based on the diffusion principle rather than combustion (kinetic NOx). In this case, the air-fuel mixture remains at high temperatures for a longer time.

3. The steam-gas turbine is a highly maneuverable engine. Therefore, when there is a load change, SGU, with its high maneuverability, easily adapts to the scheme. SGU is equipped with “bypass” pipes to realize its maneuverability.

4. Compared to steam turbines in power plants, SGU consumes three times less cooling water, making it more efficient. This results from the steam turbine in SGU working at 1/3 of its capacity. Less water consumption is a practical advantage for SGUs.

5. SGU construction and maintenance costs are lower. Unlike steam turbines, SGUs require smaller parts, simpler construction energy boilers, and fewer expensive components like regenerative heating schemes or high-cost boiler pipes. Thus, SGU is economically advantageous compared to steam turbines.

6. The repair time of SGUs is shorter because the design is modular, making the repair process easier.

7. SGU has no practical disadvantages. However, such units work primarily with natural gas fuel. For other fuel types, energy boilers must be designed, and emissions should be purified. The decrease in fuel efficiency (42-44%) may lead to economic disadvantages, especially in gas-rich countries like Azerbaijan and Russia. Nevertheless, SGU refurbishment and usage remain economically feasible.

When selecting equipment for future SGU power plants, their technical characteristics must align with global standards. By 2070, their features should comply with Russia’s technical policy concept requirements.

Conclusion:

1. Different types of steam-gas turbines have been studied and compared.

2. The advantages of steam-gas turbines have been explored, concluding that these turbines are an efficient and environmentally friendly way of generating electricity.

3. The amount of nitrogen oxide (NO_x) emitted from the steam-gas unit is quite low.

4. Such stations have the highest efficiency and lower fuel consumption compared to other stations. Therefore, the amount of flue gases emitted into the atmosphere decreases, and the environmental load is reduced.

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建立多年冻土条件下铁路桥梁建设和运营期间土壤和基础的信息模型
**CREATION OF INFORMATION MODELS OF SOILS
AND FOUNDATIONS OF RAILWAY BRIDGES DURING
CONSTRUCTION AND OPERATION IN PERMAFROST SOIL
CONDITIONS**

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摘要。考虑到气候变化引起的趋势，与永久冻土条件下人工结构（桥梁）的运行有关的问题在各个方面都很重要。在这种情况下，我们不仅谈论现有的交通基础设施人工结构，还谈论正在建设的对象以及计划建设的对象。例如，俄罗斯联邦 40% 的领土和俄罗斯远东地区 80% 的领土位于永久冻土区，而每 1 公里轨道就有 1 个与小型铁路桥梁相关的对象，这对监测它们的技术状况提出了额外的要求。当今存在的监测技术状况的方法使我们能够控制并以高度的可靠性预测事故的可能情况、原因和后果；然而，鉴于信息建模、可视化和预测的可能性不断增加，建议利用所有可用的机会形成铁路桥梁的信息模型，以最有效地维护其工作状态。

关键词：永久冻土、地基、基础、数值建模、信息模型、监测、安全运行。

Abstract. *Issues related to the operation of artificial structures (bridges) in permafrost conditions, taking into account trends caused by climate change, are important in all aspects. In this case, we are talking not only about existing artificial structures of transport infrastructure, but also about objects under construction, as well as about objects planned for construction. For example, 40 percent of the territory of the Russian Federation and 80 percent of the territory of the Russian Far East are located in the territory with permafrost soils, while per 1 km of track there is 1 object related to small railway bridges, which imposes additional requirements for monitoring their technical condition. The methods*

of monitoring technical condition that exist today allow us to control and, with a high degree of reliability, predict possible conditions, causes and consequences of incidents; however, given the growing possibilities of information modeling, visualization and forecasting, it is advisable to use all available opportunities to form information models of railway bridges for the most effective maintenance of their working condition.

Keywords: *permafrost, foundation, foundation, numerical modeling, information model, monitoring, safe operation.*

The article considers an example of numerical modeling of the base and foundation of railway bridges, provides a solution to the numerical problem of heat field distribution, and solves a numerical problem with a forecast of changes in the time perspective.

The purpose of this study was to assess possible negative events at various stages of the life cycle of railway bridges and build information models to predict safe operation.

As a result of the research, information models of foundations and bases were obtained that can be used to solve various problems, and a justification for the feasibility of building information models of transport infrastructure structures is given.

Introduction

Since artificial structures are not only important infrastructure facilities, but also strategic objects, ensuring the safe operation of these structures is an important task. It is worth noting that in the Far Eastern Federal District, bridge structures are operated in harsh climate conditions, permafrost and significant loads. Due to increased requirements for railway bridges, it is necessary to take into account the impact of harsh climatic conditions on their performance characteristics. To date, significant experience has been accumulated in the operation of railway bridges in conditions of permafrost soil distribution.

The main problem of operating railway bridges in the cryolithozone is the possible deformation of the bases and foundations due to the degradation of permafrost. At the same time, the nature of the increase in the temperature of frozen soils, unfortunately, is unpredictable, the external manifestation of which is manifested in the deformation of the supports of bridge structures.

For the most effective assessment of the development of negative processes, in particular, an increase in the maximum values of frozen soils, numerical modeling is used, with an assessment of the possibility of permafrost degradation development in the areas of interest. An example of such a solution is shown in Fig. 1, it shows the distribution of temperature fields based on the results of a numerical problem based on the physical and mechanical characteristics of the soil and the

results of periodic monitoring of the temperature regime of permafrost soils, with temperature measurements in thermal wells. Assessing the difference in the available results, it is necessary to note the development of a zone with a temperature of $-1\text{ }^{\circ}\text{C}$ along the depth of frozen soil. If as of 2022 this temperature is distributed at a depth of more than 10 m, then by 2027 the depth of distribution of this temperature decreases to 7 m, which indicates a constant process of degradation of permafrost soils in this area, which in the future can lead to an uncontrolled decrease in the bearing capacity of the foundation and foundation settlement.

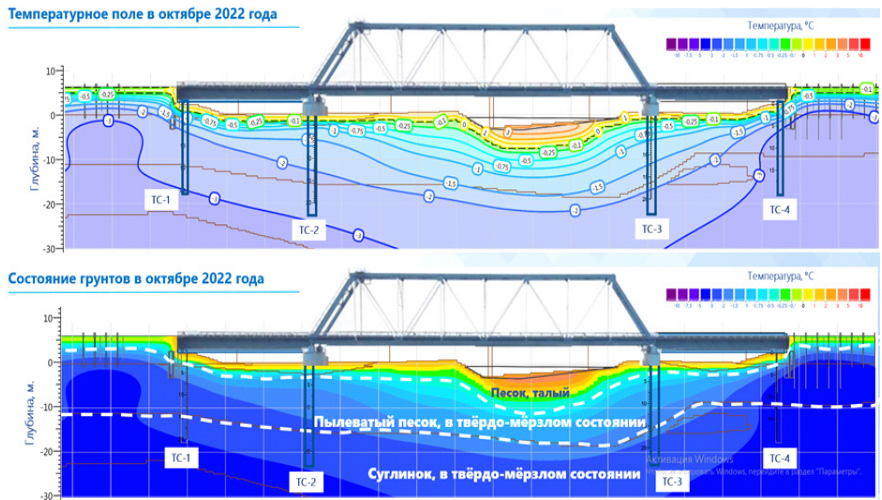


Figure 1. Example of numerical modeling. Solution of the numerical problem of distribution of thermal fields based on the results of periodic monitoring of the soil temperature regime

To assess the change in temperature after 5 years, a thermophysical problem was solved based on the existing trends (Fig.2).

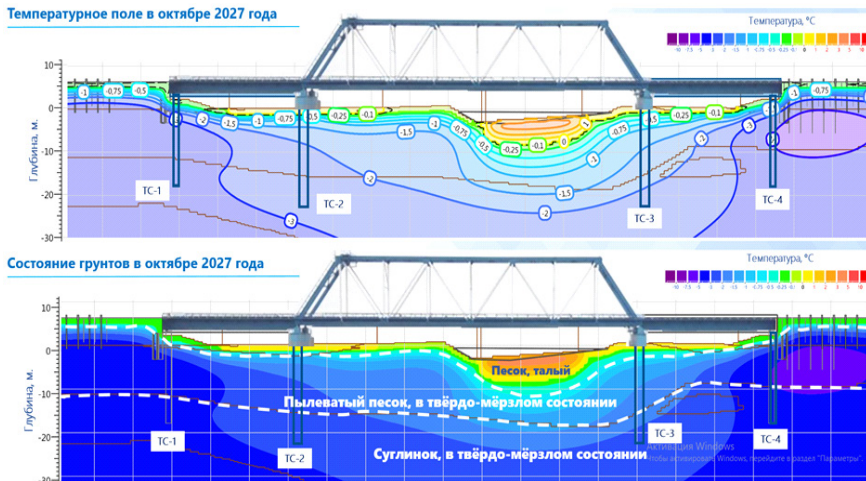


Figure 2. Solution of the numerical problem on the distribution of thermal fields with a forecast of changes in temperature fields in 2027.

An analysis of changes in soil temperature at a depth of 10-15 m is presented in Fig. 3, it shows that the increase in the soil zone with elevated temperature will continue to develop without the use of measures to reduce this trend.

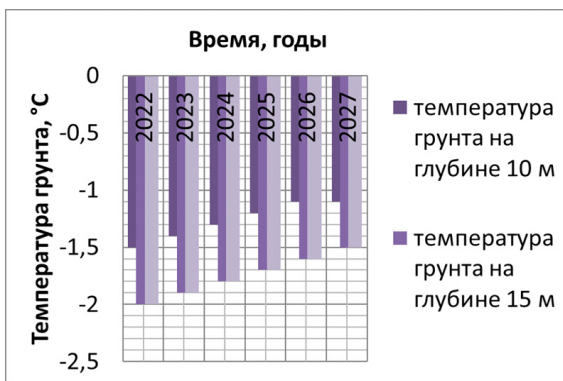


Figure 3. Analysis of changes in soil temperature at a depth of 10 and 15 m.

It should be noted that at the site under consideration, negative trends were identified primarily within the river bed. At the same time, small railway bridges in the territory of the Far Eastern railway infrastructure serve to overcome low-flow rivers. In this regard, to determine the factors that negatively affect the tem-

perature increase in the permafrost zone and the possible increase in the active layer, it is necessary to include the following:

1. Current morphometric surveys (determination of characteristic levels, flow rates and water consumption, construction of the longitudinal actual profile of the river, current hydrological data on the watercourse);
2. The influence of the maximum temperature state of the river bed;
3. Maximum reshaping of the river banks;
4. Accounting for water filtration through a through talik of maximum dimensions under the river;
5. The presence of additional hazardous geological processes.

It should be noted that if for foundation structures monitoring the technical condition is a task with a fairly large number of solutions, especially taking into account the currently existing methods of monitoring and the possibilities of compiling information models, with subsequent solution of problems taking into account various negative factors, then for foundations located in the thickness of frozen soils the construction of accurate information models-twins is, in fact, the only way to objectively assess the possibility of trouble-free operation. С учетом вышеуказанного примера является целесообразным составление информационных моделей, особенно фундаментов, возможно с использованием различных программных продуктов, главным условие которых является учет всех факторов влияющих на повышение температуры в рассматриваемых зонах многолетнемерзлых грунтов.

These conditions include the following:

1. Taking into account the effect of heat transfer from the support into the soil thickness with a foundation width of more than 500 mm;
2. Taking into account the effect of protective measures (thermal stabilization, reduction of the soil surface temperature or temperature bridges);
3. Taking into account negative factors (maximum soil waterlogging, high filtration rate).

In this case, the thermophysical problem will be solved based on the following dependencies:

$$Z = \alpha \sqrt{t} \quad (1)$$

where: Z is the depth of the thawing or freezing front, m; t is the time of freezing or thawing, days; α is the coefficient of the functions of soil properties and boundary conditions.

$$\frac{\alpha}{2(a_{th})^{0.5}} = f \left\{ Ste, \left[-\frac{T_g \lambda_f}{T_{surf} \lambda_{th}} \left(\frac{a_{th}}{a_f} \right)^{0.5} \right] \right\} \quad (2)$$

where: Ste is the Stefan number, expressed as the coefficient of heat release into the specific heat of phase transformations:

$$Ste = \frac{C_{th} T_{surf}}{L_0} \tag{3}$$

Parameters: a_{th} and a_f - coefficients of temperature conductivity of thawed and frozen soil:

$$a_{th} = \frac{\lambda_{th}}{C_{th}} \tag{4}$$

$$a_f = \frac{\lambda_f}{C_f} \tag{5}$$

It is worth noting that the presence of factors influencing the increase in thermal conductivity in the soil massif is taken into account when setting the problem and forming the boundary conditions. An example of solving a thermophysical problem on thawing a massif of permafrost soil, taking into account the influence of the existing building on the temperature regime of the foundation, is shown in Fig. 4.

As can be seen from the example, it is possible to trace the dynamics of the development of the soil thawing process, taking into account the influence of existing factors and the influence of the building itself on the cryogenic processes.

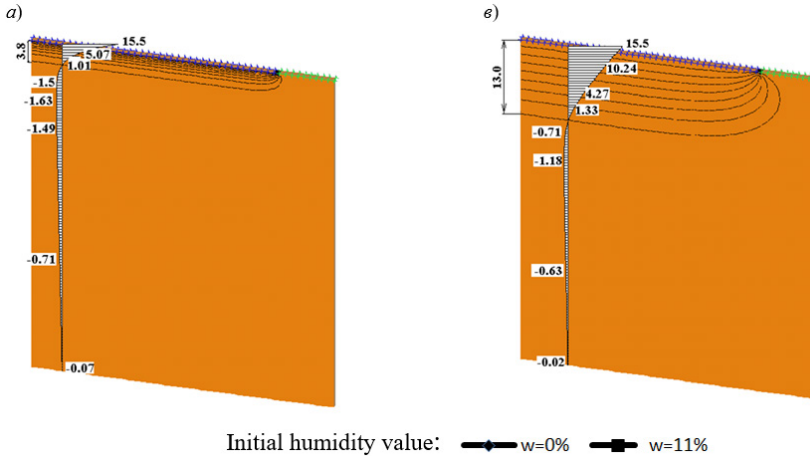


Figure 4. Temperature isolines and thawing basin of permafrost soil under the building for the period of time: A) 1.0×10^4 (1.1 years); B) 1.0×10^5 (11 years); Thermal conductivity of soil λ_{th} : 2×10^3 Cal/(hour·m·°C) (frozen) and 1×10^3 Cal/(hour·m·°C) (thawed); soil moisture w - 0.18 d.u.

In addition, for the Far Eastern polygon of transport infrastructure, numerical calculations were performed to determine the development of permafrost degradation

processes, taking into account the influence of the identified negative factors (Fig. 5-8). Calculations were performed based on the initial data: characteristics of building structure materials, physical and mechanical characteristics of foundation soils, temperature values of soils and outside air, hydrological conditions, all this allows us to determine the boundary conditions for solving the temperature and humidity problem within the framework of thermophysical calculations to obtain accurate data that can be used as initial information models when forming electronic operational documentation for the facility, both as a whole and for its individual parts.

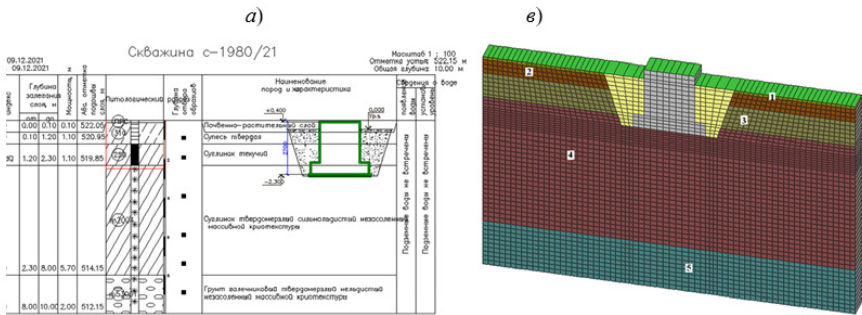


Figure 5. A) Engineering and geological conditions of the research object. B) Calculation scheme of the structure: 1 – soil and vegetation layer; 2 – hard sandy loam; 3 – fluid loam; 4 – hard-frozen loam, strongly ice-containing, non-saline, massive cryo-texture; 5 – pebble soil, hard-frozen, non-ice-containing, non-saline, massive cryo-texture

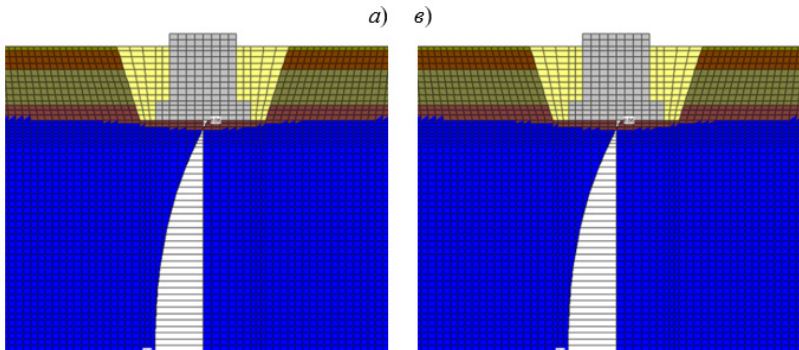


Figure 6. A) Freezing zones (blue) and thawing zones of the soil from the impact of the foundation structure in the 1st year for October, temperature diagram, °C; B) Freezing zones (blue) and thawing zones of the soil of the foundation structure in the 10th year for October, temperature diagram, °C

soil. It is worth noting the positive experience of using such models to predict various operating conditions for various operating modes, including when planning repairs and reconstructions.

Conclusions

Based on the results of the study, the following conclusions and proposals can be made:

1. The formation of information models is necessary for the formation of an object passport, which allows using the available information for planning various activities.
2. For objects under construction and planned for construction, the formation of information models can be called a necessity, taking into account the significant amount of information when forming design and acceptance documentation.
3. In order to compile reliable information when forming information models of existing objects, it is necessary to update information on the actual condition of both building structures and the characteristics of the soil mass, using non-destructive testing methods.

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STIGMATIC TRIGONOMETRY

Apartsev Oleg Rolenovich

摘要。本文研究了最简单的二维物体——矢量三角形的属性，并研究了在矢量三角形的代数表示中获得矢量形式等效映射的可能性。分析表明，除了描述矢量的角度和振幅属性的4个实数值变量外，矢量三角形的属性还定义了另外两种具有符号特征的变量，称为旋转（4个）和缩短（4个）符号变量。使用这两种类型的符号变量，代数表示可以明确地描述任意三角形。建议将发现的变量视为量子。此外，在三角形物体的静止状态下，符号变量具有两级“位”的含义，而在非静止状态下，符号变量变为三级，获得“量子位”属性，这可能可用于某些物理量子系统的数学建模。关键词：矢量三角形、符号变量、矢量方程、代数方程、属性、位、量子位、矢量三角形的柱头、量子对象。

Abstract. *The work is devoted to the study of the attributes of the simplest two-dimensional object – a vector triangle, for which the possibility of obtaining an equivalent mapping of a vector form in the algebraic representation of it is investigated. The analysis showed that in addition to the 4 real numerical variables describing the angular and amplitude properties of vectors, the properties of a vector triangle define two more types of variables that have a sign character, which were called rotational (4 pcs.) and foreshortened (4 pcs.) signed variables. Using both types of signed variables, with which the algebraic representation becomes possible to unambiguously describe an arbitrary triangle. It is proposed to treat the found variables as quantum. Moreover, in stationary states of triangular objects, sign variables have the meaning of two-level, “bit” ones, and in non-stationary states, sign variables turn into three-level ones, acquiring “qubit” properties, which can probably be used for mathematical modeling of some physical quantum systems.*

Keywords: *Vector triangle, sign variables, vector equation, algebraic equation, attribute, bit, qubit, stigmat of a vector triangle, quantum objects.*

1. Introduction

This paper continues the development of the topic, which was initiated in the articles [3, 4], where the method of transformation of a vector equation into an algebraic expression was discussed:

$$\bar{a} + \bar{b} + \bar{c} = 0. \gg \begin{cases} a \cos \alpha + b \cos \beta - c \cos \gamma = 0, \\ a \sin \alpha + b \sin \beta - c \sin \gamma = 0. \end{cases} \quad (1)$$

where a, b, c – amplitudes of vectors forming a vector triangle, and α, β, γ – angles between the corresponding vectors and an arbitrary vector that belongs to the plane of the vector triangle, called the “polarization vector”. Correlating triangle vectors with a non-local \bar{e} vector is a systematic approach that aims to introduce an “extroverted” system coordinates of the triangle. It allows you to abandon the use of global coordinate systems and, thus, provides an opportunity to take a step towards a more objective description of the properties of the triangle itself.

In the above works [3,4], another step was taken: one of the vectors that is part of the triangle was assigned as the polarization vector, for example – \bar{c} . By taking $|\bar{c}| = 1$ and counting the angular values of the other two vectors from it, the vector triangle obtains an even more individualistic way of describing an – “introverted” system coordinates. In this case, the system of algebraic equations (1) becomes even more compact:

$$\begin{cases} a \cos \alpha + b \cos \beta - 1 = 0, \\ a \sin \alpha + b \sin \beta = 0. \end{cases} \quad (2)$$

The resulting expression takes a fairly simple, but at the same time, universal form for describing an arbitrary vector triangle. The main incident of transformation from vector to algebraic form, as it turned out, is the uncertainty of choosing a single option from the resulting double solutions [3,4] when trying to solve the expression algebraically (2).

2. Rotational attributes of a vector triangle

As a first step towards eliminating the identified ambiguity of solutions let us establish that for a certain Virtual Observer viewing the plane of a triangle from a certain side, vectors that have the right rotational direction \ (clockwise) relative to any point belonging to the inner region of the triangle will be considered negative and preceded by the sign”–”.

In contrast, vectors that specify the left rotational direction (counterclockwise) relative to any point in the inner area of the triangle will be considered positive, and will be accompanied by a “+ “ sign.

In fact, we are talking about applying the well-known “gimlet” or “right screw” Rule.

Thus, all possible combinations of the vector expression (1) will be reflected in the vector equation, where the accepted Rule and the vector equation (1) merge.:

$$\pm \bar{a} \pm \bar{b} \pm \bar{c} = 0. \quad (3)$$

Note that the vectors in the expression (3) can’t be swapped arbitrarily, since. It is obvious that the configuration of the resulting triangles is not equivalent when changing the order of any two vectors, therefore, the proposed vector algebra does

not have commutativity. However, the equivalence still holds for cyclic permutations of vectors.

An extroverted algebraic representation of a vector triangle will appear as (4), where the signs of the terms of the upper and lower expression before the conjugate with vectors will coincide (without taking into account the signs of the trigonometric functions themselves and the signs of amplitudes, in cases of their alternating sign):

$$\begin{cases} \pm a \cos \alpha \pm b \cos \beta \pm c \cos \gamma = 0, \\ \pm a \sin \alpha \pm b \sin \beta \pm c \sin \gamma = 0. \end{cases} \quad (4)$$

It can be argued that (4) there is an unambiguous description of any vector triangle (3) in extrverted polar coordinates on the plane, which defines a complete equivalent representation of the triangle in algebraic form because it completely describes the initial state of the vector triangle.

Let us strengthen the universality of the representation of the algebra of vector triangles. Matrix expression syntax (4) allows the following transformation:

We generate a vector \ - matrix, which we will call “rota - vector “ (from Lat. “rota” – wheel), which reflects the values of the signs of the corresponding vectors, taking into account the rotational direction of the vectors relative to an arbitrary point that is the inner point of the triangle:

$$\bar{r}(r_a, r_b, r_c) \in \{\pm 1, \pm 1, \pm 1\}. \quad (5)$$

Then the matrix representation equivalent to (4), takes the form:

$$\bar{l} \bar{T} \bar{r} = 0. \quad (6)$$

The equation describes the relationship between the amplitude and angular values, as well as the rotational statuses of the vectors that make up the triangle.

Expanded algebraic analog of (4) will be represented by the following system:

$$\begin{cases} r_a a \cos \alpha + r_b b \cos \beta + r_c c \cos \gamma = 0, \\ r_a a \sin \alpha + r_b b \sin \beta + r_c c \sin \gamma = 0. \end{cases} \quad (7)$$

The equation describes the relationship between the amplitude and angular values, as well as the rotational statuses of the vectors that make up the triangle.

Expanded algebraic analog of (4) will be represented by the following system $|\bar{c}| = \gamma = \{0\}, \cos \gamma = \{+1\}$:

$$\begin{cases} r_a a \cos \alpha + r_b b \cos \beta + r_c (+1) = 0, \\ r_a a \sin \alpha + r_b b \sin \beta = 0. \end{cases} \quad (8)$$

And for extroverted coordinates, for which we assume that $\bar{c} = \bar{e}$:

* $|\bar{c}| = 1, \gamma = \{0, \pi\}, \cos \gamma = \{\pm 1\}$:

$$\begin{cases} r_a a \cos \alpha + r_b b \cos \beta + r_c \cos \gamma = 0, \\ r_a a \sin \alpha + r_b b \sin \beta = 0. \end{cases} \quad (9)$$

Moreover, we consider a variable with two values $\cos \gamma = \{1, -1\}$, which is given the meaning of the direction \bar{c} , determined, according to the right-hand screw

rule, relative to the position of the external Virtual Observer, no matter how it is set.

Thus, the components of the **rota-vector** should be considered essential attribute elements of an arbitrary vector triangle, both in vector and algebraic representations of.

Perhaps the following explanation is required:

By giving the vector \bar{c} the meaning of a single polarization vector from the point of view of an External Observer, the question of invariance of the description for any relative position of the triangle and the Observer and the definiteness of the destination is solved all other components of the rota-vector, as well as the angular coordinates.

3. The algebraic Triangle: a philosophical background

Recall that the main task of the study is to find the attributes that follow from the proper laws of existence of the considered objects. Philosophical understanding of the resulting system of equations (8) learning about the structure itself, or its operational use, can help, which can, even if implicitly, reveal a new essence of. And the question that is asked here is: can such an analysis lead to the recognition of some hitherto unknown attribution?

Consider the first equation from (2), by presenting it in a simplified form in comparison with (8), but without missing the point:

$$a \cos \alpha + b \cos \beta = 1, \quad (10)$$

We can say that the equation defines the proportions of projections of vectors \mathbf{a} и \mathbf{b} together constituting the vector \bar{c} . In other words, the equation defines an attribute that expresses the proportions of the contributions of two vectors to the amplitude of the selected polarization vector \bar{c} . We assign variables with the symbols P_a and P_b to the values of the projections of vectors on the direction of the vector \bar{c} :

$$\begin{aligned} P_a &= a \cos \alpha, \\ P_b &= b \cos \beta. \end{aligned}$$

In general, only one of the variables P is important, taking into account their semantic equivalence and absolute connectedness.

$$P_a + P_b = 1. \quad (11)$$

But perhaps the second equation is more interesting (2), which we can represent as:

$$S_a + S_b = 0. \quad (12)$$

In it, the value of the area of a triangle was inexplicably hidden, since it is known that the area of an arbitrary triangle [2] is defined as:

$$\begin{aligned} S_a &= 1/2 * c * a * \sin \alpha, \\ S_b &= 1/2 * c * b * \sin \beta. \end{aligned} \quad (13)$$

On condition $\mathbf{c} = \mathbf{1}$:

$$\mathbf{S}_a = -\mathbf{S}_b = \mathbf{1}\sqrt{2} * \mathbf{a} \sin \alpha = -\mathbf{1}\sqrt{2} * \mathbf{b} \sin \beta. \quad (14)$$

Due to the equality of the two terms of the second equation of the system (11), in fact, only one of the two terms \mathbf{S} is an attribute variable. It is obvious that the areas of triangles formed by the vectors \mathbf{a} and \mathbf{b} have the opposite sign due to the opposite direction of the angles α and β . The resulting system of equations turns out to be quite interesting, both from the aesthetic point of view and, as we will see later, from the point of view of revealing a deeper attribute structure of triangulated objects, but it is already clear that new attribute variables have been found: \mathbf{S} and \mathbf{P} . The system of equations (9) can be represented by (11, 12), in the form of:

$$\begin{cases} \mathbf{P}_a + \mathbf{P}_b + r_c \cos \gamma = \mathbf{0}, \\ \mathbf{S}_a + \mathbf{S}_b = \mathbf{0}. \end{cases} \quad (15)$$

4. Stigmatic description of an algebraic triangle

In an attempt to describe the attribute properties of triangulates in an absolute way, starting with the simplest of them – a triangle, we will try to analyze the algebraic form more deeply (15), based on (8). Let us represent the terms of the first equation (8) as:

$$\begin{aligned} r_a \mathbf{a} \cos \alpha &= [r_a][\cos \alpha] \mathbf{P}_a, \\ r_b \mathbf{b} \cos \beta &= [r_b][\cos \beta] \mathbf{P}_b, \\ r_c &= [r_c]. \end{aligned} \quad (16)$$

Here the expressions in square brackets are $[\mathbf{x}]$ are symbolic sign multipliers, $[\mathbf{x}] \in \{\pm 1\}$, rotational signed variables r_a, r_b, r_c (5) and signed multipliers of functions $\cos \alpha, \cos \beta, \cos \gamma$, which are suggested to be named “**perspective sign variables**”, considered without taking into account the proper signs of the variables \mathbf{P}_a and \mathbf{P}_b , or rather, without taking into account the signs :

$$\begin{aligned} \mathbf{a} \cos \alpha &= [\cos \alpha] \mathbf{P}_a \\ \mathbf{b} \cos \beta &= [\cos \beta] \mathbf{P}_b. \end{aligned} \quad (17)$$

In the second equation (17), the sign functions of expressions $\sin \alpha, \sin \beta$ will also be defined as **perspective sign variables**:

$$\begin{aligned} r_a \mathbf{a} \sin \alpha &= [r_a][\sin \alpha] 2\mathbf{S}_a, \\ r_b \mathbf{b} \sin \beta &= [r_b][\sin \beta] 2\mathbf{S}_b. \end{aligned} \quad (18)$$

And, based on (12), all expression (8) takes the form:

$$\begin{cases} [r_a][\cos \alpha] \mathbf{P}_a + [r_b][\cos \beta] \mathbf{P}_b + [r_c][\cos \gamma] = \mathbf{0}, \\ [r_a][\sin \alpha] + [r_b][\sin \beta] = \mathbf{0}. \end{cases} \quad (19)$$

Overall, (19) is equivalent to the algebraic expression of a vector triangle in the extroverted coordinate system (8), taking into account all its possible states for a unit polarization vector $\bar{\mathbf{c}}$. The resulting expression contains an equivalent symbolic imprint of the original vector triangle, and therefore it seems that an

adequate name for the new approach can be: “stigmatic representation of a vector triangle”, and a set of variables necessary for describing an object: “*stigmata of a vector triangle*” (from Greek. Stigma – brand).

✓ *It is interesting for the stigmatical representation of a vector triangle that the function of symbolic (sign) multiplication coincides with the logical equivalence function [2]:*

in binary algebra // or in complex numbers:

$$\begin{aligned} \text{If } [x]=[y]= -1 // -i, & \quad [x][y]=1; \\ \text{If } [x]=[y]= 1 // +i, & \quad [x][y]=1; \\ \text{If } [x]= 1 // +i; [y]= -1 // -i, & \quad [x][y]= -1, \\ \text{If } [x]= -1 // -i; [y]= 1 // +i, & \quad [x][y]= -1. \end{aligned}$$

It follows that, if desired, all 8 signed variables can be represented by the complex numbers.

5. Unity of quantum and continuous variables

Transforming the system (19) to the matrix form, as a derivative of (6):

$$\bar{T}\bar{r} = 0. \gg \bar{T}\bar{S}^*\bar{r} = 0. \tag{20}$$

$$\begin{pmatrix} a & 1 \\ b & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} \cos\alpha & \cos\beta & \cos\gamma \\ \sin\alpha & \sin\beta & 0 \end{pmatrix} \begin{pmatrix} 1 & 1/|\sin\alpha| \\ 1 & 1/|\sin\beta| \\ 1 & 0 \end{pmatrix} ([r_a] \ [r_b] \ [r_c]) = 0. \tag{21}$$

\bar{S}^* – this is a matrix of signed angle variables.

However , the expression (21) does not look aesthetically pleasing from a mathematical point of view, since the matrices contain both real and signed variables at the same time. If the matrix of angular values \bar{T} , is changed accordingly, it can be transformed:

$$\begin{pmatrix} a & 1 \\ b & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} |\cos\alpha| & |\cos\beta| & |\cos\gamma| \\ 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} \cos\alpha/|\cos\alpha| & \sin\alpha/|\sin\alpha| \\ \cos\beta/|\cos\beta| & \sin\beta/|\sin\beta| \\ \cos\gamma/|\cos\gamma| & 0 \end{pmatrix} * ([r_a] \ [r_b] \ [r_c]) = 0. \tag{22}$$

Which means, in essence:

$$\begin{pmatrix} a & 1 \\ b & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} |\cos\alpha| & |\cos\beta| & |\cos\gamma| \\ 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} [\cos\alpha] & [\sin\alpha] \\ [\cos\beta] & [\sin\beta] \\ [\cos\gamma] & 0 \end{pmatrix} ([r_a] \ [r_b] \ [r_c]) = 0. \tag{23}$$

Obviously, the first two matrices \bar{T} , \hat{T} in the expressions (22, 23) represent only real variables, while the last two in them: \bar{S}^* , \bar{r} contain only signed variables.

And for some applications, the algebraic representation of a triangle can be like this:

$$\begin{pmatrix} P_a & P_b & 1 \\ 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} [\cos\alpha] & [\sin\alpha] \\ [\cos\beta] & [\sin\beta] \\ [\cos\gamma] & 0 \end{pmatrix} ([r_a] \ [r_b] \ [r_c]) = 0. \tag{24}$$

The extravagance of the stigmatic representation of a vector triangle is that it involves 8 binary variables-carriers of the sign:

$$[r_a], [r_b], [r_c], [\cos\alpha], [\cos\beta], [\cos\gamma], [\sin\alpha], [\sin\beta].$$

The extravagance of the stigmatic representation of a vector triangle is that it involves 8 binary variables-carriers of the sign: P_a and P_b .

Of course, keep in mind that these two variables contain 4 valid variables: b , $|\cos\alpha|$, $|\cos\beta|$, according to (10).

Original expression (19), formally consisting of two equations, contains two types of variables, which, on the one hand, requires resolution with respect to both signed and real variables, but the same is the possibility of finding in a system of two equations 4' s unknown, two of each type.

Thus, any vector triangle in the stigmatic representation in the extroverted coordinate system is given by the associated 12-th variables:

4-th real numbers and 8-th binary quantum.

✓ *And, interestingly, the description also applies to cases where the triangle does not belong to a plane, but, for example, is located on some spherical or other curved surface. This is made possible by the adopted special coordinate system.*

Even more interesting is that the system (19) does not cover all possible “boundary” states of such a complex object as a vector triangle. And you should discuss alternative states of the system that were not considered earlier.

6. The Ternary Logic of quantum Stigmata

There is an obvious fact: stigmata are quantum variables, except for the range of values $[x] \in \{\pm 1\}$ can have a third state, this is the “zero” state.

For example, for trigonometric functions:

$$[\cos\alpha] = 0, \text{ if } \alpha = \frac{1}{2}\pi,$$

$$[\sin\alpha] = 0, \text{ if } \alpha = 0,$$

And similar values hold for trigonometric functions with β .

Also, switching the sign with the acquisition of a “zero” value can occur at the moment of changing the direction of any component of the rota-vector $\vec{r}(r_a, r_b, r_c)$.

Moreover, there are conditions when not only individual terms of the system of equations (19) are converted to 0, but the total values of two or even three terms are converted to 0 (for the first equation).

Such collisions put the system of equations (19) in a non-stationary state, since zeroing the terms, either in the first or in the second equation, reduces to a state of uncertainty some part of the variables inherent in this system of equations. Of course, the presence of such excesses will require a separate consideration of the features of the passage of vector triangles of the described states, which will be other work.

- ✓ *Quite complex, from a methodological point of view, is the question: When a Virtual Observer intersects the plane of finding a triangle, at the moment when the Observer intersects the plane of the triangle, the signs of the components of the rota-vector, as well as the angular variables of the triangle, change the sign.*
Does the vector triangle system break out of the stationary state or not? The author is of the opinion that the system loses its stationary state, since the outcome of the event, from the Observer’s point of view, becomes unpredictable.

Thus, the stigmatic representation of triangulates can be considered as a basis for describing not only binary, i.e. “bit” quantum states in vector systems, but, as it becomes obvious, the representation also makes sense in three – level states - “qubit”, which arise in two-dimensional systems vector objects with three states:

$$[r_a], [r_b], [r_c], [\cos\alpha], [\cos\beta], [\cos\gamma], [\sin\alpha], [\sin\beta] \in \{1,0,-1\}.$$

What all signed variables have in common is that zero states of variables or integer terms create a singular uncertainty of values for the coordinates of the vector triangle. The quantum properties of triangulates during transitions from bit to qubit manifestations should be considered one of the paradoxical attribute properties generated by objects existing in continuous compensated field spaces, described mathematically as vector triangles. The potential for applications of this phenomenon remains to be explored.

7. Conclusion

1. Developing A Philosophical Theory Ambivalent Generalization [1], which indicates the attributive nature of any objectness, in this paper we propose and implement a methodological approach that serves to identify implicit attributes of the simplest two-dimensional mathematical object, such as an elementary vector triangle.

One of the goals of this work was to demonstrate a methodology that allows for a thorough attributive analysis, including abstract constructs, and not only metaphysically solid real objects belonging to the natural and social sciences.

2. In this paper, we obtained previously unnoticed attributes that are assigned to the simplest abstract object -a vector triangle. The results obtained allow us to open up new approaches to solving vector and triangulation problems through an algebraic representation that allows us to unambiguously describe an arbitrary vector triangle in individual coordinates on the plane, which can then be easily linked to any global coordinates.

3. In this paper, we find and justify the mutual equivalence of vector, algebraic, and, rather extravagant, stigmatic representations of vector triangles in their corresponding forms:

- **Vector map:** $\bar{a} + \bar{b} + \bar{c} = \mathbf{0}.$

- **Algebraic**, in the matrix representation:

$$\bar{r} \bar{T} \bar{l} = \mathbf{0},$$

where \bar{l} – is the vector of amplitudes,

\bar{T} – is the matrix of angular coordinates of vectors,

\bar{r} – is a vector expressed in signed rotational variables, an indicator of the “torsion” of the triangle.

- **Stigmatic**, in the matrix representation, in the extravert coordinate system of the triangle:

$$\bar{l} \bar{T} \bar{S}^* \bar{r} = \mathbf{0},$$

where \bar{S}^* – is the matrix of signed angle variables.

4. The universality of trigonometric relations observed in the surrounding world seems to be a global pattern that follows from an innumerable volume of inductively and deductively on firm facts. In this paper, we were able to show that triangular vector objects, in addition to linear and geometric attributes, generate 8 binary attributes that manifest in stationary states, and in non-stationary situations they are transformed into 8 ternary (qubit) attributes. There is an assumption that it is possible to use model representations described by the laws of compensated vector physical substances by reducing the latter to problems on triangulates (systems of closed triangles) for two-level quantum logic.

5. Also, the paper shows an approach to the consideration of non-stationary vector substances that provoke three-level quantum states, which, apparently, will expand the possibilities of describing some part of quantum objects-carriers of ternary, that is, qubit logic.

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