SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

Proceedings of the International Conference

Date: August 9

Beijing, China 2023

上合组织国家的科学研究：协同和一体化国际会议

参与者的英文报告

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

Part 2

2023 年 8 月 9 日。中国北京
August 9, 2023. Beijing, PRC

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

(August 9, 2023. Beijing, PRC)

ISBN 978-5-905695-82-7

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ISBN 978-5-905695-82-7

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DOI 10.34660/INF.2023.49.98.118

宏观经济不稳定背景下俄罗斯金融领域创新技术发展前景
PROSPECTS FOR THE DEVELOPMENT OF INNOVATIVE TECHNOLOGIES IN THE FINANCIAL SECTOR OF RUSSIA IN THE CONTEXT OF MACROECONOMIC INSTABILITY

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抽象的。文章确定了俄罗斯联邦金融部门创新技术发展的关键领域，并评估了宏观经济不稳定背景下其发展前景。分析了检疫措施和经济制裁对金融技术的影响。结论是，俄罗斯金融体系迅速适应了不断变化的宏观经济形势，国内企业利用竞争压力减轻的机会，创建并推广自己的解决方案。阻碍俄罗斯金融科技发展的因素已经确定。

关键词：金融科技、数字化、创新、制裁、信贷机构、FPS、FMTS、NPCS

Abstract. *The article identifies key areas for the development of innovative technologies in the financial sector of the Russian Federation and assesses the prospects for their development in the context of macroeconomic instability. The impact of quarantine measures and economic sanctions on financial technologies is analyzed. It is concluded that the Russian financial system quickly adapted to the changing macroeconomic situation, and domestic companies took advantage of the reduced competitive pressure to create and promote their own solutions. The factors hindering the development of fintech in Russia have been identified.*

Keywords: *fintech, digitalization, innovations, sanctions, credit institutions, FPS, FMTS, NPCS*

The relevance of the research topic is due, firstly, to the ongoing process of digital transformation of the Russian economy, in which the development of financial technologies plays an important role. They are agents of change in all sectors of the economy, as they can significantly increase the level of availability of goods and services provided, reduce the costs of both consumers and suppliers.

Secondly, in 2022-2023 there was a significant change in macroeconomic conditions. The unprecedented economic sanctions imposed in 2022 had a strong impact on the established economic processes in Russia. The sanctions that had the strongest impact on the Russian financial system include the freezing of Russia's

gold and foreign exchange reserves, the blocking of the SWIFT international payment system for the largest Russian banks, and the withdrawal of many foreign companies from the Russian market.

In the changed economic conditions, it is impossible to follow the previously chosen methodology and it is necessary to reorient the financial sector to modern conditions with the help of new technological solutions.

According to the definition of the Bank of Russia, financial technologies (fintech) are the provision of financial services and services using innovative technologies such as Big Data, artificial intelligence and machine learning, robotization, blockchain, cloud technologies, biometrics and others [5].

The development of financial technologies makes it possible to increase the availability, quality and range of financial services; reduce risks and costs in financial transactions, ensure security in the financial sector.

The purpose of the study is to establish key areas for the development of innovative technologies in the financial sector of the Russian Federation and assess the prospects for their development in the context of macroeconomic instability.

In the last decade, fintech in Russia has been demonstrating a rapid pace of development. The digitalization of financial processes, the growth and acceleration of transactions have led to a restructuring of the financial services market, and the ubiquity of the Internet has expanded online interaction between consumers and sellers of financial services due to the speed, simplicity and convenience of service [6].

Since 2014, the sanctions imposed on Russia, as well as the threat of additional restrictive political and economic measures, have contributed to the development of innovative technologies and the introduction of domestic services in the financial sector.

In 2014, the Financial Message Transfer System (FMTS) was launched in Russia, designed to exchange financial information between legal entities. It is an alternative to the international SWIFT system and by 2023. its operation has extended to fourteen countries.

In 2014, the National Payment Card System (NPCS) was also established, on the basis of which the domestic payment system Mir and the Fast Payment System (FPS) were created.

In recent years, cards of international payment systems are gradually being replaced by domestic ones. By 2023, almost 204 million Mir payment cards were issued, and the share of transactions with Mir cards in the total volume of all card transactions in Russia reached 46% [3].

The FPS was launched in 2019. It allows individuals to make instant interbank funds transfers based on a recipient ID. By 2023, more than 200 banks have already been connected to the SBP.

Thus, in a short time in Russia it was possible to create an alternative to international payment systems.

In addition to traditional tools, blockchain-based services are also developing in Russia. In 2016, the Masterchain blockchain platform was tested for the first time, and in 2023, the issuance of digital financial assets started on the platform. In 2020, the Federal Tax Service launched a blockchain platform for issuing interest-free loans to small and medium-sized businesses. Initially, the project was aimed at supporting industries affected by the coronavirus pandemic. Then the platform continued to develop and services appeared on it for creating customer dossiers and profiling their risks, obtaining powers of attorney, etc.

A new round of development of the Russian financial market is associated with the development of the Marketplace project, which was initiated by the Bank of Russia in 2017 and received a legislative basis in 2020. In 2020-2021, several financial marketplaces were launched in Russia at once: “Open Financial Marketplace ”, “Financial Services” from the Moscow Exchange, etc.

A number of factors contributed to the accelerated creation of marketplaces. Among them are an increase in demand for remote financial services, an influx of funds from individuals into the financial market, an increase in the trend towards the development of banking ecosystems, etc. [2].

By 2021, Russia has become one of the world leaders in the digitalization of the financial sector and has taken leading positions in various international rankings [4].

This was facilitated, among other factors, by quarantine measures introduced during the coronavirus pandemic. The forced transition to remote services has shown the attractiveness of many digital financial services, stimulated their wider use and the creation of new services.

The impetus for development during this period was received by Internet banking - the provision of financial services through mobile and online platforms. Thanks to them, clients of credit institutions get online access to a variety of financial applications, save time and money by increasing the speed and quality of service [1].

In 2022, large-scale economic sanctions were imposed on Russia. A number of large Russian banks have been disconnected from SWIFT. Some foreign companies and payment systems (Apple Pay, Google Pay, Visa and MasterCard) have left the Russian market.

The Russian financial system quickly adapted to the changing situation, and domestic companies took advantage of the reduced competitive pressure to create and promote their own solutions.

The volume of the Russian financial technology market at the end of 2022, according to the Smart Ranking agency, reached 138.88 billion rubles, having increased by a third (by 32.7%) compared to 2021 [7].

The revenue of Russian payment systems in 2022 increased to 29.63 billion rubles, by 20.5% compared to 2021. [7].

In 2023, a new form of national currency appeared in Russia - the digital ruble. It will be issued by the Bank of Russia in digital form and stored in an electronic wallet on the platform of the Bank of Russia.

The Bank of Russia takes an active part in the development of fintech in Russia. Thus, roadmaps were developed for the development of technologies used by state regulators to improve the efficiency of control over the activities of financial market participants and to simplify their compliance with the requirements of the regulator. The Bank of Russia took part in the creation of the digital infrastructure of the financial sector: a system of fast payments, marketplaces, a digital ruble, a regulatory sandbox, etc. At the initiative of the Bank of Russia, at the end of 2016, the FinTech Association was established, which unites financial market participants and participates in the development and implementation innovative technologies in the financial sector. Among them are services based on distributed ledger technology, retail payment space, open AP in the financial sector, etc.

In Russia, fintech is developing mainly due to large banks. There are relatively few fintech companies, which hinders the development of services for the financial industry. In 2022, the majority of foreign software vendors left the Russian market, which created additional difficulties for financial market participants. To solve this problem, the Central Bank decided to create a repository of IT solutions for the financial industry. It is expected that it will contain proven IT solutions, and service providers will be able to offer customized solutions to users of the repository, if they are needed.

The following can be noted as barriers to the development of innovative technologies in the financial sector: digital divide and insufficiently developed access to the Internet in remote regions; low level of public confidence in digital technologies; insufficiently prompt improvement of legal regulation; cyber threats [2].

In 2022, the number of cyber attacks on Russian business, incl. in the field of finance, increased several times. In 2023, the background of cyberattacks remains tense, and there has been no decrease in their number. For the first quarter of 2023, the Central Bank recorded more than 20 thousand computer attacks. It can be assumed that this problem remains relevant for the financial sector of the Russian Federation for a long time, which must be taken into account by financial market participants.

The development of fintech in Russia is also constrained by the lack of highly qualified IT specialists and insufficient R&D funding.

Thus, new financial technologies allow to significantly expand, diversify and modify the ways of providing and consuming traditional financial services.

The Russian financial system quickly adapted to the changing macroeconomic situation. In a short time, Russia has managed to create an alternative to international payment systems, to rapidly develop the digital infrastructure of the financial market (financial marketplaces, mobile and online platforms, blockchain platforms, etc.).

Payment systems and financial marketplaces have become the fastest growing areas of innovative technologies in the financial sector. Further introduction and development of fintech will contribute to the renewal of the financial system, reduce the damage from sanctions, increase the level of independence and security of the financial system, and create favorable conditions for economic growth. The most promising areas of innovative technologies in the financial sector at the moment are the digital ruble and digital financial assets.

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DOI 10.34660/INF.2023.74.54.066

中国的对外直接投资和加强其在工业 4.0 领域的领导力。
CHINA'S FOREIGN DIRECT INVESTMENT AND STRENGTHENING ITS LEADERSHIP IN INDUSTRY 4.0.

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注解。作者描述了中国 FDI（外国直接投资）在世界各地区和各大洲日益增长的影响力，对全球中国跨国公司的依赖，并决定了中国自身全球化产业的科学技术发展趋势，这些产业对全球经济发展负有责任。整个世界经济从冷战后的衰退中崛起，并在未来工业4.0的碎片化链条中占据基础和决定性的地位。

关键词：俄罗斯、SMO、乌克兰、元宇宙、生态系统、中国、美国、外国直接投资、日本、拉美和加勒比地区、亚太地区、四方联盟、北约、AUKUS、NBICS、金砖国家、上合组织、脱钩、人工智能、大数据、工业4.0。、BigTech、了解-怎么样，非洲，东盟。

Annotation. *The authors describe the growing influence of Chinese FDI (foreign direct investment) in various regions of the world and continents, becoming dependent on global Chinese MNCs and determining trends in the development of science and technology of China's own globalised industries, which are responsible for the emergence of the entire world economy from the post-Cold War recession, as well as occupying basic and determining positions in the fragmentation chains of the future Industry 4.0.*

Keywords: *Russia, SMO, Ukraine, metaverse, ecosystems, China, USA, FDI, Japan, LAC, APAC, QUAD, NATO, AUKUS, NBICS, BRICS, SCO, decoupling, AI, Big Data, Industry 4.0., BigTech, know-how, Africa, ASEAN.*

China, as the leader of the global ICT industry and the growing digital storm, needs constant synergies to maintain its leadership as the fastest growing technology region. For this purpose, the Celestial Empire today redirects the main outgoing flows of PRC direct FDI to the countries of Southeast Asia, which in the process of U.S.-China dicapping are defining the leaders of Industry 4.0. and creating critical infrastructure in the 7th robotic-technological mode.

Consider the impact of PRC's FDI in ACAP, Central and South America, and Africa to see the ongoing transformation of these nations' regions through the Celestial giant's financial and digital storm.

ASEAN is the PRC's largest trading partner from 2020. China, in turn, has been ASEAN's largest trading partner for 10 years. FDI from China to ASEAN countries in 2021 increased 96% year-on-year to US$13.6bn. FDI from China to ASEAN countries in 2021 increased by 96% year-on-year to US$13.6bn, with investments mainly in manufacturing, electric vehicle-related activities, digital economy, infrastructure and real estate[1]. China is currently the second largest investor in ASEAN countries after the US.

The graph shows the volume of China's accumulated FDI in Southeast Asian countries. It can be noted that the main recipient countries are Singapore and Indonesia, to a lesser extent the flow of investments is directed to Vietnam, Malaysia, Laos and Thailand. Insignificant investments can be observed in such countries as Cambodia, Myanmar, the Philippines and Brunei Darussalam.

[1] ASEAN Investment Report 2022 [Electronic resource] / / Mode of access: https://unctad.org/publication/asean-investment-report-2022 (date of access: 03/07/2023)

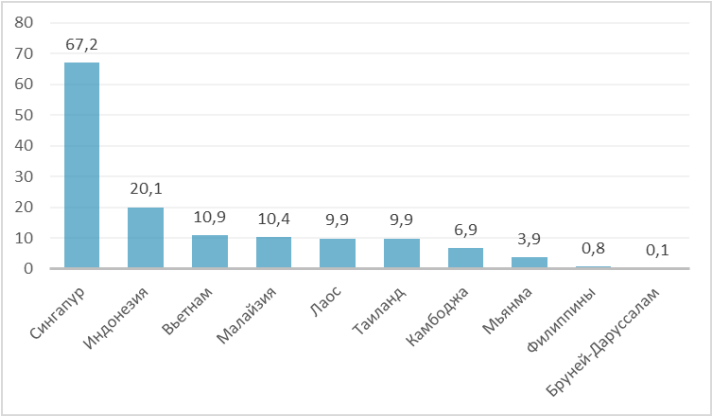

Figure 1. *PRC's accumulated FDI to ASEAN countries for 2021 in USD billion. USD*

Source: Compiled by the authors based on data from the China Outbound Direct Investment Statistics Bulletin 2021. (http://www.tounali.com/details.html?cid=372&nid=26)

The ASEAN-China Strategic Partnership Vision 2030 was signed in 2018 (кит. 中国-东盟战略伙伴关系2030年愿景) within the framework of which the parties formed the main vectors of co-operation in such areas as politics, economy, security and culture. The sides confirmed their intention to further co-operate within the framework of China's "One Belt, One Road" initiative, to deepen co-operation in the digital economy and technological innovations, with a special focus on the development of "smart cities", e-commerce and telecommunications.[2]

One of the main reasons for China to invest in ASEAN is the aggregate consumption capacity of ASEAN member markets. In 2020, the combined population of ASEAN countries is 660 million people - 8.5 per cent of the global population. The median age of the population in the ASEAN region is 30.3 years, according to the UN World Population Prospects 2022 report[3]. Given the enormous consumption power of such a young population, the World Economic Forum report "The Future of Consumption in Fast-Growing Consumer Markets: ASEAN"[4] presents

[2] ASEAN-China Strategic Partnership Vision 2030 [Electronic resource] / Mode of access: https://www.fmprc.gov.cn/web/ziliao_674904/1179_674909/201811/t20181115_7947869.shtml (Date of circulation: 03/07/2023)

[3] UN Report «World Population Prospects» [Electronic resource] / Mode of access: https://population.un.org/wpp/ (circulation date: 03.07.2023)

[4] The Future of Consumption in Fast-Growing Consumer Markets: ASEAN [Electronic resource] / Access mode: https://www3.weforum.org/docs/WEF_Future_of_Consumption_in_Fast_Growth_Consumer_Markets_ASEAN_2020.pdf (circulation date: 03/07/2023)

a forecast that in the next 10 years ASEAN will add 140 million consumers to the global market, GDP per capita will grow at an average annual rate of 4%, and ASEAN's position as the fifth largest economy will rise to fourth by 2030. [1]

In addition to strong market demand, the business environment in the 10 ASEAN member countries has improved markedly according to the World Bank's Doing Business 2020 report[5]. Among ASEAN member countries, Singapore maintained its place in the top three, Malaysia moved up to 12th in 2020 from 23rd in 2010, and Indonesia and the Philippines moved up significantly to 73rd and 95th respectively from 122nd and 144th in 2010. However, this data may not reflect the current situation, as the Business Ready (B - Ready) project, which will replace Doing Business in 2021, has not yet published updated data on the state of the world's business environment.

Third, Southeast Asian countries have a rich resource base. The availability of resources in selected ASEAN countries is summarised in more detail in Table 1.

Table 1

Natural resources of South-East Asian countries

Country	Resources
Brunei Darussalam	Petroleum, natural gas, wood
Vietnam	Phosphates, coal, manganese, rare earth elements, bauxite, chromates, wood
Indonesia	Petroleum, tin, natural gas, nickel, timber, bauxite, copper, gold, silver, coal
Cambodia	Oil and gas, timber, gemstones, iron ore, manganese, phosphates
Laos	Wood, tin, gold, precious stones
Malaysia	Tin, oil, timber, copper, iron ore, natural gas, bauxite
Myanmar	Petroleum, timber, tin, antimony, zinc, copper, tungsten, lead, coal, marble, limestone, gemstones, natural gas
Singapore	Aquatic bioresources
Thailand	Tin, rubber, natural gas, tungsten, tantalum, wood, lead, fish, gypsum, brown coal, fluorite
Philippines	Oil, gold, silver copper, nickel, cobalt, timber

Source: Compiled by the authors on the basis of UNCTAD's ASEAN Investment Report 2022

It can be noted that the resource base is based on non-ferrous and rare earth metals. As noted above, China is actively investing in production and in areas

[5] World Bank Report «Ease of Doing Business Index 2022» [Electronic resource] / Mode of access: https://openknowledge.worldbank.org/server/api/core/bitstreams/75ea67f9-4bcb-5766-ada6-6963a992d64c/content (circulation date: 03/07/2023)

closely related to electric vehicles, in this regard, special attention should be paid to the reserves of metals such as nickel and cobalt, which are used for battery production. Chinese FDI in the electric vehicle value chain includes activities from nickel mining and smelting to battery production, as well as related R&D activities and investments in new infrastructure. The participation of Chinese companies in specific parts of the value chain is summarised in the diagram below [2].

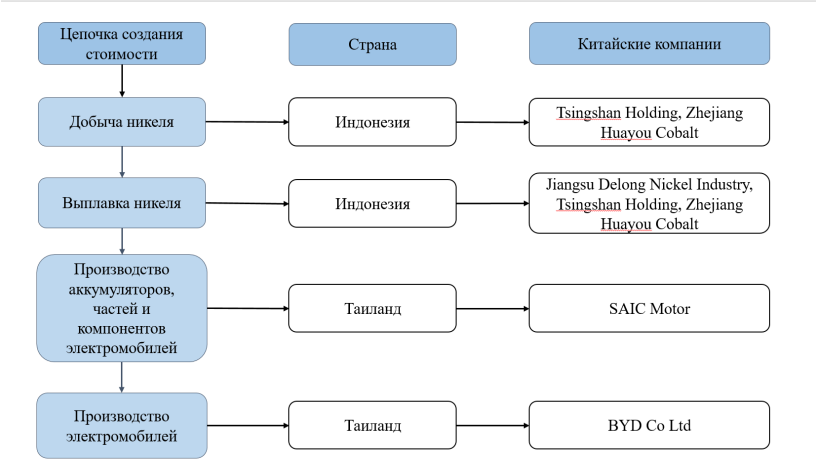

Figure 2. *Participation of Chinese companies in the electric vehicle value chain in ASEAN countries*

Source:Compiled by the authors based on UNCTAD's ASEAN Investment Report 2022

It can also be noted that Singapore, with the least amount of natural resources, is the largest recipient of Chinese investments. The main flow of Chinese investments is directed towards projects in such areas as cryptocurrency, blockchain technology, fintech and artificial intelligence.

Singapore also has a fairly strong presence of Chinese-funded financial institutions. As economic ties between Singapore and China deepen, an increasing number of businesses from China are utilising Singapore as a base to expand their operations in the region. As a result, Chinese financial institutions have expanded their range of services to include commercial banking, investment banking, private banking, insurance, securities and investments.

Last year, China Construction Bank became the third Chinese bank to be granted a "full qualified licence" - the equivalent of a universal licence in Russian law from the Monetary Authority of Singapore. It also became the first foreign bank in

the past eight years to be granted such a licence. To date, the Monetary Authority of Singapore has licensed only ten foreign banks, with banks from China receiving the largest number. The other two Chinese banks with full-fledged bank status are Bank of China and Industrial and Commercial Bank of China (ICBC)[6].

In addition, the PRC is actively investing in artificial intelligence, digital and high technology in Southeast Asia. Faced with rapidly growing urban populations and seeing the potential of digital transformation and new technologies such as AI to revitalise their economies, Southeast Asian countries are particularly eager to cooperate with Chinese technology companies in implementing smart city programmes. In the Philippines, for example, the New Clark City smart city is being built under the OSOP with the assistance of China Construction Engineering Corporation[7]. In Malaysia, one of the largest Chinese developers, Country Garden Holdings, has invested $4 billion in the construction of the Forest City smart city, and plans to invest $40 billion for a total project cost of $100 billion[8].

In terms of digital infrastructure, Alibaba Group Holding and Huawei Technologies, China's largest technology companies, are actively building data centres in Southeast Asia. For example, Huawei completed construction of a data centre in Indonesia in November 2022, with two such centres already built earlier in Thailand and Singapore[9].

It is also worth mentioning the China-ASEAN investment cooperation within the framework of China's Belt and Road Initiative, as in addition to the above-mentioned reasons, Southeast Asia is of great strategic importance for China due to the geographical proximity of Southeast Asian countries and the passage of two land economic corridors and the 21st century Maritime Silk Road through these countries [3].

First of all, ESDP is being actively integrated into existing regional cooperation formats and initiatives, such as the Greater Mekong Economic Growth Area and the Comprehensive Regional Economic Partnership (CREP). China is also coordinating the implementation of the ESDP with ASEAN strategic plans, such as the ASEAN Master Plan on Connectivity 2025, the ASEAN Energy Coopera-

[6] Official site of the Monetary Authority of Singapore [Electronic resource] / / Mode of access: https://eservices.mas.gov.sg/fid/institution?sector=Banking&category=Qualifying%20Full%20Bank (circulation date: 03/07/2023)

[7] Manila Times: 10 companies that are investors in New Clark City [Electronic resource] / / Mode of access: https://www.manilatimes.net/10-firms-to-invest-in-new-clark-city/553736/ (circulation date: 03/07/2023)

[8] Reuters: Country Garden Holdings announced the launch of a new smart city project in Malaysia [Electronic resource] / / Mode of access: https://www.reuters.com/article/uk-forest-city-strategy-idUKKBN1AK0QP (circulation date: 03/07/2023)

[9] Jacarta Globe: Huawei built a data centre in Jakarta in just 37 days [Electronic resource] / / access mode: https://jakartaglobe.id/tech/huawei-builds-jakarta-data-center-in-just-37-days (circulation date: 03/07/2023)

tion Action Plan 2016 - 2025, the ASEAN Climate Change Strategic Action Plan (ACCSAP) 2023-2030, and others. Among others, Southeast Asia is a suitable and promising platform to realise the Digital Silk Road idea[10].

In conclusion, it is necessary to briefly characterise the obstacles to China's investment activities in the region.

The main stumbling block in relations between China and Southeast Asian countries is undoubtedly the territorial conflict in the South China Sea. Despite the fact that China is preventing ASEAN countries from forming a single coordinated position on this issue through economic bribery of political elites in Cambodia and Laos, anti-China sentiments are growing in ASEAN countries and against this background the government opposition is becoming more active, opposing the course of rapprochement with China. Anti-China protests were seen in Myanmar in 2016, 2019 and 2021, Vietnam in 2018, the Philippines in 2021, Indonesia in 2019 and 2023, and other countries. These protests were mostly related to concerns about Chinese economic expansion, Chinese enterprises' failure to comply with environmental regulations or labour condition[11].

The second no less important factor is the clash of interests with other states - major investors in ASEAN. To a greater extent, these are the USA, Japan and the EU countries. The US is the largest foreign investor in the ASEAN countries as of 2022, and the US is also actively investing in maritime infrastructure, financial technology, digital and high technology [4].

Of particular note is the growing outbound flows of direct PRC FDI to Latin America and the Caribbean.

Over the past two decades, China has become one of Latin America's key trading partners. Bilateral merchandise trade between Latin America and China increased significantly over this period, from $14.6 billion in 2001 to $486 billion in 2022, a 33-fold increase since China's accession to the WTO[12]. At the same time, China is the second largest trading partner of Latin America after the United States. In the first half of 2022 alone, US-Latin American bilateral trade reached $568 billion[13]. However, it should be noted that such a high indicator was achieved

[10] Kanaev E.A. Chinese business presence in Southeast Asia as a factor in the development of the Belt and Road Initiative // Southeast Asia: Actual Problems of Development, 2022, Vol. 1, № 1 (54). p. 33.

[11] 刘倩, 陈济冬, 中国对东南亚国家直接投资的政治效应 (Liu Qian, Chen Jidong, Policy effects of Chinese direct investment in Southeast Asian countries) 世界经济与政治. -2022. - №2. - pp.60-76. URL: https://d.wanfangdata.com.cn/periodical/sjjjyzz202202004 Access mode: by subscription.

[12] Bilateral trade between the PRC and Latin America and the Caribbean in 2022. [Electronic resource] / / Mode of access: https://www.ndrc.gov.cn/fggz/jjmy/dwjmjzcfx/202301/t20230131_1348032.html (Date of circulation: 03/07/2023)

[13] ECLAC Report Trade Development between the United States and Latin America and the Caribbean in 2022. [Electronic resource] / / Mode of access: https://www.cepal.org/sites/default/files/

mainly due to trade turnover with Mexico, with which the United States cooperates quite closely under the United States-Mexico-Canada Agreement (USMCA) and, until 2018, under the North American Free Trade Agreement (NAFTA). Other major economic partners in the region are the European Union, Japan, and India.

Regarding China's outbound investment in Latin America and the Caribbean, the dynamics from 2007 to 2022 can be described as positive, with the exception of 2017 and 2019. In the first case, the decline in China's outbound FDI is due to the tightening of regulations on overseas investment and the Chinese government's fight against the rising debt burden of Chinese companies. And in the second case, the main reason for the decline in outbound PRC FDI flows was the trade war between China and the US. It is worth noting that the trend applies to the total outbound FDI flows of the PRC in these years [5].

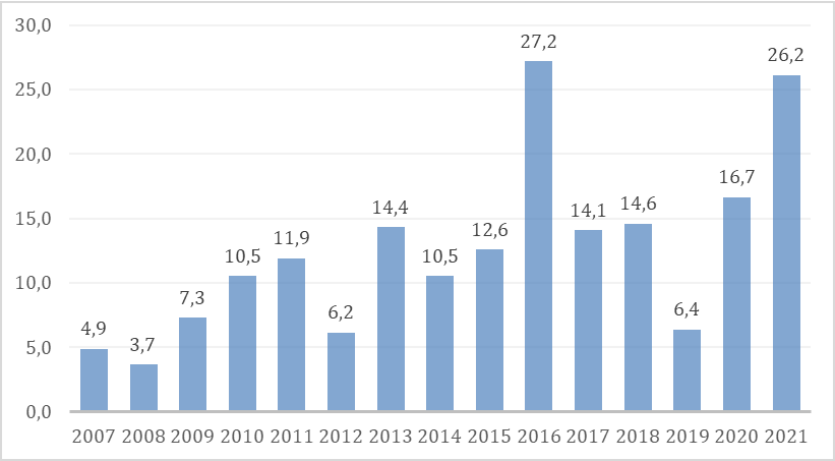

Figure 3. *PRC FDI outward flows 2007 - 2021 in USD billion. USD*

Source: Compiled by the authors based on data from the China Outward Direct Investment Statistics Bulletins 2007-2021.

Since 2015. China has established three regional funds to support its investments in LAC:

– China-LAC Industrial Cooperation Investment Fund (CLAI Fund) of US$30 billion. This fund was established to promote cooperation be-

news/files/trade_web.pdf

tween China and Latin America in the field of manufacturing facilities and equipment manufacturing[14]

– China-LAC Cooperation Fund (CLAC Fund), established by the China Export-Import Bank in the amount of 10 billion US dollars to promote investment, economic and trade cooperation between China and Latin America and the Caribbean, as well as actively participate in the development of an open economy countries of the region[15];
– The China and Latin America Special Infrastructure Lending Program for China and Latin America in the amount of $20 billion, implemented by the China Development Bank since 2018. Under this program, loans are issued to support infrastructure projects in the fields of energy, communications, ports, logistics, energy, mining and agriculture in Latin America and the Caribbean with the participation of Chinese enterprises. Eligible projects must contain a Chinese element (i.e. equipment and services from China, etc.) of at least 60% of the total investment, and the total loan amount, in principle, must not exceed 70%[16].

One of the main reasons for the investment attractiveness of this region for China is the resource base possessed by the LAC countries. First of all, we are talking about large oil reserves; proven oil reserves in LAC countries amount to 329.5 million barrels, of which 303.5 million barrels are attributable to Venezuela, the state with the largest proven oil reserves[17]. Second, the availability of metals and minerals such as copper, lithium and nickel plays a key role, as these are the resources that underpin the global energy transition [6]. According to the Metals and Minerals Yearbook published by the US Geological Survey, 40% of the world's copper reserves are found in Chile, Peru and Mexico. Brazil is the third country in the world in terms of reserves of the superconductor graphene, it also accounts for 17% of the world's nickel reserves. Almost 70% of the world's lithium reserves are found in the following countries in the region: Chile, Peru, Argentina, Mexico, Brazil and Bolivia[18].

[14] Xinhua News Agency: Li Keqiang: China will set up a special fund totalling $30 billion to promote cooperation with Latin America [Electronic resource] / / Mode of access: http://russian.news.cn/china/2015-05/20/c_134252979.htm (Date of reference: 03.07.2023)

[15] Website of the China-LAC Cooperation Fund [Electronic resource] / / Mode of access: http://www.clacfund.com.cn/ (Date of address: 03/07/2023)

[16] Website of the PRC Embassy in Grenada [Electronic resource] / / Access mode: http://gd.chinaembassy.gov.cn/zlhz/zljcsszxdk/ (Date of circulation: 03/07/2023)

[17] OPEC Annual Statistical Bulletin (2022) [Electronic resource] / / Mode of access: https://asb.opec.org/index.html (date of access: 03.07.2023)

[18] U.S. Geological Survey, Yearbook of Metals and Minerals 2023 [Electronic resource] / / Mode of access: https://www.usgs.gov/centers/national-minerals-information-center/minerals-yearbook-metals-and-minerals (Date of circulation: 03.07.2023)

In addition, China sees LAC countries as markets for Chinese technology, among other things, and to do so, it needs to improve the overall economic development of the region, which will help increase its ability to pay. At the 2018 China-CELAC Forum, Chinese Foreign Minister Wang Yi devoted much of his speech to the topic of China's technology exports to LAC countries[19]. This has become particularly relevant following the events of the trade war between China and the US and the impact that US sanctions have had on Chinese companies such as Huawei, ZTE, Dahua and Hikvision. Over the past few years, China has grown its exports of finished technology products, with Chinese smartphones accounting for 19.9 per cent of the South American market share in April 2022 and continuing to grow[20]. Also, the availability of mineral resources favours the establishment of production facilities for smartphones and other electronic products in the territory of LAC countries, for example, in Argentina, the Chinese company Xiaomi has opened a smartphone production facility in 2022. And Huawei has invested USD 800 million in 2019. In 2019, Huawei will invest USD 800 million to build a smartphone manufacturing plant in Brazil[21].

As China ramps up its investment in LAC, the composition of investment has also changed significantly over the past decade. Chinese investment in LAC, which used to be concentrated mainly in fossil fuels, metals, agriculture and other natural resources, is increasingly leaning towards manufacturing and service industries such as transportation, electricity, financial services and information and communication technology (ICT).) [7].

The power generation and distribution sector, in particular, has become one of the main targets of Chinese investment. LAC countries welcome Chinese investment in this sector as imperfect energy infrastructure undermines the competitiveness of the economy, is costly to households and businesses, and leads to power outages. China is actively occupying this niche amid growing demand for electricity in the LAC countries, as well as the withdrawal of assets of Western companies from this sector. For example, in 2019, one of China's leading state-owned grid companies acquired Chiquinta Energia, Chile's third-largest electricity distributor, for $3 billion. And in 2020, China Yangtze Power International acquired Luz del Sur, Peru's largest electricity company, for $3.6 billion. Both of these com-

[19] Katkova E.Y., Eremin A.A. PRC relations with Latin America and the Caribbean at the present stage // Bulletin of International Organisations. 2022. T. 17. № 2. pp. 164-188

[20] Matsur V. A. Chinese smartphones in Latin America. Geographical and institutional bases of production // Latin America - 2022. - Issue No. 9 pp. 6-18 [Electronic resource] / / Mode of access: https://latamerica-journal.ru/S0044748X0021675-1-1

[21] China Daily: Huawei to build $800m plant in Brazil. US dollars in Brazil [Electronic resource] / / Mode of access: https://www.chinadaily.com.cn/a/201908/14/WS5d5360d8a310cf3e355659d1.html (Date of circulation: 03.07.2023)

panies were formerly owned by Sempra Energy, a US utility holding company[22]. In 2023, China also plans to start building a new $8 billion nuclear power plant near the Argentine capital, Buenos Aires, in addition to two hydroelectric plants in southern Argentina[23].

Another area that China is actively developing is transport infrastructure. This sector showed the highest growth between 2015 and 2021 among all Chinese infrastructure investments in LAC countries. Transport infrastructure projects included the construction of seaports, airports, railways and roads. In 2020-2021. 36 of China's 57 infrastructure projects in LAC came from the transport sector and accounted for 58% of the total infrastructure investment during this period[24].

The projects that have been implemented under the Belt and Road Infrastructure Initiative have already been touched upon above. At the moment, 21 LAC countries are members of the BRI and have signed memoranda with the PRC. However, it is worth emphasising that the 21st Century Maritime Silk Road route does not pass through the LAC countries. According to statements by Chinese officials, "Latin America is a natural extension of the 21st Century Maritime Silk Road", but they have not been officially included in the route. Latin America is assigned the role of an important platform of the Silk Road in terms of its digital content. The role of LAC countries in the Digital Silk Road is discussed by such Russian scholars as E. I. Safronova[25] and Yakovlev P. P [26].

Chinese President Xi Jinping, in his keynote speech at the Second World Conference on Internet Governance in 2015, proposed to promote changes in the global internet governance system and "jointly build a community of common destiny for mankind in cyberspace". In the same year, the Belt and Road Forum for International Cooperation announced that technology projects would be combined in the Belt and Road Initiative to create the 21st Century Digital Silk Road[27].

[22] Sempra Energy website: Sempra Energy completes $3.59bn sale of Luz Del Sur in Peru. [Electronic resource] / / Access mode: https://www.sempra.com/sempra-energy-completes-359-billion-divestiture-luz-del-sur-peru (Date of circulation: 03.07.2023)

[23] Safronova E. I. The importance of Latin America for China's international positions // China in World and Regional Politics. History and Modernity. - 2022. - Issue №27. - pp. 210-225.

[24] Monitoring Chinese Infrastructure in Latin America and the Caribbean 2022. [Electronic resource] / / Mode of access: https://www.redalc-china.org/monitor/index.php?option=com_content&view=article&id=438 (Date of circulation: 03.07.2023)

[25] Safronova E. I. The importance of Latin America for China's international positions // China in World and Regional Politics. History and Modernity. - 2022. - Issue №27. - pp. 210-225.

[26] Yakovlev P.P. (2022). Trends changing the economy of Latin America // Contours of global transformations: politics, economics, law. T. 16. № 1. pp. 77-101.

[27] Xinhuanewsagency:Chinawillredoubleeffortstodevelopthedigitaleconomy[Electronicresource] / / Mode of access: http://www.chinaview.cn/20221028/2aa7c829ddff431cbd4a9503b99ef4d1/c.html (Date of circulation: 03.07.2023)

The digital aspect of the OSOP is quite large, as it includes fibre optic cables, 5G networks, satellites, data centres, smart city projects and devices connected to these systems, all of which in turn can support the business of information and communication technology. And many developing countries have welcomed the 21st century Digital Silk Road. Many emerging economies lack basic telecommunications technology and need significant infrastructure upgrades to reach the stage where they can have 4G and 5G networks [8].

Few Latin American governments are making strategic and systematic investments in digital infrastructure, services and skills. Latin American financial technology startups also face difficulties in attracting funding. In 2019, Brazil's Ministry of Science, Technology, Innovation and Communications unveiled a plan to develop machine-to-machine services and the Internet of Things. Chile's economic development agency launched a smart industry strategy. The Mexican government has released a roadmap for the development of the Internet of Things. And at the subcontinental level, LAC members created the Digital Agenda for Latin America and the Caribbean[28]. Currently, three companies lead in the development and implementation of 5G equipment and complex systems: Huawei (China), Ericsson (Sweden) and Nokia (Finland). Huawei currently leads in the number of patents and 5G implementation. With a lack of domestic investment, foreign capital and foreign technology enterprises play a crucial role in Latin America's innovative development.

Alibaba is the world's largest online retailer and ranked fourth in Latin America by the end of 2019. AliExpress, a platform that offers international shoppers direct access to Chinese goods, has fuelled Alibaba's growth in Brazil, Chile and Mexico. The company has also established partnerships in the region, including in Mexico and Argentina, to give Chinese consumers access to Latin American goods. Alibaba has committed to helping Chinese logistics and financial companies enter the Latin American market. It has also pledged to help Latin American SMEs trade across borders.

In early 2017, the Chilean government announced a plan to realise the Trans-Pacific Submarine Optical Cable project connecting Latin America and Asia, a project that would in principle connect Shanghai to Chile. This project, with a total length of 22,800 kilometres and an investment of about $500 million, was of great importance to Chile. The project, totalling 22,800 kilometres and an investment of about $500 million, was of great importance to the Chilean government. However, under pressure from the US government, many Digital Silk Road projects never moved to the realisation stage.

[28] Kuchinov P. A. Digitalisation of transport and logistics industry of Latin America in the paradigm of «Industry 4.0» // Latin America - 2022. - Issue № 12 pp. 27-46

In addition to all of the above, Latin American countries are of great interest to China politically. Often, PRC Investment acts as a guarantee of support for mainland China's political position on Taiwan's status.

China's so-called «cheque diplomacy» is yielding results. As of May 2023, only seven Latin American states recognise Taiwan: Belize, Guatemala, Guatemala, Haiti, Paraguay, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines. In the last five years, the following states in the region have broken relations with the Republic of China and recognised the One China principle: El Salvador (21 August 2018), Honduras (26 March 2023), Nicaragua (10 December 2021), Dominican Republic (1 May 2018), and El Salvador (26 March 2023)[29].

There are not many risks that Chinese investors may face in the markets of Latin America and the Caribbean. First of all, attention should be paid to the risks of China's conflicting interests with other major investor states in the region. First of all, we are talking about the USA and the intersection of interests of the two powers around the Panama Canal.

The second risk, which is also typical for Chinese investors in other regions of the developing world, is the risk of investment freezing due to the project's non-compliance with environmental standards. An example is the construction of a dam in Argentina, 85% of which was financed by Chinese bank investments, but the project was frozen because the Argentine Supreme Court accepted a complaint by environmental organisations that the project lacked a proper environmental impact assessment and ordered the government to conduct an environmental study and public hearings[30].

A special mainstream of the whole world is the outgoing flows of direct PRC FDI to African countries, which significantly overtake the Anglo-Saxons and European former overlords [9].

Over the past two decades, bilateral trade between China and Africa has grown steadily. Due to the disruption of supply chains during the COVID-19 pandemic, trade between China and Africa fell to $176 billion in 2020. In 2021, this figure rose to $251 billion, but did not reach pre-pandemic levels.

In 2021, South Africa, Angola and the Democratic Republic of the Congo became the largest exporters to China from Africa. The largest importers of Chinese goods in 2021 were Nigeria, South Africa and Egypt.

PRC FDI flows to Africa increased from US$75 million in 2003 to US$5 billion in 2021. They peaked at US$5.5 billion in 2008 due to the purchase of a 20%

[29] Official website of the Ministry of Foreign Affairs of the Republic of China (Taiwan) [Electronic resource] / / Mode of access: https://en.mofa.gov.tw/AlliesIndex.aspx?n=1294&sms=1007 (Date of circulation: 03.07.2023)

[30] Argentina is under pressure to resume construction of dams in Patagonia [Electronic resource] / / Mode of access: https://chinadialogue.net/en/energy/10055-argentina-under-pressure-to-revive-dams-in-patagonia/ (Date of circulation: 03.07.2023)

stake in Standard Bank of South Africa by the Industrial and Commercial Bank of China (ICBC).

As shown in the chart below, Chinese FDI flows to Africa have exceeded US FDI flows since 2013, while US FDI flows have been declining overall since 2010. Top 5 African Chinese FDI destinations in 2021 - Democratic Republic of Congo, Zambia, Guinea, South Africa and Kenya[31].

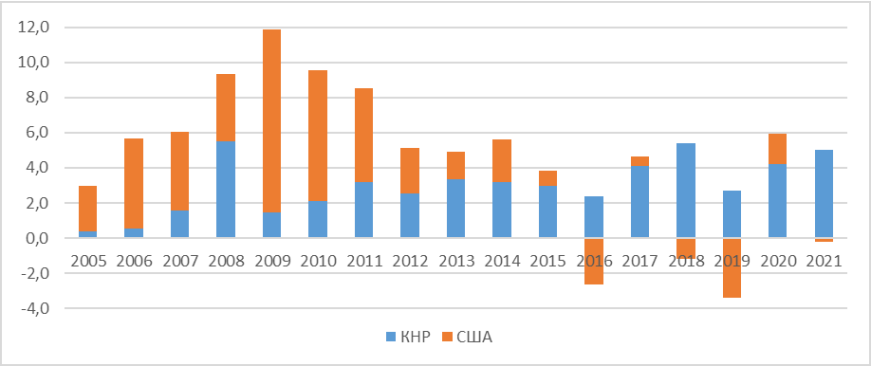

Figure 4. *Comparison of PRC and US FDI flows to Africa, USD billion. USD*

Source: Compiled by the authors based on data from Statistical Bulletins of China's Outbound Direct Investment 2005-2021, U.S. Department of the Treasury

According to the Shanghai University of International Business and Economics 2021 report, since 2000. China has invested a total of US$47bn in Africa. China has invested a total of US$2.96bn (in 52 out of 54 countries), with new investments totalling US$2.96bn in 2020. This represents an increase of US$2.96bn (an increase of US$200m over the previous year). The vast majority of Chinese investment - 87 per cent - is concentrated in four sectors: energy, transport, metals and real estate. The Export-Import Bank of China provides most of the financing for infrastructure projects in Africa, but a number of commercial banks have also opened branches across the continent. However, despite these figures, Africa attracted only 4% of China's outbound FDI in 2021[32].

The chart below shows the sectoral structure of Chinese outbound FDI to Africa. The construction and mining sectors account for more than half of the total investment 37% and 23% respectively. A fairly large share of the investment flow

[31] China-Africa Research Initiative [Electronic resource] / / Mode of access: http://www.sais-cari.org/data (Date of circulation: 03.07.2023)

[32] China Daily China's accumulated FDI in Africa exceeds $47bn. The report [Electronic resource] / / Mode of access: http://www.chinadaily.com.cn/a/202109/10/WS613ac86ea310efa1bd66ea24.html (Date of circulation: 03.07.2023)

in 2021 went to the manufacturing sector at 13%. To a lesser extent, investments are going to sectors such as financial and commercial services[33].

Figure 5. *Distribution of PRC outbound FDI to African countries by sector, 2021.*

Source: compiled by the authors based on data from the China Outbound Direct Investment Statistics Bulletin 2021.

China has a fairly wide range of interests in the African continent. First of all, similar to its interests in Central Asia and Latin America, in order to maximise the diversification of energy supplies, China is actively investing in oil extraction, refining and the construction of related infrastructure.

According to the OPEC Annual Statistical Bulletin 2022, the proven oil reserves of all African states as of 2021 totalled 120.2 million barrels. The main reserves are in the following countries: Algeria (48.4 million barrels), Angola (37 million barrels), Congo (12.2 million barrels), Egypt (6.9 million barrels), Equatorial Guinea (5 million barrels), Gabon (3.3 million barrels), Libya (2.5 million barrels), Nigeria (2 million barrels)[34]. However, oil reserves and production are declining year on year

Three key players - China National Petroleum Corporation (CNPC), China Petroleum and Petrochemical Corporation (SINOPEC) and China National Offshore Oil Corporation (CNOOC) - account for almost an equal share of the projected US$15 billion in upstream capital expenditure in Africa.

For example, in 2019, China National Petroleum Corporation (CNPC) signed an agreement to build and operate the Niger-Benin oil pipeline. This is a 1980 kilometre cross-border oil pipeline under development between Niger and Benin

[33] Statistical bulletin of China's outbound direct investment in 2021 [Electronic resource] / / Mode of access: http://www.tounali.com/details.html?cid=372&nid=26 (Date of circulation: 03.07.2023)

[34] OPEC Annual Statistical Bulletin (2022) [Electronic resource] / / Mode of access: https://asb.opec.org/index.html (Date of circulation: 03.07.2023)

in Africa that connects the Agadema Rift Basin region in Niger to the Port Seme terminal in the Republic of Benin. It will have a capacity of 90000 bpd. It is currently the company's largest investment in cross-border oil pipelines, and coincidentally the largest oil pipeline in Africa by kilometres. In addition, according to China National Petroleum Corporation's 2021 report, the company's six onshore oilfield facilities at Block H in Chad were commissioned in February. Construction of the second phase of the project in Niger has begun. The construction and commissioning of a floating liquefied natural gas (FLNG) facility in Mozambique was completed in November and headed to the field site[35].

According to China National Offshore Oil Corporation's (CNOOC) 2022 annual report, the company holds the rights to many exploration blocks in Africa, totalling 18,000km². Africa is an important source of overseas oil and gas for the company. The company's assets in Africa are mainly located in Nigeria and Uganda. For example, the company holds a 45% interest in Oil Production Sector №130, a deepwater block comprising four oil fields. In addition, the company holds a 20% non-operating interest in sector №138 offshore Nigeria and 18% non-operating interest in sectors №139 and №154. The company holds a 28% interest in each of the EA 1, EA 2 and EA 3A blocks in Uganda. The blocks are located in the Lake Albert Basin in Uganda, which is one of the most prospective basins in terms of oil and gas resources onshore Africa. In February 2022, full construction of the trunk pipeline project was officially commenced[36].

Another strategically important sector in which China is investing is the extraction of non-ferrous, rare earth metals and minerals, which is associated with the increasing pace of the energy transition. Iron, copper, aluminium, nickel, lithium, cobalt, manganese, platinum, silver and rare earth metals are of greatest interest to China in this regard.

According to the US Geological Survey for 2023, Zimbabwe is among the top 10 leading countries in terms of lithium reserves - 310,000 tonnes. The top 10 countries in terms of cobalt reserves include two African states - the Democratic Republic of Congo (4 million tonnes) and Madagascar (100,000 tonnes). The Democratic Republic of Congo and Zambia have copper reserves of 31 thousand tonnes and 19 thousand tonnes respectively. In terms of platinum group metals reserves, 2 states - South Africa and Zimbabwe are in the top 5 with reserves of

[35] Annual report of China National Petroleum Corporation for 2021. [Electronic resource] / / Mode of access: https://www.cnoocltd.com/module/download/down.jsp?i_ID=15337967&colID=3881 (Date of circulation: 03.07.2023)

[36] Annual Report of China National Offshore Petroleum Corporation [Electronic resource] / / Mode of access: https://www.cnoocltd.com/module/download/down.jsp?i_ID=15337967&colID=3881 (Date of circulation: 03.07.2023)

63 million tonnes and 1.2 million tonnes respectively. Madagascar, Tanzania and South Africa have large reserves of rare earth metals (REM)[37].

China's Shenzhen Chengxin Lithium has completed the acquisition of the Bikita mine in Zimbabwe, holding a 100 per cent interest in 2021[38]. Another Chinese company, China Molibdenium (CMOS), announced a $1.8bn investment in June 2022 to develop the Kisanfu mine and produce copper and cobalt in Congo. Another Chinese company, China Molibdenium (CMOS), announced a US$1.8bn investment in the Kisanfu mine and copper and cobalt project in Congo in June 2022. Currently, SMOS holds a 72% stake, another Chinese lithium battery company, Contemporary Amperex Technology (CATL) holds a 23% stake, while the government of the Democratic Republic of Congo holds the remaining 5% stake in the mine[39].

In parallel with investments in the mining and oil and gas sector, China is actively investing in the construction of transport infrastructure due to the need to create optimal routes for exporting raw materials from Africa and importing and distributing finished consumer products to African markets.

China is actively engaged in the construction of railways and motorways, seaports and airports. Since 2000. China has built more than 6,000 kilometres of railways, 6,000 kilometres of roads, and about 20 ports in Africa[40] [10].

In addition to infrastructure for freight transport, China is also developing the transport structure in major cities. For example, the Chinese construction company China Civil Engineering Construction Corporation completed and commissioned a light metro in Nigeria's capital Abuja in 2018, and a light metro in Lagos (a major port and business centre) will be launched in 2022[41]. [11]

In addition to financial injections in the form of FDI into these regions, China is actively helping the deindustrialisation of Europe, according to the last stage of the Marshall Plan, when highly innovative enterprises of the Old World, due

[37] U.S. Geological Survey, Yearbook of Metals and Minerals 2023 [Electronic resource] / / Mode of access: https://www.usgs.gov/centers/national-minerals-information-center/minerals-yearbook-metals-and-minerals (Date of circulation: 03.07.2023)

[38] Annual report Shenzhen Chengxin Lithium 2021. [Electronic resource] / / Mode of access: https://v4.cecdn.yun300.cn/100001_2103305047/%E3%80%9020220329%E3%80%912021%20Annual%20Report.PDF (Date of circulation: 03.07.2023)

[39] Annual report of China Molibdenium Company for 2022. [Electronic resource] / / Mode of access: https://en.cmoc.com/html/InvestorMedia/Performance/ (Date of circulation: 03.07.2023)

[40] Official website of the Ministry of Foreign Affairs of the People's Republic of China Regular press conference on 31 January 2023 at the official representative of the Ministry of Foreign Affairs of the People's Republic of China Mao Ning [Electronic resource] / / Mode of access: https://www.fmprc.gov.cn/rus/mtfw/ce_cegw_chn/lxjzhzhdh/ (Date of circulation: 03.07.2023)

[41] Annual report of China Civil Engineering Construction Corporation for 2022. [Electronic resource] / / Mode of access: https://www.cscec.com.cn/tzzgxnew/tzgg_new/ (Date of circulation: 03.07.2023)

to the end of the era of cheap Russian hydrocarbons, are forced to leave for India and Vietnam, Bangladesh and Indonesia, Malaysia and China itself, to create their own clusters of their globalised industries, being in a constant search for an optimum between the "hidden champions" of classical development and the growing "unicorns". [12] Therefore, this policy helps China to latently feed itself with the required amount of materials and metals for its ICT leadership and to involve Europeans under Chinese leadership in new technopolises and campuses of nanocluster development, which allows NBICS-technologies and patent backlogs to remain in the hands of the Celestial Empire and its friendly and financially and technologically controlled satellites. [13]

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DOI 10.34660/INF.2023.59.48.067

数字科学计量学平台是提高效率、接受度和科学独立性的一种方式
DIGITAL SCIENTOMETRICS PLATFORMS AS A WAY FOR EFFICIENCY, ACCEPTANCE AND SCIENTIFIC INDEPENDENCE

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抽象的。本文致力于在领先的科教组织的基础上创建一个新的科学计量平台，能够尽可能准确地评估科学领域的发展，客观、全面、定性地沉积科学成果，并开展科学计量工作。客观审查和评估。考虑了非通货膨胀和受控通货膨胀平台的概念。

关键词：

Abstract. *This article is devoted to need to create, on the basis of leading scientific and educational organizations a new scientometric platform that allows to assess the development of scientific areas as accurately as possible, objectively and fully and qualitatively deposit scientific works, as well as conduct their objective review and assessment. The concepts of non-inflationary and controlled-inflationary platform are considered.*

Keywords: *Qualimetry - is a scientific field in which the methodology and problems of complex quantitative assessment of the quality of objects of any nature having a material or spiritual nature, artificial or natural origin are studied.*

Scientometrics - is a field of science that conducts the study of science by quantitative methods; a scientific discipline that studies the evolution of science through numerous measurements and statistical processing of scientific information. The term "scientometry" first uced in 1969 by russian scientists V.V. Nalimov and Z. M. Mulchenko in their monograph.

Introduction

At present time, the problem of scientometrics, based on international metrics with dominance of "Scopus/WoS/Hirschthe" triumvirate, has become firmly entrenched in the discussion field. The problem of quantitative measuring qualities indicators of the science has always been on the agenda, and with the rising trend towards scientific globalization and the development of technological opportunities for the exchange of scientific knowledge, it has only worsened. Today it is connected with the fundamental essence of scientometrics and subject-subject communications and does not have a universal solution.

Russian scientometrics has a great history. For a long time before the USSR dissolution it was distinguished by high coverage and quality. But now, according the current geopolitical situationon and trends related to large-scale informatization, it is not enough to participate in western scientometrics model or to return to the Soviet scientometrics model. This is reason think that the only correct strategy will be the creation of a modern russian scientometrics system based on trusted technologies.

In present time, one of the most important issue for the Russian science is the issue of the existence of an effective model for managing scientific activities and research (on which depends the efficiency of spending state budget funds). According to publicly available OECD data, R&D funding for Russia has grown from $30 billion to $48 billion, or 60%. For comparison, in Japan, growth was less 17%, and in Israel - did not reach $20 billion.

On the effectiveness of methods for assessing professional qualities and merits of scientists

Data on the main types of financing suggest that the amount of funding for scientific researches depend on quality and objectivity of scientometrics. Therefore, it is obvious that the management of science and scientific research is necessary.

It should be noted that in order to organize scientometrics, it is necessary to determine the range of goals, tasks, objects and subjects of scientometrics and, depending on them, develop a system of effective tools. The strategy of the Russian State Social University includes in-depth analysis and practical application of the best scientific and business practices for management of the scientific and educational space. In accordance with this approach, we will consider below a method for assessing "360 degrees" within the framework of scientometrics practice. The essence of the "360 degrees" method is that the employee is evaluated by his entire working environment. The result of the assessment is the rating of the employee's qualities. Using a self-assessment block this method allows a source of feedback.

It is very good to extend this approach to the scientometric data base of scientists.

Let's consider the mechanism for applying these methods based on the "Seshat" platform developed in the Russian State Social University.

Basic principles of operation of Seshat scientometric platform

The Seshat platform (Semantic-Natural Scale of Analysis of Texts (Works)) register researchers those wishing to join it as experts. Any participant with a scientific degree will be able to register on the platform on an individual basis, and a fledgling scientist - on the proposal of any corporate participant of the Seshat platform (university, publish house, company etc.). When an expert take part in the assessment, he is selected at random. For assessment, expert receives a one-time identifier, which stops action after fixation ballroom metrics in Seshat platform. Seshat platform, in addition to the anonymizing of experts, use an editorial anonymizating. In this way evaluated materials will not contain information about the authors and their employers. This options will not give us complete objectivity assessment, but in combination with the anonymity of experts and the randomness choice of them, we consider this as a way to achieving objectivity.

The main idea of the Seshat project: the creation of a modern qualimetric platform for scientometric assessment of saentific publications based on the principles of a self-regulatory organization with a pilot at the Russian State Social University and with future using for Russian scientific community.

The basic hypothesis "Seshat": scientists and researchers will make the best assesment the qualitative characteristics of scientific work it is only necessary to provide opportunities for anonymity of assessment.

Below are the start positions for the development of the Seshat project.

Structure of Seshat platform

At present time, Seshat platform includs 24 scientific industries. In the future, we will add scientific industries to the structure of platform and install a list of subsections (Seshat will support voting option).

List of possible requests to Seshat platform: adequacy of the abstract to the content of the scientific research, relevance of specified list of references, scientific innovation, originality of the scientific research, fundamentality of the scientific research, integrity of the scientific research, completion of the scientific research, application aspects of the scientific research, advantages of the scientific research, perspective of the scientific research, research foundation, compliance to State programs for scientific research.

Administrative roles of the Seshat platform. Administrator, moderator, referent and ligal roles will be included in subsections, sections and the whole platform. Their functions will correspond to the established customs of document management, and statuses will be determined by the platform levels (specialists - in subsections, senior - in sections, managers - on the platform as a whole).

Dynamic rank of platform experts. Any specialist, registering as an expert on the platform, receives from 1 to 10 starting rank points at the start, depending on his scientific merits and status. To obtain it, the expert may fill out a master data questionnaire, confirm it, select sections/subsections for participation and accept the platform rules. Seshat platform will process the request and send to participant Sertificate with personnel ID and current rank (or send a motivated refusal). In future, the dynamic rank will has an automatically support - when an expert take part in assessment procedure whey may add to their rank from “plus 1” to “minus 1” points to his rank. The expert receives “plus 1” if their score coincides the median score and “minus 1” - if their score is falling out. In the case of multi-evaluation (multiple query), the platform summ scores and fix average dynamic rank to the expert.

Community self-regulation of the on the platform. The authority of an expert depends on their dynamic rank. The maximum value of dynamic rank on the platform is 100.

Now the list of powers in the Seshat platform community is approximately the same. In future it may be reinstalled.

List of ranks:

Rank up to 10. Participation in assesment procedures.

10 + to 20. Correspondence with the subsection “Seshat.” Subsection chats.

20 + to 30. Correspondence with the “Seshat” section. Section chats.

30 + to 40. The ability to instal a short texts.

40 + to 50. Correspondence with the Seshat platform. Whole-platform chats.

50 + to 60. Offering 1-st category innovation. Formats and procedures.

60 + to 70. Offering 2-nd category innovation. Possibility of voting in section.

70 + to 80. Offering 3-rdcategory Innovation. Possibility of whole-platform voting.

80 + to 90. Any expert activity in the section. Crowdfunding.

Rank 90 +. Any expert activity on the Seshat platform. Possibility of appeal.

Today MVP (Minimum Viable Product) of the Seshat platform is limited to 18 elements. In future the productive framework of the platform will be increase.

MVP cnceptual design

The Seshat project is main features:

The first feature is that for the MVP stage and widespread use, the platform is implemented on the basis of a web interface and users workplaces.

The second feature is to minimize functionality at the user’s workplace. The user at the workplace generates only their individual data and security codes, including e-signature and authentication codes for a distributed database (blockchain). All work functions, statistics and semantic algorithms are implemented on the server platform.

The third feature is the use of reliable metrics to work with articles. When an article is submitted for review, a set of metrics is calculated for it and then the comparison of texts with the corpus of texts in the same topics occurs with linear labor intensity, since all previous articles are already indexed.

The fourth feature - the platform is based on trusted algorithms that allow subsequent certification from state regulators.

The fifth feature is possibility of future monetization - there are tokens on the platform that pay for the functions of the system (authors pay tokens for reviews, experts receive them, tokens are also deducted to the administrative staff of the platform). The development of this feature involves the effective accounting of labor costs for obtaining various services by users and participants of the platform. It is important to note that in addition to users and operators, there are a participants in the platforms who indirectly uses the platform services and may be direct or indirect beneficiary of platform services.

When designing and implementing platforms is necessary to implement the mechanisms of distributed registry, and for operational or transactional platforms to use consensus mechanisms or distributed database that contains information about all transactions conducted by system participants. For example, for the scientometric and qualimetric platforms we are considering, it is necessary to implement the Proof-of-History (PoH) mechanism, which is that events on the platform (in particular, the receipt of scientific materials for deposit or review) occur in an evidence-based sequence when one material evidentially arrived on the platform before another. To implement PoH, it is necessary to create data chains, the integrity and sequence of which is protected by cryptographic methods (authentication code), the platform operator service, adding real-time labels to the data chains, which users and platform participants are guided by, as well as issuing receipts to users and participants about their actions and parameters of the PoH protocol. The authors of this article propose and implement in the Seshat platform follow concept that combine PoH and PoW (Proof-of-Work) mehanisms. In this case, proof of work can be implemented in the form of copying changes to the platform data to its other distributed elements (nodes), or to a remote resource that is writable, but not available for changes even to the platform operator (“Write only”). The advantages of this approach are primarily to reduce the overhead of implementing proof of work and protect the integrity and resiliency of data within the platform. This PoW mechanism becomes proof of useful work (Proof-of-Useful-Work, PoUW) since it does not use optional operations related to the waste of platform resources (in bitcoin, PoW is associated with a significant consumption of electrical energy to generate hash values of a certain type), but ensures the functionality and reliability of the platform. The backup mechanism can be supplemented with other mechanisms for proving useful work. Useful work in scientometric platforms can

also be associated with information indexing. In this case, the platform acquires a very evidence-based economy.

Concepts of non-inflationless and controlled-inflationary platform

Consider a financially heterogeneous platform where is possible to use tokens. Tokens may be exchanged at any convenient time for users and system participants for fiat funds. The exchange is carried out from the implementation of local procedures, with the participation of a financial or credit institution, when, in exchange for a certain number of tokens, the participant receives standard payment instruments from financial or credit institution in accordance with the exchange rate of tokens for fiat funds. Let's call the platform non-inflationary if the set of fiat means associated with it is provided with a deterministic public procedure for exchanging tokens for these fiat means with their full coverage. Let's call the platform manageable-inflationary if it implements mechanisms of futures behavior or bills of exchange that allow token owners to receive fiat funds in the future.

1. Registration users on the platform

The user enters their name, gets the anonymous name UserX, generates his key in a key container protected by a password. Uploads his qualification documents. Next, the user fills out a questionnaire, where he indicates the topics on which he gives reviews or conducts examinations. The Verification Administrator verifies the downloaded documents and the user and completes their registration. The user gets the status - one or more roles and a list of topics in which he is competent. The user's settings are reflected in their profile.

2. Loading articles (scientific works, documents)

Articles are downloaded for assessment or deposit. When the article is loading, it is indexed and its belonging to the topic is established. Indexing of articles is performed by participant of the platform before its downloading or during the download process and after that they receive digital financial assets (tokens). Once the article has been successfully downloaded, the Review Administrator directs it to review or deposit it. When loading and searching, the semantic service kernel (text indexing and comparison processes) is used, which is implemented in the PoUW system.

3. Articles assessment

The reviewer makes assessments of the article and justifies them in the form of a review, which he signs with his e-signature. Reviews and assessments are moderated by the administrator for the purpose of additional anonymization of the expert to exclude clarification of their identity and to exclude pressure on them. A mode without moderation is possible, if at least three experts made an assessments and reviews and platform sent to author an average assessment.

4. Calculate tokens for reviews and statistics

After forming a review and assessment, experts are awarded real tokens in accordance with their rating. It is possible that tokens are not enough to pay for the work of experts, in this case, accrued tokens are marked as credit (bill of exchange) and are taken into account as real tokens appear in the chronological order of payment for expert services. All activities are registered in PoH-compliant logs.

5. Work of external customers (platform participants)

The external customer is registered separately, and they may goes through the verification procedure as an individual or legal entity. He is also may be a donor of tokens, while tokens are provided with real money that the participant contributes to a current account associated with the platform. They have the an opportunity to get acquainted with the statistics of entry of articles, their estimates and additionally pay for the procedures of a detailed search - when their text request is compared with topic articles taking into account the given threshold of their rating (average expert assessment). The search can also take place only by the rating of articles. External customers also include experts of government agencies and services who seek facts of priority or plagiarism, various characteristics of scientific achievements of authors or experts.

Correct platform hypothesis

To implement the non-inflationless platform model, an algorithm for proving useful work for both participants and platform users must be built into it. The evidence-of-work consensus applied in entry-generation cryptocurrencies is not focused on non-inflationary models. In the platform we discussed and in some other systems, the text indexing algorithm is used as PoUW. Important for user rights will be a service execution receiptsis which generation on the platform. In addition, the implementation of cryptographic mechanisms for authenticating users and protecting the information transmitted between users and the platform. The useful work parameter can be the number of indexed units of information or the speed of such indexing. The application of the PoUW approach within platforms can also be extended to partial training of neural networks.

Demand and acceptance of digital platforms

The considered approaches make it possible to formulate a broader scientific task, which concerns primarily the voluntary acceptance by users of services, provided by the platform, including the artificial intelligence platforms, actively introduced into the scientific and household turnover, such as ChatGPT. The correct economic model of the platform is also very important, supporting the turnover of both digital financial assets and real fiat funds, as well as compliance with the laws and rights of platform users.

Returning to the Seshat platform, we can state that trust, demand and acceptance in it are solved not only organizationally, but architecturally and technically.

Now a significant part of the process of developing tools for digital platforms and AI systems is lacking in terms of general strategies for the development and implementation of solutions. And if for systems of "artificial intelligence" such a view on the construction of meanings may be enough, then for digital platforms this is clearly not enough, and it is very important to also take into account such marketing concepts from the field of economics as "product-driven and "market-driven". To date, during the development and implementation of a large number of projects in the field of digitalization, digital platforms and AI, companies, guided by the product-driven concept, are developing solutions that do not meet the expectations and needs of other market participants. Therefore, given this trend, we can say that the concept in which we do what we can (product-driven) instead of doing what we need (market-driven) - there is a fundamental socio-psychological position of present time. A similar situation de facto develops in the landscape of AI systems: the triumph of practice completely supplanted the theory, which led to the inconsistency of AI decisions with market expectations and to a very low level of acceptance of AI systems.

This situation needs a fundamental change, which we propose having considered the basic principles of building the Seshat platform.

Conclusions

Today, the need to create, on the basis of leading scientific and educational russian and international organizations, a scientometric system that allows to assess the development of scientific areas as accurately as possible, objectively and fully and qualitatively deposit scientific works, as well as conduct their objective review and assessment. In this regard, it is most advisable to create a qualimetric platform for scientometric assessment based on the principles of a self-regulatory organization for assessing the qualitative characteristics of scientific works by participants in the scientific community with the possibility of scaling and replication of the platform.

To ensure the acceptance and inflectivity properties of the platform, it is advisable to implement a proof of useful work related to the accrual of tokens in it. The token exchange rate should be set based on the possible full coverage of platform-associated fiat tools.

Important for the rights of users and participants is the formation of receipts on the platform for their actions and services.

In addition, the implementation of cryptographic mechanisms for authenticating users and protecting information transmitted between them and the platform is mandatory.

The useful work parameter can be the number of indexed units of information or the rate of such indexing, or the number of objects used for training.

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DOI 10.34660/INF.2023.46.59.068

俄罗斯联邦二次资源基础设施综合体公共管理系统的发展
THE DEVELOPMENT OF THE PUBLIC ADMINISTRATION SYSTEM FOR THE FORMATION OF THE SECONDARY RESOURCE INFRASTRUCTURAL COMPLEX IN THE RUSSIAN FEDERATION

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抽象的。该研究课题是由于需要解决俄罗斯联邦形成利用二次资源的基础设施综合体以及基于系统方法开发公共管理系统的实际科学问题。找出了各地区、各经济部门、各企业、各组织资源节约型发展中存在的主要问题。为了解决形成生产和技术基础设施的优化布局问题，确定了二次资源（物质和能源）在整个生命周期中的利用效率参数的进一步研究向量。

关键词：二次资源、公共管理、公共政策、环境保护、基础设施、基础设施综合体、系统方法、最佳可行技术、资源节约、资源效率、原材料基础、经济周转、可持续发展、环境安全、俄罗斯联邦。

Abstract. *The research topic is due to the need to solve the actual scientific problem of the formation in the Russian Federation of an infrastructure complex for the use of secondary resources and the development of a public administration system based on a systematic approach. The main problems hindering the development of resource saving in the context of regions, sectors of the economy, enterprises and organizations are identified. To solve the problems of forming the optimal location of the production and technological infrastructure, the vector of further research into the parameters of the efficiency of the use of secondary resources (material and energy) throughout the entire life cycle is determined.*

Keywords: *secondary resources, public administration, public policy, environmental protection, infrastructure, infrastructure complex, systemic approach, best available technologies, resource saving, resource efficiency, raw material base, economic turnover, sustainable development, environmental safety, Russian Federation.*

Ensuring national security and sustainable economic development of the country in the face of increasing external restrictions is impossible without the

mobilization of all economic reserves. In this regard, the tasks of saving materials, expanding the raw material base of the Russian economy through the use of secondary resources are of particular relevance. The solution of these problems can be ensured by the formation of a systematic approach to the management of resource conservation and the use of secondary resources (material and energy) at the state level.

Improvement of the state policy in the field of waste management, formation and further development of the infrastructure complex for the use of secondary resources, taking into account their life cycle, should provide high-tech processes for the reproduction, processing and use of such natural and man-made resources, and the logistics of their flows. In the context of increasing external constraints, the existing supply chains associated with the formation and use of secondary resources are also undergoing significant changes. Thus, the conjugation of the problems of the development of state management of the infrastructure complex for the use of secondary resources and the logistics of the processes associated with their formation and use requires further research and development of scientific and methodological foundations. At the same time, the problem of state management of the formation and further development of the infrastructure complex for the use of secondary resources at all stages of their life cycle and based on the principles of a circular economy is still poorly understood.

Building an infrastructure that facilitates the involvement of secondary resources in economic circulation will ensure the rational economic activity of enterprises and organizations in various sectors of the economy, firstly, by reducing the generation of waste, that is, increasing the resource efficiency of production; secondly, due to the reuse in the on-farm turnover of all resources suitable for use. Here it is important to take into account that the development of the system of state management of such an infrastructure complex for the use of secondary resources ensures the expansion of the raw material base of the national economy, the reduction in the cost of final products, and ensures environmental safety.

The combination of the need for the rational use of all types of secondary resources, and the emergence of new ways to improve this activity at the level of public administration is one of the most important features of the modern socio-economic sphere and overcoming the negative consequences of external restrictions.

The development of a circular economy using renewable resources is based on the principles of environmentally sound and sustainable development. The previously established practice of extensive economic growth, which does not ensure the growth of the economy of states in the long term, and the postulate of the inexhaustibility of natural resources are recognized as erroneous.

The task of ensuring effective management of secondary resources in most developed countries is solved at the state level. Comparison of the scale and quality of management with the restorative capabilities of natural systems provides prerequisites at the state level for the formation of an organizational and technological infrastructure that ensures an increase in the efficiency of involving secondary resources (secondary raw materials) in industry [1].

In accordance with paragraphs. 3 paragraph 4 of the passport of the sectoral program "Use of secondary resources and secondary raw materials from waste in industrial production" eco-industrial parks (eco-technoparks) should become the basic element of the infrastructure. These are networks of integrated innovative industries that provide deep processing of resources and the production of products based on secondary resources, secondary raw materials. The result of such industrial symbiosis is the exchange of resources between its participants and the reduction of the negative impact on the environment [1].

The relevance of improving the state management of the infrastructure complex for the use of secondary resources in the Russian Federation is due to the need for a radical restructuring of the waste management system, ensuring an effective solution to the problem of waste disposal and processing, and the most complete involvement of them in economic circulation as secondary material and energy resources.

According to the statistical reporting of the Federal Service for Supervision of Natural Resources (Rosprirodnadzor) in the form 2-TP (waste), the volume of waste in 2021 amounted to 8.449 billion tons of waste, which is 21.5% (1.493 billion tons) more than in 2020 and by 9% (0.698 billion tons) - in 2019 [4].

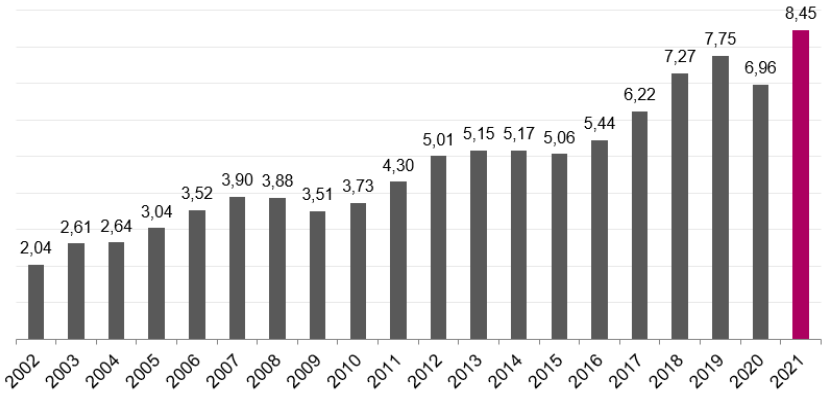

Figure 1. *Production and consumption waste generation by years, 2002 - 2021, billion tons [5]*

The transition to resource-saving, processing, recycling and neutralization technologies involves the formation of an effective system of separate waste collection not only in the housing and communal services sector, but also at industrial enterprises, as well as the subsequent processing, recycling and neutralization of such waste on an industrial scale, and the involvement of waste fractions in economic circulation.

The Strategy for the Development of the Industry for the Processing, Recycling and Neutralization of Production and Consumption Wastes for the Period up to 2030, approved in January 2018, outlines the formation and future development of the industry for the processing, recycling and minimization of the amount of waste not subject to further disposal as the main goal , with the application of the global 3R principle (waste prevention, reuse, recycling into secondary resources).

This goal implies the creation of a technical and economic system that minimizes the volume of waste disposal and increases the re-engagement into economic circulation as raw materials, materials, products of previously recycled waste components for the manufacture of new products and energy generation [3].

Increasing the competitiveness of the Russian economy is impossible without the involvement of secondary resources in the economic turnover. This approach provides a solution not only to key economic (reducing the cost of finished products through the introduction of the most effective resource-saving technologies available), but also environmental (reducing the level of environmental pollution) problems.

The development of state management of the infrastructure complex for the use of secondary resources provides a solution to an important national economic problem of expanding the raw material base of the Russian economy, ensuring a reduction in the cost of output by enterprises of various sectors of the economy and forms of ownership. The rational use of secondary resources also contributes to the solution of environmental problems to prevent environmental pollution. The modern process of reproduction should be ensured by the use of material-saving technologies, the rational use of the potential of secondary resources, and contribute to the effective solution of environmental problems of our time.

The role of the state is to create conditions for increasing the sustainability of the activities of organizations in various sectors of the economy on the principles of effective management of the potential of secondary resources. These principles include the use of production technologies, cyclical business models that ensure not only the rational use of material resources, but also the reduction of inevitable production waste.

To ensure the stability and further development of the Russian economy in the face of increasing external restrictions, it will be necessary to mobilize all economic reserves. This will require solving issues related to the development

of legal support, the implementation of the principles of the circular economy in the management, regulation and development of the economic mechanism for resource conservation and circulation of secondary resources [2].

An analysis of the existing practice of using secondary resources, implementing resource-saving measures and applying technologies at the micro-meso- and macro levels in the Russian Federation made it possible to identify the main problems hindering the development of resource conservation in the context of regions, sectors of the economy, enterprises and organizations, namely:

Imperfection of the regulatory framework in the field of resource conservation and circulation of secondary resources, fragmentation of measures of state regulation of resource conservation.

Insufficiency of the pace of implementation of a unified state strategy that ensures the country's transition to an intensive resource-saving type of economic growth; insufficient state support measures for rational resource consumption, increasing the resource efficiency of domestic enterprises by reducing the material and resource intensity of production, developing and implementing innovative resource-saving technologies for processing waste and secondary material resources; forms and methods of development of the organizational and economic mechanism in the field of resource saving.

The underdevelopment of the infrastructural complex for waste disposal, which ensures the effective separate collection of secondary raw materials from the population and business entities.

4.Problems of transition of enterprises and organizations to activities in the field of production waste management based on the principles of the best available technologies (BAT). Lack of a strategy (at the federal and regional levels) for a phased transition of business entities to the best available technologies (BAT), regional environmental standards, etc.

To ensure a systematic approach to the management of secondary resources (material and energy), which are the result of waste recycling, it is also necessary to determine the parameters of the efficiency of their use throughout the entire life cycle. The application of BAT technologies contributes to the rational use of natural and man-made resources.

Solving the problems of collecting, harvesting and using secondary resources (material and energy) obtained from production and consumption waste, the need to use cyclical business models are becoming the most urgent tasks to ensure the further growth of the Russian economy. This is due to the significant scale of the problem and the need to improve state policy in this area, including in connection with the strengthening of external restrictions and the need to reorient the Russian economy to new markets.

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DOI 10.34660/INF.2023.72.65.069

俄罗斯国家社会政策体系中的非营利部门
THE NON-PROFIT SECTOR IN THE SYSTEM OF STATE SOCIAL POLICY IN RUSSIA

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注解。本文概述了俄罗斯联邦非营利部门结构的特点。对社会导向非营利部门的量化指标进行了分析。作者给出了俄罗斯联邦非营利组织的分类。俄罗斯联邦国家和非营利部门之间的部门间互动问题暴露出来。

关键词：非营利组织、面向社会的非营利组织、国家支持、非营利组织融资。

Annotation. *The article presents an overview of the peculiarities of the structure of the non-profit sector in the Russian Federation. The quantitative indicators of the socially oriented non-profit sector are analysed. The author's classification of non-profit organisations in the Russian Federation is given. Problems of intersectoral interaction between the state and the non-profit sector of the Russian Federation are revealed.*

Keywords: *non-profit organisations, socially oriented non-profit organisations, state support, financing of non-profit organisations.*

Peculiarities of the structure of the non-profit sector in Russia

According to a study by Johns Hopkins University, the non-profit sector (third sector) includes non-governmental non-profit organisations (NNPO).[1] I.e. organisations that are independent from the state in their activities and money management. NNPOs may receive state funding and have executive bodies and local authorities as members of the collective governing body, but the condition of full independence of NNPOs from the state must be observed.

In view of this rather simple and clear interpretation of the concept of the non-profit sector, we should consider its structure in Russia.

The non-profit sector in Russia does not have sufficiently clear boundaries. It is a set of various public associations, non-governmental non-profit organisations

[1] Salamon L.M. & Anheier H.K. (1997). Defining the nonprofit sector: A cross national analysis. Manchester: Manchester University Press; Salamon L.M., Sokolowski, W., & Associates (2004). Global civil society: Dimensions of the nonprofit sector. Bloomfield, CT: Kumarian

of various organisational and legal forms, including state non-profit organisations. The diversity of the Russian non-profit sector sometimes takes such contradictory forms that it is difficult to understand the structure of our non-profit sector. Which forms can be referred to real, classic NPOs, and which are called non-profit only formally?

Under the classical non-profit sector within the framework of this paper the author means socially oriented non-profit organisations, which are established for the purpose of implementing non-profit socially significant projects that solve social problems and develop civil society institutions in the Russian Federation. Socially oriented NPOs carry out special types of activities, which are stipulated by Article 31.1 of the Federal Law "On Non-Profit Organisations". Such as: social service of citizens, social support, protection of citizens, environmental protection, protection of animals, prevention of socially dangerous forms of citizens' behaviour, charitable activities, patriotic education of citizens, etc. It should be noted that the legislator does not refer state corporations, state companies, political parties to socially oriented NPOs .

So, how is the Russian non-profit sector organised?

According to the Federal Law "On Public Associations" dated 19.05.1995 N 82-FL, public associations on the territory of the Russian Federation can be established in various organisational and legal forms: a public organisation, a political party, a public movement, a public foundation, a public amateur body, a public institution.

According to the Federal Law "On non-profit organisations" of 12.01.1996 N 7-FL NPOs may be registered in the following forms: public and religious organisations (associations), communities of indigenous peoples of the Russian Federation, Cossack societies, foundations, state corporation, state company, non-profit partnerships, private institutions, state, municipal institutions, budgetary institution, autonomous non-profit organisation, associations (unions).

According to Russian legislation, a non-profit organisation is an organisation that does not have financial goals aimed at making profit in carrying out its activities. Also, the condition of non-distribution of the profit received between the participants of a non-profit organisation must be met. Non-profit organisations are established to achieve goals significant for society. For example, social, charitable, cultural, educational, scientific, managerial. Also, the purpose of an NPO may be the protection of health of citizens, development of physical culture and sports, satisfaction of spiritual and other non-material needs of citizens, protection of rights, legitimate interests of citizens and organisations, resolution of disputes

and conflicts, provision of legal assistance, as well as other purposes aimed at achieving public benefits.[2]

Based on the legislative classification presented above, non-profit organisations of the Russian Federation can be conditionally divided into the following categories: **classical, profile, special, mixed.**[3]

We have already discussed classical NPOs above, so let's move on to the next category.

NPOs providing special services to the population and the state can be classified as specialised NPOs. As a rule, the activities of such NPOs are regulated by separate federal laws - on advocacy and notary activity, on political parties, etc. The profile NPOs may also include HOAs and other forms of non-commercial associations of citizens for the purposes of joint property management.

Special NPOs may include religious organisations and organisations carrying out their activities to represent the interests of small groups and nationalities (Cossack, small nationalities, etc.).

Mixed NPOs include those that carry out quite commercial activities: sports organisations, public mass media. For example, many football and sports clubs are registered as non-profit organisations, receive state funding, but at the same time conclude commercial contracts.

Public media are, as a rule, non-commercial organisations. But it is not always appropriate to classify them as third sector, as there is a clear disproportion in favour of state funding.

Thus, we can see that the structure of the non-commercial sector in Russia at the moment is somewhat contradictory. The undoubted fact for the author is that among the variety of forms, only classic NPOs can make the most significant contribution to the realisation of the state social policy. Since only this form of NPO is created for the implementation of socially significant, non-profit projects aimed at solving socially important problems.

Quantitative indicators of socially oriented non-profit organisations in Russia

State registration of non-profit organisations is carried out by the Ministry of Justice of the Russian Federation. It also maintains various statistical registers of NPO activities. For example, the register of performers of socially useful services.

According to the Federal State Statistics Service, the number of socially oriented NPOs tends to decline. Thus, 146,481 socially oriented NPOs were registered in 2019, in 2020 - 128,685, and at the end of 2021 - 127,632. Thus, we observe

[2] Art. 2 of the Federal Law of 12.01.1996 N 7-FL (ed. of 29/07/2018) "On non-profit organisations".

[3] Author's classification of non-profit organisations.

a decrease in the number of socially oriented NPOs for three years by almost 12.87% [16].

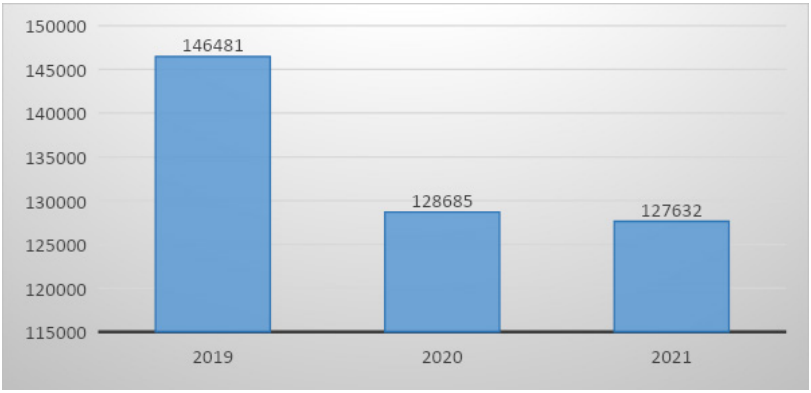

Diagram 1. *Dynamics of quantitative indicators of socially oriented NPOs*[4]

According to the Ministry of Justice of the Russian Federation, the total number of registered non-profit organisations also tends to decline slightly. Thus, 216,800 NPOs were registered in 2019, 210,568 in 2020, and 209,818 at the end of 2021. Thus, we see a decline in the number of NPOs by almost 3.22 per cent in three years.

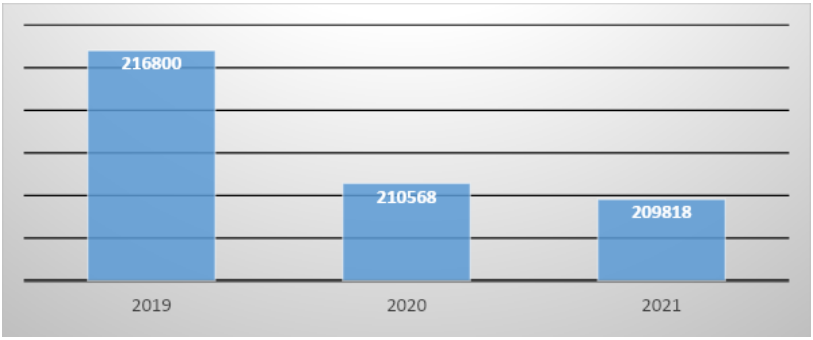

Diagram 2. *Dynamics of NPO quantitative indicators*[5]

In our opinion, the reasons for the decrease in the number of registered NPOs and socially oriented NPOs may be the following: tightening of control over the

[4] Compiled by the author on the basis of data from the Federal State Statistics Service.

[5] Compiled by the author on the basis of data from the Ministry of Justice of the Russian Federation.

activities of non-profit organisations by the state, liquidation of fictitiously created NPOs, liquidation by court decision, introduction of the register of NPOs - foreign agents, etc.

However, we are inclined to believe that cleaning of the non-profit sector is an effective tool on the part of the state, as more viable NPOs remain in the third sector, providing competition in the market of social services. Therefore, the state is ready to provide financial support to strong non-profit organisations. This is evidenced by the dynamics of growth of state support to socially oriented NPOs. Thus, the volume of state financial support for socially oriented NPOs in 2019 totalled RUB 34.7 billion, in 2020 - RUB 53.3 billion, and in 2021 reached RUB 162.3 billion. Where most of the financial support is provided on a competitive basis and in competition, which only socially oriented NPOs with a developed management system can afford [18].

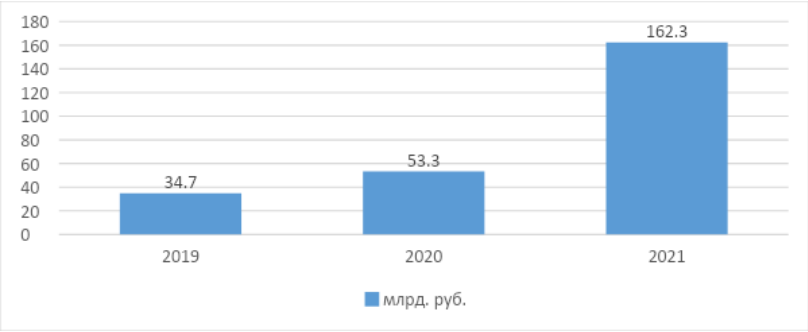

Diagram 3. *Dynamics of state support to socially oriented NPOs*[6]

Intersectoral interaction between the state and the non-profit sector in the social sphere

Despite imperfect statistical and other state accounting, Russia's non-profit sector exists. And it is a strong enough sector that can be a powerful catalyst for the social policy of the Russian Federation. In this regard, it is necessary to establish an effective system of intersectoral social partnership between the state and the non-profit sector. This means that only in constructive interaction between the state and NPO in solving social problems the synergetic effect of adding up different resources is ensured. The state and the non-profit sector have different opportunities and resources to participate in solving social problems, they have different ideas about the very nature of social problems. However, despite all the

[6] Compiled by the author on the basis of data from the Ministry of Economic Development of the Russian Federation.

differences, co-operation between the sectors is necessary, as neither the state, nor business, nor citizens can overcome the burden of accumulated social problems and resolve conflicts alone.[7]

Over the ten years of intersectoral social partnership between the state and NPOs, we can note significant shifts in the denationalisation of the social sphere, which is directly related to the creation of conditions for non-state organisations in the production of social services.[8] And it is social services that are the most demanded by the Russian population. Therefore, in order to improve the quality of social services, the government is trying to involve the non-profit sector in their provision.

Despite the government's active efforts, there are still a number of problems in intersectoral cooperation.

Firstly, there are no clear mechanisms for granting privileges to non-profit organisations - providers of socially useful services. In this regard, priority financing is not provided, and the status of "provider of socially useful services" is in fact only an image status for NPOs.

Secondly, when participating in tenders for the right to provide social services, there is an inequality between socially oriented NPOs and representatives of small and medium-sized businesses, which have competitive advantages in terms of providing a lower price for the services provided.

Thirdly, socially oriented NPOs cannot receive property support from the state on a gratuitous or favourable basis, in case they have been reimbursed for the provided social services.

If these problems are of purely legislative nature and they can be solved by improving the relevant regulations. The following problems are purely administrative barriers to intersectoral co-operation.

Thus, according to the data of the Public Chamber of the Russian Federation, in many regions there is a situation when small socially oriented NPOs providing a very narrow set of services cannot be included in the number of social service providers. Local executive bodies are oriented towards providers with a wider range of services. Such administrative barriers can be solved through constructive negotiations, convincing the PSI body that the number of social services does not indicate that the provider does not deserve to be an equal partner in the provision of social services.

The next, most important problem is the lack of market-based tariffication in reimbursement for social services provided. State compensations do not cover

[7] Yakimets V. N., Nikovskaya L.. I. Mechanisms and principles of intersectoral social partnership as a basis for the development of public-public management // Authority. 2018. № 4. pp. 15-25. DOI: https://doi.org/10.31171/vlast.v26i4.5757

[8] Nikovskaya L. I. I., Molokova M. A. The role of intersectoral partnership in realising the potential of the social state in Russia // Authority. 2017. № 11. pp. 31-37.

even minimal expenses of a non-profit organisation. For example, the state tariff for psychological assistance and support, including to citizens providing home care for a seriously ill recipient of social services is 20.7 rubles per 1 service. The state finances the non-profit sector and regional municipal social institutions on absolutely equal terms. But this does not take into account the fact that the state assumes regional and municipal expenses for premises, administrative expenses and others. And no one reimburses such expenses, so such a low tariff is not able to provide either the salary of a specialist, or even more so any expenses for conducting activities.

Thus, we have considered the peculiarities of intersectoral interaction between the state and the non-profit sector in the social sphere, identified the main areas of activity, problems and ways to solve them.

Conclusions.

According to international studies, the non-profit sector includes non-governmental non-profit organisations that are fully independent from the state in the management and disposal of funds.

The non-profit sector in Russia does not have sufficiently clear boundaries. It is a set of various public associations, non-governmental non-profit organisations of various organisational and legal forms, including state non-profit organisations. Attributing some NPOs to the non-profit sector is controversial, due to the peculiarities of disproportional financing, tasks performed and controllability of the state.

Despite the fact that the Russian Federation systematically increases the volume of financing of the non-profit sector, involving it in the implementation of the social policy of the state. Nevertheless, so far the funds allocated to the third sector in terms of total state expenditures on social policy are insignificant.

In addition, there are legislative problems, administrative barriers and non-market tariffication in reimbursement of costs for social services.

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DOI 10.34660/INF.2023.86.51.070

育种成果成为俄罗斯法律保护的对象
BREEDING ACHIEVEMENT AS AN OBJECT OF LEGAL PROTECTION IN RUSSIA

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注解。文章将育种成果视为对象（植物品种、动物品种）。它的复杂特征包括育种结果、名称和基因工程设计（如果是转基因的话）都得到证实。认为有必要补充两项可保护性条件的标准体系，以及在"单独"共同著作的基础上对转基因育种成果授予一项专利的转基因对象的保护方式。

关键词：植物品种、动物品种、育种成果、转基因育种成果、能力保护条件。

Annotation. *The article considers a breeding achievement as an object (plant variety, animal breed) as an object. Its complex character including the result of breeding, its name and genetically engineered design if it is genetically modified is substantiated. The necessity of supplementing the criterion apparatus with two conditions of protectability and the approach to protection of genetically modified objects on the basis of "separate" co-authorship with issuance of one patent for genetically modified breeding achievement is argued.*

Keywords: *plant variety, animal breed, breeding achievement, genetically modified breeding achievement, ability protection conditions.*

The era of ancient civilisations in different parts of the Old and New Worlds (1) began with the artificial creation of plant varieties and animal breeds by man. Both in ancient times and nowadays, breeding achievements are strategic objects in terms of economic and political significance. The XXI century rigidly puts before the leaders of most countries, including Russia, very difficult tasks: on the one hand it is necessary to provide the population with nutritious food, and on the other hand - to preserve the natural environment as a condition for the very existence of life on Earth. Due to the lack of available resources, plant and animal breeding is carried out not only by traditional methods, but also through genetic modification of living organisms, including breeding achievements (2).

During the Soviet period and before the completion of the codification of civil legislation in Russia by Part 4 of the Civil Code devoted to intellectual property rights, the legislation on breeding achievements belonged to the public-law sphere of regulation (land law), and the development of intellectual rights was given secondary importance. After the inclusion of the right to a breeding achievement (sui generis object) into the system of rights to the results of intellectual activity and means of individualisation (3), there appeared studies devoted to the regulation of relations in the sphere of creation and use of breeding achievements from the civil law standpoint. However, some important problems have not been solved. Suffice it to say that for three decades since the adoption of the Law "On Selection Achievements" (4), which was included in the Civil Code of the Russian Federation practically without any changes, no normative material directly related to the sui generis object has been introduced, and there are no materials on selection achievements in the reviews of judicial practice and in the decisions of higher courts. This is due to both the youth of the law and the general critical state of Russian science, including biological science with its special prerequisites - the "Lysenko phenomenon" is "imprinted" in the history of genetics, which is the key for all biology, breeding, and medicine (5).

However, perhaps, the most important reason for the above-mentioned state of legislation on legal protection of breeding achievement is the complexity of the legal nature of the sui generis object itself, which should be taken into account in the construction of the system of protection. If in copyright law an image system is protected, in patent law a device, substance, microorganism strain or cell culture itself, a method (as a process of performing actions on a material object with the help of material means), and the rights to means of individualisation cover designations intended for individualisation of objects, it has to be admitted that in a breeding achievement all these objects are as if combined. The description of an object covers its image system (morphological and biological features, structure, content of certain substances), and, in addition, one has to take into account its inseparability from "its" material carrier, its ability to self-reproduce together with it, the necessity of individualisation, without which it is impossible to distinguish a separate object from the environment of homogeneous ones.

In the Russian legislation, a breeding achievement is presented as a result of breeding, the legal protection of which is provided if it meets the four conditions of protectability stipulated by the International Convention for the Protection of New Varieties of Plants, to which Russia has been a party since 1998: novelty, distinctiveness, homogeneity and stability (Article 1413 of the Civil Code of the Russian Federation).

A variety shall be deemed to be new if, at the date of filing of the application for a patent, its seeds have not been sold or otherwise transferred by the breeder, his legal successor or, with their consent, by another person for use:

1. in the territory of a Contracting State earlier than one year before the said date;
2. in the territory of another state earlier than four years or, for woody forms of plants, six years before the specified date (clause 3 of Article 1413 of the Civil Code of the Russian Federation).

Thus, the "**novelty**" of a breeding achievement of "conventional" level is reduced to its unavailability for use in the territory of the member states of the International Union for the Protection of New Varieties of Plants (hereinafter - UPOV), except for the above-mentioned restrictions. For the loss of "novelty" it is sufficient to establish not the fact of sale, but the fact of being on sale, for example, by placing an advertisement having the nature of a public offer of a retail sale contract in accordance with Article 494 of the Civil Code of the Russian Federation (6).

A breeding achievement shall be clearly **distinguishable** from any other well-known achievement existing at the time of filing an application for the grant of a patent. Commonly known subject matter shall be subject matter which is found in official catalogues, reference collections or detailed in a published description. Filing an application for a patent in any country makes an object generally known, provided that a patent is granted for it (Clause 4 of Article 1413 of the Civil Code of the Russian Federation; Article 7 of the UPOV Convention). Thus, the "distinctiveness" must be world-class. When introducing this condition, the impossibility of giving the object features beyond the genetically determined limits of species variability was taken into account, therefore, even if it differs from well-known varieties by one feature, compliance with the condition is recognised (Clause 2 of Article 1412 of the Civil Code of the Russian Federation).

Plants must be sufficiently **homogeneous** in their features, taking into account individual deviations that may occur due to the peculiarities of reproduction (Clause 5 of Article 1413, Article 8 of the UPOV Convention). Homogeneity is a requirement for similarity between individuals of the same generation of a varietal population. The presence of deviations in the "preserved" set of traits (categories of "original seeds" of plants, "purebred pedigree material" of animals is not allowed (Article 1440 of the Civil Code of the Russian Federation).

A breeding achievement is considered **stable** if its main features remain unchanged after repeated reproduction, and in case of a special cycle of reproduction, at the end of each cycle (Clause 6 of Article 1413 of the Civil Code of the Russian Federation, Article 9 of the UPOV Convention).

These conditions of protectability proceed from the nature of a breeding achievement as a crop, expressing the genetic "programme" formed by the breed-

er in a material medium, which is characterised by all the signs of life: movement, metabolism, growth, reproduction, etc. The breeding achievement can be considered as a genetic "programme". Compliance of a breeding achievement with these conditions of protectability is sufficient to establish its protection and registration in the State Register of Protected Breeding Achievements (Article 1414 of the Civil Code of the Russian Federation), but it is not sufficient to realise the exclusive right to use it in civil turnover. In order for a protected object to be allowed for use, it must be tested for its economic utility and, if it has such utility, registered in the State Register of Protected Breeding Achievements allowed for use. In the absence of economic utility, the protected breeding achievement is not allowed for circulation, replenishing from year to year the list of such achievements in the annex to this register.

Tests of new plant varieties for their economic utility have always been conducted in the USSR, the State Register of Breeding Achievements of the USSR included information only on economically useful objects and protection documents were issued only for these varieties. But the requirement of economic utility was not established in the Soviet legislation (7), as it is not established in the Civil Code of the Russian Federation due to its absence in the UPOV Convention (Art. 5). The author considers that the condition of economic utility should be established as the main criterion for protection of a breeding achievement, and to protect as a breeding achievement an object not suitable for use in economic activity is a wrong construction in the Russian legislation. In more mature patent law there is a similar requirement of "industrial applicability" (Clause 4 of Article 1350, Clause 4 of Article 1351, Clause 1 of Article 1352 of the Civil Code of the Russian Federation). Patents are not granted for "mind games"! The unification of these conditions of protectability in the 72nd and 73rd Chapters of Part Four of the Civil Code of the Russian Federation is quite justified, it is one of the purposes of codification. After all, the absence of the criterion "economic utility" in the criterion apparatus of protectability, for which varieties have always been tested and for the sake of this test a special (second) State Register of breeding achievements admitted to use is kept, harms the national interests of Russia. V.A. Dozortsev wrote: "In the process of development and improvement of the national legislation, it is necessary to take into account the trends of development of international regulation quite clearly. At the same time, it should be realised that the national legislation should be in some way ahead of the international regulation, paving the way for it" (8).

The name of a breeding achievement, without which it cannot be distinguished from similar ones, must also comply with the requirements of the law and be assigned to the breeding achievement during its registration for the whole period

of its existence regardless of its protection (Article 1419 of the Civil Code of the Russian Federation and the Rules (9)).

The registration of the name of the breeding achievement declared by the author may be refused due to its non-compliance not only with the requirements of the Russian legislation, but also with Article 20 of the UPOV Convention, which provides for "the same name in all Contracting Parties". Thus, registration of a breeding achievement is possible only if the novelty of its name is of "conventional" level. In cases when the names proposed by the author do not meet this requirement, and the author has not proposed an appropriate name approved by the Federal Executive Body for Breeding Achievements, the latter has the right to refuse to register the breeding achievement (Article 1419 of the Civil Code of the Russian Federation). Thus, when registering a breeding achievement, a strong legal connection arises between the breeding result and its individualising name, which unites such heterogeneous information objects into one whole throughout the whole period of its existence, both during the period of protection and when used in the public domain (Article 1425 of the Civil Code of the Russian Federation). At the same time, its part representing the breeding result must meet the conditions of novelty, distinctiveness, homogeneity and stability, and the name performing the function of a means of individualisation must meet the condition of "conventional novelty" at the moment of registration as a breeding achievement. The legal relationship between a breeding result and its name is similar to the one between a legal entity and a firm name (Clause 1 of Article 1473, Clause 2 of Article 1474 of the Civil Code of the Russian Federation), goods and a trade mark. This is the reason for refusal to register trademarks identical or confusingly similar to the names of protected breeding achievements in respect of homogeneous goods (Clause 8 of Article 1483 of the Civil Code of the Russian Federation).

Plant varieties and animal breeds are also created through the use of genetic engineering (Paragraph 7, Clause 4, Article 1421 of the Civil Code of the Russian Federation). A genetically engineered design is protected by patent law as an invention (Clause 1 of Article 1350 of the Civil Code of the Russian Federation). Inclusion of alien genetic material into the genome of a breeding achievement changes its morphological and biological features (modification). However, there is no approach to the protection of genetically modified breeding achievements in Russian law. Genetically modified breeding achievement is protected only in respect of intellectual rights to the genetic design. The author believes that when a genetically modified object is created, two independent information objects are merged into one whole expressed by original features, and the protection of this whole should be based on the approach applied in copyright law to a work consisting of parts created by different authors, i.e. "separate co-authorship" (I.A. Gringolts' term (10)). The author considers the approach to the protection of ge-

netically modified breeding achievement existing in the patent law to be incorrect, since during its creation the result of breeding is included in its entirety, but not as a prototype from which the features for the new object are selected. This selection is not possible at all, as most of the traits of the breeding result are under the control of a huge number of genes, co-adapted into blocks and their transfer by known methods is not feasible yet (11). The author believes that there is no obstacle to the recognition of separate co-authorship of geneticists and breeders in the legislation on breeding achievements: both geneticists and breeders in traditional breeding work with one object - genetic information, hence co-authorship of the creators of genetically engineered design and the result of traditional breeding is quite natural.

Genetically modified breeding achievement is a single complex object consisting of parts, the rights to which may belong to different persons. One patent should be granted for it. This will put the creators of the complex object in equal conditions and will avoid dependence of the objects when it is necessary to use the complex object, which in such a case will result in limitation of the right to dispose of the exclusive right (Article 1358[1] of the Civil Code of the Russian Federation). Thus, three independent objects can be simultaneously used in circulation: traditional breeding achievement, genetically modified breeding achievement and genetically engineered design.

In a patent for genetically modified breeding achievement as a complex object, the authors of the traditional plant variety and the authors of the genetic design should be indicated as co-authors, and the owners of exclusive rights to these objects should be indicated as co-owners of the patent. It is proposed to include in the name the names of both objects.

One of the unresolved problems in the legislation is the lack of protection of new plant varieties and animal breeds before their registration in the status of breeding achievements (Article 1424 of the Civil Code of the Russian Federation). Of course, new varieties of plants and animal breeds are the results of scientific research, but unlike other creative results they exist in living material media. Absence of their protection before registration means that they are not objects of civil rights (Article 128 of the Civil Code of the Russian Federation). Therefore, the right of authorship of a variety and breed, the right of the author to select a name for registration of a breeding achievement under it, the right to obtain a patent, temporary protection of a variety established prior to registration in the status of a breeding achievement cannot arise in the sui generis system (Chapter 73 of the Civil Code of the Russian Federation), they are actual constructions.

The author believes that new plant varieties and animal breeds as scientific results should be protected by copyright. But the form of their expression is not written, pictorial and others listed in paragraph 3 of Article 1259 of the Civil Code

of the Russian Federation, but phenotype (a set of external features, image system as a whole). At the moment of creation of a new variety, breed, the author should arise, as a general rule, the right of authorship. If the creator does not have it at the moment of creation, there is no possibility to restore it after registration of the breeding achievement, when the right of defence arises, as provided by Article 1410 of the Civil Code of the Russian Federation, which allows to challenge unjustified authorship. The rights that have the character of factual constructions in sui generis law, as well as the exclusive right that arises in the author in the copyright system but is not realised in it, are the rights of this system.

In the sui generis system, protected objects are **forms of existence** (breeding results are inherently form objects!), designated by the legal categories "seeds" and "breeding material", intended for reproduction of breeding achievements and described by a list of essential features, which is typified for each crop or close crops. This list is used to determine the presence or absence of similarity between comparable varieties of the same crop.

In view of the fact that the concept of breeding achievement has not been developed, the author proposes to recognise as a breeding achievement an economically useful result of breeding activity, which, according to the totality of essential features of a plant or animal population, has distinctiveness, stability, homogeneity, novelty for use, as well as an individualising name. She believes that this definition corresponds to modern ideas about the results of intellectual activity, which by their nature are informational, intellectual rights to which do not depend on proprietary rights to their material carriers (Clause 1 of Article 1227 of the Civil Code of the Russian Federation).

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One of the notes: a new plant variety, a new breed of animal are the results of scientific research (R&D), but **the objective forms of their existence are not scientific reports (paper descriptions),** from which they are not reproduced, but the categories of **"seeds", "breeding material"** (genetic structures = genotypes expressed in living material carriers, capable together with the carriers to self-reproduction on the basis of their own genetic information. **The form of their expression** is not written, pictorial and other (see Clause 3 of Article 1259 of the Civil Code of the Russian Federation), but **phenotype** (a set of external features). Scientific results are protected by copyright (clause 1 of Article 1255 of the Civil Code of the Russian Federation). Doctor of Law V.A. Dozortsev, who did a lot for systematisation and codification of intellectual rights in the civil legislation, believed that **only existing in literary form** can be protected by copyright from scientific works. V.A. Dozortsev himself recognised that legal norms are not a bone system, they are subject to development... But it is more difficult to convince the scientific community that a new variety of plant, a new breed of animal should initially be protected by copyright as a scientific work (for this purpose it is necessary to include "phenotype" in the list of forms of expression, i.e. in paragraph 3 of Article 1259 of the Civil Code of the Russian Federation). Otherwise, there will continue to be a paradox: since new varieties, breeds are not protected as scientific results, as unprotected results of intellectual activity, they do not belong to the objects of civil law (Article 128 of the Civil Code of the Russian Federation). They are nothing. Most importantly, the creators do not have the right of authorship on them as a general rule from the moment of creation of the object. The question

arises: is there really a possibility to restore authorship, as it is "promised" by Article 1410 of the Civil Code of the Russian Federation? The answer is no. Moreover, such breeding results can be genetically modified without asking the permission of their "powerless" creators.

When an application for a patent for a breeding achievement is filed, a patent shall be granted if the variety or breed complies with the requirements of the law. **The subjective rights** to the breeding achievement are **indicated in the patent on the basis of information from the application**. Applications for service breeding achievements (most of them) are made by the employer. If the patent specifies a person who has not created a variety or a breed as the author, it is impossible for the real author to challenge the patent: the right to breeding achievement (Chapter 73 of the Civil Code of the Russian Federation) does not provide this possibility (Article 1441 of the Civil Code of the Russian Federation). Neither the CAO nor the Criminal Code contain sanctions against violators of breeding achievement rights.

DOI 10.34660/INF.2023.95.24.071

高职院校学生交际文化的发展
DEVELOPMENT OF COMMUNICATIVE CULTURE OF STUDENTS OF TECHNOLOGICAL COLLEGE

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注解。本文旨在解决高职院校学生在轮廓周期学科学习过程中的交际文化发展问题。特别关注大学生交际文化现状的诊断。为轮廓周期学科学习中学生交际文化的发展提供了系统的建议。

关键词：交际文化、发展、学生、技术学院、学科概况。

Annotation. *The article is aimed at solving the problem of development of communicative culture of students of technological college in the process of studying disciplines of profile cycle. Special attention is paid to the diagnosis of the current level of communicative culture of college students. Methodical recommendations for the development of communicative culture of students in the study of disciplines of profile cycle are offered.*

Keywords: *communicative culture, development, students, technological college, profile disciplines.*

In modern society, the development of communication skills and abilities is becoming more and more important for successful professional activity. It is especially relevant for students of vocational education system, who are preparing to become future specialists and enter the labour market. However, there is a problem of insufficient development of communicative culture in students, caused by the emphasis on technical and specialised knowledge in educational programmes. Meanwhile, the crucial importance of developing communicative culture in college students lies in the need to train specialists who are able to interact effectively and adaptively with colleagues, clients, management and other participants of the professional environment. Communication skills such as effective communication, listening, persuasion and conflict management play a key role in the success-

ful realisation of professional potential. Lack of confidence and skills in building effective interactions can have a negative impact on students' ability to achieve success in their professional endeavours.

In light of the above factors, this study aims to develop effective methods and approaches that promote the development of communicative culture of college students in the process of studying disciplines of the profile cycle.

In the framework of solving the first problem, which consists in determining the essential characteristics of communicative culture and identifying the educational potential of disciplines of the profile cycle in the formation of college students' communication skills, it was revealed that the communicative culture - knowledge, skills and qualities of personality that contribute to effective learning and achievement of pedagogical goals. It depends on communicative skills, including effective communication, clear expression of thoughts and understanding of information from interlocutors. Successful communication requires listening, teamwork, conflict resolution, knowledge of cultural norms, and the use of non-verbal means of communication. Communicative culture facilitates interaction and contact with others. At the same time, communicative culture plays a significant role in various spheres. It provides the basis for establishing harmonious relations and co-operation, which is essential in education and professional sphere.

The development of communicative culture in students is influenced by a variety of factors. Among them - the level of communicative competence of parents, which has a significant impact on the development of communication skills; access to the necessary resources for the development of communicative skills, which depends on the level of family income; living conditions and national-cultural characteristics, which affect the adaptation to local rules and norms of communicative behaviour; gender, age, educational level and profession, which determine the differences in communication style; technological progress, which affects the ways of communication. In addition, the educational environment, psychological features of personality and the influence of teachers also play an important role in the formation of communicative culture of students of secondary vocational education.

Disciplines of the profile cycle have a significant educational potential in the development of communicative culture of college students. They contribute to the formation of tolerance, respect and active life position in students. The use of various teaching methods, such as trainings, role-playing games, negotiations and teamwork, helps students not only to deeply understand and assimilate the material, but also develops their communicative skills. Visual, verbal and practical teaching methods take into account the individual characteristics of each discipline, contributing to a more effective educational process and the holistic development of students.

As part of the solution of the second task - to develop criteria for assessing the level of communicative culture of students of secondary vocational education in the study of disciplines of the profile cycle and to conduct a diagnostic study, the *criteria* for the formation of communicative culture were identified: *cognitive*, characterizing the aspect of communicative competence associated with cognitive processes and intellectual abilities, which affect communication; *activity-related*, associated with active practical activities and skills for implementing communication in various situations; *motivational*, determining the motivation and attitude of the individual to communication. It assesses the motives, goals and interests that push a person to actively and effectively interact with other people.

The levels of communicative culture formation were *high, medium and low.*

In the framework of the research the diagnostics of the third and fourth year students of Kazan Technological College Federal State Budgetary Educational Institution of Higher Education "KNRTU" was carried out. Students of the direction 18.02.12 "Technology of analytical control of chemical compounds" of the 1st year took part in the experiment. In total 19 people took part in the survey. The experiment was conducted in the framework of testing by the method of diagnostics of assessment of self-control in communication M. Snyder, assessment of communicative skills [6], as well as Thomas-Kilmann methodology: Type of behaviour in conflict.

Having analysed the test results (*correspondence to the ranges 0-3, 4-6 7-10*), we can conclude about predominantly (*10 people*) average level of communicative control. 9 students are observed with a high level of self-control (*9 people*). A positive result is the absence of students with a low level of self-control (Fig. 1).

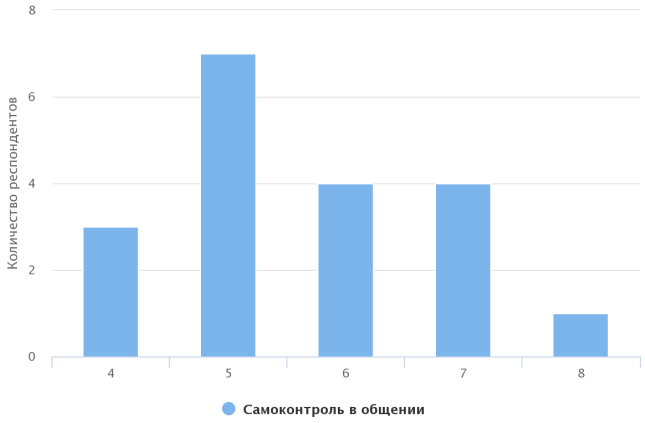

Figure 1. *Results of the test of self-control in communication*

Figure 2 shows the results of communication skills assessment, where the high level of communication culture (91 to 100), medium level of communication (61 to 90), and then insufficient (31-60) and problematic (below 30), *which combined into a single "Low" level.*

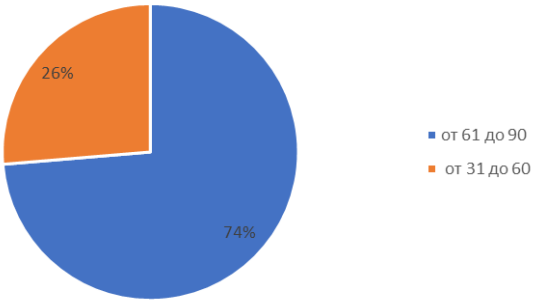

Figure 2. *Results of communicative skills assessment*

There is an absence of students who achieved a high level of communicative skills in communication (more than 91 points), but there are also no students with significant problems in communicative culture. The majority of students (14 students) demonstrate an average level of communication skills in the range of 61-90 points, which indicates their ability to control their behaviour in communication and only 5 students have a low level of communication skills, they received scores in the range of 31-60 points.

Figure 3 shows the results of the survey on the type of conflict behaviour. Different types of behaviour are presented: Rivalry, Cooperation, Compromise, Avoidance, Adaptation.

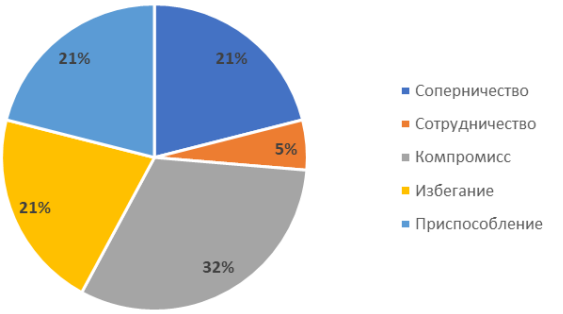

Figure 3. *Results of the Behavioural Type Survey*

According to the survey results, the majority (more than a third) of students show *Compromise* style of behaviour in conflicts, further the same number of students have *Rivalry* (tendencies of competition), *Avoidance* (passive behaviour in resolving contradictions) and *Adaptation* (strive to adjust to the needs and expectations of people around them). *The least popular variant is Cooperation*, which probably indicates insufficient readiness to work in a team.

The conducted diagnostics allowed us to draw conclusions that

1. the level of understanding, analysing, interpreting and using information in the communication process is predominantly high (42%) or average (32%); the low level of the cognitive component is observed in about a quarter of students in the group.
2. More than half of the students have an average level of communicative culture in the activity component. More than a third of students have a high level, 10 per cent of students have a low level.
3. The motivational component shows a small difference between the average and high level, only 21% of students have low motivation to develop communicative culture (Fig.4)

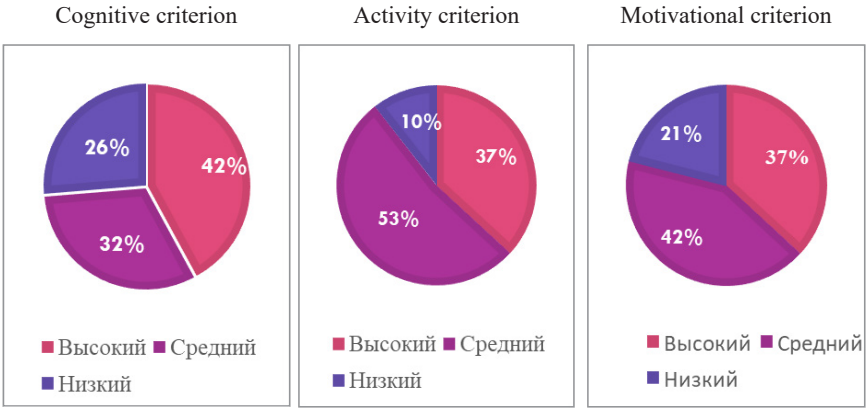

Figure 4. *Results of students' diagnostics*

As part of the solution of the last task - to propose methodological recommendations and develop measures for the formation of communicative culture of students of technological college in the study of disciplines of the profile cycle, the following methodological recommendations were identified and justified.

Conducting trainings (on the development of effective listening and active participation in dialogue, conflict management, development of cooperation and

teamwork skills, development of public speaking skills and emotion management) related to the disciplines of the profile cycle will give students the opportunity to practice their communication skills adapted to their future professional activities.

Practical exercises, such as group work on projects, discussions, game situations and other forms of active interaction will help students to consolidate their skills and apply them in practice.

The use of information and computer technologies for the formation of students' communicative culture in the disciplines of the profile cycle (web-conferences and online forums, use of online databases and resources, creation of multimedia presentations and videos, communication via e-mail and messengers, collective projects using online tools) will allow students to actively participate in the learning process, develop communication skills, independence and research approach in the study of chemistry.

All of the above recommendations can be implemented in the process of studying disciplines of the profile cycle. It is important to create a supportive and stimulating environment in which students can develop their communication skills and receive feedback from lecturers and fellow students. The results of the study will be important for optimising the educational process, adapting programmes and teaching methods, as well as improving the quality of preparation of students of technological college for successful professional activity.

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DOI 10.34660/INF.2023.67.92.072

俄罗斯普通教育250年国家监管
250 YEARS OF STATE REGULATION OF RUSSIAN GENERAL EDUCATION

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注解。本文探讨了十九世纪至二十一世纪初俄罗斯帝国、苏联、俄罗斯联邦普通教育国家监管的形成和发展；追踪参与这项任务的社会机构。

关键词：普通教育、全国教育体系、教育法、国家教育战略、教育部。

Annotation. *In this article the formation and development of state regulation of general education in the Russian Empire - USSR - RF during the XIX - early XXI centuries is considered; social institutions involved in this task are traced.*

Keywords: *general education, nationwide education system, educational law, state educational strategy, Ministry of Education.*

The problems of state strategy and tactics in the field of education are complex both in past political history and for modern states. In the Russian Empire, the creation of a nationwide education system under the control of the state began in the era of Catherine II. It was then that the Commission on the Establishment of Public Schools (since 1872) and the first act regulating the activities of homogeneous educational institutions “Statute for Public Schools in the Russian Empire” (5.08.1786) appeared.

Education management in Russia in the XIX - early XX centuries was concentrated in the Ministry of Public Education (MPE), the Military Ministry, the Spiritual Department and the Office of Empress Maria’s Institutions. Each of them acted completely independently and developed the system of education and upbringing that it considered the best. What united them was the national idea that education in the state should consist in the realisation in all elements and in all strata of society of the spirit of love, devotion and the good of the Fatherland. This was to be served by the state administration, all state public institutions, the press, literature and all civil structures, and first of all by the school as a state and at the same time public institution. Emperor Nicholas I, when formulating the ed-

ucational doctrine of the Russian Empire in his Manifesto of 13.07.1826, pointed to the school as one of the most important means of managing the socio-political situation.

The state endeavoured to keep the management of both public and private educational institutions in its hands. Despite this, the private ones had considerable rights in determining the content of education within the framework of state norms. Course selection in private institutions was to be at the discretion of the institution itself, with the exception of those quadrilateral (foundational) courses that were equally necessary for each learner, "such as: Law of God, Russian language, Russian history and Russian geography".[1]

The Ministry of Education, along with others, was established in 1802, during the reign of Alexander I. Over the course of history, the name of the Ministry has changed, as well as the tasks that were assigned to it in connection with such changes: the Ministry of Public Education, the Ministry of Spiritual Affairs and Public Education, the People's Commissariat for Education of the RSFSR, the Ministry of Education of the USSR (RF), the USSR State Committee for Education, the Ministry of Education and Science of the Russian Federation, etc.

Since the 19th century, a detailed regulated system of education and the state enlightenment doctrine were formed in the state. The minimums and maximums of educational courses were determined, certain methods were prescribed, the circle of citizens subject to education in educational institutions of the level that corresponded to the class belonging was defined. The first attempt was made to codify the norms of educational law, but this process remained incomplete. With the coming to power of Nicholas I (1825-1855), after the relative freedom during the reign of Alexander I, the government strictly controlled textbooks and manuals. Censorship was introduced not only in fiction and journalism, but also in educational literature. It also defined the teaching staff and the procedure for obtaining their ranks and titles. All basic documents defined not only the educational but also the educational aims of the school system. § 49 of the Statutes of Gymnasiums and Progymnasiums of 1864[2] standardised the number (up to forty) of pupils in classes. In Soviet and present times, the number of pupils is regulated by the Sanitary Rules and Norms (Sanpin).

The state manages and controls social institutions primarily through law. The task of educational law for effective state regulation is to create an instrument of modern era regulation of educational legal relations, to free itself from imperfec-

[1] Charnolusky, V. I. Ministerial schools: A systematic collection of laws, regulations, rules, instructions, programmes and reference information on two-class and one-class rural and railway schools of the Ministry of National Education. 2nd edition, revised [text]. - SPb. Knowledge, 1909. - p. 1.

[2] Statutes of gymnasiums and progymnasiums. 19 November, 1864. // Collection of resolutions on the Ministry of National Education. The reign of Emperor Alexander II. 1855 - 1864. T. 3 [text]. - St. Petersburg, 1865. - Stlb.1301 - 1326.

tions and emerging shortcomings. Since the time of Catherine II there has been a continuous process of creating regulatory documents that are the basis of Russian educational law. They include Laws, Resolutions, Orders, Circular Letters of the Minister of Public Education, Statutes of educational institutions, Regulations of educational institutions of different types, which were preceded by "Preliminary Rules of Public Education" (24.01.1803), curricula, educational plans. Initially, education in the empire was regulated by the norms of civil and administrative law, and in Soviet times also by the state (constitutional) law.

The system of general education being created in Russia was based on the university districts established in the early 19th century. That is why the first Statutes of individual educational institutions bore too obvious an imprint of the parent University to which they were subordinated and were clearly individualised. After the reforms of the end of the 20th and especially of the 60th years of the 19th century, all educational institutions unified themselves to such an extent that differences could be found only in the teaching of local languages. In the second half of the 19th century, educational institutions were finally transferred to educational districts independent of the University, and all primary and secondary schools of general education were now governed by standardised Statutes and Rules. They were published both in separate brochures and in Compendiums.

In the 70s of the 19th century, the publication of two collections containing legislative acts on education began. The Collection of Resolutions on the Ministry of Public Education (17 volumes) and the Collection of Orders on the Ministry of Public Education (16 volumes) contained not only the Statutes, but also the whole range of resolutions, orders and circulars adopted from the moment of the Ministry's establishment up to and including 1917. Additions to the already published collections were periodically issued. Such was, for example, "Supplement to the Collection of Resolutions of the Ministry of Public Education for 1803-1864" 1867.[3]

At the beginning of the 20th century, not only generalised Compendiums of Resolutions and Ordinances became popular, but also sub-sectoral ones, such as Compendiums of Resolutions and Ordinances for real schools of the Ministry of Education and Science, teacher training institutes, teacher seminaries, and city schools of the Ministry of Education and Science. They were more convenient for principals, inspectors, and teachers because they contained special collection of documents and were much smaller and in a more convenient format for frequent use. In the early twentieth century, a 16-volume edition in four books of the Code of Laws of the Russian Empire by A. M. Nurenberg was published. M. Nuren-

[3] Supplements to the Collection of Resolutions on the Ministry of Public Education 1803-1864. [text]. - St. Petersburg. : 1867. - 1096 p.

berg.[4] Here in Book Three, Volume XI is devoted to education legislation as of 1908.

Changes in public education were actively discussed in the 3rd State Duma (1907-12), in particular the Bill on the introduction of universal primary education in the Empire. The topic of universal primary education had been on the pages of the pedagogical press and in periodicals since the 80s of the 19th century. However, it was only during the radical change of the regime from samoderjavie to the Duma monarchy that it began to be discussed in the form of a bill that could be implemented.[5]

The revolutionary events of 1917 left a deep mark on all branches of law. The laws of the Russian Empire were cancelled. Instead of laws, the Decrees and Declarations of the Soviet power acquired their force. But it soon became evident that the legal situation of education could not be regulated by them alone. All the affairs of education are transferred to the State Commission for Public Education created on 09/11/1917. State Commission for Public Education (later Narkompros). During the years of Soviet power, a new system of educational law was gradually formed: laws and legislative acts, resolutions, instructional letters, instructional and methodological letters, model statutes of educational institutions, programmes for academic disciplines and curricula approved by the Ministry of National Education. In the system of Soviet educational law, as well as in other branches, a significant place was occupied by party documents of the RCP (b) - CPSU (b) - CPSU: decisions of party congresses, resolutions of the Central Committee and its bureau, as well as documents of the All-Union Leninist Communist Union of Youth and the All-Union Central Council of the Pioneer Organisation. A significant share was made up of documents of the All-Union Central Council of Trade Unions, a trade union structure that was practically allied with the Bolshevik state.

The educational law of the renewed Russia received its first document on 20.01 (2.02) 1918. - Decree on the separation of church from state and school from church [aka “On Freedom of Conscience, Church and Religious Societies”], in the very first months of the Bolsheviks’ accession to power, and a little later - the Regulation on the organisation of public education in the Russian Republic (18/07/1918). At the transitional stage of formation and strengthening of the Soviet power all laws and by-laws were published in periodicals, special collections, separate brochures. In the 1920s, the Systematic Collection of Current Laws of

[4] Code of Laws of the Russian Empire. All 16 volumes, corrected according to the Continuations of 1906 and 1908 and supplemented by later laws, in 4 books / Compiled and published by Chartered Attorney A. M. Nurenberg. Vols. X-XII, vol. XI, part I, section two. Book three [text]. - M., 1910.- 1036 p.

[5] Resolutions of the First All-Earth Congress on Public Education in Moscow 16-30 August 1911. [text]. - M., 1912.- 35 p.

the Union of Soviet Socialist Republics (1926) and the Collection of Codes of the RSFSR were published.

Initially, the role of Statutes in the Soviet school was fulfilled by Regulations. These were the "Regulations on the Unified Labour School of the RSFSR" 1918[6], adopted in October and the "Declaration on the Unified Labour School". The Regulations became the first Soviet law on educational school, approved by the Presidium of the All-Russian Central Executive Committee. But later returned to the practice of Charters of educational institutions - "Charter of the Unified Labour School" (1929), "Charter of the secondary general education school" (1971). In Soviet times, it was intended to regulate the typical relations of a typical school. Today the Charter is a local normative act, but mandatory information is defined by the Law on Education (Art. 25).

Another important source of educational law is Curricula. Having appeared in the 1820s, they took a firm place in the system of organisation of the educational process, which they still are today. For example, on the threshold of the reform of 1864, the capital's publishing house published the Plan and Distribution of the Teaching of Sciences in Higher Public Schools, Gymnasiums and Progymnasiums, based on the draft Statutes of Lower and Secondary Schools, compiled by the Ministry of Education and Science. The first curricula contained methodological recommendations on teaching, which significantly distinguished them from modern curricula, which detailed recommendations only on teaching time. Each subject was outlined: what was to be learnt and what was to be taught; the teacher was instructed on which methods to use to achieve the best results in the subject. The value of the first plans was the indication that they were to be drawn up according to the teacher's personal idea without reference to official teaching aids. But later attempts by students (teachers) to deviate from the state-approved curricula were repressed. Teaching in all subjects was conducted in accordance with the Ministry's curriculum.

Programmes of academic disciplines for gymnasiums appeared for the first time in the 1860s. Initially, they included not only the content of the subject, but also detailed methodological recommendations, as mentioned above. Since 1866, the Ministry of Education has been closely engaged in bringing the curricula into a unified state system both in terms of content and teaching methods and techniques. The Minister obliged the chiefs of educational districts to submit to him the programmes unified by districts for approval. Later, the programmes were written only on the basis of the intended topics of study with the number of hours of teaching time allotted. Unlike gymnasiums, the folk school had no official programmes until 1872, although it was under strict state care. It was not until 1891

[6] Regulations on the Unified Labour School of the RSFSR. Publication of the Vyatka Provincial Department of Public Education [text]. - Vyatka, 1918.- 125 p.

that compulsory programmes were introduced for all schools. From 1872-73, Compendiums of Programmes appeared, including programmes for all academic disciplines of the respective school. A similar document has been prepared today (2023). Alexander II called for strict punishment of teachers for any deviation from the approved programmes, as well as from the plans, which, in fact, was the introduction of police supervision over the teaching process: "teaching that is contrary to the existing rules and hostile to the fundamental foundations of faith and the conditions of moral and material well-being of the people cannot be tolerated".[7] The strictest supervision was prescribed for private educational institutions and home teachers.

In Soviet times, curricula and study programmes were regularly published. Despite the name "exemplary sample", all educational institutions were obliged to follow them. As in the past, they were published in separate brochures and Collections of Programmes.[8] Since the 70s of the 20th century, it has become popular to use not only state programmes, but also author's programmes, which received the Ministry of Education's approval, and democratisation of school education has been revived.

Among auxiliary sources one of the most important places is occupied by the reports of ministers to the Emperor (and in Soviet and subsequent times to the Head of Government and Head of State). Their publication began in the 40s of the 19th century. Circulars of the Minister of Education - orders sent as directives to subordinate institutions and persons - had a significant place in the system of relations between the Ministry and the school. This name in official correspondence began to appear in the Nicholas era, and came into common use after the reforms of the 60s, especially in the last third of the XIX century. There are dozens of them, they were addressed most often to the directors of schools and gymnasiums, heads of educational districts and employees of the Department of Education. The Circulars were devoted to the issues of education in the whole diverse spectrum: from the content of education to salaries and acquisition of educational libraries. It is impossible to find the Circulars in a separate edition, they are included in the Collection of Orders of the Ministry of Public Education.

In Soviet times, along with documents of various legal plans, in crisis or war years People's Commissars of Education resorted to such a form of by-law as an Order. Such was, for example, the Order of the People's Commissar of Education of the RSFSR on curricula for primary, incomplete secondary and secondary

[7] Collection of Orders of the Ministry of Public Education. 1865-1870. Vol. 4. / № 84, stlb. 334 [text]. - St. Petersburg, 1874.

[8] See, e.g., Sample Programmes of the Soviet Unified Labour School of the 1st stage, compiled by the subject commissions of the Novonikolayevsk Department of Public Education [text]. - Novonikolaevsk, 1920. - 80 p. Or Approximate curricula for the 1st and 2nd stages in the unified labour school [text]. - M., 1924. - 8 p.

schools № 862 of 23/09/1935.[9] These documents were akin to the Tsarist Circulars and were to be implemented immediately without further explanation or comment. After the Great Patriotic War, in 1946, the development of new programmes began, which tried to bring school education closer to modern scientific achievements. For the first time since the establishment of Soviet power, not only ministry officials and practising teachers, but also scientists were involved in the process of developing new programmes. Each programme was developed by a specially created team. At least two draft subject programmes were proposed. Only after discussion were they approved by the RSFSR Ministry of Education. Ten years later, a new draft curriculum was proposed to the wide strata of the teaching profession in pursuance of the decisions of the XX Congress of the CPSU on polytechnicisation of schools, according to which more time was given to familiarisation with real production in the subjects of the scientific and natural cycle. There appeared optional courses and classes in clubs at the request schooler, such as bookkeeping, housekeeping, young technicians, young naturalists, training in driving a car or agricultural machinery, training in agricultural technology, etc.[10]

In 1970, a new Charter of the secondary general education school was adopted,[11]In 1970 the Law on Schools was adopted, and three years later the Fundamentals of Legislation of the Union of Soviet Socialist Republics and Union Republics on Education were adopted, repeating the basic principles and provisions of the Charter of Schools.

In the early 1870s, Instructions, another form of by-laws, appeared, the first of which was addressed to inspectors and other persons sent to audit educational institutions. From that time such Instructions became a legal norm.

The scope and content of education in the empire were made interdependent with the acquisition of ranks and titles (e.g., "On the rules for promotion to the ranks of civil service and tests in the sciences, for promotion to collegiate assessors and state counsellors" of 6.08.1809, etc.). The Ministry of Education and Science had to monitor compliance with the tsar's decrees in this area. Examinations were introduced for all officials, regardless of whether they were entering the service for the first time or had already fulfilled their duties but wished to be promoted. During the reign of Nicholas I, political loyalty to the state became a statutory requirement for the selection of teachers for educational institutions. Later, the level

[9] Order of the People's Commissar of Education of the RSFSR on curricula for primary, junior secondary and secondary schools No. 862 of 23/IX-1935 / Curricula for primary, junior secondary and secondary schools. Narkompros RSFSR [text]. - M. : Uchpedgiz, 1935. 31 p.

[10] On the draft of a new curriculum for primary, seven-year and secondary schools [text]. - M., 1956. - 20 p.

[11] Resolution of the Council of Ministers of the USSR No. 749 of 8 September 1970. -https://www.consultant.ru/search/?q=Постановление+Совета+министров+СССР+№+749+от+8+сентября+1970+года (date of circulation 30/07/2023).

of education was taken into account when enlisting in the army and influenced the length of service in the tsarist army.

At the end of 1872, the Ministry streamlined the examination system in the country. According to the Rules on testing of pupils of gymnasiums and progymnasiums, admission, transfer and final examinations were introduced, which were oral or written. In Soviet times, the final examinations for the course of basic and secondary school in Russian language and mathematics were written and oral, for other subjects, the number of which changed over time - oral. In modern Russia, the system of state final attestation was introduced, and the exams in all subjects became written, but in foreign language the exam also contained such an oral element as "speaking".

On 13/03/1850, a Committee was constituted to review textbooks. Until then, there were many textbooks, but they were not compulsory. In the 1860s, the Minister of Education sent a directive to the heads of educational districts to bring uniformity to gymnasium textbooks and to prohibit the use of several textbooks simultaneously in the teaching process. The use of several textbooks, as noted in the document, was only permissible for teaching students.

The creation of a mass general education school is a merit of the USSR. In the 1920s, the elimination of illiteracy, unparalleled in the world, was implemented, when the citizens of the new Russia were subject to education regardless of age. In the 1930/31 academic year, the Decree of the All-Russian Central Executive Committee and the USSR Council of People's Commissars introduced universal compulsory education: four-year primary education in rural areas and seven-year primary education in cities. From 1/01/1974 the transition to universal compulsory secondary education in the volume of ten grades began, which was actually completed by 1976. This meant that now every child could receive free secondary education in the volume of 10 grades (since 2007 - 11 grades) and continue it in other types of state (free) educational institutions.

In 1977, party resolutions were adopted aimed at the development of the entire education system: "On Further Improvement of Education and Upbringing of General Education School Pupils and Their Preparation for Labour" and "On Transition to Free Use of Textbooks by General Education School Pupils". The 1978 Constitution of the RSFSR, following the Union legislation (art. 43), consolidated the results achieved and proclaimed the right of Soviet citizens to education in their native language and the possibility of self-education.

All subsequent amendments - the 1992 Law on Education,[12] The Constitution of 1993, the Decrees of the President of the Russian Federation, the adoption of FSES (Federal State Standard) in education, the introduction of the State Final

[12] Law of the Russian Federation "On Education" from 10/07/1992 N 3266-1. -https://www.consultant.ru/document/cons_doc_LAW_1888/ (date of circulation 30/07/2023).

Attestation (2008), the emergence of the Federal Service for Supervision of Education and Science (Rosobrnadzor) in 2004, etc., were essentially a continuation of the implementation of state policy to regulate the education and upbringing of the younger generation.

Thus, the analysis shows that with the transition of Russian society to industrial development and all subsequent time, the state was directly interested not only in all-encompassing regulation of education, from determining the level, content, methods of education and upbringing necessary for the solution of state tasks, the number and duration of lessons, the number of students in classes, the qualifications of teachers and educators to control not only education, but also the entire system that provides it.

DOI 10.34660/INF.2023.42.89.073

多结构语言中的“愚蠢”概念（基于俄语、英语和德语谚语）
THE CONCEPT “FOOLISH” IN MULTI-STRUCTURAL LANGUAGES (BASED ON RUSSIAN, ENGLISH AND GERMAN PROVERBS)

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抽象的。文章致力于对不同体系语言中含有“愚蠢”成分的谚语、俗语进行对比分析。分析揭示了不同文化中独特和常见的图像。比较是通过从谚语、俗语词典中连续抽样的方法选取的俄语、英语和德语的paroemia材料进行的。作为研究的结果，作者揭示了每种研究文化中愚蠢人的独特特征，例如德国人的骄傲，（«Je dicker die Bretter, je tifer der Bolz; ein Je dummer Watering der Bengel, jegrosser der Stolz»);对于俄罗斯人来说 - 一个人的外表和内心世界之间的差异（“头就像牛的头，但你看，一切都很小”；“树桩很大，但傻瓜”；“额头”很宽，但大脑很小»）；对于英国人来说——幼稚的粗心（“孩子和傻瓜都过着快乐的生活”）。同时，我们还发现了所有研究文化中低智力人群的共同特征（健谈、运气、狡猾）。

关键词：概念、谚语、语言世界图景、谚语、俗语、比较分析。

Abstract. *The article is devoted to a comparative analysis of proverbs and sayings with the component “stupid” in languages of different systems. The analysis reveals unique and common images in different cultures. The comparison is carried out on the material of paroemias of Russian, English and German languages, selected by the method of continuous sampling from dictionaries of proverbs and sayings. As a result of the study, the author reveals the distinctive specific features of stupid people in each of the studied cultures, for example, for the Germans - pride, («Je dicker die Bretter, je tiefer der Bolz; ein Je dummer watering der Bengel, je grosser der Stolz»); for Russians - a discrepancy between the appearance and the inner world of a person («The head is like that of an ox, but everything, you see, is small»; «The stump is great, but the fool»; «The forehead is wide, but the brain is small»); for the British - childish carelessness («Children and fools have merry lives»). At the same time, common features are found that are characteristic of people with low intellectual abilities in all the studied cultures (talkiness, luck, cunning).*

Keywords: *concept, proverbs, language picture of the world, proverbs, sayings, comparative analysis.*

Each language is a reflection of a certain culture and characteristics of the nation-native speaker, through the language the diversity, the uniqueness of this or that language is revealed: «Through the variety of languages, the wealth of the world opens up for us. Language always embodies the originality of a whole people...» [2, p. 103].

In this article, we will try to compare the low intellectual characteristics of a person in the mirror of Russian, English and German paremiology, find common features for representatives of these nations, as well as unique principles underlying the image of a stupid person.

Intelligence is a basic concept in cognitive linguistics [3, p. 155]. However, despite all the achievements in this area, the problem of intelligence and intellectual qualities, as well as human abilities, is debatable and has not been completely resolved at the moment. In confirmation of this, scientists have not yet come to an agreement on the definition of the concept of «intelligence», although they operate with it in many sciences. The universality of intelligence is one of the reasons it is difficult for theorists to define this phenomenon.

According to the philosophical definition, intellect/mind is the general mental potential of a person, the degree of realization of the abilities that he expediently uses to adapt to life. Thanks to the intellect, a person can compare, develop abstractions, form concepts, judgments, and make conclusions [7, p. 493-494].

In the explanatory dictionary of S. I. Ozhegov, the following definition is given: «intelligence (mind) is a thinking ability, a mental beginning in a person» [6, p. 249].

In English, the concept of intellect is interpreted as: «the power or ability of the mind by which one knows or understands, capacity for thinking and acquiring knowledge, esp. of a high or complex order; mental capacity» [12, p. 990]; - «the ability to understand or deal with ideas and information» [9, p. 815].

As can be seen from the above-mentioned definitions, the concept of «intelligence» is closely related to the concept of «ability/quality». Thus, the identification and comparison of the intellectual characteristics of a person through the prism of languages with different structures will allow a better understanding of the culture and characteristics of these nations. The comparison is based on proverbs and sayings, since they most clearly reflect the uniqueness of a particular nation, its originality and color.

The linguocultural analysis of the studied paroemias with the “stupid” component is based on a comparative approach, as a result of which it is possible to

divide into the following semantic groups: 1) paremias describing stupidity; 2) proverbs describing fools and their actions.

Let's consider each group of the presented proverbs.

In all studied languages the opinion coincides that fools always tell the truth. For example, in German – «Lachend sagt der Narr die Wahrheit» (Laughing, the fool tells the truth); in Russian – «Stupid and child always speak the truth»; and in English – «Children and fools tell the truth».

In the view of the Russians and the British, stupid people are talkative. For example, in Russian – «A stupid person talks, a smart person thinks»; «A person with a short mind acquires a long tongue»; «The donkey is known by the ears, and the fool - by the speeches»; in English – «Foolish tongues talk by the dozen». Also, in English they say «A fool's tongue runs before his wit», which corresponds to Russian proverbs – «A fool's tongue runs ahead of his feet»; «A fool has words ahead of his mind»; «A fool speaks first, thinks later». In German, stupidity is associated with gossip. For example, «Wo viel Geschwatz ist, da fehlt es auch an Narren nicht» (Where there is much gossip, there is no shortage of fools).

The thoughtless actions typical of stupid people are ridiculed in the linguistic cultures of the studied languages, which is reflected in the non-equivalent proverbs of the Russian and English languages, respectively, «Give a stupid horse, he's not, and he'll go to hell» - «Set a beggar on a horseback, and he'll ride to the devil»; «Give a fool a rope, he will hang himself» - «Give a man rope and he will hang himself»; «A bad head does not give rest to the feet» - «Little wit in the head makes much work for the feet»; «And fool rope enough, and he will hang himself»; «Make a fool pray to God - he will hurt his forehead» - «A fool always rushes to the fore»; «Without a mind, the head is ruin for the feet» - «Little wit in the head makes much work for the feet».

In the cultures studied, the notion that stupid people are often lucky in life also coincides, for example, in the German language «Die dummsten Bauern haben die grossten Kartoffeln» (The dumbest farmers have the biggest potatoes); «Dummsten haben das meiste Gluck» (The dumbest are the luckiest); also parallels in Russian and English languages «Fools in all happiness», «Happiness loves fools, but not happiness destroys the smart» - «Fortune favours fools»; «Fools for luck»; «God sends fortune to fools»; «God has a lot of mercy on a fool» - «God sends fortune to fools».

In English, fools are compared to children in terms of a carefree attitude to life, for example – «Children and fools have merry lives», which corresponds to the Russian proverb «To live a fool in the world is not to grieve about anything».

Ironic jokes that fools are not brought up, but they themselves are born, take place in the studied languages, for example, full equivalents in German and English, respectively, «Narren wachsen unbegossen» (Fools grow up here without wa-

ter) – «Fools grow without watering» and the Russian equivalent is «They don't sow fools, they don't reap, they will be born on their own». Also, the Russian proverb about a large number of fools «There will be no fools in our century (and there will be enough for yours)» also depends on its correspondence in the English «The world is full of fools».

The manifestation of a person's stupidity is not connected with appearance, which is proved by Russian proverbs – «The head is like a stump, but everything, you see, is small»; «An empty ear stands higher»; «The stump is great, but the fool»; «The forehead is wide , but the brain is small»; «In the beard, buckwheat blooms, but in the head the chill is not a godfather»; «Head with a basket, but not a crumb to the brain»; «It's thick on the head, but empty in the head»; «The big one grew up, but we didn't get out of our minds»; «It shines on the head, but whistles on everyone's head»; «The forehead is wide, but the head is tight». Also, correspondences in Russian and English – «Beard is not a replacement for the mind» - «The wise brains don't lie in the beard»; «The head is big, but the brain is small» - «Big head, little wit»; «Wisdom is in the head, not in the beard» - «The brains don't lie in the beard»; «Not everyone is smart, who has a head» - «All asses wag their ears». Or only in English – «He has a head and so has a pin».

A large number of proverbs oppose the concepts «smart» - «stupid», for example, in the German language the opposition is based on talkativeness and silence – «Es schweigen mehr kluge Leute als dumme» (Smart people are more silent than stupid ones); «Ein weiser Mann lachelt, ein Narr lacht» (The smart one smiles, the fool laughs). There is also a parallel in Russian and English, respectively, «A smart one is silent when a fool grumbles» - «Wise men silent, fools talk».

In the studied cultures, wealth without mind is condemned, for example, in Russian. «For a foolish son, wealth does not help» – English proverb «Without wisdom, wealth is worthless». The British believe that preference should be given to wisdom over wealth «Better wise than wealthy»; «Wit is better than wealth». The Germans find common features between the rich and stupid – «Reich und dumm vertragen sich gut» (Rich and stupid get along well). The Russians and the British believe that similar people quickly find a common language – Russian proverb «A fool praises a fool» – English proverb «One fool praises another». In Russian and English linguistic cultures, there is an opinion about the extravagance of fools, for example, English proverbs «A fool has a hole in his handful»; «A fool easily parted with money» - Russian proverb «A fool and his money are soon parted».

In the course of the study, non-equivalent proverbs were found in all languages: Russian – «They didn't know yet - they called him Ivan, but they found out, they called him a blockhead»; «The eye sees far, but the mind sees even further»; «Every Jeremey, think about yourself»; «Growth from Ivan, but with a mind like

a blockhead»; English – «Penny wise and pound foolish»; «An ounce of practice is worth a pound of precept»; German – «Ein gescheiter Teufel ist besser als ein dummer Engel» (Smart as hell is better than a stupid angel); «Wer mit der Dummheit kampft, muss scharfe Pfeile haben» (He who fights stupidity on the side must have sharp arrows).

In the course of the study of the paremiological fund of the presented languages, a certain image of a stupid person was formed in the studied cultures. According to the material obtained in the course of a selection of words, proverbs and sayings, it is possible to identify qualities common to all cultures, inherent in stupid people. These are such qualities as talkativeness, noisiness, fussiness, luck and extravagance. For example, parallels in all studied languages, in German in the language – «Lachend sagt der Narr die Wahrheit» (Children and fools speak the truth); in Russian – «Stupid and small always speak the truth»; and in English «Children and fools tell the truth». In the cultures studied, the notion that stupid people are often lucky in life also coincides, for example, in the German language «Die dummsten Bauern haben die grossten Kartoffeln» (The dumbest farmers have the biggest potatoes) ; «Dummsten haben das meiste Gluck» (The dumbest are the luckiest); also parallels in Russian and English languages «Fools in all happiness», «Happiness loves fools, but not happiness destroys the smart» – «Fortune favours fools»; «Fools for good luck»; «God sends fortune to fools»; «God has a lot of mercy on a fool» – «God sends fortune to fools».

The distinctive specific features of stupid people in the studied cultures are:

for the Germans - pride, for example, «Je dicker die Bretter, je tiefer der Bolz; ein Je dummer watering der Bengel, je grosser der Stolz» (The thicker the boards, the deeper the bolt; and the dumber the scoundrel, the greater the pride); «Dummheit und Stolz wachsen auf einem Holz» (Stupidity and pride grow on a tree); «Je grosser Narr, je grosser Hochmut (Stolz)» (The bigger the fool, the bigger the pride);

for Russians, it is a discrepancy between the appearance and the inner world of a person, for example, «The head is like that of an ox, but everything, you see, is small»; «The stump is great, but the fool»; «The forehead is wide , but the brain is small»; «In the beard, buckwheat blooms, but in the head the chill is not a godfather»; «Head with a basket, but not a crumb to the brain»; «It's thick on the head, but empty in the head»; «The big one grew up, but didn't take out his mind»; «It shines on the head, but whistles in the head»; «The forehead is wide , but the head is crowded»;

for the British - childish carelessness, for example, «Children and fools have merry lives».

In the studied linguocultures, an opposition was found - on the one hand, nothing will save a fool, and he will not grow wiser, on the other hand, with age, a

fool can learn something. For example, in the German «Dumm geboren, dumm verstand geblieben» (Born stupid, remained stupid) and «Die Zeit macht auch den Narren klug» (Time makes fools wise), the proverb «Die Zeit vergeht, der Narr besteht» (Time flies, the fool endures). Also, parallels in Russian and English, respectively, «You were born a fool, you will die a fool» – «He that is born a fool is never cured»; «Fools will be fools still»; «At forty years there is no mind - and there will not be» – «A fool at forty is a fool indeed»; «Old fools are dumber than young ones» - «There is no fool like an old fool».

Thus, the results of the study fully confirm our working hypothesis that, considering English, Russian and German proverbs that describe the low intellectual characteristics of a person, and the linguistic picture of the world of different linguistic cultures, they have a general idea of a person and his abilities. At the same time, each language implements a certain way of displaying reality in accordance with the historical experience of a given people, its culture and living conditions.

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DOI 10.34660/INF.2023.45.93.074

中国大众传媒的评价
VALUATIVES OF CHINESE MASS MEDIA

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注解。价值的概念首次被引入新闻理论中。它们通过识别指标来描述，包括价值观、规范和传统、英雄万神殿和反英雄肖像、评价性描述语言、文化艺术、意识形态。以矩阵形式，它们将价值表示为一个整体。对大众媒体的内容分析使我们能够将几代中国领导人的思想称为有价值的思想

关键词。有价值的。矩阵。中国一代领导人。

Annotation. *For the first time the concept of valuatives is introduced into the theory of journalism. They are described by identification indicators, including values, norms and traditions, pantheon of heroes and portraits of anti-heroes, language of valuative description, culture and art, ideology. In matrix form, they represent the valuative as a wholeness. Content analysis of mass media allows us to name the ideas of generations of Chinese leaders as valuatives*

Keywords: *Valuative. Matrix. Generation of Chinese leaders.*

The term “valuative” was introduced into scientific circulation in September 2011 by Julia Mikhailovna Korotchenko (Simferopol), associate professor at the V. I. Vernadsky Tauride National University, candidate of philosophical sciences. Then she made a significant clarification as a basic term of the methodology of valuative analysis, clarification of its heuristic potential, as well as in the aspect of the possibilities of internal valuative modelling[1].

Valuatives are of significant state importance because, according to Article 22 of the Constitution of the People’s Republic of China (PRC), it is “the state that develops... the press, radio and television, and publishing”. In the search for the valuatives of the Chinese media, one should also bear in mind that in the 21st century, researchers in China tend to consider the mass media in the broad context

of the formation of the political culture of society. The most significant are the research works of Wang Guohua [2], Wang Zhan Yang [3], Ye Hao [4], Liu Bosian [5], Liu Jinglin [6], Cui Baogo [7], Zhang Zhou [8], Shen Guofan [9], Yu Guomin [10] and others. The most notable among Chinese researchers of the role of the media in the formation of political culture of society is the work of Professor Tong Bin of Beijing State University [11].

At the turn of the XX-XXI centuries, the issues of media influence on the formation and development of political culture took one of the central places in the works of many researchers. This problem was first formulated by such Chinese sociologists and politicians as Wang Ping [12], Liu Jun[13], Ding Fan Jian[14], Deng Jian[15], Ma Li[16], Zhang Xiao Guang[17], Zhang Yao [18], Zhou Taizi [19], etc.

The empirical basis of the study was the media leadership documents adopted by the central organs of the Communist Party of China (CPC) [20, 21, 22].

The auxiliary method in this paper is the matrix method. Matrices were first mentioned back in ancient China, called then “magic square” (chinese 魔术广场， pinyin móshù guǎngchǎng). A matrix is a mathematical object written in the form of a rectangular table of elements, which is a set of rows and columns at the intersection of which its elements are located [23].

$$M = \left\| \begin{array}{ccccc|ccccc} 1 & 0 & 0 & \dots & 0 & b_{11} & b_{12} & \cdots & b_{1r} \\ 0 & 1 & 0 & \dots & 0 & b_{21} & b_{22} & \cdots & b_{2r} \\ 0 & 0 & 1 & \dots & 0 & b_{31} & b_{32} & \cdots & b_{3r} \\ \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & \dots & 1 & b_{k1} & b_{k2} & \cdots & b_{kr} \end{array} \right\|.$$

The number of rows and columns determines the size of the matrix. In the “magic square” with some set of rows or cells we have inscribed the Chinese ideological valuative. Y.M. Korotchenko imagines that the organising centre of stable social formations is a certain integrity that can be set systematically as an ordered ***n***-unit of elements and that is characterised by certain identification indicators [V_1 (values), V_2 (norms and traditions), V_3 (pantheon of heroes and portraits of anti-heroes), V_4 (language of valuative description), V_5 (culture and art), V_6 (ideology)]. She calls this integrity the valuative [24].

Content analysis of mass media, study of Party documents shows that the ideas of generations of China’s leaders can be called valuatives. The Preamble of the Constitution of the People’s Republic of China (2018 version) states that “the peoples of all nationalities of China, led by the Communist Party of China and guided by Marxism-Leninism, Mao Zedong’s ideas, Deng Xiaoping’s theory, the theory of “three representations”, the scientific concept of development, Xi Jin-

ping's ideas of socialism with Chinese characteristics of the new era, will continue to uphold the democratic dictatorship of the people and the socialist path" [25]. Chronological groups of leaders are usually referred to as "generations of Chinese leadership", there is no exact equivalent to this expression in Chinese. The usual term in official discourse for such a group is "leadership collective", which is counted in generations. In official discourse, they are also not seen as leaders of the state (People's Republic of China), but rather as leaders of the party (CPC).

It has become a tradition to correlate each generation with the corresponding theoretical achievements. The first generation is associated with Mao Zedong, the second with Deng Xiaoping, the third with Jiang Zemin, the fourth with Hu Jintao (since 2002), and the fifth with Xi Jinping (since 2012) (see Table 1). In official CCP discourse, the division into "generations" and the definition of a "main leader" for each of the first, second, and third generations was established during Jiang Zemin's rule and first publicised in 1999. Jiang's successors maintained this generational division but moved away from the definition of "core leader" in the fourth generation, and the next general secretary, Hu Jintao, was never identified in official announcements as the "core" of the fourth generation, preferring to be referred to simply by the title "General Secretary." Xi Jinping continued this practice until October 2016, when the 6th Plenary Session of the 18th Central Committee referred to him as "core leader" in a document.

Table 1

Generations of Chinese leaders

Generation	Leader	Beginning	End	Ideas
The first	Mao Zedong	1949	1978	The theory of «new democracy» and the doctrine of building socialism
The second	Deng Xiaoping	1978	1989	Building socialism with Chinese specificity;
The third	Jiang Zeming	1989	2002	«Important Ideas of Triple Representation.»
The fourth	Hu Jintao	2002	2012	A scientific theory of development
The fifth	Xi Jinping	2012		Socialism with Chinese specificity of the new era

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DOI 10.34660/INF.2023.57.78.075

数字哲学——奥古斯特•孔德三阶段逻辑中人类进化第四阶段形成的概念
DIGITAL PHILOSOPHY - A CONCEPT FOR THE FORMATION OF THE 4TH STAGE OF HUMAN EVOLUTION IN THE LOGIC OF THE 3 STAGES OF AUGUSTE COMTE

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抽象的。目前，当人类的生活充满了数字产品，没有小玩意、电脑等电子手段的世界已经不可能继续存在时，我们可以断言，数字技术时代已经到来。今天，智能手机是人手的延伸，互联网信息是全人类思想的延伸。人工智能极大地补充了智人（lat. Homo sapiens）的现实，因此安装替代机械植入物可以改善生物体的身体，以及将数字植入物引入生物体的技术能力，包括。和大脑中的传感器 - 不仅可以监视个体，还可以控制生物体的各个器官。如果说十年前，科学家们关心的是数字产品在人类生活中的传播，那么今天的问题是使用这些数字智能的伦理领域，这一点在国际层面上也得到了证实，并被《建议书》一致通过。联合国教科文组织关于人工智能伦理的问题。因此，有必要认识到人类进化已进入新阶段——数字智能。人类进化第四阶段的概念——数字哲学，在奥古斯特•孔德提出的人类进化三个阶段的逻辑框架内，积累并系统化了当前所有正在发生的事件。

关键词：数字哲学、数字智能（DI）、人工智能（AI）、奥古斯特•孔德、赛博格、后人类、机器人。

Abstract. *At present, when all human life is filled with digital products and the continued existence of the world without gadgets, computers, and other electronic means is not possible, we can assert that the era of digital technologies has arrived. Today, a smartphone is an extension of a person's hand, and information on the Internet is an extension of the thought of all mankind. Artificial intelligence significantly complements the reality of Homo sapiens (lat. Homo sapiens), so the installation of alternative mechanical implants improves the body of a biological being, and technological capabilities for the introduction of digital implants into biological beings, incl. and sensors in the brain - allow not only to monitor the individual, but also to control various organs of biological beings. If 10 years ago, scientists were concerned about the spread of digital products in human life, today the issue is in the field of ethics in the use of these digital intelligences, which is also confirmed at the international level, unanimously adopted by the*

"Recommendation on the ethics of artificial intelligence" in UNESCO. Thus, it is necessary to recognize the transition to a new stage in the evolution of mankind - digital intelligence. The concept of the 4th stage of human evolution[1] *– - digital philosophy, accumulates and systematizes all ongoing events in the present time, within the framework of the proposed logic of Auguste Comte - 3 stages of human evolution.*

Keywords: *Digital philosophy, Digital intelligence (DI), Artificial intelligence (AI), Auguste Comte, cyborg, posthuman, robot.*

Digital intelligence helps biological beings

Scientific and technological progress has become the main driver for the emergence of machines that can be useful to mankind. In the beginning, we got steam engines, then electricity, the culmination of the accumulation of knowledge can be considered the appearance of the first computers, which accelerated scientific and technological progress. So Moore's law, which was formulated by Gordon Moore, co-founder of Intel in 1965, states that the number of transistors on an integrated circuit will double approximately every two years, which will lead to an increase in computing power and a decrease in the cost of electronics.[2]

Geometrically, the progress in the development of computers as a whole is confirmed, although it was proposed not by a calculation method, but by a prediction method. Mechanical processes in mankind began to be replaced by automation, software allows not only to speed up processes, but also to make the results of labor more accurate, which greatly facilitated the labor processes for mankind.

At the moment, the question is generally radically on the map of humanity, will machines be able to correct biological defects and errors? Will it be possible to make the blind - sighted, and unable to move - to walk? This problem is being solved today by Elon Musk Neuralink. In July 2023, Elon Musk shared his vision for the future: "I think it would be great to help millions of people around the world and give them an arm or a leg that is just as good, maybe better in the long run, than biological", ibid. "By combining a Neuralink implant and a robotic arm or leg for someone with an amputated arm or leg (or all arms or legs), we can create a cyborg body that will give people with disabilities incredible abilities" [Elon Musk wants Tesla and Neuralink to build a cyborg body to turn amputees into the bionic man https://finance.yahoo.com/news/elon-musk-wants-tesla-neuralink-155932038.html?utm_source=ixbtcom]

Can technology increase life expectancy? Can biological beings live forever? This question is obvious that it is not, but cyborgs, a post-human who will replace

[1] V. Smetana. EVOLUTION OF POSITIVE PHILOSOPHY OF O. KONT IN THE CONTEXT OF NEW KNOWLEDGE IN THE 21st CENTURY. Journal "Sociology" №3, 2023

[2] Moore, Gordon E. (April 19, 1965). "Cramming more components onto integrated circuits"

individual elements of the body with implants, may prolong their existence, can be confidently assumed.

Artificial intelligence today makes it possible to simplify many everyday tasks for a person, can coordinate biological activity, and can solve production problems. In the Western world, there is a myth about the desire for "abundance", the availability of everything that will make a person's life better, maybe it is the new, 4th stage of human evolution that is able to provide this?

Thus, digital products are an integral part of human life today. Life becomes more comfortable and convenient, which is fully consistent with the logic of scientific and technological progress. At the same time, digital philosophy is able to study the ongoing processes of change in the world and not only in the field of ethics in the use of artificial intelligence.

Digital intelligence governs and controls biological beings

Trust in machines is steadily growing, and this is confirmed by the results of many years of interaction. Thus, humanity is gradually outsourcing certain functions to digital technologies, for example, security issues. Large industrial facility under the full supervision of digital intelligence, control and manage sensors with specific functions. Recent developments in the field of the use of unmanned vehicles tell us about the trend of transferring rights to artificial intelligence over the safety of human life. When the machine takes full control and guarantees trouble-free results.

There are many interesting solutions in the field of medicine using non-invasive sensors for collecting information that can control, for example, the sugar level and the vital activity of other organs of a biological being with specific recommendations: "what and how to do at one time or another."

The next stage of evolution is the installation of sensors in the body of a biological being, which will collect information on the one hand, and correct or improve life, on the other hand. If earlier the Elon Musk Neuralink company conducted experiments on pigs and monkeys, then in May, 2023 the Neuralink company announced that it received permission from the Food and Drug Administration (FDA) of the US Department of Health to conduct clinical trials on humans. Now on the Neuralink website, you can apply for the installation of a sensor for a person for US citizens.

Thus, biological beings, seeing opportunities to improve certain functions of their body, after a certain period of time will begin to install different implants and move into a new type of biological being - a cyborg or a posthuman. This issue requires serious study, because. if elements are installed in a biological being that are controlled by artificial intelligence, then who is responsible for the decisions and actions of such a biological being - a cyborg, a posthuman?

Digital intelligence will exclude biological beings from the control of the world

The population of biological beings is at its peak, and new types of labor resources are already emerging today - digital assistants, consultants, etc. using artificial intelligence. This process of replacing a biological being with a digital one has been taking place at an accelerated pace in recent years.

But a new breakthrough in replacing human labor can be seen with the introduction of assistant robots that can perform heavy, difficult, dangerous or monotonous work. On the future of robots, Elon Musk said: "Robots are originally needed to do mechanical, dangerous or boring work, basically this is the kind of work that people do not want to do until they are paid"[3]. The sale of such robots is planned for the coming years, which means that robots, as a whole class of labor professions, will replace humans in production processes. At the same time, what you should pay attention to is that robots will have artificial intelligence, which means that digital intelligence will be able to control robots without human intervention.

Robots control robots. The rate of propagation of such a model is difficult to predict. Biological beings will not be able to compete with new technologies.

Thus, in the new model of humanity, where in its natural form there will be less and less "homo sapiens" over time, and more cyborgs, posthumans and robots, as it seems to us in the worldview of the future humanity.

The 4th stage of the evolution of mankind - digital, did not arise in one day, the process of formation of this stage was formed earlier and can last for decades in the 21st century. The transition from "positive philosophy" to the era of "digital philosophy" is a consequence of scientific and technological progress, which is confirmed everywhere in everyday life.

[3] https://m.youtube.com/watch?v=uaARb9eDzOY

DOI 10.34660/INF.2023.75.98.076

透过人口系统论的棱镜看唯心主义与唯物主义的对抗
THE CONFRONTATION OF IDEALISM AND MATERIALISM THROUGH THE PRISM OF THE THEORY OF POPULATION SYSTEMS

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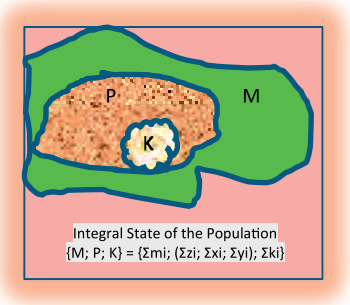
抽象的。试图以“人口系统矛盾概括论”的方法论来思考哲学中观念与物质的首要性问题以及这些概念之间的本质关系。

关键词：种群理论、矛盾概括、唯心主义、唯物主义、属性、原子、思想量子、量子比特、种群动态、意识形态复合体。

Abstract. *An attempt to consider the issues of the primacy of Idea and Matter, as well as the essential relations between these concepts in philosophy, based on the methodology of the “Theory of Ambivalent Generalization of population systems”.*

Keywords: *population theory, ambivalent generalization, idealism, materialism, attribute, atom, quantum of idea, qubit, population dynamics, ideological complexes.*



The population approach, applied as a methodological basis for the study of the surrounding World, turns out to be a very effective way of interpreting a very large number of phenomena faced by modern sciences, both natural and humanitarian [1, 2, 3, 6]. It is the generality and universality of the proposed population

method that pushes us to move away from the particulars of cognition in individual sciences towards a philosophical understanding of the general movement of cognition, considering the phenomenology of popularity as a new global worldview paradigm.

The simplicity inherent in the initial rules of population interactions and transformations is in striking contradiction with the resulting wealth of possibilities for simulating very many, if not any processes of the surrounding reality [4].

This seems to be a paradox, but, apparently, it is the primitiveness of the basic postulates of the population approach that is the main reason for the unconscious, and therefore not disclosed to science until now, the true meaning of the embeddedness of population mechanisms in all processes of the surrounding reality. And at the same time, the motley world of population diversity surrounding us, as if deliberately scattering our attention, creates barriers of intricacy and multivariance for our mind, and we limit ourselves to primitive constructions within the framework of linear object-to-object interactions in all scientific fields.

In this paper, an attempt is made to shift attention from methodological issues of population theory to the discussion of emerging approaches to the interpretation of mental-gnostic concepts that lie in the circle of general philosophical issues. It is supposed to realize this through the involvement of axiomatic and methodological approaches based on them, which are a consequence of the general axiomatic assumption about the popularity of the surrounding world in its metaphysical reality.

The version of the Theory of Population Systems proposed by the author [4] has another identifying name; "The Theory of Ambivalent Generalization" (TAG), which is due to the fact that the main focus of the theory is focused on the study of the mechanisms of competing reactions in populations that occur as an ambiguous collective response to provoking external conditions. The conceptual outcome of the theory is the clarity of the sources of ambivalence – the confrontation of intra-population processes and the causes of the large variability of outcomes that occur, in fact, in all population formations.

In this article, an attempt will be made to consider one rather old philosophical problem – the collision between Idealism and Materialism.

The main contradiction in philosophy

The world around us for modern man appears in the form of an increasingly complex formation, as contradictory as it is unpredictable, a holistic view of which even great minds cannot form. This is easily illustrated by endless disputes, both in person and in absentia, between brilliant thinkers, as well as frequent weather vane switches of public and scientific opinions between mutually negative narratives of various scientific schools.

The complexity of ideas about the foundations of the existence and functioning of the surrounding World, and about the place of a person in this World, is so contradictory that in order to gain at least some stability in assessing what is happening around, fixing the generality of phenomena, and sometimes in attempts to combine directly contradictory judgments, people come up with special mental constructions - "concepts". These include a large number of observable and, sometimes, exclusively conceivable entities, which, according to observers, are quite stable and uniform in their manifestations, which are united by signs of identity into some, sometimes large abstract groups. It must be recognized that even if the manifestations of reality combined into concepts do not have absolutely indisputable evidence regarding their kinship or equivalence, their use still makes it possible to universalize cognitive approaches and simplify the systematization of various manifestations of real entities.

Among the many most generalized concepts, two stand out, forming two completely disjoint sets of observable entities, which, according to general scientific opinion, are in radical opposition to each other, which were formed under the terms "idea" and "matter".

The term "idea" expresses the emergence of consequences for the configuration of real objects in connection with the commission, or refusal to commit a certain object of goal-setting actions aimed at achieving certain results. The existence of ideas as universal entities that have the meaning of predetermined goals can be inductively proved even for a mind that is not sophisticated in philosophical and logical knowledge, as well as the understanding that actions that implement ideas do not always lead to the achievement of planned results.

Modern science tends to answer that there are also global Universal ideas that determine the laws of Nature, but the source of such ideas and their full list are not fully known. A special conflict arises when answering the questions: Are the sources of all ideas in the universe related to intelligent objects or do ideas arise sporadically from an unreasonable substance? What are the relations between global and private, i.e. local ideas?

At the moment, there are various answers to these questions.

In some of the answers, combined under the name "materialistic concept", the emergence of the essence of ideas is considered as a result of some phenomenon of the development of the laws of Nature, which has no clear explanations, within the framework of the complication of the reflection function arising in complex objects, including, among other things, living organisms, within the framework of the materialistic theory of reflection.

In another line of answers, called the "idealistic concept", a certain global idea is called the generative principle, which is based on sometimes hidden, sometimes directly formulated theological justifications.

There is also a third type of answers, mixed, discussing various combined ways of generating and translation global and local ideas, and this type of answers can be attributed to compromise idealistic-materialistic theories.

We will not delve into the analysis of these concepts, their motivational nuances, pointing out only that today all the existing attempts to legalize the concept of ideas give too primitive and vague interpretations that do not allow us to reliably explain the mechanisms of origin, existence, and indicate the carriers of ideological entities. And also, they lack explanations regarding the mechanisms of the relationship of ideas with material objects, and the principles of interaction between global and local ideas.

Matter is a somewhat less controversial concept from the point of view of modern science, in view of its greater observable evidence and a significant degree of study of possible transformations, although the source of the origin of matter is unknown and the laws of transformation of matter have been studied by science only partially. The only defining and integral essence of matter is its objectness, which can be called "local physical representation" and "irreducibility" in space-time under any transformations. We will point out another essence of matter, this is the statement of its "atomicity", in the sense of wholeness for any object, and further, the presence of stable fragmentation for the internal structure, i.e. atomicity, reproduced at any level of consideration of objects representing matter.

However, the unsolved problem of the unity of matter, for modern science, remains the need to recognize the field description of interactions between any material objects, be they atoms, corpuscles or particles, which are characterized by spatial dispersion of physical fields, in accordance with experimental conclusions, which is opposed to the fundamental localization of atoms. And, at least today, fields have no scientifically confirmed representability in atomic form, and, therefore, are considered a special form of matter.

The division of all things into ideological and material manifestations, which has persisted in this state for thousands of years, sets the main line of confrontation between existing scientific views endeavoring to establish the primacy of either one or the other, or to endow one of them with more fundamental properties.

Duality of a population object

To clarify the relationship of TAG to the concepts of idealism and materialism, we will first describe the essence of the population theory with sufficient detail to form a position.

From now on, we will understand by a population a set of objects that are united by the presence of a common list of external manifestations, in other words, properties represented as a set of certain interaction attributes. According to the TAG, not only atomic objects are listed among metaphysical entities, but also, on the rights of legitimate metaphysical objects, populations are included in this list.

Thus, the “end-to-end”, i.e., the universal population structure of the surrounding World is confirmed. In general, the main method of TAG is to consider the inter–population and intra-population interactions of any populations at all levels of the Universe.

Thus, according to the TAG, the material component of the surrounding Universe is represented in the form of population formations of various capacities, in which each member of an arbitrary population must have at least one attribute. What is the reason for the requirement of minimum attribution? The answer is simple: if an object does not have a single attribute, it means that it cannot be counted among material entities, in view of its complete undetectability, i.e. its inconsistency in interactions.

Thus, the attribute is assigned as an indispensable and irreplaceable companion of a material object, a sign of its materiality.

But, on the other hand, the presence of an attribute is by no means a fact of the implementation of the act of interaction itself, it is only a potential possibility of its implementation, nothing more. Shifting attention to a single one-factor attribute as an independent entity, we can call its unrealized state a “quantum of potential interaction”, or a “single idea” of the intended interaction.

So, by the simplest logical constructions, leading to the abstract definiteness of the relationship between the concepts of one particle and its attribute, we come to the duality of their essences, and the fundamental indivisibility of the material and ideal. Note that by the very fact that the simplest single attribute is defined as a property of interaction, it acquires the ability to be in three states:

- Unwillingness to interact;
- Willingness to interact;
- Completeness of interaction.

At the same time, the one–factor attribute sets the quantum of an idea, bringing the world of ideas to quantum concepts, and coincides to full equivalence with what physicists in quantum mechanics called a “qubit” - a triplet of possible quantum states for a single particle in the only possible position. In physics, such metamorphoses are described by the spin state in a series of values for different types of particles: (+1; 0; -1), or (+½; 0; -½).

Thus, an elementary or primary idea introduced in an abstract way, associated with a certain material object, turns out to have a prototype of quite real physical embodiments, which, generally speaking, is an encouraging fact for the continuation of the development of the TAG methodology.

Relations of objects to space and time

Of course, questions remain unresolved regarding the substantiality of other extremely important concepts, such as “space”, “time”, which, upon observation, participate in defining the existence of particles and their attributes. But, due to the

insufficient development of fundamental sciences, the time has not yet come for an adequate interpretation of these concepts. Therefore, we will apply these concepts in the values traditional for modern science – in the form of continuous, freely deterministic, local coordinates. Thus, in our reasoning, we do not ask questions about the nature of space-time, presenting these concepts as infinite continuums.

In this regard, we point out that as the basic postulate of the TAG, we axiomatically accept the statement about the complete and continuous stability of material objects and their attributes at any point in space and time, outside the moment of interaction with other objects.

We will assume that the acts of interobject interaction that change attributes take place in an infinitesimal time, that is, instantly.

Quasi - continuous fields

Let's consider the fixed spatial structure of a certain simplest population. It is obvious that in an abstract way, with the help of mathematical interpolation, it becomes possible to represent such a structure, with a sufficiently large number of population members, in the form of a quasi-continuous formation.

Thus, with respect to all material populations, we can say that they can be adequately described, both in the form of discrete and quasi-continuous spatial representations.

Reasoning further, it can be seen that particles ordered within a certain structure, being inextricably linked with attributes, can be interpreted in an abstract way, including as fields, or spatial formations consisting not of objects, but of ideas, no matter how extravagant it may seem at first glance.

And, it can be argued that we already use the "fields of ideas", considering them "material fields", without regarding such transformations as the conversion of ideological entities, and without giving ourselves an account of the unconscious speculative transformations extended to pseudo-materialized representations.

That is, population objects, which are any physical objects, are replaced by the ideological essence, with our unconsciousness of this substitution. For example, an empty bottle implements the idea of a container, and, because of this, being an ideological embodiment, it is nevertheless perceived by us as a material entity, in cases where it does not matter significantly, but the opposite situation may arise.

Also, it is quite simple to imagine, as an example of the incarnation of an ideological essence, for example, a geometric field of a paper sheet with the symbol of the letter "A" applied (in ink). This is exactly the ideological embodiment of the letter "A" on a material carrier, moreover, this meaning is not lost, wherever, and whatever, this symbol is not reproduced, even by the contrail of an airplane in the sky.

A philosophical discussion of examples of the conversion of ideological and material substances can be addressed in a new paradigm, noting that the TAG

allows for a reverse course, from idea to matter through attributive-atomic duality, returning the meaning of material objects by attributive interaction, and to produce it from objects that do not coincide with the initial realization.

Don't you think that this could be the basis for essential modeling in general? As well as a systematic materialistic approach to the phenomena of reflection in Nature, for example, in the human brain, or even in automated systems that simulate certain natural processes?

Summarizing, it can be argued that material objects from some simplest population of single-attribute particles can be identified with a primitive field of triplet states, and this is the simplest of possible ideological fields.

With this approach, the problem that arises when defining the physical concept of "field", which has a non-local space-time embodiment in physics, can have a corpuscular solution. This will allow us to consider field phenomena as not violating the unity of the atomic structure of matter, up to the discovery of scientific facts that violate this picture of the World..

Limitations of primitive populations

Thus, in a somewhat extravagant way, through the application of an abstract axiomatic method that addresses reality, a solution to the problem of the primacy of an Idea or Matter is proposed by accepting the interdependence of their existence. Within the framework of the proposed model, the opposition of idea and matter is rejected, and the general idea of the relationship of these concepts is reduced to duality.

Through a primitive one-particle and one-attribute model of some abstract population, the embodiment of the simplest idea possible was determined, that is, the concept of "idea" acquired the status of a "quantum substance", which brought the metaphysical essence of physical Matter and the Ideas.

It turned out that even the most primitive object can be in three possible "ideological" states, which partially reveals the reasons for the complexity of the perception of the concept of "idea" itself, taking into account the degree of uncertainty set by the object of interaction.

However, considering only a primitive model does not allow us to explain the generation of a plume of ideas generated in different populations, and to reveal the mechanisms of complication of ideological complexes, even with a general understanding of the attributive basis for these processes. Although logic allows us to make a generalizing conclusion about greater ideological variability with an increase in the number of participating attributes available to members of an arbitrary population.

One of the most important conclusions of the TAG should be considered the complete closure of the ideological and material constructs of natural science, social sciences and mathematics, including computer science, leaving no room for

appeals to some unknown virtual entities, such as: information and bio-information fields, digital universes, and this is simply in the absence of necessity, at least because the principle of "Occam's Razor" [6].

To obtain a general solution for developing ideological complexes of populations, it is proposed to use methods of analyzing population dynamics developed within the Ambivalent Generalization algebra, where this becomes possible through mutual consideration of intra-population and external attributive interactions [5].

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DOI 10.34660/INF.2023.35.35.077

19 世纪和 20 世纪之交，黑山人在耶路撒冷的俄罗斯大院服役
MONTENEGRINS IN SERVICE WITH THE RUSSIAN COMPOUND IN JERUSALEM AT THE TURN OF THE 19TH AND 20TH CENTURIES

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抽象的。本文探讨了 19 世纪和 20 世纪之交，在俄罗斯大规模朝圣的框架内，黑山人在俄罗斯帝国驻耶路撒冷总领事馆和帝国东正教巴勒斯坦协会担任卡瓦斯（或卡瓦斯、卫兵）和向导的现象。圣地。特别关注最著名的黑山导游 - 马科•朱里奇 (Marko Djuric) 以及他的亲戚乔治•朱里奇 (George Djuric) 的生活。首次公开了一些照片和档案文件。

关键词：俄罗斯帝国、黑山、中东、圣地、耶路撒冷、俄罗斯帝国驻耶路撒冷总领事馆、巴勒斯坦东正教协会、朝圣。

Abstract. *The article examines the phenomenon of Montenegrins serving as kavasses (or kawasses, guards) and guides in the Russian Imperial Consulate General in Jerusalem and the Imperial Orthodox Palestinian Society at the turn of the 19 and 20 centuries in the framework of mass Russian pilgrimage to the Holy Land. Special attention is paid to the life of the most famous of the Montenegrin guides - Marko Djuric (Djouritch), as well as his relative George Djuric. For the first time, several photographs and archival documents are published.*

Keywords: *Russian Empire, Montenegro, Middle East, Holy Land, Jerusalem, Russian Imperial Consulate General in Jerusalem, Imperial Orthodox Palestine Society, Pilgrimage.*

Russian activity in Palestine (by that time part of the Ottoman Empire) reached a zenith in the second part of the 19th century. It should be viewed in light of two factors that made its involvement different from that of other European powers. First, massive pilgrimages of Orthodox Russians to Palestine since olden times linked Russia with the Holy sites of Jerusalem and Palestine. Second, the existence in the Holy Land of a large Greek Orthodox community to which the great majority of Christian Arabs belonged, as they were politically orientated towards

Russia, their declared protector since 1774 (through the Treaty of Küçük Kaynarca)[1].

The Russian Imperial Consulate in Jerusalem was established in 1858. Among its goals was to take care of numerous Russian pilgrims. The second part of 19th century witnessed a rapidly increasing number of the Russian pilgrims in the Holy Land. At this point it is worth mentioning that they truly became significant factor in Jerusalem as among other things they created a demand for various light industries, thus stimulated commerce in the city. The Orthodox pilgrims, who were mainly peasants, embodied the essence of what we today call *the Russian presence in the Holy Land*. They travelled from Russia to the Mideastern Holy sites through the Black and Mediterranean seas. Upon arrival to Jaffa they proceeded to Jerusalem.

Alongside with the Consulate there were other Russian institutions functioning in Jerusalem: the Russian Ecclesiastical Mission (established in 1847) and the Imperial Orthodox Palestine Society (IOPS, established in 1882). The latter provided the direct assistance to pilgrims as well as managed education of the Arab Orthodox population and facilitated the strengthening of Russia's political and religious influence in the region.

As a result of joint efforts of the abovementioned Russian institutions in the Holy Land, a unique cultural and historical phenomenon - *the Russian Palestine* - has been formed. These institutions assisted thousands of pilgrims to Jerusalem[2] and ensured the safe and comfortable conduct throughout the region as the pilgrimages in actual fact were not by any means a cakewalk. Many of the Russian pilgrims perished during the arduous journey[3]. Therefor their caravans were necessarily accompanied by guards and guides.

When the IOPS came into existence in 1882, approximately 2,000 pilgrims visited the Holy Land annually. By the outbreak of the First World War, nearly 15,000 Russians visited Jerusalem annually, the majority of whom were there on Easter Sunday[4]. For their needs the IOPS built in Jerusalem hostels, refectories, cisterns for water, laundry, baths and other facilities.

It is worth noticing that until now architectural monuments related to the Russian activities largely define the historical image of Jerusalem. The earliest of them is the architectural ensemble known as the Russian Compound. It includes

[1] Carmel, A. Russian Activity in Palestine in the 19th century. Vision and Conflict in the Holy Land. Yad Izhak Ben-Zvi Jerusalem. St. Martin's Press. New York. 1985. P. 50.

[2] Frary, L. J. Russian Missions to the Orthodox East: Antonin Kapustin (1817–1894) and his World. Russian History, vol. 40, no. 1. 2013. P. 151.

[3] Hopwood, D. The Russian Presence in Syria and Palestine 1843-1914. Clarendon Press. Oxford. 1969. P. 10.

[4] Stavrou, T. G. Russian Interests in Palestine 1882-1914. Institute for Balkan Studies. Thessaloniki. 1963. P. 209.

the Holy Trinity Cathedral, the buildings of the Russian Ecclesiastical Mission, the Consulate's building, several hospices and the Russian Hospital. The Russian Compound continued to play an important role in the accommodation of Russian pilgrims right up to the First World War. It even contained a court-house, in which cases affecting Russian citizens or visitors enjoying Russian protection were heard, as well as a guard unit and, later on, postal facilities[5].

At this point the role of these guards should be mentioned. They are known as *kavasses* (or *kawasses*) - a type of 19th century Ottoman guard and escort, serving local and foreign dignitaries such as ambassadors and consuls.

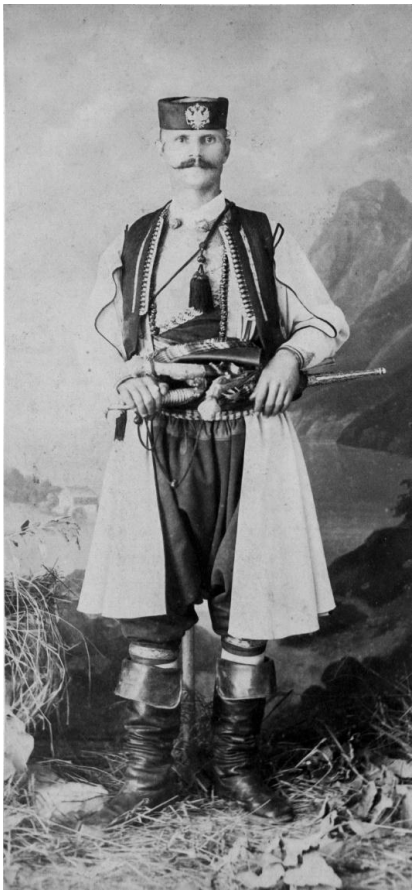
By mid-January 1859, the staff of the Russian Consulate in Jerusalem consisted of Consul V. I. Dorgobuzhinov, Secretary A. K. Krivoshein, one member of the chancellery (or scribe) P. D. Levitov, one dragoman (interpreter), M. O. Shakhashiri and two consular Muslim guards, *kavasses*, designated among the local people[6]. By 1880 there were already four *kavasses* serving at the Russian Consulate.

Picture 1. *Consul General V. F. Kozhevnikov with his spouse. 1880.*

[5] Ben-Arieh, Y. Jerusalem in the 19th century - Emergence of the New City.Yad Izhak Ben-Zvi Jerusalem. St. Martin's Press. New York. 1985. P. 74.

[6] Mironenko-Marenkova, I., and Vakh, K. Chapter 10 An Institution, Its People and Its Documents: The Russian Consulate in Jerusalem through the Foreign Policy Archive of the Russian Empire, 1858–1914. In Ordinary Jerusalem 1840–1940, Leiden, The Netherlands: Brill. 2018. P. 205.

In 1866 it was Consul V. F. Kozhevnikov (1866-1876, later Consul General 1880-1885) who first hired an Orthodox Christian Montenegrin as *kavass* to serve among local Muslims. His name was Marko Djuric (Djouritch), born in a small village of Kovaci[7]. *Kavass* Luka was another Montenegrin serving alongside Marko during Consul General Kozhevnikov's cadence. It is worth noticing that there were Serbian employees in the Russian Consulate as well: Kozhevnikov's servant Nikolaj Grandovic. The latter stayed in Jerusalem after Consul General's death in 1885 and married to a Russian woman of the Yenisei province Agrafena.



Picture 2. *Kavass Marko Djuric. The eighties of the 19th century.*

[7] Exhibition Grbaljers in Jerusalem. Posted on 14 July 2018. In Montenegrin. http://www.grbalj.com/vijesti/1108_Изложба_Грбљани_у_Јерусалиму [Accessed 05 August 2023]

Picture 3. *Kavass Luka and Kozhevnikov's servant Nikolaj Grandovic. The eighties of the 19th century.*

A Montenegrin *kavass* can be easily distinguished in photographs of that time by the uniform with features of the national costume. One can see a headdress, in Montenegrin *kapa*, which is decorated with a double-headed royal eagle of the Russian Empire. An embroidered vest is worn over a white *talarez*. Saddle pistols are also part of the national costume. The *kavass* is girded with a colored wide belt.

Picture 4. *Group photo of staff members of the Russian Consulate in Jerusalem. 1. Consulate Administrator A. P. Beliaev. 5. Kavass Marko. 14. Kavass Niko Baikovic. 6, 18, 19. Local Muslim Kavasses in their traditional uniforms. 1891.*

In 1889 Marko Djuric started to serve as *kavass* of the IOPS in Jerusalem, later as a guide (from 1894), then as a senior guide (from 1900). Marko Djuric received a salary of 150 francs per month and was given an additional allowance for uniform (150 francs annually). For many years he provided high qualified assistance to Russian Orthodox pilgrims in the Holy Land. The advantage of Marko as well as other Montenegrins over local escort was the similarity of Slavic languages, in virtue of which often illiterate pilgrims could easily find a common language with their guides. One of Marko's duties was to guard the pilgrimage caravans that traveled through Palestine. Numerous references to him can be found in the memoirs of Russian clergy and pilgrims of that epoch. In 1914, by that time a profoundly old man, he was invited to serve as an escort of honour to Prince Felix F. Yusupov, who arrived in Palestine on a pilgrimage. Marko Djuric died in Jerusalem on August 8, 1918, and was buried in the Russian cemetery at the Mount of Olives.

Montenegrins who served at the Russian Compound in Jerusalem originated from the villages Kovaci and Glavati. Their known names are Marko and Pero

Djuric, Niko Bajkovic, Lazar Ban, George Buzdovan, Christo Doljanica and Nikola Peranovic[8].

The historical archive of the IOPS at Sergey Compound in Jerusalem contains many documents of the IOPS, dated from the period of the turn of the 19th and 20th centuries, including mentions of Montenegrins serving as *kavasses* and guides. Access to the archive was obtained by Russian researches only in 2009, after the Compound was transferred to Russia by the Israeli authorities. In February and March 2009, the authors of this article had the honour to assist to the representatives of the IOPS in conducting a primary inventory and systematization of this archive.

Picture 5. *Authors of the article at historical archive of the IOPS at Sergey Compound in Jerusalem. 2009.*

Picture 6. *Copy-books of the Archive. 2009*

A remarkable document was found in the letter copy-book dated 1906, which is directly related to the history of Montenegrins in active service of the IOPS. That is a certificate issued in French language (lingua franca of those days) to an-

[8] Ibid.

other member of Djuric clan George I. Djuric sighed by the Administrator of the Russian Compound in Jerusalem N. G. Michailoff on August 5/18, 1906[9]. It states that George Djuric had been serving at the Russian Compound as a guide for the period of 1900-1906. During his service he demonstrated "the full knowledge of his duties, conscientious attitude to all the duties assigned to him and impeccable honest behavior". Working with the archive documents allows us to shed light on the glorious pages of friendly and fruitful relations between Montenegrins and Russians as well as to find out the names of all Montenegrins in service with the Russian Compound in Jerusalem.

Supplement

Certificate

5/18 August, 1906
Reg. № 149

This present certificate is issued to George I. Djuric to acknowledge that he was in the service of the Imperial Orthodox Palestinian Society in Jerusalem as a guide from May 1, 1900 to August 6, 1906, when he left the service of his own volition.

During his entire time in the service of the Company, G. Djuric was distinguished by full knowledge of his duties, conscientious attitude to all the duties assigned to him and impeccable honest behavior, which I confirm with this certificate.

Manager of the Russian Compound in Jerusalem
N. Michailoff
Red inked stamp of the IOPS

Translated from French into English by Daria Georgi

Illustrations 1-4: Courtesy The National Library of Israel. Photograph Collection, The National Library of Israel, The Pritzker Family National Photography Collection.

[9] The historical archive of the IOPS at Sergey Compound in Jerusalem. Copy-book per 1906. P. 72-73.

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DOI 10.34660/INF.2023.80.21.078

罗斯托夫地区自治的组织：从传统形式到地方自治
ORGANISATION OF SELF-GOVERNANCE IN ROSTOV REGION: FROM TRADITIONAL FORMS TO LOCAL SELF-GOVERNANCE

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注解。本文介绍了罗斯托夫地区地方自治组织的经验；它揭示了地方自治机构发展的主要趋势，及其从产生之时到目前状态的质量特征的变化。对地方自治组织和发展史料的研究，可以通过揭示罗斯托夫地区的特点，有助于展示俄罗斯公权力机构形成和发展的历史。为进一步完善地方自治制度作出贡献。

关键词：地方自治、哥萨克自治、罗斯托夫地区。

Annotation. *The article deals with the experience of local self-government organisation in the Rostov region; it reveals the main trends in the development of local self-government institutions, changes in their qualitative characteristics from the moment of their emergence to the current state. The study of the historical material of the organisation and development of local self-government allows by means of revealing the peculiarities characteristic of the Rostov region to contribute to the display of the history of formation and development of public-power institutions in Russia, which should contribute to the further improvement of the institute of local self-government.*

Keywords: *local self-government, Cossack self-government, Rostov region.*

A unique practice of local government organisation - the system of Cossack self-government - has been developing on the territory of the modern Rostov region for several centuries. The peculiarity of the Rostov region lies in the fact that in the XV - early XX centuries its territory was part of the Land and then the Oblast of the Don Army and the main part of the population belonged to the Cossacks - a kind of military ethnosociety [1], which had its own traditions in the organisation of self-government. For a long time, the legal status of the army was determined by the presence of its own territory, institutions of power that functioned in the form of communal democracy, political sovereignty and customary law as a regulator of social relations [2].

The established system of governance on the Don significantly differed from the system of governance in the Russian Empire. The supreme body of Don Cossacks' self-government was the army circle, a traditional representative body, the general army council of Cossacks, based on the principles of customary law and fulfilling the legislative function. The army circle had its origins in the 16th century and for a long time retained the functions of the supreme authority. At the circle were solved issues of military, economic, administrative, socio-political, legal, social and domestic nature, the most important issues were the issues of declaring, waging war and making peace. A distinctive feature of the organisation of power in the army of Don was autonomy in the field of court and foreign relations. The assembly of the army circle judged Cossacks, organised embassies, concluded international treaties, passed laws, elected all officials of the Army of Don, including the army ataman. The army ataman concentrated in his hands the full extent of executive power. In peacetime he was the executor of the will of the people's assembly and guardian of order, in wartime he had almost unlimited powers.

The situation of the autonomy of the Don army changed radically after the Azov campaigns of Peter the Great. The strengthening of economic, military and political dependence of the Cossacks allowed the representatives of the autocratic power to violate their sovereignty. At the beginning of the XVIII century the territory of the Don region was actually included in the Russian state [3]. At the same time, the position of the army circle as the supreme authority was gradually changing. It mainly began to gather to announce tsarist decrees, to receive the tsar's salary, as well as to solve the most important court cases. The government of the Russian Empire cancelled the electivity of the ataman's office and since 1723 the ataman of the army was appointed by the tsar and was called not the ataman of the army, but the "nakazny" ataman. After incorporation into Russia, the self-government of the Cossacks was gradually limited and by the end of the XVIII century remained in fact only at the level of stanitsa - the lowest administrative-territorial unit of the army of Don [4].

Self-government in Cossack towns and stanitsa was organised according to the army model [5]. A stanitsa as an administrative-territorial unit included the settlement of the stanitsa itself and neighbouring hamlets. Local self-governance was exercised by the stanitsa society - Cossacks, who lived on the territory of the stanitsa and farms, through the stanitsa circle (assembly). The most important administrative and economic issues were solved at the general village meeting, officials were elected, and regular lists of Cossacks for field service were approved.

Until 1836, all executive power belonged to the village ataman, who was elected at the village assembly [6]. The village ataman was in charge of the economic life of the village, informed the members of the village about the regulations and orders of higher authorities, ensured the protection of public property, security of

the borders of the village lands, organised actions in emergency situations, controlled the order of service of the Cossacks, etc. Issues beyond the authority of the village ataman were decided at the village assembly.

In 1836, on the basis of the "Regulations on the Administration of the Army of the Don", the general Cossack assembly elected stanitsa boards as the executive administrative and judicial power in the territory of stanitsa and yurts. The bodies of the stanitsa administration were determined by the stanitsa assembly as a collegial body of administration, which included the stanitsa ataman, his assistants, judges, treasurer, trustees of the stanitsa board and from 30 to 100 elected Cossacks-householders according to a certain norm of representation [4]. The stanitsa assembly elected the board, made decisions on land and economic issues, performed judicial functions on minor criminal offences, misdemeanours and private civil suits. The highest instance for the village authorities was the regional board. Issues that exceeded the authority of the village circle or remained unresolved after long efforts were referred to the capital for consideration by the army circle.

Volosts were established in places of permanent residence of peasants in the Oblast of the Army of the Don. According to the 1861 regulations, a volost was a unit of peasant administration. The body of local self-government in volosts was the volost assembly. The chief official of the volost was the volost foreman.

As an attempt to bring the system of local self-government on the territory of the Don Army Region to the all-Russian one, the Emperor's decree in 1876 (according to the law on zemstvos of 1864) introduced zemstvo institutions - elected bodies of self-government. The non-Cossack population of the Don met the innovations with enthusiasm, which ensured their right to participate in local government on an equal footing with the Cossacks. Regional and district zemstvos were established, the apparatus of which consisted of administrative bodies - regional and district assemblies and executive bodies (administrations).

The first "Regional Zemstvo Assembly" as an elected all-sex body of local self-government was opened on 16 April 1876 [7]. The range of issues of the Don zemstvo included: maintenance of postal stations; construction and repair of roads, bridges, dams and dikes; maintenance of administrative buildings, hospitals, village prisons; assistance in the development of public education and enlightenment, trusteeship of primary schools, craft schools; assistance to medical institutions, the cost of identifying and combating epidemics, maintenance of zemstvo doctors, assessors in district police departments, prison wardens, cordon commands and much more.

The Cossacks were very wary of the new order of local self-government, considering the traditional village administration to be the most effective. Most of the Cossacks were dissatisfied with the activities of the zemstvo institutions and especially with the system of zemstvo taxation. The unwillingness of a significant

part of the Cossacks to pay zemstvo fees and the refusal to elect vowels from the stanitsa led to the crisis of the zemstvo, and already in 1882 the activity of zemstvo institutions was suspended, and their functions were transferred to the regional and district zemstvo committees created under the army administration. The zemstvo could only survive in the cities of Rostov-on-Don and Taganrog, which were not part of the Don Army Region. Thus, all-seat representative democracy did not develop in the majority of Cossack settlements, although attempts to restore zemstvo institutions were made repeatedly by supporters of the zemstvo movement.

The beginning of the twentieth century in the Don, associated with revolutionary upheavals, hardships of the First World War and the Civil War, ensured that the region was actually under martial law and suffered significant losses among both the Cossack and non-Cossack population. Local self-government continued to exist in the form familiar to the Cossacks until the end of the Civil War [8]. The final establishment of Soviet power was made by the Decree of the Council of People's Commissars "On the construction of Soviet power in the Cossack regions" of 25 March 1920. The unified bodies of Soviet power, provided for by the Constitution of the RSFSR and the provision of the All-Russian Central Executive Committee on village councils, were established and thus the separate councils of Cossack deputies and Cossack self-government bodies were liquidated. Immediately after the establishment of Soviet power, the oblast was renamed the Don Oblast with its centre in the city of Rostov-on-Don. In 1924 the Don region as an administrative-territorial unit was abolished and its territory became part of the North Caucasus Territory. Subsequently, the administrative-territorial structure of the region underwent repeated changes until in 1937 the Rostov region was separated from the Azov-Black Sea region by the decree of the Central Executive Committee of the USSR. Rostov Oblast included seven cities - Rostov, Kamensk-Shakhtinsky, Krasny Sulin, Millerovo, Novocherkassk, Taganrog, Shakhty and 61 rural districts.

The organisation of local power in the RSFSR was based on the principle of unity of the system of representative bodies of the people - Soviets, as bodies of state power, acting on the principle of strict subordination of lower bodies to higher ones: in towns and villages - Soviets, at the regional and republican level - congresses of Soviets, which elected executive committees and their presidiums. All soviets worked in the mode of carrying out party-state policy in the field, but their important function was also to solve problems of local importance.

The establishment of the new Russian statehood in the early 1990s was accompanied by an intensive search for a new conceptual model of development of the institution of local self-government. Attempts were made to gradually reform local authorities into local self-government bodies. In 1991 in the Rostov Oblast the process of formation of executive authorities began [9]. The President of the

Russian Federation appointed V.F. Chub as the head of the regional administration, who headed a fundamentally new structure of executive power. The head of the regional administration began to form a new system of power through the appointment of the heads of administrations of cities and districts in coordination with the local Councils of People's Deputies. The newly created administration of all levels, which replaced the executive committees, was removed from the system of Soviets, became directly under the control of the federal authorities, and also changed the principle of its activity - the rejection of collegiality in favour of sole authority. The newly created executive branch of power co-existed until autumn 1993 together with the structures of Soviet power.

The stage of gradual reforming of local bodies of state power into local self-government bodies ended in autumn 1993, when the President of the Russian Federation issued several decrees aimed at liquidation of the system of Soviets of People's Deputies and accelerated formation of local self-government in Russia. The Constitution of the Russian Federation adopted in December 1993 established completely new basic principles for the development of local self-government as an independent institution in the system of public power [10].

In the Rostov region the dismantling of the Soviet political institutions took place peacefully. Thus, in October 1993, in connection with the Resolution of the Head of the Oblast Administration "On measures to implement Presidential Decree No. 1617 of 9 October 1993" all 496 village, district and city Soviets completed their work, transferring their functions and powers to local administrations [11]. For some more time the small Council of the region functioned for the preparation and holding of elections to the new representative bodies of power. The first elections to the Regional Legislative Assembly and representative bodies of local self-government in the cities of regional subordination of the Rostov region were held on 27 March 1994. In November of the same year, elections were held and representative bodies of local self-government were formed in rural districts of Rostov Oblast.

Currently, in accordance with the norms of federal and regional legislation, Cossack societies can be involved in state and municipal service. Thus, the Charter of the Rostov region recognises the Cossacks as a subject of social and political life, providing an opportunity for Cossack societies to really get involved in governance at the regional and municipal levels. Within the limits of their competence, Cossack structures deal with the issues of ensuring the safety of citizens, protection of cultural heritage, significant objects of the region's infrastructure, fish protection, military-patriotic and spiritual and moral education of youth. Despite repeated attempts in some individual settlements of the Rostov region to restore Cossack self-government in its traditional forms, it is obvious that it is impossible to implement such an idea in modern conditions due to changes in so-

cio-economic living conditions. Currently, the descendants of the Cossacks do not form a special community organisation, being members of public organisations (Cossack societies) and equal citizens of the Russian Federation as a democratic state, and the system of local self-government built in the Rostov Oblast meets the constitutional principles in organisational terms.

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DOI 10.34660/INF.2023.80.74.079

关于意识形态争论的一些论点
SOME ARGUMENTS TO THE DEBATE ON IDEOLOGY

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抽象的。文章讨论了民族国家意识形态形成过程中出现的一些问题。作者参考了有关这项任务的历史经验。在制定意识形态基础时，提出要依靠社会发展的客观因素。笔者认为，社会意识形态分析应注重历史证明的原则。

关键词：意识形态、国家、社会、社会制度、价值观、协同作用、地点、时间、人、经验、文明、客观因素。

Abstract. *The article discusses some of the problems that arise on the way to the formation of a national-state ideology. The author refers to the historical experience concerning this task. In formulating the foundations of ideology, it is proposed to rely on the objective factors of social development. The author believes that attention should be paid to the historically proven principles of the analysis of social ideology.*

Keywords: *ideology, state, society, social institutions, values, synergy, place, time, people, experience, civilization, objective factors.*

In Russian society, the discussion about ideology, its necessity, possibility and some specific proposals regarding its components does not cease. Politicians, representatives of civil society, belonging to various public institutions speak out on this issue. The President of the Russian Federation also contributes to the discussion about ideology, periodically declaring what he considers the most significant for today's Russian society.

Starting to consider this problem, first of all, it should be noted that the attitude to the impossibility of having a state ideology in our constitution is unchanged. Amendments to the constitution left this provision unchanged. In this regard, it should be noted that those who do not want to have their own ideology, their own system of values, get over themselves the one that is the most common in the world today. According to N.Ya. Danilevsky in his famous "Russia and Europe" [1], whoever accepts the values of the currently dominant cultural-historical type, thereby makes himself a building material for him. The presence of liberal values

in the public consciousness of modern Russia is a natural result of this. Today, many domestic political scientists and public figures insist on developing their own model of social development, which could become a model for other states and peoples of the world.

It is also important to recognize that after the collapse of the Soviet model of the socio-state and political system, we have moved to a model of a transitional type, which implies political pluralism and the coexistence of sometimes mutually exclusive values. Party ideologies and programs in such a society are already ambiguously "red", "white", "brown", "green", etc.. All of them, figuratively speaking, can only be gray, i.e. hybrid. Representatives of Western social thought, such as P. Berger, P. Sztompka, I. Wallerstein, wrote a lot and in detail about this. The transition to a bourgeois-democratic regime presupposes unified socio-cultural and political technologies, unified principles for the life of the social institutions of society.

It is important, in this regard, to note that we have moved to a model that was itself in crisis, and this crisis is now only deepening. This today is not recognized only by an absolute minority in our society. The economic model of the liberal-bourgeois society turned out to be the most vulnerable today, and economic collapse is almost inevitable.

Modern Russian society has adopted many features of the Western model of social structure. This concerns, to a large extent, the social sphere of society. Based on this, attempts to build a unified ideology in a stratified society, with huge gaps in the income level of the population, are very problematic. Accounting for interests, and ideally the unity of interests, is a condition for the formation of a single ideology.

In the discussion about ideology, the point of view of those who speak about state ideology is very common. In such a formulation of the question, the difficulties and contradictions outlined above are partially removed. The "statists" are talking about common views on domestic and foreign policy, a unified approach in the field of information and educational policy. However, even in this case, the liberal model of social structure makes itself felt. The ruling class, those whom we classify as the elite, have different views on the tasks of state building. In the development of decisions on issues of social organization, the role of those who are commonly called compradors is very significant. The model of social structure we have chosen since the collapse of the USSR assumed an increase in the role of these people in making government decisions. There are many of them in power structures, and their role is especially significant in the industrial and financial sector. Their influence is also great in other areas: culture, education, science.

In the history of society, there is already a rather contradictory experience of how to formulate ideological postulates and how following them looks in practice.

Obviously, the task of forming a national-state ideology is not set on this basis either. If we follow the already known approaches in this matter, then the appearance of state bodies to oversee the purity and correctness of ideological content, centers for coordination and training of personnel becomes mandatory. In this case, the very model of the state and society becomes clear. Is Russian society ready for such a turn?

From the foregoing, it would seem that the conclusion should follow that any conversations on this topic are unproductive, and in solving these problems, society will face a number of objective and subjective difficulties. However, the purpose of our participation in the discussion is different. We believe that ideology is always present in society, it cannot be canceled, its new content and meaning cannot be announced. Let's clarify our position. In our opinion, ideology is an objective product of the spiritual creativity of broad sections of society. The best proof of our conclusion is the very spiritual history of Russian society. Let us recall the well-known wording of the Minister of Education of Russia, Count S.S. Uvarov "Orthodoxy, Autocracy, Nationality" [2]. For Russian social science, for a long time, this became the definition of the ideology of autocracy as a socio-political system. Did Uvarov set himself the task of formulating the meaning of Russian ideology? Rather, in our opinion, it reflected some objective reality in an ideal form, and therefore it did not die, but was fixed in the minds of many generations.

Another example of the formulation of a social ideology was the socio-philosophical ideology of the Slavophiles. Its Soviet social science interpreted as an expression of the protective ideology of tsarism. However, this is true only for some of the followers of the founders of Slavophilism. Samih A.S. Khomyakova and I.V. It is wrong to rank Kirievsky among the ideologists of the autocracy, if only because the authorities themselves were very critical of them and in no way associated their own policy with Slavophilism. The Slavophiles expressed some very significant socio-cultural features of the Russian people, to a large extent, in an idealistic form. A successful form of the Russian civilizational code was found by the neo-Slavophile K.N. Leontiev, defining the essence of Russian ideology as Orthodox Slavic Russism. Leontiev refers to this idea repeatedly, especially in the work "Byzantism and Slavism" [3].

An illustrative example of the vicissitudes and contradictions was the implementation of communist ideology on Russian soil. It is well known that the Bolsheviks who came to power in 1917 constantly corrected the ideology and practice of communist construction. Already by the 30s I.V. Stalin and his associates realized that it was impossible to build an effective system of upbringing and education on the denial of the historical past, on the abstract formulas of communist ideology. In the 1930s, the view of national history was revised. Many important figures of the historical process were appreciated and found their place in the new ideology.

The most striking example of ideological synthesis and reliance on basic cultural values was the restoration of the rights of the Russian Orthodox Church in 1943.

An example of a serious ideological mistake was the announcement at the 22nd Congress of the CPSU about the possibility and historical timing of building a communist society. Everything was wrong in this - from the announcement of the deadlines to the setting of the main task. One of the main tasks of the period of extensive communist construction was formulated as "more and more complete satisfaction of the growing material and spiritual needs of the people." [4]. This installation was repeated in approximately the same formulations at subsequent congresses of the CPSU. The construction of a communist society by Soviet ideologists was understood, in many respects, as the construction of a consumer society. To fail along the way is quite natural. We raised Soviet society and, especially, the Soviet elite on these principles as the antipode of socialism and communism.

Today we learn much more about the national history and practice of the Soviet period than was possible before. It turns out, in particular, that the Soviet economy of the Stalin era was multi-structural, and thanks to this, more flexible and efficient. This, in turn, suggests that the model of Soviet society was also more complex, in a sense, suggesting hybrid forms. We came to a linear, monosyllabic understanding of socialism and communism in the post-Stalin era and did not cope with the challenges of the time.

Interesting, in the context of considering this issue, is the position of N.A. Berdyaev on the nature, nature and origins of communist ideology. In his works "The Origins and Meaning of Russian Communism" [5], "The Russian Idea" [6], he convincingly showed that socialism on Russian soil has found a fertile basis in the very nature of Russian culture, mentality, and social practices that have emerged over the centuries. As long as there was this harmony, communism had a real base in the public consciousness. The translation of ideology into a system of dogmatic formulas that contradict both common sense and basic values and principles has given rise to a deep social crisis.

The social science of the last decades of the Soviet period gave birth to such thinkers as E.V. Ilyenkov and A.A. Zinoviev. These personalities had a very limited influence on the state of affairs in the social sciences. Have representatives of the social sciences ever had an influence on the formation of state ideology? In our opinion, it is unlikely. Or maybe they don't need to be engaged in the construction of ideal models for the development of society? Perhaps, according to the precepts of Hegel, to deal only with the real? Hegel believed that a philosopher should write "gray on gray" [7], not paint life, but understand it and follow only its objective manifestations.

In the best traditions of world philosophy lies the principle of relying on the real, on what underlies human existence. Even the philosophers of antiquity un-

derstood being as an arena for the action of the main entities: demos, topos, hromos (people, place, time). In our social science discourse, these entities appear constantly. In our opinion, we should talk not only about a deep analysis of each of the components, but also about the need to study them in interconnection and synergy.

In modern socio-political discourse, the theme of the people, population occupies a leading place. President V.V. Putin considers the idea of saving people an important component of Russian ideology. In this case, we are talking not only about demographics, the problem is wider. It is in the correct understanding of human nature, the preservation of traditional views on issues of family, gender, identity. Different views on human nature lead to demarcation in the global civilizational plane.

In the modern world, the territorial problem is no less significant. The struggle for a place under the sun is an age-old problem that gave rise to wars and conflicts, and today it has become more urgent. Russia, according to some politicians in the world, owns not only too much living space, but also resources.

It is also indicative how a Russian positions himself in relation to his place of residence, whether he is a patriot of his homeland or a citizen of the world. It is known that even in previous centuries, part of the Russian elite did not associate themselves with Russian reality, with their homeland. Hence, it is quite natural and logical to consider the territorial problem as the most important in ideological discourse.

The place of time in the minds of people is extremely important, to a large extent it is the essence of human existence. The problem of time in the context of the study of ideology occupies no less significant place than the two components discussed above.

Russian society in the post-Soviet period tried to repeat the negative experience of the early Soviet approach, when the task was to break with the past. The emotional charge for what was called “repentance” is partly understandable and acceptable. At the same time, the main thing is not to trample on and not to slander what preceded the new historical reality. A part of our society still suffers from this disease today, but a different position is becoming more common. It consists in following the principle of continuity in the understanding of national history. Only such an approach will make it possible to preserve everything positive from the past and fill modern social practices with time-tested technologies.

Social time is accelerating its course, however, even in these conditions it is necessary to follow the logic of historical time correctly, relying on the past. Insisting on the need to refer mainly to the three basic essences of human existence: people, place and time, we certainly cannot reject the methods and principles of ideology formation that are already familiar to us. It is important, in our opinion,

to abandon attempts to impose on society, even outwardly attractive, but no longer working values, principles, rules. More attention to what is born by life itself and verified by history.

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DOI 10.34660/INF.2023.48.30.080
UDC 613.31: 577.2: 663.63

顿巴斯现状饮用水质量综合评估

INTEGRATED ASSESSMENT OF DRINKING WATER QUALITY IN THE CURRENT CONDITIONS OF DONBASS

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抽象的。这项工作的目的是证实饮用水质量复杂卫生评估的主要参数。水和血清流变特性的研究可用于评估饮用水的生物学价值，这预示着界面张力测定快速方法的前景。为了评估饮用水的质量，不仅需要研究其参数的重要性，还需要研究包装容器的毒理学特性，以考虑饮用方式对健康状况综合指标（工作能力、发病率等）的影响。

关键词：饮用水，综合评估，生物学价值，相间张力测定。

Abstract. *The aim of the work was to substantiate the main parameters of complex hygienic assessment of drinking water quality. The study of rheological properties of water and blood serum can be used to assess the biological value of drinking water, which indicates the prospectivity of express methods of interfacial tensiometry. To assess the quality of drinking water it is necessary to study the significance of not only its parameters, but also toxicological characteristics of packing containers, to take into account the influence of drinking regime on integral indicators of health status - working capacity, morbidity and others.*

Keywords: *drinking water, integrated assessment, biological value, interphase tensiometry.*

Introduction

In the Russian Federation the task of providing the population with quality drinking water is implemented by the implementation of the Technical Regulation of the Customs Union TR TS 021/2011 "On the safety of food products", the

Federal Law "On the sanitary and epidemiological welfare of the population" № 52-FL from 30 March 1999, SanPiN 2.1.4.1116-02 "Drinking water. Hygienic requirements to the quality of water packed in containers. Quality control". In addition, the Federal Project "Clean Water" (approved by the RF Government Decree No. 1092 of 22 December 2010) provides for the development of a system of measures to ensure the quality and increase the supply of bottled drinking water to the population [1].

After the inclusion of packaged water in the list of food products, drinking water repeats all the stages of food evaluation.

At the first stage, the determining factor is the harmlessness of the product - the focus is on epidemic and toxic safety - according to the generally accepted indicators SanPiN 2.1.4.1116-02 "Drinking water. Hygienic requirements for the quality of water packaged in containers. Quality control", providing hygienic requirements to the quality of drinking water packed in containers, intended for drinking purposes and cooking, as well as requirements for the organisation of quality control. But compliance of bottled water with the requirements of regulatory documentation on the content of chemical elements is not always a guarantee of the authenticity of water of a particular origin and its compliance with the reference brand of this name. In addition to the requirements for the water itself, considerable attention is paid to packaging. For example, today more than 18 million tonnes of polyethylene terephthalate (PET) are produced worldwide for the manufacture of packaging containers, which corresponds to more than 400 billion PET bottles. The commercial benefits of using PET have made the product world famous. However, data on the safety of PET use in the food industry are contradictory, making further research to identify the possible toxicity of both PET and other food plastics necessary.

At the second stage, the consumer is interested in the nutritional value of the product, in relation to water - total mineralisation, the content of individual salts, anions and cations.

At the third stage, the consumer requires information about the biological value of the product, but the indicator for assessing the biological value of drinking water has not yet been developed. In recent years, redox potential - ORP (Redox - Reduction/Oxydation) has been used as such a characteristic of water [2]. ORP of ordinary drinking water is always greater than zero and is usually in the range from +250 to +450 mV.

The use of interfacial tensiometry methods allowed us to establish that the surface tension of natural and fresh water is reliably lower than in control water samples [3], and this indicator is considered as one of the physical criteria for the presence of structural ordering of drinking water [1]. It should also be taken into account that the important regional peculiarities of drinking water in industrial

regions, including Donbass, include high content of organochlorine compounds formed due to the use of chlorination as the main method of water disinfection. In this connection the application of the method of research of rheological characteristics of biological liquids by methods of interphase tensiometry is promising.

To assess the biological value of drinking water, it is necessary to study the significance not only of its individual parameters for the organism, but also of the processes occurring in the water environment, their role for normal human activity [1]. In our opinion, it is advisable to evaluate it by its influence on integral indicators of health status - work capacity, morbidity, etc., which are largely determined by the level of acquired specific (adaptive) immunity.

The aim of the work was to substantiate the main parameters of complex hygienic assessment of drinking water quality taking into account its biological value in modern conditions of Donbass.

Material

The analysis of official statistical data of the laboratory of SE " WATER OF DONBASS" on organoleptic, physico-chemical, sanitary-toxicological and microbiological indicators of drinking water in Donetsk for 2011-2021 was carried out. Hygienic evaluation of the material was carried out on 13 samples of bottled (packaged) water containers. The assessment was carried out on the main toxic component - PET.

Hygienic research methods were used to assess the factors affecting the formation of the functional state of the organism (FSO) of the inhabitants of the region when consuming different types of drinking water, including. before the beginning of combat operations - in three series of experiment on 27 practically healthy student volunteers - physiological (BP, HR, EQ, muscle strength and endurance), psychophysiological (corrective test, SUN questionnaire), immunological (indices of adaptive immunity), biochemical (general blood analysis), questionnaire (nature and volume of water consumption).

The method of interfacial tensiometry (maximum bubble pressure) was used to assess the surface tension of water and serum of volunteers. In the search for a simpler parameter, the surface tension dynamics of typical drinking water samples consumed daily by the population was also investigated. Sixteen water samples were collected, of which 13 were natural bottled water (non-carbonated), 1 was spring water, 1 each was tap water and melt water prepared from tap water. The studies were carried out on the basis of a standard computer tensiometer MPT2-Launda (Germany).

Data processing was carried out by methods of variation statistics. Reliability of differences between the studied parameters was evaluated using Student's criterion (in case of normal distribution) and Wilcoxon's criterion (in case of deviation

from the normal law of distribution). Data processing was performed using the licensed statistical packages MedStat and STATISTICA 6.0.

Results

The analysis of statistical materials allowed us to assess the dynamics of water indicators from sources of domestic drinking water supply and the impact of the consequences of the local military conflict on it. In 2014-2015, due to damage during shelling, the Severskiy Donets-Donbass canal was repeatedly stopped, which led to the deterioration of drinking water quality indicators: organoleptic (colour, turbidity, taste, seasonal hardness), toxicological (primarily organic compounds, including phenol and its derivatives) and integral - acidification. Thus, in January 2020, in samples from the Upper Kalmius reservoir, the concentration of phenols exceeded the MAC by 13-20 times. A year later, the concentration of ammonium in the water supply source increased up to 1.37 mg/l, in the distribution network - up to 0.50-1.25 mg/l, turbidity and acidity indicators deteriorated. Thus, under the conditions of the ongoing military conflict, the population of our region consumed poor-quality drinking water from centralised water supply sources until March 2022, with the situation worsening due to anthropogenic pressure and unfavourable climate change [3]. At present, the population of the DNR consumes only packaged (bottled) drinking water on a non-alternative basis.

Samples of containers of 0,5 dm^3 (PET-1); 1,5 dm^3 (PET-1); 18,9 dm^3 (polycarbonate (PC) and polypropylene (PP-5) were selected, the original label of which indicated storage conditions - containers of 0,5 - 1,5 dm^3 (PET-1) should be stored at temperatures from $+20^0$C to $+250^0$C, relative humidity not higher than 85% not more than 12 months. containers of 18,9 dm^3 (PC) and (PP-5) - $+50^0$C to $+200^0$C and relative humidity not more than 75% in rooms protected from direct sunlight, (PP-5) - 3 months, (PC) - 6 months. In Russia, the state standard for PET is GOST 32686-2014 “Polyethylene terephthalate bottles for food liquids. General technical conditions”, in which the conditions of transport and storage of containers made of polyethylene terephthalate are temperature not lower than $+5^0$Cand relative humidity not more than 80% - up to 12 months. Note that the storage conditions for PET containers, specified on the label, do not meet the requirements of GOST 32686-2014 [4]. It can also be assumed that the different volume of used containers predetermines the different ratio of container volume to its surface that comes into contact with water. Consequently, the shelf life of bottled water should also depend on the volume of the packaging, since the equilibrium sorption capacity of the surfaces and the equilibrium concentration of bottled water components in containers of different volumes are different. The ratio of surface area to container volume is inversely proportional, which means that the largest amount of precipitated particles will be in smaller volume containers. In addition, the equilibrium sorption capacity of the bottle surfaces and the equilibrium concentration

of water elements will also be different at different storage temperatures. Thus, the sale and transport of bottled water in polymer containers in summer time without observing the temperature regimes established by TU, can lead to deterioration of its consumer properties.

Before the start of the experiment, questionnaires revealed that all subjects used mostly or only tap water for drinking and cooking purposes. During a month volunteers consumed natural prepackaged water “A.” in the same volume as before (pH=7.61; mineral water). (pH=7.61; salinity=300 mg/l; ORP=190 mV) or fresh tap water prepared from tap water by “freezing” (pH=6.91; salinity=190 mg/l; ORP=149 mV). Taking into account the possible influence of seasonal and other fluctuations of the functional state, the same parameters were studied in the subjects one month after returning to the previous drinking regime [1].

All the subjects used only tap water for drinking and cooking purposes, 37% of them occasionally used bottled water for drinking, 33% - water purified with filters, 30% - juices, 33% - water from decentralised water supply sources at home. Only 15% of students are satisfied with the quality of tap water, and the same number of students attribute unfavourable changes in their health status to water consumption. The average daily fluid intake was 1.0-2.5 litres for 85% of students, with 1.0-1.5 litres for 44%. The same indicator of water consumption during the day was 0.5-1.5 litres in 85%, including 0.5-1.0 litres in 52%. The amount of water drunk during the educational process was from less than 0.5 to 0.75 litres in 96% of the subjects, including less than 0.5 litres in 52%. From the current position the volume of water consumed by students should be recognised as insufficient.

After a month of drinking natural packaged water, 67% of the subjects had increased lymphocyte content and CD3 - T-lymphocyte subpopulation (both specific weight in % and concentration, in G/l). The content of CD4 (T help.) increased in 2/3 (% and G/l); CD8 (T supr.) - decreased in 55% (% and G/l) of students. Accordingly, their ratio (IRI), which determines the strength of the immune response, increased significantly ($p < 0.05$) in 67% of the subjects. The content of CD22 (B-lymphocytes, % and G/L) subpopulation increased in 55% of cases, and the content of CD16 (NK) (%) decreased. Changes in phagocytic index were multidirectional, phagocytic number increased in 89% of students. The concentration of IgA, IgM, IgG increased in 67%, 67% and 78% of cases, respectively. Taking into account the possible influence of seasonal fluctuations in the number and functional activity of T- and B-lymphocytes, the same indices were studied in 44% of the subjects one month after returning to the previous drinking regime. The opposite direction of shifts in lymphocytes (G/l), CD4 (% and G/l), CD8 (% and G/l), IRI, CD16, IgA, IgM, IgG - in 75-100% of cases - was revealed.

The following changes in clinical blood analysis were observed in Donbass students who constantly consumed tap water: 22% - decrease in haemoglobin lev-

el, 44% - decrease in the number of erythrocytes, 11% - increase in ESR and total number of leukocytes, 33% - increase in the percentage of lymphocytes and, as a consequence, decrease in the shift index of blood leukocytes. Consumption of natural prepackaged water led to an improvement in haematological parameters. One month after returning to the previous drinking regime, 25% of female students showed signs of moderate anaemia - reduced haemoglobin and erythrocyte count.

In 78% of subjects the accuracy and mental efficiency indices increased reliably ($p < 0.05$), in 67% the EQ indicators improved. Muscular endurance (in 44% $p < 0.01$) and muscle force impulse (in 56% $p < 0.01$) increased significantly in all students. Normalisation of systolic and diastolic blood pressure parameters were observed in 44% of cases. Memory improvement was shown by 67% of students. ⅔ of the subjects showed improvement of well-being and activity, 78% - of mood.

As follows from the established dynamics of rheological indicators, when drinking natural prepackaged water, the equilibrium surface tension of blood serum of the examined volunteers significantly ($p < 0.05$) increased ($p < 0.05$) compared to the indicators before the beginning of consumption. After discontinuation of natural packaged water consumption, the value of the index decreased again. At the same time, the tensiogram slope angle ($\lambda 2$) significantly decreased by 1.45 times during the use of packaged water, while after discontinuing the use of natural water one month later, the value of the index increased significantly again. The same tendency is observed with respect to the dilatation modulus (viscoelastic modulus - E), which characterises viscoelastic properties of surface (interphase) layers, and relaxation time in the stress experiment. During the study of elasticity indices it was found that surface elasticity (a1) of blood serum of the subjects during the use of natural packaged water significantly increased by 1.03 times, while after the termination of the study in a month the value of the index was almost equal to the initial value before the use of natural drinking water. The opposite trends were observed in the study of the slope angle of surface elasticity (c1): when drinking natural water, the value of the indicator decreased, and after discontinuation of the study, it decreased even below the initial level. Similar dynamics was observed in the group of subjects when drinking fresh water. The established regularities [5] indicate a better penetration of drinking water inside the cells of the body in 78% of the subjects, which indicates a high biological value of the studied types of water, which by the principle of substitution therapy displaced the “used” unstructured water into the bloodstream.

Table 1

Surface tension dynamics of the investigated water samples

№ s/p	Name of liquids	Б1, mN/m (T =1000s)	Б, mN/m (T =50000 s)	Δσ
1	Drinking water №1	71.3	71.2	0.1
2	Drinking water №2, deep well 340m	72.0	71.7	0.3
3	Spring water №3	71.7	70.7	1.0
4	Melted mineral drinking water №4	71.2	71.1	0.1
5	Mountain drinking water №5	71.6	71.4	0.2
6	Drinking water of the first category №6	71.5	71.4	0.1
7	Melted water №7	71.3	71.0	0.3
8	Drinking water №8	72.0	68.0	4.0
9	Artesian drinking water №9	71.6	70.8	0.8
10	Natural water №10	71.5	70.7	0.8
11	Tap water №11	72.2	70.2	2.0
12	Melted water №12	71.3	70.8	0.5
13	Spring water № 13, Donetsk	71.6	71.0	0.6

Based on the data of dynamic studies (see Table), the best surface tension values after 50000s (13 hours 52 min.) were determined in those 7 water samples, where the decrease did not exceed 0.1- 0.3 mN/m, which determines the strength of adhesion between liquid molecules and indicates a high biological value of the studied drinking water [6]. Changes in the interfacial surface area disturb the adsorption equilibrium and initiate processes that lead to the restoration of the equilibrium state of the system. Such a restoring process in this case are, diffusive transfer of substance from the volume to the surface of the droplet. The proposed express-method for assessing the biological value of drinking water can be used to control the quality of tap water, as well as in the production of bottled water - both natural and purified.

Conclusion

1. Unfavourable dynamics of water quality indicators from sources of household drinking water supply in Donbas under the influence of the consequences of the local military conflict is observed. Currently, the population consumes only packaged (bottled) drinking water on a non-alternative basis.

2. It was found that the storage conditions of polyethylene terephthalate containers indicated on the label do not meet the requirements of the current GOST. Sale and transportation of bottled water in polymer containers in summer time without observance of the established temperature regimes can lead to deterioration of its consumer properties.

3. The students of Donbass have secondary immunodeficiency, adverse changes in haematological indicators, parameters of mental and physical performance, sensorimotor reactions, blood pressure, subjective self-esteem, which, apparently, were caused by the environmental situation in the region. The consequences of military distress aggravate the effect of environmental risk factors.

3. Consumption even within a month of high-quality drinking water leads to improvement of the functional state of the organism, which, in particular, is manifested by a reliable improvement of the indicators of adaptive immunity - both cellular and humoral, increased efficiency, normalisation of well-being and blood pressure.

4. Assessment of rheological properties of water and blood serum can be used to assess the biological value of drinking water, which indicates the prospect of using express methods of interphase tensiometry.

5. To assess the quality of drinking water it is necessary to study the significance not only of its individual parameters, but also the toxicological characteristics of packaging containers. According to the data of the conducted studies it is necessary to take into account the influence of drinking regime on integral indicators of health status - working capacity, morbidity, etc., which are largely determined by the level of acquired specific (adaptive) immunity.

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DOI 10.34660/INF.2023.14.33.081

患有各种耳鼻喉疾病的儿童的听管功能障碍
AUDITORY TUBE DYSFUNCTION IN CHILDREN WITH VARIOUS ENT PATHOLOGIES

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注解。输卵管功能障碍的及时、准确诊断和治疗是耳鼻喉科、理疗领域最具挑战性的问题之一[1,4,6]。这是由于听管解剖位置的特殊性及其可视化的某些技术困难，因此对鼻咽和听管口的详细、有针对性的检查并不总是得到足够的重视[5,7]。这项工作的目的是研究检测各种耳鼻喉疾病中听管功能障碍的诊断价值，并展示对患有各种耳鼻喉疾病并可靠检测到听管功能障碍的儿童进行复杂检查和康复的结果[2,8,10]。对患者进行了临床和仪器研究。 [3,9].. 应用了经典医学治疗，儿童还接受了"Milta-F-8-01"设备的经典激光治疗，并且患者组不仅接受了复杂的经典医学治疗，还检查并介绍了"Tonsillor-MM"设备的医用低频超声治疗、"Milta-F-8-01"设备的激光治疗以及"fermencol-gel"中引入的药物制剂。

关键词：听管功能障碍、激光治疗、"Milta-F-8-01"装置、Tonsillor-MM 装置药品的药物低频超声治疗、注射"fermencol-gel"。

Annotation. *The issue of timely and accurate diagnosis and treatment of tubar dysfunction is one of the most challenging in otorhinolaryngology, physiotherapy [1, 4, 6]. This is due to the peculiarities of the anatomical location of the auditory tube and certain technical difficulties of its visualisation, as a result of which detailed, targeted examination of the nasopharynx and auditory tube mouths is not always given sufficient attention [5, 7]. The aim of this work is to study the diagnostic value of detecting auditory tube dysfunction in various ENT pathologies, and to show the results in the complex examination and rehabilitation of children with various ENT pathologies with reliably detected auditory tube dysfunction [2,8,10]. Clinical and instrumental investigations were performed on the patients. [3,9].. The classical medical treatment was applied, also children received additionally classical laser therapy from the device "Milta-F-8-01", and also the group of patients receiving in a complex not only classical medical treatment, but also medicinal low-frequency ultrasound therapy from the device "Tonsillor-MM",*

laser therapy from the device "Milta-F-8-01", with pharmaceutical preparations introduced in "fermencol-gel" was examined and presented.

Keywords: *auditory tube dysfunction, laser therapy, "Milta-F-8-01" device, drug low-frequency ultrasound therapy from Tonsillor-MM device pharmaceuticals, with "fermencol–gel" injected.*

Bibliography: 10 sources.

A group of 1520 patients was under observation. Nasal and perinasal sinus diseases - rhinosinusitis 320(21,05%), allergic rhinitis134(8,87%). Pharyngeal diseases-adenoiditis 336(22,10%),tonsillitis 264(17,36%).Ear diseases-tubo-otitis 150-(9,86%),acute catarrhal otitis 148-(9,73%),exudative otitis including recurrent course 168(11,05%). Patients were divided into 7 clusters:

CLUSTER I . Rhinosinusitis-ICD-10 (J01).(1,2,3 groups).

Rhinosinusitis was diagnosed in a group of children and treated in 320 children. (44,37%)

Table 1

Rhinosinusitis complicated by auditory tube dysfunction

Age of children	boys	girls	total
3-6 years old	12(3.75%)	10(3.12%)	22(6.87%)
7-10 years old	42(13.12%)	38(11.85%)	80(25%)
11-14 years old	10(3.12%)	16(5%)	26(8.125%)
15-18 years old	6(1.875)	8(2.5%)	14(4.37%)
total	70(21.87%)	72(22.5%)	142(44,37%)

Patients with rhinosinusitis were randomly divided into 3 groups according to the method of applied rehabilitation complex:

The 1st group (control) of 100 patients received standard medical treatment.

The 2nd group (comparison) of 110 patients on the background of standard drug therapy received laser exposure to the area of the sinuses, endonasally.

The 3rd group (the main group) of 110 patients, who against the background of standard drug therapy received laser treatment of the area of the sinuses, ultraphonophoresis of the preparation "Fermencol" endonasally.

CLUSTER II . ALERGIC RINITIS ICD -10- J30 (groups 4-5-6).

The group of children with allergic rhinitis was observed as 134, a-94(70.14%) dysfunction.

Table 2

Distribution of children by age and sex with pathological function of auditory tube

Age of children	boys	girls	total
3-6 years old	4(2,9%)	5(3.7%)	9(6,7%)
7-10 years old	16(11.6%)	14(10,4%)	30(22%)
11-14 years old	15(11,19%)	15(11,19%)	30(22,38%)
15-18 years old	12(8,9%)	13(9,7%)	25(18,6%)
total	47(35,07%)	47(35.07%)	94(70.14%)

Patients with allergic rhinitis were divided into 3 groups according to the method of the applied treatment complex

The 4th group (control group) of 44 patients received drug treatment.

The 5th group (comparison) of 45 children received drug treatment in combination with laser therapy on the projection of HF sinuses and endonasally.

The 6th group (main) of 45 patients received drug treatment in combination with laser therapy on the projection of HF sinuses, endonasally, and ultraphonophoresis "Fermencol" endonasally.

CLASTER III. Hypertrophy of adenoid vegetations -ICD-10 (J35.2) (7,8,9)

A group of 336 children, out of which 264 patients (78.57% were noted with auditory tube dysfunction).

Table 3

Gender and age distribution of children with auditory tube dysfunction

Age of children	boys	girls	total
3-6 years old	64(19,08%)	66(19,64%)	130(38,69%)
7-10 years old	34(10,11%)	30(8.92%)	64(19,04%)
11-14 years old	22(6,5%)	24(7,14%)	46(13, 69%)
15-18 years old	10(2,97%)	14(4,16%)	24(7,14%)
total	130(38,69%)	134(39.88%)	264(78,57%)

Patients with adenoid vegetations were divided into 3 groups according to the method of treatment

The 7th group (control group) of 100 patients received medical treatment

The 8th group (main) of children (118 patients) received medical treatment in combination with laser therapy on the projection of adenoidal vegetations, endonasally.

The 9th group (comparison) 118 children received drug treatment in combination with laser therapy on the projection of adenoidal vegetations, endonasally, ultraphonophoresis "Fermencol" endonasally according to the proposed methodology.

Cluster IV. Chronic tonsillitis ICD-10- J35.0 (10,11,12)

A group of 264 children suffering from chronic tonsillitis with frequent exacerbations was observed.

Auditory tube dysfunction was noted in 143 patients, which is 54.1%.

Table 4

Dysfunction of the auditory trumpet in children with chronic tonsillitis.

Age of children	boys	girls	total
3-6 years old	4(1,5%)	4(1.5%)	8(3%)
7-10 years old	28(10.6%)	31(11.74%)	59(22,3%)
11-14 years old	33(12,5%)	35(13,25%)	68(25,7%)
15-18 years old	3(1.13%%)	5(1.89%)	8(3%)
total	68(25,75%)	75(28,4%)	143(54.16%) от 264

Patients with chronic tonsillitis were divided into 3 groups according to the method of treatment

The 10th group (control) 80 patients received medical treatment

The 11th group (main) 90 patients received medical treatment in combination with laser therapy on the projection of the palatine tonsils, on the palatine tonsils.

The 12th group (comparison) 94 patients received medical treatment in combination with laser therapy on the projection of the palatine tonsils, on the palatine tonsils, ultraphonophoresis “Fermencol” on the palatine tonsils according to the proposed method.

Cluster V. *Tubootitis* (eustachitis) ICD-10-(H68.0) Eustachian salpingitis and obstruction)(13,14,15)

Group of children with tubootitis-150 patients (72(48%) auditory tube dysfunction.

Table 5

Distribution of children by auditory tube pathology.

Age of children	Type “A,” closer to “C.” 76±12.5daPa	Type «C» 98±13.4 daPa	Type «B»	Total
3-6 years old	30(20%)	31(20,66%)		61(40,66%)
7-10 years old	25(16,66%)	24(16%)		49(32,66%)
11-14 years old	16(10,66%)	13(8,66%)		29(19,33%)
15-18 years old	7(4,66%)	4(2,66%)		11(7,3%)
total	78(52%)	72(48%)		150

Patients with eustachyitis were divided into 3 groups according to the method of treatment

The 13th group (control) 50 patients received medical treatment

The 14th group (main) 50 patients received medical treatment in combination with laser therapy endaural, antebrachium, behind-the-ear area.

The 15th group (comparison) 50 patients received drug treatment in combination with ultrathonovorescence fermencol endaural according to the proposed technique

Cluster VI. *Catarrhal otitis.* IBC 10 - N65.3(16,17,18)

The group of patients with catarrhal otitis -148 children.

Table 6

Children with involvement of the auditory tube in the inflammatory process

Age of children	boys	girls	total
3-6 years old	39(26,35%)	36(24,32%)	75(50,67%)
7-10 years old	29(19,59%)	23(15,54%)	52(35,13%)
11-14 years old	8(5,40%)	7(4,79%)	15(10,13%)
15-18 years old	3(2,02%)	3(2,02%)	6(4,05%)
total	79(53,37%)	69(46,62%)	148

Patients with acute catarrhal otitis media were divided into 3 groups according to the method of treatment

The 16th group (control) 48 patients received medical treatment.

The 17th group (main) 50 patients received drug treatment in combination with LT endaural, antebrachial, behind-the-ear area.

The 18th group (comparison) 50 patients received drug treatment in combination with laser therapy endaural, antebrachium, occipital region ultaphonophoresis “Fermencol” endaural.

Cluster VII. Exudative otitis -ICD-10(H65.0)(19,20,21)

Children presenting with *exudative otitis* -168 patients.

Table 7

Distribution of children by auditory tube pathology

Age of children	Number (%)	Total
3-6 years old	88(52,38%)	88(52,38%)
7-10 years old	48(28,57%)	48(28,57%)
11-14 years old	24(14,28%)	24(14,28%)
15-18 years old	8(4,76%)	8(4,76%)
total	168(100%)	168

Patients with acute exudative otitis were divided into 3 groups according to the method of treatment

The 19th group (control) 48 patients received drug treatment.

The 20th group (main) 60 patients received drug treatment in combination with LT endaural, antebrachial, behind-the-ear area.

The 21st group (comparative) 60 patients received drug treatment in combination with LT, endaural, antebrachium, occipital region.

Physiotherapy techniques

Laser therapy

Infra-red laser irradiation in a constant mode, endonasally, on the projection area of the maxillary sinus, as well as the projection of the palatine tonsils from both sides was carried out on the palatine tonsils - the wavelength of radiation 0.85 μm, at a power flux density -2.2 mW/cm2, 1-2.5 minutes per field, depending on the age of the child, endonasally, endoureally for 30 seconds. The course of treatment was 6-10 procedures, daily. The dose per 1 procedure ranged from 592 mJ to 1.46 J. For the course of treatment, the total dose ranged from 3.552 J to 14.6 J (Fig.9).

Ultraphonophoresis "Fermencol" of the palatine tonsils

Injection into the submucous layer of the palatine tonsils by means of the "Tonsillor-MM" apparatus.

Methodology of procedures: preliminary sanation of the palatine tonsils (removal of caseous masses from the lacunae) was carried out. During the procedure the patient sits. Tongue is removed from the tonsils, on which the procedure will be carried out, with a spatula. On the nozzle "VI-13" from the device "Tonsilor -MM" put on gauze in 4 layers, moistened "fermencol" gel, so that its working part was in contact with moistened gauze pad, the frequency of ultrasonic oscillations at contact sounding of tissues through the intermediate drug - 26.5 kHz; - amplitude of oscillations of the radiating end of the waveguide of the instrument - 10-40 microns (corresponds to the values of 1-2 indicators, we start treatment with one division of the indicator) - exposure of ultrasound exposure - from 30 seconds per tonsil to 2.5 minutes, depending on the tolerance of the procedure and the age of the patient. The course of treatment was 10 procedures daily.

Ultraphonophoresis "Fermencol" endoureally. The patient is laid on a couch or sits with the patient's ear upwards (we had to make sure of the integrity of the tympanic membrane before each procedure of ultraphonophoresis) The auricle is pulled upwards in order to straighten the ear canal, then the ear canal was filled with turundas impregnated with "Fermencol" gel, the turunda obturates the ear canal and fills the auricle, then the working part of the ultrasound device "Tonsillor MM" was inserted into the ear canal to the entrance of the ear canal, so that its working part was in contact with the turunda, with the applied fermecol-gel. Beforehand, the working part of the waveguide was set to a minimum of 40 microns, and then the sounding was carried out for 2-3 minutes, at a frequency of 26.5 kHz. After sounding, moistened tissues were left in the ear canal for 20-30 minutes. The course of treatment was 10 procedures daily. At the first procedures, there were difficulties with exposure to the radiator of the device "Tonsillor-MM".

Ultraphonophoresis "Fermencol" endonasally

Washing of nasal passages according to Politzer. (figure) before the procedure. Sanation of the nasal cavity (if necessary) with antiseptic solutions (nitrofuran solution 1: 5000) was carried out. Before the beginning of nasal passages washing it is necessary to establish a trusting relationship with the child, to warn about the painlessness of the procedure (Fig. 2). Then we introduced into the nasal passage turundus moistened with fermencol-gel, then introduced the working part of the ultrasound device "Tonsillor MM", so that its working part was in contact with the turunda, with applied fermecol-gel. Beforehand, the working part of the waveguide was set to a minimum of 40 microns, and subsequently the sounding was carried out for 2-3 minutes, at a frequency of 26.5 kHz. After sounding, moistened tissues were left in the nasal passage for 20-30 min.

In all clusters, a persistent positive result of resolution of auditory tube dysfunction was obtained in groups of children receiving complex medical and combined physiotherapy of fermencol gel.

Cluster I (142 patients)

In group 1 after treatment dysfunction remained in 12 patients (8,4%), in group 2 9 (6,3%), group 3 (2,8%). ***Cluster II (94 patients)***

In group 1, dysfunction persisted after treatment in 13 patients(13.82%), in group 2 8 (8.5%), group 3 5(5.3%)***. Cluster III (264 patients).***

Group 1 dysfunction persisted after treatment in 18 patients(6.8%), group 2 14 (5.3%), group 3 9(3.4%)***. Cluster IV(143 patients).***

Group 1 dysfunction persisted after treatment in 13 patients(9%), group 2 11 (7?6%), group 3 7(4.8%). ***Cluster V(150 patients).***

Group 1 after treatment dysfunction persisted in 19 patients(12.6%), group 2 14 (9.3%), group 3 3(2%). ***Cluster VI(148 patients).***

Group 1 after treatment dysfunction persisted in 11 patients(7.4%), group 2 6 (4.05%), group 3 4(2.7%). ***Cluster VII(168 patients)***

Dysfunction persisted in 22 patients (13.09%) in group 1 after treatment, in group 2 Conclusions. The use of only drug therapy in the treatment of children with chronic ENT pathology does not allow to stop not only the manifestations of diseases, but also in the restoration of the dysfunction of the auditory tube, while the introduction of laser irradiation and ultraphonophoresis of the preparation "Fermencol" from the device "Tonsillor" in the treatment complex allows to significantly increase the effectiveness of treatment, which is confirmed by the data of objective methods of research.

The authors of the article confirmed the absence of a conflict of interest to be reported.

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DOI 10.34660/INF.2023.86.63.082

秋明地区南部和北部稳定型缺血性心脏病正在接受药物治疗和接受 PCI 的患者的单独观察结果的比较特征

COMPARATIVE CHARACTERISTICS OF THE SEPARATED RESULTS OF OBSERVATION OF PATIENTS WITH STABLE ISCHEMIC HEART DISEASE WHO ARE ON MEDICATION AND WHO HAVE UNDERGONE PCI, LIVING IN THE SOUTH AND NORTH OF THE TYUMEN REGION

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Relevance: Ischemic heart disease still occupies a leading position among the causes of death and accounts for up to 47% in the Russian Federation. The main

reasons for the development of coronary heart disease (CHD) is the appearance of atherosclerotic plaques and functional constrictions in the coronary arteries. Determining the optimal tactics for managing a patient with stable coronary artery disease and the presence of hemodynamically significant stenoses of the coronary arteries has been a subject of discussion for a long time [1]. There are several modifiable risk factors such as: dyslipidemia, arterial hypertension, diabetes mellitus, smoking, physical inactivity, obesity, stress, and non-modifiable ones - male gender and age. It is known that the doctor's "northern" experience of a patient in real clinical practice is assessed as an independent risk factor, along with body weight, smoking, gender, age, etc. For patients living in extreme climatic conditions of the Far North, it is especially important to provide medical care, including high technology and drug therapy. The conditions of the north leave their mark on the course of diseases such as coronary artery disease, which in turn is often the cause of total mortality [2].

Noteworthy is a small number of studies on the use of percutaneous coronary interventions in the treatment of stable coronary artery disease under long-term follow-up.

Therefore, the purpose of our study is to evaluate long-term results in patients with stable heart disease after percutaneous coronary intervention and the use of drug therapy in people living in the south and north of the Tyumen region.

Materials and methods:

300 patients were randomly selected from the "Register of performed coronary angiography operations", four groups of patients were formed according to the area of residence and the method of treatment. Group 1 consisted of 70 patients who received isolated drug therapy and lived in the south of the Tyumen region, group 2 included 60 people who lived in the north of the Tyumen region and received conservative therapy. Group 3 consisted of 98 patients who lived in the south of the Tyumen region and underwent PCI, group 4 included 72 patients living in the north of the Tyumen region who underwent PCI.

The studied groups were comparable in terms of gender, age, presence of excess body weight, diabetes mellitus, arterial hypertension, and a history of myocardial infarction. Also, the groups were comparable in terms of angina pectoris, heart failure. Table 1.

Table 1

Clinical characteristics of the studied groups.

Groups/ indicators	MT		p	PCI		p
	South	North		South	North	
Average age	53,2±8,7;	52,98±8,3		53,64±8	50,1±5,3	
Overweight BMI >25 kg/m^2	(30)66,6%	(35)81,5%	0,3	(52) 81,4%	(35)81,4%	0,5

Diabetes		(6)9,4%	(5)9,1%	0,9	(6)6,4%	-	0,04
Arterial hypertension in anamnesis		(43)68,3%	(35)64,8%	0,6	(69)73,4%	(54)79,4%	0,2
Need for nitroglycerin		(22) 46,8%	(21)48,8%	0,8	(37) 54,4%	(25) 34,7%	0,9
MI in anamnesis		(38)62,3%	(41)77,4	0,3	(51)56,7%	(39)59,1	0,9
men		(56)80%	(55)91,7%	0,06	(87)88,8%	(65)90,3%	0,7
smoking		(13)35,1%	(15)35,7%	0,8	(24)38,7%	(15)33,3%	0,4
FC angina pectoris	I	(9)12.9%	(9)15.1%	0,4	(1)1,0%	(6)8.3%	0,09
	II	(21)30.0%	(21)35.0%		(32)32,7%	(25)34.7%	
	III	(26)37,1%	(21)35,0%		(46)49.0	(1)1.4%	
FC(NYHA)	I	(17)24.3	(12)20.0	0,8	(17)17,3%	(19)26,4%	0,6
	II	(35)50.0	(36)60.0		(60)61,2%	(35)48,6%	
	III	(11)15.7	(6)10.0		(13) 13,3%	(14)19,4%	

The follow-up period was 88.05±46.47 months.

The groups were comparable in terms of hemodynamically significant lesions of the main coronary arteries, second-order arteries were considered in the aggregate - no differences were found in this indicator. The groups were comparable in terms of the type of myocardial blood supply and the number of affected arteries. Table 2.

Table 2

Angiographic characteristics of the studied groups.

Groups/ indicators		**MT**		**p**	**PCI**		**p**
		South	**North**		**South**	**North**	
By type of blood supply to the heart	bal	(11)19,3%	(36)20,8%	0,178	(12)16,0%	(12)18,8%	0,9
	left	(3)5,3%	(9)18,8%		(11)14,7%	(7)10,9%	
	right	(43)75,4%	(29)60,4%		(52)69,3%	(45)70,3%	
By the number of affected arteries	Single vessel	(38)54,3%	(36)60%	0,917	(61)62,2%	(38)52,8%	0,2
	Two vessel	(19)27,1%	(8)13,3%		(20)20,4%	(18)25,0%	
	Multivessel	(13)18,6%	(16)26,7%		(17)17,3%	(16)22,2	
Anterior interventricular artery		(33)47,1%	(33)55,0	0,4	(49)50%	(39)54,2%	0,6
Right coronary artery		(30)42,9%	(30)50,0	0,5	(51)52,0%	(38)52,8%	0,7
Left coronary artery		(2)2,9%	(1)1,7%		(2)2%	-	
Hemodynamically significant damage to the coronary arteries of the second order		(57)52,9%	(22)36,7%	0,07	(57)37,8%	(33)45%	0,3

The following events were evaluated: myocardial infarction (MI), total mortality, coronary artery bypass grafting, MACE. Cardiovascular event excluded from analysis after CABG.

Patients were recommended groups of drugs in accordance with current recommendations for the treatment of coronary artery disease: β-blockers, ACE inhibitors, sartans, statins, antiplatelet agents.

Statistical analysis of the results was carried out using the statistical software package SPSS for Windows (version 21), Statistica. With a normal distribution, the results are presented as mean and standard deviation (M±SD); when the distribution is different from normal, the values are represented by the median and interquartile range: Me [25%; 75%]. The distribution of quantitative variables was determined using the Kolmogorov-Smirnov test. When comparing two groups with a normal distribution of quantitative data, the Student's t-test was used, with a distribution other than normal, the Mann-Whitney test was used. Qualitative parameters were compared by chi-square test or Fisher's exact test. Survival was assessed by the Kaplan-Meier method; a log-rank test was used to assess differences. Differences were considered statistically significant at $p<0.05$.

Results of the study: Among patients receiving conservative therapy, the number of myocardial infarctions exceeded by 3.4% in patients living in the south of the Tyumen region (MI 1 group 7 (10.9%), group 2 -4 (7.5%) n.d.), and among patients after PCI, myocardial infarctions were 6.1% more common among residents of the south of the Tyumen region (MI 3 gr. 16 (16.7%) and 4 gr. 7 (10.6%) nd). Mortality was significantly more common among residents of northern latitudes who received conservative therapy (1 gr 7 (10.9%) and 2 gr 6 (11.3%) p 0.021), while no cases of death after PCI were registered among residents of northern latitudes. was, and in the south of the Tyumen region 5 cases (5.2%) di.

CABG was performed more often in patients living in the south of the Tyumen region, regardless of the chosen tactics for the treatment of stable coronary artery disease: 1 gr - 14 (21.9); 2 gr-10 (18.9) nd; 3 gr - 13 (13.5); 4 gr 7 (10.6) di.

The total number of registered adverse events after PCI is twice as high among residents of the south of TO, 3 gr 34(34.4) and 4 gr 14(19.7) p=0.018. In groups of patients receiving conservative therapy, the same percentage of events was registered in patients regardless of the place of residence 1 gr 28 (39.1) and 2 gr 20 (39.0) n.d. Figure 1.

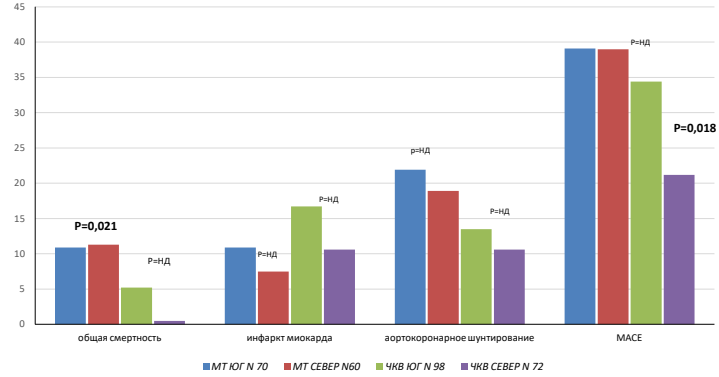

Figure 1. *Long-term results results*

Table 4

Lipid spectrum of patients at the control visit.

	1 group 25 h	**2 group 16 h**	**p**	**3 group 53h**	**4 group 26 h**	**p**
Total cholesterol mmol/l	4,6	4,9	di	4,4	4,6	di
HDL mmol/l	1,2	1,09	di	1,1	1,1	di
LDL mmol/l	3,3	3,0	di	2,8	3,3	0,039
Triglycerides mmol/l	1,7	1,7	di	1,4	1,5	di

Patients underwent a lipid spectrum study at a face-to-face visit. Significant differences were shown in groups of patients after PCI. In the same group, the highest turnout for an in-person visit was observed among the other subgroups.

Table 5

Adherence of patients to therapy

	1 group 70 h	**2 group 60 h**	**p**	**3 group 98**	**4 group 72**	**p**
nitroglycerine	3 (4,3%)	3(5,0%)	di	10(10,2%)	4(5,6%)	di
blockers	11(15,7%)	13(21,7)	0,000	18(18,4)	12(16,7)	di
Calcium channel blockers	3(4,3%)	2(3,3)	di	3(3,1)	3(4,2)	di
ACE inhibitor	7(10,0)	12(20,0)	di	11(11,2)	13 (18,1)	0,043
ACC	60 (85,7%)	9(15,0)	0,000	-	11(15,3)	0,05
clopidogrel	1(1,4%)	-	di	3(3,1)	2(2,8)	di
sartans	3(4,3%)	-	di	2(2%)	1(1,4%)	di
statins	10(14,3%)	8(13,3)	di	14(14,3%)	11(15,3%)	di

When analyzing the data on the drugs taken in the MT group, it was revealed that patients living in the north of the region more often took β-blockers, practically ignored the use of antiplatelet agents. And groups of patients after PCI showed greater compliance with ACE inhibitors, ACC among patients living in northern latitudes.

Conclusion: In the long-term follow-up period, when choosing the tactics of managing patients with stable coronary artery disease, there is a decrease in the mortality rate with the use of PCI in residents of the northern latitudes. Whereas, with the use of conservative therapy, mortality is significantly higher among residents of the north of TO. Mortality in these groups does not exceed the all-Russian indicators, according to various registers, they range from 0.6-1.4% per year. Our study lasted about 10 years.

CABG is performed more often in patients living in the south of TO, which we associate with better coverage of the population with medical care.

IM according to the registers is 0.6-2.7% per year.

The FAME 2 study involved patients with CIHD. The study found that PCI performance with a FFR ≤0.8 was associated with a decrease in the incidence of the combined endpoint (death/MI/urgent revascularization) compared with drug therapy at a follow-up period of 2 years; in our observation, this trend was confirmed after 10 years of follow-up in a group of patients living in northern latitudes. We associate this feature with the good availability of medical care in the northern districts [3].

The ISCHEMIA study compared two management strategies for patients with stable coronary artery disease with significant myocardial ischemia during a stress test - conservative and revascularization strategies, 5179 patients participated. The main result of ISCHEMIA was that there was no difference between the two groups in the primary endpoint, which included cardiovascular death, myocardial infarction, hospitalization for unstable angina, heart failure, and resuscitated cardiac arrest. There were no differences for the main secondary end points: cardiovascular death and myocardial infarction. The only thing in which revascularization outperformed conservative tactics was the reduction in angina symptoms [4]. According to our observations, the use of PCI for patients living in the north is extremely important. There are no reported cases of death in our group, and the main control points for MI, CABG and MACE are minimal compared to the presented subgroups. Thus, when a patient lives in the conditions of the Far North, the tactics of treating IHD should be chosen more aggressive - with the use of PCI to improve the patient's prognosis.

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DOI 10.34660/INF.2023.95.89.083

在各种身体活动中调节呼吸

REGULATION OF BREATHING IN A WIDE RANGE OF PHYSICAL ACTIVITIES

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engineer, pensioner

抽象的。系统分析表明，在超过50W的物理负荷下，组织呼吸调节子系统被激活，提供足以消耗氧气量的体积血流量，并且在外部呼吸子系统中，通过动脉血中的氧张力进行调节被激活，并且二氧化碳张力的调节被停用。显示了呼吸频率在增加通过肺泡毛细血管膜的扩散速率中的作用。给出了关于心脏窦房结感觉性质的假说的论证。

适合生理学家、医疗专业人员和培训师。

关键词：生物调节；组织呼吸；外部呼吸；呼吸率;窦房结；心率。

Abstract. *System analysis showed that under physical load of more than 50 W, the subsystem of tissue respiration regulation is activated, providing a volumetric blood flow rate adequate to the amount of oxygen consumed, and in the external respiration subsystem, regulation by oxygen tension in arterial blood is activated, and regulation by carbon dioxide tension is deactivated. The role of respiratory rate in increasing the rate of diffusion through the alveolar-capillary membrane is shown. The argumentation of the hypothesis about the sensory nature of the sinoatrial node of the heart is given.*

For physiologists, medical professionals and trainers.

Keywords: *bioregulation; tissue respiration; external respiration; breathing rate; sinoatrial node; heart rate.*

It is known that the tension of oxygen and carbon dioxide in arterial blood is controlled by vascular chemoreceptors located in the zone of bifurcation of the carotid artery (carotid sinus) and giving a signal to the respiratory center (hereinafter referred to as RC) (discovery of Corneille Heymans, Nobel Prize winner in Physiology or Medicine for 1938).

Heymans found that the concentrations of respiratory gases and hydrogen ions are maintained in balance by reflexes of the nervous system, which combine: 1) vascular chemoreceptors of respiratory gases (oxygen and carbon dioxide), 2) the respiratory center of the medulla oblongata (hereinafter, RC) and 3) lungs. This

is, in general terms, the composition of the external respiration regulation system. RC is activated when the concentration of carbon dioxide increases and when the concentration of oxygen decreases. At the same time, by default, it was assumed that the structure of the regulation system did not change over the entire range of physical loads. But the role of vascular chemoreceptors in arterial oxygen concentration was unknown. So, Breslav I. S. [2, p. 44] suggested that the hypoxic stimulus in the body is reserved for an "emergency" situation.

Thus, according to modern concepts, the flow of oxygen from the atmosphere into the blood is provided by the ventilation of the alveolar space under the control of RC (external respiration regulation system with the concentration of carbon dioxide in arterial blood as a controlled variable). According to the classification [3, 7], this is a parametric reducing system. Further, by diffusion, oxygen enters the blood through the alveolar-capillary membrane (hereinafter, ACM), and the diffusion flow of oxygen from the circulatory system to tissues (tissue respiration) appears to be a passive autonomous process.

The present system analysis has shown that such representations adequately describe the work of the respiratory system of the body only at rest. However, the state of the body is not limited to a state of rest. Nature allows arbitrary, relatively high, physical activity, and man actively uses this in practice. Therefore, the description of the work of the respiratory regulation system in a wide range of physical loads (from the state of basal metabolism to the state of load close to the maximum) is an urgent task. This article is devoted to the solution of this problem.

It is known [6, graph] that the rest state is limited by a load of approximately 50 W. At rest, with an increase in the concentration of carbon dioxide in the arterial blood (PaCO2), the regulation system increases the ventilation of the alveolar space, which provides the necessary amount of oxygen diffusion into the blood. In addition, it is obvious that an increase in ventilation provides some additional increase in the concentration of oxygen in arterial blood (PaO2) due to the involvement of additional (reserved) alveoli in the diffusion process. All this reliably deactivates oxygen chemoreceptors.

But an increase in physical activity increases the oxygen consumption of tissues, and the concentration of oxygen in the venous blood (PvO2) inevitably decreases. So [6, graph], during exercise more than approximately 50 W, the oxygen tension in the venous blood decreases to approximately 25 mmHg. But this is already the limit, below which the diffusion of oxygen in the tissue becomes insufficient, and the body goes into a state of stress. In this state, the heart, by increasing the heart rate, increases blood flow (blood flow rate), thereby increasing the rate of oxygen delivery to the tissues.

Physiology has deeply explored the structure and function of the heart. But all the tasks of research and the data obtained at the same time relate only to how the

heart is maintained in a working state under various conditions (trophic, energy, own functions, adaptation). This complex and important (however, service) task is solved both by the central nervous system and local compensatory mechanisms of the heart. About the most important function of the heart in the respiratory system, for the implementation of which it was created by nature - the operational maintenance of blood flow, adequate to the current oxygen consumption by the body, it is only known that this function (de facto) takes place. But how this function is carried out, modern physiology does not describe.

This circumstance stimulated the author to put forward a hypothesis about the sensitivity of the sinoatrial node (hereinafter, SAN) to the oxygen concentration in the venous blood (hypothesis about the sensory nature of the sinoatrial node of the heart), which consists in the following.

It is known that the value of heart rate is set by the SAN, located in the area where the superior vena cava enters the right atrium, and is considered a spontaneous pacemaker or pacemaker of the heart. It is known that SAN provides automatism of the heart due to the existence of special cells in its structure - true pacemakers. The action potential of these cells has the property of supposedly spontaneous (i.e. spontaneous) slow diastolic depolarization from the level of the resting potential to the threshold value (the so-called 4th phase of the action potential). The value of heart rate depends on the duration of this phase. It is known that the duration of this phase can be changed by many factors, and it is possible that not all of them are known to science yet.

In view of the above, the following arguments are used in the basis of the stated hypothesis:

1. The body needs (and it actually takes place) regulation of the volumetric blood flow velocity as a function of the oxygen tension in the venous blood to provide tissues with oxygen in an amount adequate to the amount consumed by them. And this function can be performed by SAN;

2. This function is especially important for the upper part of the body, where the brain is located, so the location of the SAN in the zone of entry of the superior vena cava into the right atrium is very significant;

3. SAN has contact with venous blood, i.e. what is necessary for regulation in the subsystem of tissue respiration;

4. There can be only one regulator of blood flow volumetric velocity in the body, otherwise there would be a conflict of regulators.

In addition, the data [1, p. 466 table 19.1] that the lack of oxygen causes “an increase in the steepness of the pacemaker potential” (a reduction in the duration of the 4th phase of the action potential), which also speaks in favor of the stated hypothesis.

So, as a hypothesis about the sensory nature of the SAN, we assume that the SAN, located at the site of the entry of the superior vena cava into the right atrium, is sensitive to the oxygen concentration in the venous blood and is the shaper of the control law of the tissue respiration regulation system (SCL_T) [3, 7] . The characteristic of this hypothetical SCL is: 1) decreasing (with an increase in oxygen tension in the venous blood, heart rate decreases), and 2) non-linear - at high values of oxygen tension (more than 25 mmHg), heart rate has a relatively small value and changes insignificantly as a function of PvO2; at low values (less than 25 mmHg), the steepness of the SCL characteristic increases significantly, and the heart rate increases significantly with decreasing oxygen pressure. A hypothetical characteristic of the shaper of the control law of the tissue respiration regulation system is shown in fig. 1.

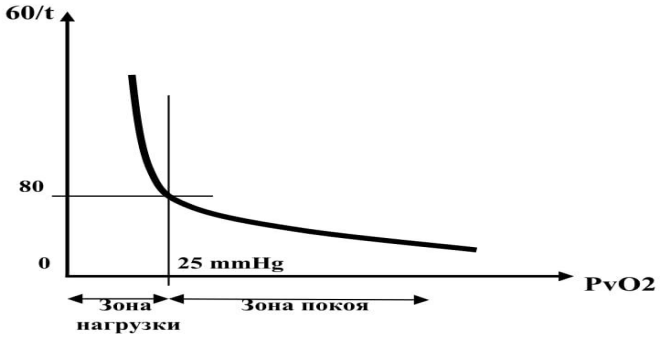

Figure 1. *Hypothetical characteristics of SCL of the tissue respiration regulation system t is the duration of the heart rhythm period (sec)*

Thus, it is assumed that while the oxygen concentration in the venous blood is above 25 mmHg, SCL is in the zone of rest (indifference), and a process well known as spontaneous slow diastolic depolarization occurs in the SAN. The heart beats at a normal resting rate. With a decrease in the oxygen concentration in the venous blood in the range of 25 mmHg and below, SCL enters the regulation zone and increases the heart rate in inverse proportion to the decrease in the oxygen concentration in the venous blood, counteracting a further decrease. Diastolic depolarization of the pacemaker in the SAN "ceases to be spontaneous", and in proportion to this decrease (depending on the oxygen content in the venous blood) accelerates significantly. The duration of the period of the heart rhythm is reduced and, as a result, the heart rate increases proportionally. As a result, the heart, as the actuating mechanism of the tissue respiration regulation system, maintains the amount of blood flow adequate to the oxygen consumption by the tissues.

Thus, the proposed hypothesis suggests that the heart rate necessary for tissue respiration is provided not spontaneously, but by the tissue respiration regulation system, which controls the heart rate. And SAN is not a heart rhythm generator, but a sensor (SCL) common for bioregulators with a significantly non-linear characteristic.

The classification proposed by the author [3, 7] defines it as a parametric boosting system. In accordance with the given heart rate, the heart provides the necessary volumetric blood flow velocity.

Thus, an increase in oxygen consumption by tissues during physical exertion of more than 50 W, according to the stated hypothesis about the sensory nature of the sinoatrial node of the heart, causes an increase in arterial blood flow adequate to it (consumption).

The tissue respiration regulation subsystem performs the task of maintaining the PvO2 value at a level not lower than approximately 25 mmHg. But, as the oxygen consumption increases and the blood volume velocity increases, the PvO2 value in the load subrange from 50 W to the limit will still somewhat decrease by the value of the static error of the subsystem.

Activation of the tissue respiration regulation subsystem creates a problem in the external respiration subsystem, because the blood velocity increases at the same time in the pulmonary capillaries. Consequently, the residence time of erythrocytes in the ACM zone decreases. Calculations show [4] that this time can (at loads close to the maximum) decrease to 0.1 sec, and even less. While at rest this time is 0.3 sec [5].

However, the less time is given for diffusion, the less oxygen, under the same other conditions, will be transferred through the ACM (erythrocytes will go into the system underloaded). Thus, in this hypothetical situation, a "vicious circle" could arise in the system: the greater the oxygen consumption in the tissues, the sooner the heart would drive blood through the pulmonary capillaries, the less oxygen would have time to enter the pulmonary capillaries and the lower the concentration of oxygen in arterial blood. In other words, there would be a positive feedback in the process of reducing the oxygen concentration in the venous blood. This would inevitably lead to an unlimited increase in heart rate and would end in a catastrophe for the body (perhaps such catastrophes do occur in practice).

This does not happen in a normally functioning system. When the tissue respiration regulation system is activated (PvO2<25 mmHg) and the blood volume velocity increases, the oxygen diffusion time through the ACM decreases and, consequently, the value of the partial pressure of oxygen in the arterial blood PaO2 somewhat decreases. This is fixed by vascular oxygen chemoreceptors in the carotid arteries, and, in accordance with this signal, RC increases the respiratory

rate (hereinafter, RR). According to the classification [3, 7], this is a parametric boosting system.

With an increase in respiratory rate, in the alveolar space in the exhalation phase, the dynamic pressure of the alveolar gas is added to the partial pressure of oxygen [4]. The greater the load, the greater the respiratory rate, the greater the dynamic addition of gas pressure in the alveoli, the faster the diffusion process, because. compression is added to ventilation. As a result, a further decrease in PaO2 stops, but not completely, because. some reduction remains due to a static system error.

With an increase in RR, the efficiency of diffusion and carbon dioxide increases (suction is added). The PaCO2 value decreases [6, graph], and the control signal from the vascular carbon dioxide chemoreceptors in the carotid arteries disappears. Those. during the transition from the state of rest of the body to the state of load, in the subsystem of external respiration there is an automatic change in the controlled value. At rest, the controlled variable is PaCO2, while under load it is PaO2. Due to the presence of a static error in the external respiration regulation subsystem in the exercise mode, which slightly reduces PaO2 with increasing exercise, this state is reliably fixed.

It is quite obvious that the influence of the dynamic additive pressure of respiratory gases in the alveolar space on their diffusion should manifest itself differently in the phases of inhalation and exhalation. In the inhalation phase, atmospheric air enters the alveolar space. This increases the concentration of oxygen in the alveolar gas. But at the same time, the dynamic pressure of the alveolar gas is reduced by the amount of pressure drop on the resistance of the airways. The diffusion of oxygen from the alveolar gas into the blood, due to the negative value of the dynamic addition, is somewhat reduced.

In the expiratory phase, on the contrary, the respiratory muscles push the alveolar waste gas into the atmosphere. Additional dynamic gas pressure is created in the alveolar space. The higher the load, the higher the frequency response, the higher the dynamic addition. There is compression of the alveolar gas.

As a result, the partial pressure of oxygen in the arterial blood flowing from the lungs during the inspiratory phase is somewhat reduced, and during the expiratory phase it is increased. When exhaling, oxygen from the alveolar gas is “pumped” into the blood by a positive addition of dynamic pressure (compression is added to ventilation). This is so effective that the amount of oxygen necessary to saturate hemoglobin manages to saturate hemoglobin even with a decrease in the time spent by erythrocytes in the pulmonary capillaries.

So, the periodic process of external respiration in the state of load becomes two-stroke, which causes a periodic change in the partial pressure of oxygen in the arterial blood. This effect was confirmed in a 2019 study by a group of scientists

from the United States and France of the process of oxygen supply to the brain tissues of mice during intensive locomotion. Article [8], containing the results of the study, was published on the Internet in the public domain.

The study [8] showed that the partial pressure of oxygen in the arteries of the brain of mice during locomotion has a pulsed character, and periodically changes during the respiratory cycle (respiratory cycle) from the minimum value to the maximum (see [8, Fig. 4a]). The authors found that the periodic curve of PaO2 changes in time, taking into account the time of blood flow from the lungs to the brain (1.4 s), correlates with the periodic curve of changes in the volume of gas in the lungs. At the beginning of exhalation (exhalation onset), when the value of the respiratory volume of the lungs is maximum, PaO2 in the pulmonary veins has a minimum value, and during exhalation increases to a maximum. At the beginning of inspiration (inhalation onset), when the value of the respiratory volume of the lungs is minimal, PaO2 in the pulmonary veins has a maximum value, and decreases to a minimum during inspiration. The authors of the experiment believe that there is reason to consider this property characteristic of all mammals.

Thus, the results of the described experiment confirm the conclusions of the author's studies that, with significant physical exertion, breathing becomes two-stroke: in the first stroke (the inhalation phase), atmospheric air enters the alveolar space and, at the same time, carbon dioxide diffuses from the blood; in the second cycle (expiratory phase), gas exits the alveolar space into the atmosphere and, simultaneously, with compression, oxygen diffuses into the blood.

The functioning of two subsystems of respiration regulation (subsystems of regulation of external respiration and tissue respiration) and their interaction are considered. An analysis of the respiratory system as a whole shows that normally each of the subsystems during physical activity must fully perform its work: the heart must maintain a partial pressure of oxygen acceptable for venous blood (25-20 mm Hg) by accelerating blood flow; the lungs must provide a partial pressure of oxygen acceptable for arterial blood (90-100 mm Hg) at an increased blood flow rate by increasing compression by increasing the RR.

In case of deviation from the norm, if the lungs cannot cope with their task, then the heart will have to compensate for the deficiency of the lungs. The heart has nowhere to go. It will literally die. And if we take into account that nature gave a person the possibility of voluntary movement and breathing, then he is completely responsible for the final result both in choosing the degree of physical activity and in providing it (load) with the method of breathing. This circumstance allows us to raise the question of the correctness of the method of breathing, i.e. adequacy of breathing to the load.

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DOI 10.34660/INF.2023.72.56.084

«拇外翻»手术治疗方法
METHOD OF SURGICAL TREATMENT «HALLUX VALGUS»

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注解。在哈巴罗夫斯克的足部病理学诊所"足病学实验室"，改良的 SCARF - 截骨术已被开发并投入实践。从 2019 年至今，已有 723 名患者使用该技术进行了手术。长期结果追踪至术后 12 个月。在手术治疗后12个月的对照检查中，绝大多数患者对手术的美容和功能结果感到满意。

关键词：扁平足、SCARF - 截骨术、拇外翻、接骨术。

Annotation. *In the clinic of foot pathology "Podiatry Lab" in Khabarovsk, modified SCARF - osteotomy has been developed and introduced into practice. From 2019 to the present, 723 patients have been operated on using the proposed technique. The long-term results were tracked up to 12 months after surgery. At the control examination 12 months after surgical treatment, the absolute majority of patients were satisfied with the cosmetic and functional result of the performed operation.*

Keywords: *flat feet, SCARF - osteotomy, Hallux valgus, osteosynthesis.*

Relevance.

Lapidus operation is considered to be one of the priority surgical techniques in the treatment of deformities of the first ray of the foot in transverse flatfoot. The effectiveness of this technique for correction of the M1M2 tarsal angle has been described in detail in the literature (1-8). SCARF osteotomy of the first metatarsal bone is also considered the “gold standard” in the treatment of this pathology. However, analysis of the literature and our own experience leads to the conclusion that these surgical techniques are not without their negative sides and require significant improvement.

Brief review of the literature.

Back in 1934, Lapidus P.W. pointed out the importance of varus deviation of the first metatarsal bone and instability of the metatarsal-clavicular joint in the formation of Hallux valgus. Lapidus P.W. suggested performing arthrodesis between the first metatarsal bone and the medial cuneiform bone or, in some cases, with the base of the second metatarsal bone in combination with soft tissue release (9-11).

This technique was originally proposed for the treatment of metatarsus primus adductus with valgus deviation of the first toe (Figure 1).

Figure 1. *Example of Lapidus operation with screw fixation. Photo borrowed from the Internet public domain*

Figure 2. *Example of Lapidus operation with plate fixation. Photo borrowed from the Internet public domain*

The technique of surgery and fixation has undergone significant changes with the advent of compression screws and plates with angular screw stability, (Figure 2).

The advantage of performing the Lapidus technique for valgus deviation of the big toe is that this procedure addresses the problem at the apex of the deformity, allows stable fixation of the fragments and stabilises the medial column of the foot.

Although the Lapidus technique has been an absolute indication for the treatment of hypermobility of the first metatarsal-cuneiform joint with valgus deviation of the big toe, the results of surgical treatment are still a matter of debate and controversy (13-17).

Most surgeons attribute hypermobility to excessive displacement of the medial column in the sagittal plane, but simultaneously believe that hypermobility in the frontal plane may occur. Based on two separate studies on cadavers, it appears that the first metatarsal-cuneiform joint is "responsible" for 41% to 57% of total medial column motion of the foot (18,19).

Most surgeons classify hypermobility as a pathological condition and have suggested that nearly half of the motion of the first ray of the foot can be reduced by isolated arthrodesis of the metatarsal-cuneiform joint. Although Lapidus surgery is associated with the treatment of hypermobility, it should be realised that osteotomies of the first metatarsal are equally effective in treating this condition.

A prospective randomised study on 101 feet by Faber et al (20) presented similar results when comparing distal metatarsal osteotomy (Hohmann type) with the Lapidus technique in patients with hypermobility. Coughlin M.J, Jones C.P. noted that hypermobility resolved after diaphyseal osteotomy and soft tissue release in all but 2 of 23 patients (21). Thus, it seems important to achieve a reduction in the intertarsal angle regardless of the method of treatment (22,23).

Despite the many advantages of this technique, there are complications that include: nerve damage, delayed fusion or non-union.

When correcting the first ray of the foot, the varus deviation of the 1st metatarsal bone must be corrected, the metatarsal bone must be shortened and plantarised, and rotation must also be corrected. Insufficient correction or on the contrary hypercorrection can lead to undesirable consequences: hyperextension of the 1st toe, residual valgus deviation of the 1st toe or on the contrary varus deviation, extensional deformation of the first toe with excessive plantarisation of the metatarsal bone, overloading in the area of the sesamoid hammock, pain in the area of the cuneiform - navicular joint, etc.

In this regard, an accurate calculation at the preoperative planning stage is necessary to obtain a good treatment result, which is technically quite difficult to do when performing arthrodesis of the medial metatarsal-cuneiform joint.

In 1926, Dr Mayer proposed SCARF, an osteotomy for the treatment of valgus deviation of the 1st toe. In 1977, Timothy James Herbert received a patent for the screws he developed, which began to be used in clinics in America. In 1986, Terry Whipple modernised the screw model by making it cannulated and patented it under the name "Herbert screw" (1).

Since the early 80s, the SCARF osteotomy technique has been widely spread in the USA, thanks to Dr L.S.Weil, and since 1991 it has been popularised in

Europe with the active participation of Dr L.S.Barouk. Since the 2000s, this technique has been actively spreading in Russia (1).

Today, this technique is a priority in the treatment of deformity of the first ray of the foot. Its essence consists of a Z-shaped osteotomy of the diaphysis of the first metatarsal bone and displacement of the plantar fragment to correct varus deviation of the first metatarsal bone. This osteotomy makes it possible to correct the position of the plantar fragment in 3 planes. However, the degree of correction and rigidity of fixation directly depends on the degree of deviation of the first metatarsal bone, its shape and width, the degree of vertical and horizontal mobility of the first metatarsal-cuneiform joint. All of the above leads to limitations in the use of this method for correction of severe deformities of the first ray of the foot, especially when combined with instability of the metatarsal-cuneiform joint.

Materials and methods.

A modified SCARF osteotomy was developed and introduced into practice at the Podiatry Lab Foot Pathology Clinic (Fig. 3,4).

Figure 3. *Appearance of the feet before and immediately after the performed surgery using the proposed technique*

Figure 4. *Radiographs of the feet before and immediately after the performed surgery using the proposed technique*

The main objective was the possibility of performing controlled correction of the first ray of the foot with subsequent stable fixation in severe deformities, including those combined with hypermobility of the metatarsal-cuneiform joint.

Changes were made in the technique of soft tissue lateral release, saw cuts in the metatarsal bone, and the method of fixation of osteotomised bone fragments

(Figs. 5,6). This made it possible not only to maximise control of correction in all planes, but also to eliminate internal rotation and to achieve stable fixation with little contact between the fragments (Figs. 7,8).

Figure 5. *Appearance of the foot before and immediately after the performed surgery using the proposed technique*

Figure 6. *Radiographs of the foot before and immediately after the performed surgery using the proposed technique*

In the period from 2019 to the present, 723 patients were operated using the proposed method. The long-term results were studied up to 12 months after surgery.

Figure 7. *Appearance of the feet before and 12 months after the performed surgery using the proposed technique*

Figure 8. *Radiographs of the feet before and 12 months after the operation using the proposed technique. Complete consolidation of osteotomised bones*

Akin - osteotomy of the proximal phalanx of the 1st toe was performed in all patients against the background of osteotomy of the 1st metatarsal bone. In a number of cases, reconstruction of the first ray of the foot was accompanied by correction of hammer toes with intervention on the central metatarsal bones and phalanges of the middle toes, and correction of the Taylor's deformity.

Results.

Postoperative wounds healed by primary tension, except for three cases of superficial infection, which was managed conservatively. There were no cases of deep infection with the development of osteomyelitis. The mean intertarsal angle M1M2 after surgery was less than 100. There was 1 case of disciplinary stress fracture of the first metatarsal bone against the background of osteotomy in a patient who had a foot injury in the first three weeks after surgery. Initial radiological signs of consolidation were noted at 3 months postoperatively.

The period of wearing Baruca shoes was 3 weeks, with the beginning of loading on the operated foot on the next day after surgery. Active movements of the toes were also allowed the next day after surgery, more active rehabilitation was started after suture removal. Swelling of the operated foot persisted on average for 6-7 months and completely disappeared by 8-10 months after surgery. At the examination 12 months after the operation the absolute majority of patients were satisfied with the cosmetic and functional result of the operation.

Conclusion.

Thus, the proposed modified SCARF - osteotomy allowed to realise the set task - to perform the optimal controlled correction of the first ray of the foot with the subsequent stable fixation in case of pronounced deformities of the 1st ray of the foot.

The changes in the soft tissue lateral release, significant changes in the technique of saw cuts, and changes in the method of fixation of bone fragments at the osteotomy level allowed not only to perform the correction in all planes under maximum control, but also to achieve stable fixation with little contact between the fragments, which in general determined the favourable result of treatment.

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DOI 10.34660/INF.2023.80.47.085

狄拉克 δ 函数弱极限下的 Hardy-Weinberg 公式系数
HARDY-WEINBERG FORMULA COEFFICIENTS IN THE CONTEXT OF THE WEAK LIMIT OF THE DIRAC DELTA FUNCTION

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注解。本文属于数学生物学领域，致力于利用数学分析仪器研究哈代-温伯格定律。考虑到归一化条件，实现该定律公式中的系数值的概率密度函数被表示为狄拉克δ函数的弱极限。概率密度函数的最大值对应于这些系数的值。选择高斯函数来对狄拉克 δ 函数背景下的概率密度函数进行建模。当种群受到干扰影响时，概率密度公式会发生相应的变化。

关键词：Hardy-Weinberg 原理、群体遗传学、等位基因、基因型、遗传漂变、狄拉克 δ 函数、函数极限、概率密度函数、高斯函数。

Annotation. *This paper belongs to the field of mathematical biology and is devoted to the investigation of the Hardy-Weinberg law using the apparatus of mathematical analysis. The probability density functions for the realisation of the values of the coefficients in the formula of this law are presented as weak limits of the Dirac delta-function taking into account the normalisation conditions. The maxima of the probability density functions correspond to the values of these coefficients. The Gaussian function is chosen to model the probability density function in the context of the Dirac delta function. When the population is subjected to disturbing influences, the probability density formulas undergo corresponding changes.*

Keywords: *Hardy-Weinberg principle, population genetics, allele, genotype, genetic drift, Dirac delta function, limit of a function, probability density function, Gaussian function.*

Introduction

The Hardy-Weinberg law is an important statement of population genetics. The essence of this law is that in a population of infinitely large size under the conditions of:

1. realisation of random crosses (panmictic population);
2. absence of natural selection;
3. absence of mutation process (mutations are completely absent or forward and reverse mutations occur with the same frequency);
4. absence of exchange of individuals with other populations;
5. absence of gene drift;
6. equal fecundity and viability of homozygous and heterozygous individuals for a given pair of alleles;
7. frequencies of genotypes for a gene will be kept constant over time from generation to generation [1].

That is, the process of inheritance does not affect the frequency of alleles in a population; possible changes in its genetic structure arise for other reasons.

The Hardy-Weinberg equilibrium is valid for ideal populations and is violated in the case of real populations. Random gene drift, mutations, migrations, natural selection shift the equilibrium [2].

The Hardy-Weinberg law has applications in medical genetics (estimation of population risk of genetically determined diseases), in breeding (estimation of genetic potential of a population), ecology (identification of the influence of various factors on populations). There are calculators for calculating genotype frequencies according to the Hardy-Weinberg law [3].

The distribution of frequencies of three genotypic classes controlled by two alleles of one autosomal gene obeys the formula:

$$(p+q)^2 = p^2 + 2pq + q^2 = 1, \quad (1)$$

where p is the frequency of occurrence of allele *A, q* is the frequency of occurrence of allele *a*,

p^2 - genotype frequency rate AA, q^2 - genotype frequency rate *aa*,

pq – genotype frequency rate A*a*.

The frequency distribution of genotypic classes will be constant, such an equilibrium is reached in one generation.

An important consequence of the Hardy-Weinberg law: rare alleles in a population are present predominantly in heterozygotes [4].

If the number of alleles of a gene is greater than two, the formula for describing the equilibrium frequencies of genotypes has the form [5]:

$$(p+q+\ldots+k)^2 = p^2 + q^2 + \ldots + k^2 + 2pq + 2pk + 2qk + \ldots = 1, \quad (2)$$

Squaring in this case occurs according to the polynomial theorem [6] (which is a generalisation of Newton's binomial).

Mathematical modelling of the probability density function for the detection probability of coefficients in the Hardy-Weinberg formula

The Dirac delta function x is a generalised function that has wide applications in higher mathematics and mathematical physics to describe concentrated quantities [7]:

$$\delta(x) = \{+\infty, if\ x = 0; 0, if\ x \neq 0\}, \quad (3)$$

Рассмотрим последовательность

$$f_n = a \cdot n \cdot exp(-(nx)^2), \quad (4)$$

which converges weakly to the δ-function as n grows [8] .

We will model the probability density of detecting the coefficients in the right part of the Hardy-Weinberg formula using the Gaussian function [9]:

$$p_1(x) = a \cdot n \cdot exp\left(-\left(n(x-1)\right)^2\right), \quad (5)$$

- probability density function for the first coefficient (this function has a maximum at $x = 1$).

$$p_2(x) = b \cdot n \cdot exp\left(-\left(n(x-2)\right)^2\right), \quad (6)$$

- probability density function for the second coefficient (this function has a maximum at $x = 2$).

$$p_3(x) = c \cdot n \cdot exp\left(-\left(n(x-1)\right)^2\right), \quad (7)$$

- probability density function for the third coefficient (also has a maximum at $x = 1$).

Thus, the highest probability corresponds exactly to those coefficients that appear in the right-hand side of the Hardy-Weinberg law.

With $n \to \infty$ the probability density of detecting the coefficients by such a number will tend to infinity, which corresponds to the ideal fulfilment of the Hardy-Weinberg law, i.e. the unperturbed problem.

The total probability of detecting a coefficient by any positive number is equal to 1, so the normalisation conditions must be satisfied [10]:

$$\int_0^{+\infty} p_1(x)dx = 1; \int_0^{+\infty} p_2(x)dx = 1; \int_0^{+\infty} p_3(x)dx = 1, \quad (8)$$

from where we can find the coefficients a,b,c:

$$a = \frac{2}{\sqrt{\pi}(erf(n)+1)}; b = \frac{2}{\sqrt{\pi}(erf(2n)+1)}; c = \frac{2}{\sqrt{\pi}(erf(n)+1)}, \quad (9)$$

where $erf(x)$ - error function, often used in probability theory and mathematical statistics [11].

Then the formulas for the probability density of detecting the values of coefficients take the following form:

$$p_1(x) = \frac{2n \cdot exp\left(-\left(n(x-1)\right)^2\right)}{\sqrt{\pi}(erf(n)+1)}; \quad (10)$$

$$p_2(x) = \frac{2n \cdot exp\left(-\left(n(x-2)\right)^2\right)}{\sqrt{\pi}(erf(2n)+1)}; \quad (11)$$

$$p_3(x) = \frac{2n \cdot exp\left(-\left(n(x-1)\right)^2\right)}{\sqrt{\pi}(erf(n)+1)}. \quad (12)$$

When a perturbation affects the population (random gene drift, mutations, inbreeding, natural selection, migration, isolation), the corresponding perturbation will be imposed on the probability density (10),(11),(12) (random changes in allele and genotype frequencies during the change of generations are called gene drift, and the effect of gene drift on the population depends primarily on its size [12]).

In this case, the normalisation coefficients will also take other values. For example, the equilibrium of gene and genotype frequencies in a population under free reproduction of individuals with partial inbreeding describes Wright's law. Wright's rule can be applied to the equilibrium of genotypes in a Hardy-Weinberg population under self- and cross-fertilisation of plants. The formula [13] is valid for a locus with two alleles and partial inbreeding:

$$(p^2 + pqF)AA + 2pq(1-F)Aa + (q^2 + pqF)aa, \quad (13)$$

where p and q are the frequencies of alleles A and a, respectively, F is the inbreeding coefficient.

Also in this work, we could use the following representation of the Dirac delta function [14]:

$$\delta(x) = b \cdot \frac{\alpha}{x^2+\alpha^2}, \quad (14)$$

which would give the results not fundamentally different from those already obtained.

At finite values of n in formulas (10), (11), (12), the probability density of detecting the values of coefficients on the graph will be a "Gauss bell", i.e. the coefficients in the Hardy-Weinberg formula can vary with the impact on the population.

Conclusion

Thus, in this paper we have presented probability density functions for realisation of coefficient values in the Hardy-Weinberg formula and found normalisation coefficients for these functions. Mathematical modelling by means of Gaussian function was carried out for the case of frequency distribution of three genotypic classes controlled by two alleles of one autosomal gene. Being weak limits of the

Dirac delta function, these functions can serve as tools for modelling perturbing influences on the population. When a perturbation is imposed on the obtained formulae, the coefficients in the Hardy-Weinberg formula and the normalisation multipliers in the probability density functions will take other values.

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DOI 10.34660/INF.2023.31.72.086

西西伯利亚中部针叶林（汉特-曼西斯克自治州 – 尤格拉条件下）灰化土上种植东方山羊豆（Galega orientalis Lam.）的前景

PROSPECTS OF EASTERN GALEGA (*GALEGA ORIENTALIS* LAM.) CULTIVATION ON PODZOLIC SOILS OF THE WESTERN SIBERIA MIDDLE TAIGA (IN CONDITIONS OF KHANTY-MANSIYSK AUTONOMOUS OKRUG - YUGRA)

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注解。介绍了东山羊豆（Galega orientalis Lam.）在西西伯利亚中部针叶林受技术干扰的土地上为期三年的引进研究结果。这是首次评估饲料容量、营养价值以及引进作物对灰化土壤肥力的影响。东方山羊豆作为绿肥和高营养饲料作物，证明了其有效的引种能力。最具前景的介绍是用Baikal-EM1微生物肥料对山羊豆种子进行播前接种。事实证明，第二种豆类成分的播种总体上抑制了所研究的培养物的生长和发育。

关键词：东方山羊豆，适应北方条件，侧鼠，饲料栽培，引种。

Annotation. *The results of three-year introduction studies of eastern galega (Galega orientalis Lam.) on technogenic – disturbed lands of the Western Siberia middle taiga are presented. It is the first evaluation of fodder capacity, nutrition value and the introduced crop impact on podzolic soils fertility. Eastern galega proved its effective introduction capability as a green-manure and highly nutritious fodder crop. The introduction is the most prospective with use of Baikal-EM1 microbiologic fertilizer for galega seeds inoculation before sowing. Sowing of the second legume component proved to be overall depressing for growth and development of the studied culture.*

Keywords: *Galega orientalis Lam., adaptation to the conditions of the North, siderat, fodder culture, introduction.*

The extreme climatic conditions of the Western Siberia middle taiga, namely low ambient temperatures with rapid daily temperature drops, short vegetation pe-

riod, drainage and permafrost processes of the soil inhibit the humus reproduction and restrain the effective use of the region's land resources.

As of today, biological agriculture is the priority direction for soil resources preservation and usage (soil fertility increase and disturbed soils recovery). It is especially necessary in conditions of intensively used technogenic-disturbed lands to which the Western Siberia territory should be ascribed.

The above mentioned peculiarities determine the urgent need for introduction in the region of plants with high ecological pliability, valuable biological and holocoenotic properties. The prospective culture to solve this problem in recent decades is a new non-traditional legume crop - eastern galega or fodder galega (*Galega orientalis* Lam.). This crop meets not only the above requirements, but possessing a powerful root system, high linear growth speed and foliation it can be used for city landscaping and provide a solid fodder resource for the development of livestock and hunting in the region. At the moment, the theoretical and practical issues of galega introduction in the Khanty-Mansiysk Autonomous Okrug are poorly studied (Lapina, 2014).

The purpose of the research is to define the character of changes in the main agrochemical fertility factors for podzolic soils, to access the productivity and fodder advantages of eastern galega at its introduction in the Western Siberia middle taiga.

Materials and methods. The object of the study is a perennial plant from legume family - eastern galega or fodder galega (*Galega orientalis* Lam.), cultivar Galega is included in the Russian Federation State Register since 1988 (http://reestr.gossort.com/reg/cultivar/300).

In order to achieve the objectives a field experiment was carried out in the soil-climatic conditions of the Western Siberia taiga. The experiment was conducted during 2013-2015 in the research plot of Surgut State University in Barsovo settlement (Surgut area of the Khanty-Mansiysk Autonomous Okrug - Yugra) in 2013–2015. The experiment was performed as follows:

1. Sowing of noninoculated seeds (Control);
2. Sowing of seeds inoculated with Baikal-EM1);
3. Sowing of noninoculated seeds under the peas cover.

The cultivated research plot had sandy podzolic soil with organic matter mass fraction 5,63 %, pH salt – 5,21, total absorbed bases – 4,7 mmol per 100 g of soil, $N\text{-}NH_4$ – 3,85 mg per kg of soil, $N\text{-}NO_3$ – 129 gm per kg of soil, P_2O_5 – 396,1 mg per kg of soil, K_2O – 66,5 mg per kg of soil. As it was the first introduction of eastern galega in the Surgut area, agricultural have have not been studies. In this regard, soil treatment, seeds scarification and sowing were made manually. Seeding rate is 2,8 million of germinating seeds per a hectare, the seeding depth is 2–3 cm as per recommendations of M. L. Puzyreva (2006) for eastern galena sow-

ing in sandy soils (Nadezkin et al., 2008). The seeds presowing inoculation with Baikal-EM1 microbiological fertilizer was performed according to the fertilized application recommendations.

The plots in the experiment more placed by a continuous method, the experiment variants are located systematically. The area of the record plot was 0,25 m^2. The total record area for each variant was 1 m^2. The test was performed in 4 replications. For the research we used conventional methods (Stankov, 1964; Nichipovich et al, 1969; Dospekhov, 1973).

Vegetation and soil specimens were selected at the end of vegetation period. The nutrients amount (NPK) in the 0–40cm layer of soil and fodder potential were evaluated as per the conventional methods at a certified test laboratory (certification protocol № RA. RU. 21ПЧ23 of. 19.08.2015) at the Federal State Budget Institution "Mariyskaya" Agrochemical Service Station", Ioshkar-Ola.

Results and discussion

The amount of precipitation during the researched vegetation periods varied from 144,6 mm (2013) to 471 mm (2015 г.). Resulting temperature for ≥ 5 ˚C varied from 1347,25 ˚C to 1793,1 ˚C, resulting temperature for < 10 ˚C varied from 1291,5 ˚C to 1597,3 ˚C. The vegetation period in 2013 showed insufficient precipitation supply to the soil and moderate temperatures. Resulting temperature for ≥10 ˚C was 1597,3 ˚C, hydrothermic index – 0,8. The vegetation period in 2014 showed insufficient precipitation supply to the soil. Hydrothermic index was 1,2 at the normal rate of 1,7, that shows low moisture supply. Resulting temperature for ≥10 ˚C is 1291,5 ˚C, precipitation shortfall is 10 % of the normal rate. The vegetation period in 2015 differed from the previous years of the research by excessive moisture supply (hydrothermic index - 2,6). Precipitation amounted to 741 mm or 149 % of the normal rate at the average daily ambient temperature of 12,5 ˚C (normal rate 11,6 ˚C). Resulting temperature for < 10 ˚C is 1576,5 ˚C.

The data analysis showed that for eastern galega cultivation in podzolic soil the increase of organic matter in the plow horizon (0-30 cm) was registered in the third year of the crop life (Table 1).

Table 1

Dynamics of organic material and nutrition elements contents in the soil after galena cropping in introduction conditions (average for 2013–2015)

Experiment stage	Year	Organic matter mass content, %	Salt extract acidity, pH	Phosphorus mass content, mg/kg	Potassium mass content, mg/kg
Baseline value		5,3	4,0	382,0	30
Control	1	5,3	4,0	382,2	30
	2	3,2	4,4	437,0	24
	3	5,0	4,2	300,0	< 50

Seeds inoculation with Baikal-EM1	1	5,0	4,0	374,2	33
	2	4,0	5,3	375,0	21
	3	7,4	4,3	374,0	< 50
Seeds sowing under peas cover	1	4,1	4,3	255,3	52
	2	4,2	4,4	386,0	31
	3	6,0	4,2	293,0	< 50
HCP_{05}	1	0,1	0,48	0,35	-
	2	0,20	0,19	1,0	-
	3	0,18	0,28	1,1	-

Table 1 Dynamics of organic matter and nutrition elements content in the soil after galena cultivation in introduction conditions (average for 2013-2015)

The maximum increase of soil organic matther was observed in the variant with sowing of inoculated seeds and amounted to 40 % to the baseline values of 2013 and 37 % to the control value in 2015. Binary sowing provided an increase in the content of this indicator, in the plow horizon only by 13 % to the initial data and by 20 % to the control values. In general, it should be noted that the amount of organic matter in the soil decreased during the first and second years of galega introduction. It might be caused by the increase in the microbial activity of the soil under the introduced crop activity.

The considered eastern galena sowing methods did not have a sufficient impact on the soil solution reaction during the three-year experiment.

By the end of the vegetation period in 2013 the extractable phosphorus content in the soil differed according to the experiment variants. Eastern galena shelter sowing had led to significant decrease in the extractable phosphorus in the year of sowing by 33 % to the base values (382 mg per kg of soil) ($\acute{a} > 0,05$). This is most likely due to the more active biological consumption of phosphorus by the cover crop. One the second year of vegetation all the experiment variants showed a trend to P_2O_5 accumulation in the plow horizon. This process was especially intensive during binary sowing variant (galega and peas). The extractable phosphorus content increased by 51% compared to the fall of 2013.

The were no significant differences in K_2O content in the horizon in the year of sowing in the control variant and the Baikal-EM1 variant of the experiment compared to the baseline value. Maximum K_2O value was observed at introduced crop sowing under peas cover (52 mg per kg of soil). This is most likely due to the increase in microbiological processes in this variant of the experiment. Since 2014 there has been a clear trend to the extractable potassium decrease in the arable horizon of podzolic soils.

In the general, we can sag that the peas green mass, in the variant with its sowing under galega, provided for extractable potassium increase and mobilization in

the plow horizon in the first year of plant life. At that due to the organic matter increase in the soil (see table 1) the effect of the siderite after effect was observed in the second year ass well.

Observation of the introduced crop growth and development during 2013-2015 allowed to conclude that the production processes in the cultivation of plants in the Western Siberia middle taiga conditions are mainly determined by the cultivation methods and the crop age (Table 2).

Table 2

Height and yield of eastern galega depending on the age of the grass stand and the methods of cultivation in introduction conditions (average for 2013-2015)

Experiment variant	Plant height, Cm		crop yield, centner/hectare	
	Average	± to control	Green mass/ ± to control	dry mass / ± to control
1st year				
Control	13,52±1,46	0	140	39
Seeds inoculation with Baikal-EM1	17,51±1,89*	+4,1	120 / + 20	32,4 / - 6,6
Seeds sowing under peas cover	13,31±1,26	-0,09	70 / - 70	21 / - 187
HCP_{05}		0,12		
2nd year				
Control	40,55 ±2,52	0	200	56,2
Seeds inoculation with Baikal-EM1	75,83±2,53*	+34,75	250 / + 50	68 / + 11,8
Seeds sowing under peas cover	22,00±3,23*	-18,45	70 / - 130	20,9 / - 35,3
HCP_{05}		2,62		
3rd year				
Control	91,9 ±2,52	0	390	111,2
Seeds inoculation with Baikal-EM1	133,4±2,53*	+41,5	470 / + 80	128,8 / + 17,6
Seeds sowing under peas cover	42,3±3,23*	-49,6	60 / - 330	18 / - 93,2
HCP_{05}		2,37		

Note: *P ≤ 0,05 (.*- differential significance ά (alpha) < or equal to 0,05 between the variants). Reliability index P = 0,95.

Our studies showed that for 3-year average the maximum height of the crop, regardless of the year of life, was observed in the variant with the use of micro-biological fertilizer fa-seeds inoculation 17,51 to 133,4 cm, which is by 30-87%

higher than the control values. The additional component of the peas had a negative aftereffect on the crop growth as a whole.

The eastern galega crop yield increased over the years of life and for 3 years in the control made 243 centner/hectare, in the variant with use of Baikal-EM1 – 280 centner/hectare, in the variant with combined sowing of galega and peas – 66,7 centner/hectare. The microbiological fertilizer increased the crop yield by 15 %, dry matter 11% compared to the control values. The additional legume component decreased the green mass yield by 72,5 % and dry matter by 71 % compared to the control values. During 3 years the galega aboveground biomass correlated with its height (r = 0,95–0,94, r^2 = 0,901–0,898).

The crop growth and development observation results allow to assume that the additional legume component of peas had a depressing impact on the introduced crop growth and development as early as the year of sowing by entering into a competitive relations for the resources leading to a decrease in the eastern galega herbage and dry mass yield in the next years.

At introduction of the fodder crop in the region and evaluation of the crop farming efficiency for livestock feeding it is important to evaluate its chemical composition and feeding nutrient value, as its intake quality define normal vital activities of livestock and the production output as a whole. The nutrient value of the feeding mass is determined by its biochemical composition. During 2013-2015 in average the eastern galega nutrient value was found to increase with the crop plant stand age regardless the experiment variant. Application of Baikal-EM1 fertilizer for presowing seeds inoculation provided an increase of crude protein in the 3rd year of life by 9 %, fat by 6,8 %, leach by 3,7 %, digestible protein by 9,6 %, exchange energy by 0,4 MJ/kg and decrease of crude fiber by 13 % compared to the control values (Table 3).

Table 3

Eastern galega biomass nutrient value depending on the grass stand age and cultivation methods during introduction (average for 2013–2015)

Experiment variant	**Year**	**Content in dry biomass**						
		%				**g/kg**	**per 1 kg**	
		Crude protein	**Crude fat**	**Crude leach**	**Crude fiber**	**Digestible protein**	**feeding units**	**EE, MJ**
Control	1	12,3	2,5	7,0	28	102	0,7	9,2
	2	13,6	2,6	7,4	28	114	0,7	9,3
	3	14,7	2,7	7,8	26	123	0,7	9,6
Seeds inoculation with Baikal-EM1	1	14,4	2,7	7,5	28	120	0,7	9,2
	2	14,0	2,6	7,2	26	114	0,7	9,6
	3	16,2	2,9	8,1	23	136	0,8	10

Seeds sowing under peas cover	1	13,9	2,7	7,4	27	116	0,7	9,5
	2	13,4	2,5	7,2	28	112	0,7	9,3
	3	14,0	2,7	7,5	24	117	0,8	9,8

According to the obtained data, the maximum crude protein content in the eastern galega dry biomass was found for the Baikal-EM1 variant. The rest of the experiment variants do not show significant deferences during the crop vegetation seasons. It should be noted that there is a trend for crude protein increase with the grass stand age and, consequently, the increase of the eastern galega nutrient value. Only 2014 showed an insignificant decrease of this value, probably, caused by insufficient heat supply during the vegetation season.

The crude fat content in the experiment variants under study was at the same level (2,5–2,9 %) independent of the galena age. Crude leach content complied with dairy cows zootechnics requirements.

The crude fiber content in the feeding mass amounting to more than 28–30 % (Aleksandrova, 2014) leads to the decrease in the digestibility of feed, the water – holding capacity of plant tissue and, in general, to deterioration in the crop nutrient value. The eastern galega herbage biochemical analysis showed that crude fiber content was within the rated values (23–28 %) during all three years of the experiment for all the experiment variants. A decrease by 2–5 % was found in the third year of the crop plant stand age. Minimal crude fiber content was observed for the variant with microbiological fertilizer use for seeds inoculation (23 %) that shows the positive impact of Baikal-EM1 fertilizer on the crop nutrition value.

The biochemical analysis revealed that the maximum digestible protein content is typical of the eastern galega biomass grown from inoculated seeds. The value was 114–136 g per 1 kg of the introducent dry biomass, that is on average by 10 % higher than the control values. Also, a continuous increase of the digestible protein content in the galega biomass was registered during the years in the control variant (by 20,5 %) and the Baikal-EM1 fertilizer variant (by 13 %). An insignificant decrease of this value in 2014 (second year of vegetation) as well as the above mentioned crude protein decrease we associate with decreased heat supply during the vegetation season. The galega and peas binary sowing influenced positively and provided digestible protein increase by 14 g compared to the control value (102 g/kg of dry mass) in the first sowing year. The following years showed the negative impact of the peas on the crop nutrition value. As a whole, during the three years of the experiment the galega seeds inoculation provided the digestible protein content of 164 g per a feed unit and 12,8 g per 1 MJ of exchange energy (accepted rate for diary cows is 8–12 g) with the respective control values of 161 g and 12,0 g. The biomass values obtained from the galega and peas binary sowing variant corresponded to 153 g and 12 g per 1 kg of dry mass.

Feed units content per 1 kg of dry mass for three years of observation was 0,7–0,8 feed units that proves good feeding capacities of the crop.

Exchange energy (EE) concentration per one unit of absolutely dry biomass averaged for the years of the experiment 9,4–9,6 MJ/kg of dry mass depending on the variant. The highest values are observed in the variant with galega inoculated seeds on the third vegetation year – 10 MJ/kg with the control values of 9,6 MJ/kg.

In general, the analysis of nutrients content in eastern galega dry biomass for three years of the experiment showed that the chemical composition of galega biomass grown in the Western Siberia middle taiga conditions corresponds to zootechnics requirements for dairy cow feeding.

Thus, we can assume that eastern galega having a high environmental plasticity to adverse environmental conditions, high yielding capacity and feeding advantages, a wide geobiocoenotic potential, can become a prospective fodder and green-manure crop for cultivation in podzolic soils of the Western Siberia middle taiga. The crop can be the most effectively introduced with use of Baikal-EM1 microbiologic fertilizer for galega seeds inoculation before sowing. Sowing of the second legume component had a depressing effect on the crop growth and development in the year of sowing and the following years. Galega cultivation on sandy podzolic soils is the most appropriate with the application of phosphate-potassium fertilizers as foliar top dressing form the second year of grass stand age. Galega usage as a green-manure crop is feasible starting from the third year of grass stand age. The introduced crop herbage having a high nutrition value, can be used for livestock feeding from the first year of vegetation.

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DOI 10.34660/INF.2023.15.62.087

芳香族染料溶液的电子束处理
ELECTRON BEAM TREATMENT OF AROMATIC DYE SOLUTIONS

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1. Introduction

Aromatic dyes are among the stable compounds with high thermodynamic stability due to intramolecular conjugation of chemical bonds. Recently, more and more dyes are acquiring the status of “food additives”, which creates an illusion in society about their harmlessness [1, 2]. The downside of persistence is the difficulty in degrading most dyes with traditional water treatment methods. As a result, getting into water bodies with sewage, dyes worsen their transparency and, thereby, weaken photosynthesis [2, 3]. Typical natural microorganisms living in water bodies are not always able to destroy aromatic dyes. Moreover, some dyes are converted into toxic products by the action of sunlight and dissolved impurities. For example, aqueous solutions of the azo dye E124 (Ponceau 4R) retain their mutagenicity even after prolonged photolysis by sunlight [4]. At the same time, electron beam radiolysis of these solutions reduces mutagenic activity to the level of spontaneous mutagenesis [5]. The reduction in color and mutagenicity induced by radiolysis occurs in parallel. Accordingly, the study of the unique mechanism of radiolytic decolorization and detoxification of food dyes is relevant for the development of promising methods for wastewater treatment. In this work, we studied the effect of accelerated electrons on solutions of dyes (quinophthalon E104; indigo E132; triphenylmethanes: E133 and E142; azo: E102, E122, E124, E129, E151, and E155), which differ both in the length of the conjugation system of intramolecular bonds and in the type of chromophore.

2. Experimental

Synthetic dyes from ABF (USA), Kerry Ingredients Flavors (Ireland) and Top Product (Russia) were used. The solutions contained 0.02 g dm^{-3} of the dye in distilled water. Tert-butanol (0.5 mol dm^{-3}) served as a selective scavenger for OH radicals. Perchloric acid ($HClO_4$; 1 mmol dm^{-3}) served as an electron scavenger. The radiation source was a linear accelerator LINS-03-350-EURF (USA) with 3 MeV electron beam energy of and 25 Hz pulse repetition rate (pulses: 4 μs; 0.88 Gy per pulse). Solutions were irradiated at 20 ± 2°C in glass test tubes with an outer diameter of 13 mm to a dose of 1–1.5 kGy. The dosimeter was a copolymer with phenazine dye SO PD(F)R-5/50 (GSO 7865-2000). The radiolysis of solutions was carried out with access to air (slow bubbling, 0.5 dm^3 min^{-1}). The optical absorption of solutions was measured on a Cary-100 UV-Vis spectrophotometer (Agilent) in quartz cuvettes. The initial radiation-chemical yield (G) of decolorization was determined from the dependence of the dye concentration on the absorbed dose in the range of low doses (up to 150 Gy).

3. Results and discussion

In azo dyes, the main chromophore functions are performed by one or several azo groups (–N=N–) connecting aromatic units. In triphenylmethane dyes, the function of a chromophore is performed by a quinoid unit formed by the introduction of an amino or hydroxy group in the para position to the central carbon of methane. The chromophore system of indigoid dyes consists of indole or benzothiophene derivatives and is characterized by the presence of an intraionized conjugation system with electron-donating and electron-withdrawing substituents at the ends. The conjugation system of the quinophthalone dye is formed by indandione and quinoline units. Regardless of the chemical structure of the studied dyes, radiolysis of both individual and mixed solutions leads to an irreversible decrease in their color with increasing dose.

The correlations between color intensity and absorbed dose are similar for all dyes tested. In the range up to 60% decolorization, the dependences of the relative color on the dose are practically indistinguishable from each other. For all solutions, the curves are located in the region between the curves for E104 and E151 (Fig. 1). However, at higher degrees of decolorization, the differences become more noticeable, probably due to the competition of the original dyes and their colorless derivatives in reactions with water radicals, due to the lack of oxygen, due to the absorption of light by suspended substances, and due to some other effects [6- 8]. For most dyes tested, the observed decolorization yield is between 0.05 and 0.08 μmol J^{-1} (Fig. 2). However, in solutions of E133 and E155, the yields are about 0.03, and in solutions of E129, E132, and E142 they reach almost 0.1 μmol J^{-1}. The observed yields (G) generally correlate with half- decolorization dose values, $D_{1/2}$. The higher G, the smaller $D_{1/2}$ (Fig. 2).

The lower degradation yield of E155 is explained by the fact that, unlike other azo dyes, the intramolecular conjugation system in it contains 3 aromatic units linked by two azo groups, which makes it more resistant to radiolysis. Complete discoloration requires damage to the conjugation of both azo groups, which consumes twice as many radiolytic reagents as the degradation of one chromophore center, as, for example, in E122 or E124. The chromophore system of triphenylmethane dye E133 also consists of several parts, where the degradation of one of them does not lead to the decomposition of the entire chromophore system. Thus, E133 and E155 show a comparatively lower degree of discoloration. Dyes E129, E132 and E142, on the contrary, have the most compact chromophore system, including one chromophore center each, the damage of which breaks the conjugation between the parts of the molecule and, thereby, leads to discoloration.

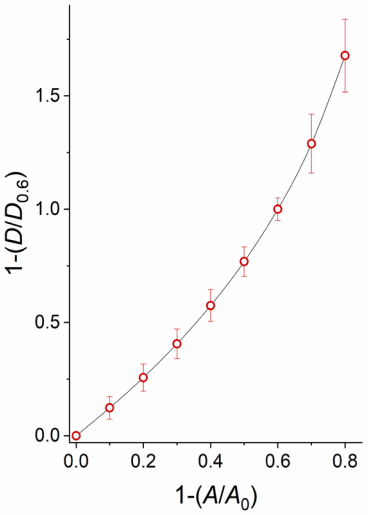

Figure 1. *Correlation between the dose and the degree of decolorization of dyes (A_0 - optical absorption in a non-irradiated solution, $D_{0.6}$ - dose at a degree of decolorization of 0.6)*

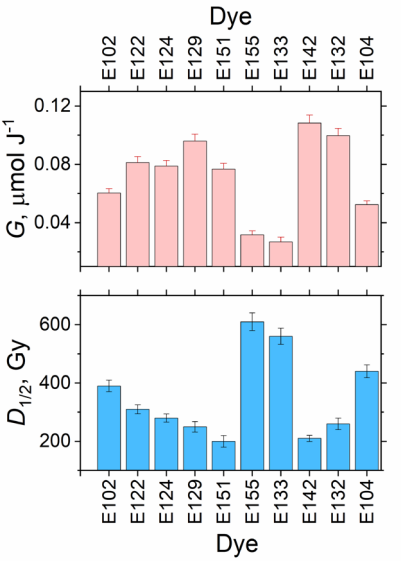

Figure 2. *Decolorization yield G and half decolorization dose $D_{1/2}$*

Obviously, due to the low concentration of dyes in the studied solutions, their decolorization occurs by the mechanism of indirect action of radiation, i.e., as a result of reactions of the dye with radicals generated from water molecules [6]. In aerated solutions, decolorization is carried out mainly by OH radicals, since the

reducing intermediates, a hydrated electron and an H atom (e_{aq} and H), are rapidly captured by oxygen to form low active radicals ($^{-}O_2$ and HO_2) [6, 7].

The key role of OH radicals in decolorization is revealed by experiments with the addition of tert-butanol (a selective scavenger of OH radicals) and perchloric acid (a selective scavenger of e_{aq}, which converts e_{aq} into less reactive H radicals). As can be seen from Fig. 3, when tert-butyl alcohol is added, the optical absorption of the solution decreases insignificantly during irradiation. In turn, the presence of $HClO_4$ provides the greatest decrease in optical density: the combined action of OH and H radicals leads to deep discoloration already at a dose of about 0.5 kGy. However, H radicals have less bleaching effect, as evidenced by the combined action of acid and tert-butanol. It is also noticeable in Fig. 3 that, with increasing dose, the absorption maximum shifts to the short-wavelength region, which indicates a decrease in the conjugation length in the chromophore system of the dye.

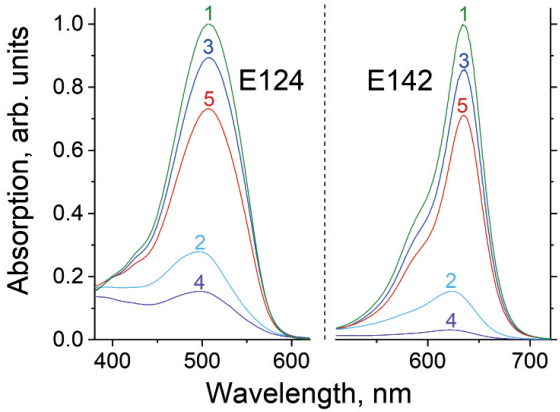

Figure 3. *Optical absorption of solutions of 0.02 g dm^{-3} E124 and E142 without additives (1; 2), with the addition of tert-butanol (3), with the addition of acid (4), and with the addition of alcohol and acid (5). 1 - 0 kGy; 2-5 - 0.5 kGy.*

Figure 4 shows the effect of the absorbed dose on the optical density of a solution containing a mixture of E104, E122, E132, and E142 (0.005 g dm^{-3} each), representing all four classes of the studied dyes. The initial difference between the observed spectrum (a) and the calculated spectrum (b), which is the sum of the spectra of individual solutions, indicates the presence in the unirradiated mixed solution (dose 0) of interaction and mutual screening of molecules/ions of different dyes compared to individual solutions. Nevertheless, almost independent discoloration of each of the components of the mixture is observed in the dose range up to 1 kGy, while spectra (a) and (b) demonstrate a similar proportionality

of the change in optical absorption with dose. The observed effect of parallel degradation is important from the point of view of the possibility of discoloration of dye mixtures in real multicomponent wastewater [6].

The elimination of color and mutagenicity of solutions is associated with a number of effects (Fig. 5). First, there is a decrease in the stability of the molecule due to damage caused by radicals to the intramolecular system of conjugated bonds. This is evidenced by the discoloration of the solution. Secondly, the molecule loses side sulfo groups, which reduces its solubility and, consequently, mobility in reactions with microbial DNA. Thirdly, there is a splitting of the connecting bridge -N=N- between the naphthalene units. Moreover, this cleavage occurs without the formation of amines or amides.

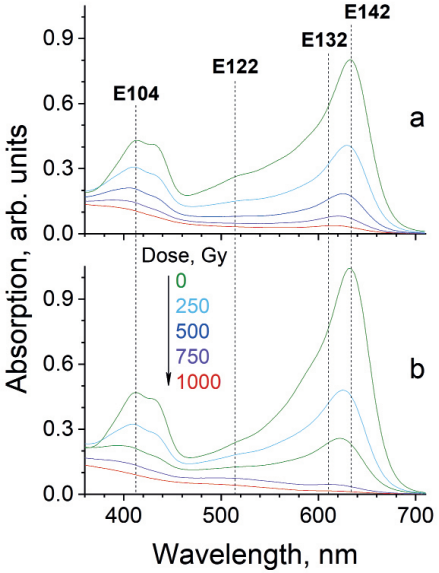

Figure 4. *Effect of dose on the optical absorption spectrum of a mixed solution of E104, E122, E132, and E142 (0.005 g/dm3 each): a – experimental results for the mixture, b – sum of the spectra for individual dyes. The values of the absorption maxima are shown by the dotted line*

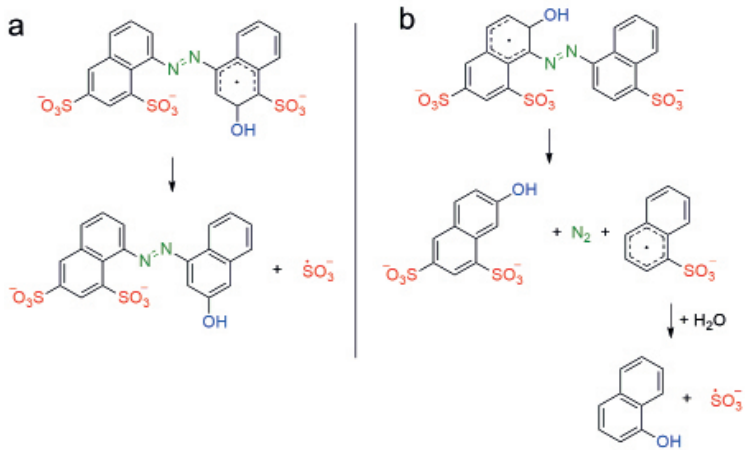

Figure 5. *Degradation of the E124 OH adduct (options a and b)*

The probability of degradation of OH adducts by a bimolecular reaction is low due to the low concentration of the dye, its low diffusion coefficient, and steric hindrance. Accordingly, most of the rapid transformations of the OH adduct proceed via the mechanism of monomolecular decomposition or pseudo-first order reactions with water molecules. The introduction of a new substituent (OH) into the naphthalene unit changes the electron density distribution that existed before the formation of the OH adduct. The unpaired electron of the OH adduct is delocalized over the remainder of the conjugation system, which includes aromatic rings, azo and sulfo groups. At the same time, the energy of the new C-OH bond is much higher than the energy of splitting of existing C-N and C-S bonds [9]. Thus, the relaxation of the OH adduct occurs due to the elimination of a substituent with a weaker bond (Fig. 5). In this case, the unpaired electron ends up on the split-off fragment. Similar dissociative processes could also occur in the absence of air due to the capture of a hydrated electron or H radical [6, 10].

At 1.5 kGy dose, each dissolved E124 molecule can interact with several OH radicals and, thus, lose all side groups without the formation of mutagenic products and intermediates. The degradation of the chromophore system occurs with the elimination of the connecting bridge and side substituents due to the radical addition of a new OH functional group, the binding energy of which is higher than that of the sulfo groups and the diazo bridge. Initially, the E124 dye in 0.02% aqueous solution is a nonspecific mutagen [5]. Without metabolic activation, it induces G→A transitions as well as +1 and -1 frameshift mutations. In turn, in the presence of liver enzymes, it causes mutations of the first two types. Electron beam-induced decolorization and detoxification occur in parallel and are due to

the same radical processes. The above-described neutralization of dyes does not require special preparation of the solution, which is attractive from the point of view of the use of electron beam processing in large-scale wastewater treatment [11].

4. Conclusion

The example of radiolysis of food coloring solutions shows the possibility of effective irreversible degradation of systems of conjugated bonds. In dye solutions, the effect of radiolysis on bond conjugation can be conveniently observed from changes in the color of the solutions. At 20 mg dm-3 dye concentration, complete discoloration is observed at 1–1.5 kGy dose. The effect is achieved under conditions of deficiency of dissolved oxygen. It is these conditions that are most attractive for large-scale electron-beam treatment of colored wastewater using powerful electron accelerators [11–13]. Radiolytic decolorization of representatives of the 4 considered classes of dyes with limited air access has an undoubted similarity, since it consists in the degradation of the intramolecular system of conjugated bonds. The main transformations consist in the addition of OH radicals to conjugated bonds and the subsequent interaction of organic radicals with dissolved oxygen or with each other. Damage to chromophore systems consists in the same type of interaction of radicals with double bonds responsible for the conjugation of atoms into a combined chromophore system.

ACKNOWLEDGMENTS

The authors are grateful to the Center for Collective Use of Physical and Chemical Research Methods at the A.N. Frumkin Institute of Physical Chemistry and Electrochemistry, Russian Academy of Sciences for the provided equipment.

FUNDING

This work was supported by the Russian Academy of Sciences, project no. 122011300061-3.

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DOI 10.34660/INF.2023.25.15.088
UDC 004.031.42:[355.58:614.876]

核电厂安全的理论问题
THEORETICAL ASPECTS OF SAFETY OF NUCLEAR POWER PLANTS

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抽象的。在文章中，作者特别关注了紧急情况的分类和核电厂安全的理论方面，这与开发管理解决方案相关，从而能够以最大的效率开展应急救援行动并应对现代社会环境问题不断涌现。

关键词：人为事故；核电厂安全；辐射污染；环境安全;监测和预测紧急情况的发展。

Abstract. *In the article, the authors paid special attention to the classification of emergency situations and theoretical aspects of NPP safety, which is relevant in connection with the development of management solutions that make it possible to carry out emergency rescue operations with the greatest efficiency and cope with constantly emerging environmental problems in modern society.*

Keywords: *man-made accidents; NPP safety; radiation contamination; environmental safety; monitoring and forecasting the development of an emergency.*

In modern society, as practice shows, destructive processes do not rarely occur in all spheres of social activity (dangerous phenomena affecting the environment) caused by various sources of emergency situations that are characterized by biological, chemical and physical effects on humans and society [1, p. 94]. And therefore, emergencies occurring today in space and time are characterized by certain stages, namely, the accumulation of contradictions and the strengthening of risk factors, and therefore, an increase in the possibility of the emergence (initiation) and deployment of the main process and the attenuation (termination) of the

emergency [2, p. 35]. Destructive spatiotemporal changes have quantitative and qualitative changes, as well as duration, which makes it possible to realize in real time the existing possibility of predicting an emergency (identifying sources and consequences), carrying out measures to ensure safety and prevent or minimize the risk of an unfavorable (catastrophic) situation [3, p. 66].

Thus, the basic element that minimizes the occurrence of emergency situations at modern nuclear power plants, as a rule, is the prediction of the destructive impact on the natural environment and society (material and human losses, environmental damage) and the development of management decisions that make it possible to carry out emergency rescue operations with the greatest efficiency (financing material and technical services, environmental costs for the rehabilitation of areas infected with radiation, providing the necessary amount of funds and resources).

Emergencies arising in the modern world are classified by causes of occurrence (military-political and socio-political conflicts, natural disasters, man-made disasters and combined environmental situations). It is combined type emergencies that affect the populations of all living organisms on our planet, including the human habitat, that are at the forefront today in solving environmental safety issues in modern society. At the same time, emergencies are classified by the time of action and speed of spread, by the scale of the covered area and departmental affiliation. Thus, a natural disaster as a destructive natural or natural-man-made phenomenon initiates the emergence of a threat to the life and health of people, as well as material objects are destroyed, which means that there is a completely unfavorable combination of such extreme options as a negative geographical event (flooding, earthquake, forest and peat fires, landslide, mudflows, avalanche, tsunami, volcanic eruption, hurricanes, storms, epidemics, space disasters), which is difficult to prevent the population on its own or to counteract the destructive phenomenon of nature. It is possible to minimize damage from a natural disaster by predicting, protecting or preventing an undesirable event that brings destruction and death of all life [4, p. 140].

It is important to take into account the fact that today there are not only natural disasters, when nature becomes an enemy of mankind, but also people themselves actively destroy the environment and in their scale of destructive impact not inferior to the natural elements, since the number of man-made disasters on our planet is constantly growing (man-made accidents or accidents, increase of production volume, increase of technological process parameters and presence of toxic, high-temperature components, concentration of huge amount of energy in a limited area, hazardous wastes and products, environmental disasters) [5, p. 485].

Let us explain that the most dangerous are explosions, fires and collapses, accidents on the power systems of nuclear power plants and chemical enterprises, oil

pipelines, which lead to the death of many people and the destruction of production facilities (high pressure in boilers, cylinders, pipelines, coal dust, gas, wood dust, paint vapors, woodworking waste). In such a catastrophic scenario as explosions and fires it is modern nuclear power plants that can become the secondary cause of similar phenomena that provoke synergistic processes and cascading accidents. And as a result, it is such disasters that forever remain in the history of mankind, since they influenced the further development of chemical production, energy and innovative technologies (the disaster in 1984 in India at the plant of the American corporation in Bhopal, the Chernobyl tragedy of 1986, as a result of which radioactive contamination of the territories of Belarus, Russia, Ukraine and European countries occurred). Thus, another natural and man-made disaster that occurred in Japan at the beginning of the 21st century at the Fukushitma-1 FES (the earthquake caused a tsunami and destroyed four units of the station) indicates that the synergy of natural disasters and technological accidents in the world does not stop. That is why the relevance of the theoretical aspects of ensuring the safety of nuclear power plants today is not accidental and quite timely for several reasons.

Firstly, most man-made accidents are accompanied by radiation pollution of the environment (environmental disasters), since any NPP is a source of ionizing radiation (Nuclear submarine and other nuclear weapons facilities, radiochemical enterprises, vehicles used in the transportation and storage of nuclear fuel, radioactive waste, spent nuclear fuel, scientific and medical institutions using installations with radioactive emitters and detectors), which is associated with radiation damage to humans and the biosphere. Thus, any NPP provides for the temporary storage of spent nuclear fuel with its subsequent transportation, which involves the construction of special enterprises for the storage and processing of radioactive waste, which requires the use of a situational modeling method focused on the study of constantly changing operating conditions of technical systems during emergency response (timely analysis of scenarios for the development of events and their consequences for ensuring public safety) [6, p. 325].

Secondly, the fundamental principle of ensuring the effective safety of nuclear power plants is layered protection based on the use of a system of barriers to the spread of radioactive substances and ionizing radiation, as well as the implementation of organizational and technical measures to protect plant personnel and the population. This, in turn, implies the creation of successive levels of protection against probable failures of modern equipment used at nuclear power plants and personnel errors (take into account the human factor, timely retraining of personnel, equipment reliability, identification and elimination of technical failures).

It is also necessary when providing engineering safety systems at NPPs performing emergency shutdown of the reactor, removal of heat from the reactor core, retention of radioactive substances within the specified boundaries of the

plant structures, to practice the most effective in-depth protection and by their actions in the event of an emergency, clearly implement the planned measures to manage the development of the designed accident and the implementation of timely management decisions in emergency situations during the elimination of the consequences of a radiation accident (structuring, aggregation, search for patterns).

And thirdly, an important element of monitoring and ensuring the technical safety of nuclear power plants is modeling, competent implementation of emergency response measures outside the NPP territory and the implementation of plans for the protection of the population and the elimination of the consequences of accidents (radiation monitoring based on gamma spectrometric and radiochemical analysis of water, earth, etc.). Of great interest today is the use of remote and local monitoring, which is due to diverse approaches to information processing. When eliminating the consequences of a radiation accident, this option may become a necessary factor that allows you to combine these methods within a single measuring task and allows you to comprehensively and relatively quickly solve problems that arise.

In this regard, it is important to use monitoring data to predict the development of an emergency, which will solve several problems:

- substantiate the structure of the geo-information system of situational modeling, which is directly related to environmental safety;

- creation of a base of local and remote changes of radioactive substances (harmful substances);

- use geoinformation system of situational modeling to automate processes of accumulation, primary processing of local and remote monitoring;

- use remote measurement methods for the main causes of air pollution and the creation of a situational pollution control center of various types. The result of this activity may be a geo-information system of situational modeling, which is directly related to environmental safety, providing support for decision-making in an emergency situation based on innovative practices (interactive educational technologies).

It should be noted that modeling management decisions in emergency situations during the elimination of the consequences of a radiation accident is directly related to technical systems, as well as to the emergence of technological industries and the introduction of computer systems based on network technologies, taking into account modern trends in dynamic digitalization.

Thus, achieving the maximum effect from the implementation of management decisions is important to adhere to the fact that it is necessary to objectively assess the professionalism of performers motivated for the high-quality implementation of management decisions in order to achieve strict implementation of the plan of

organizational and technical measures for the implementation of the decision, especially in emergency situations when eliminating the consequences of a radiation accident.

And, in this case, the management decision is focused on the rapid achievement of the result, which determines management activities and modeling in extreme conditions in the event of an emergency at the nuclear power plant. In addition, it is important to optimize measures to eliminate the consequences of possible accidents during the production and transportation of various hazardous substances in order to ensure also environmental safety under international law (creation of electronic databases on changes in the ecological state of all continents, satellite and ground monitoring of air pollution in urabanization territories of different countries).

Summarizing, let us explain that focusing on the classification of emergency situations and ensuring the safety of nuclear power plants today is necessary for one reason, namely, theoretical aspects make it possible to identify those constants that are most significant for the survival of a modern person and society. It should also be noted that technogenic civilization should pay special attention to human spirituality and rethink the destructive orientation of its activities, as a result of which the radiation background, atmosphere, soil, vegetation, groundwater and climate on our planet quickly change [7, p. 80]. And it is difficult to disagree that global changes are taking place at the beginning of the 21st century, since the Earth's ecosystem suffers from aerosols and anthropogenic impact, human-initiated urbanization processes contribute to population growth, an increase in the density of urban buildings and the road network that pollute the natural landscape and the biosphere as a whole.

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DOI 10.34660/INF.2023.73.76.089

液体体积不变化时和体积变化时液体的运动。 “悖论”茶叶

THE MOVEMENT OF A LIQUID IN THE CASE WHEN THE VOLUME OF THE LIQUID DOES NOT CHANGE AND IN THE CASE WHEN THERE IS A CHANGE IN VOLUME. “PARADOX” TEA LEAF

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抽象的。实验展示了不可压缩流体的两种类型的运动。第一种类型是由于弹性变形而导致体积不变化的流体运动。第二种类型是在接收额外动能的液体膨胀过程中形成涡流。提出了涡流的计算和建模公式。

关键词：动能；弹性变形；涡流;实验。

Abstract. *Experiments are presented showing two types of motion of an incompressible fluid. The first type is the movement of a fluid without a change in volume, due to elastic deformation. The second type is the formation of vortices during the expansion of a liquid that has received additional kinetic energy. Formulas for calculation and modeling of vortices are proposed.*

Keywords*: kinetic energy; elastic deformation; vortex; experiment.*

Introduction

Let us give definitions of fluid and incompressible fluid from textbooks. Liquid is an aggregate state of matter, intermediate between solid and gaseous states. A liquid, while retaining individual features of both a solid and a gas, has, however, a number of features inherent only to it, of which the most characteristic is fluidity. Like a solid, a liquid retains its volume, which is manifested in its low compressibility. The liquid has a free surface.

An incompressible fluid is a mathematical model of a continuous medium, the density of which is preserved when pressure changes.

When defining an incompressible fluid, it is understood that it retains the basic properties of the fluid, in particular, change shape at a constant volume.

Let us show that this property allows an incompressible fluid to create motion in a closed space. To do this, we expand the definition of an incompressible fluid - there is the smallest incompressible particle of a fluid that can change its shape while maintaining its volume.

1. Experiments of fluid motion without volume change, due to elastic deformation.

Water has an insignificant coefficient of compression and in many cases is suitable for studying the processes of motion of an incompressible fluid.

At the lessons of physics, an experiment is demonstrated, the fall of a body in a liquid, fig. 1

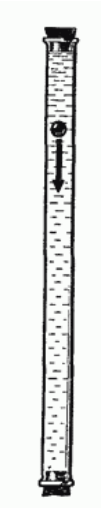

Figure 1.

Naturally, we see only the movement of a rigid body. Let us describe the motion of a fluid at a constant volume.

Let's do some thought experiments.

Let the smallest incompressible particle of a liquid can take the form of a cube of 2 x 2 x 1 conventional units, fig. 2.

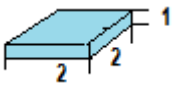

Figure 2.

Thought experiment 1. We have a cubic vessel with dimensions 4 x 4 x 1. The vessel is absolutely solid. Let's place in a vessel 4 particles of equal volume 2x2x1, 3 particles of liquid and 1 solid particle of the same shape, Fig. 3a. The vessel is closed on all sides. The mass of a solid particle is greater than the mass

of a liquid particle. Under the action of gravity (g), particle 0 will deform particle 2. According to Pascal's law, the pressure will spread to all particles of the fluid. Let's get the movement of all particles in the vessel, fig. 3b, p.

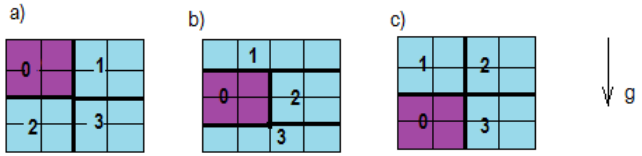

Figure 3.

Thought experiment 2. A solid particle has a mass less than the mass of a liquid particle. The solid particle is placed at the bottom of the vessel, Fig. 4a. Let's get the ascent of a lighter solid particle, Fig. 4b, p.

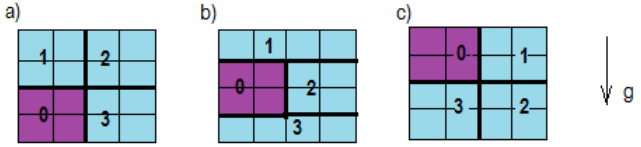

Figure 4.

In addition to the visible movement of solid particles, the movement of fluid particles was obtained.

Thought experiment 3. Let's replace a solid particle (0) with a liquid particle with a momentum different from the momentum of other particles. In a liquid, there will be an exchange of momentum between particles by means of an exchange of elastic impacts. If the difference between the momenta is large enough, then during the exchange of momentum, elastic deformation of the particles and topological motion of the fluid will occur. Naturally, the topology of changing particle shapes will be much more complicated than in previous experiments. In a real fluid, the impulses will equalize and the topological motion will tend to zero.

2. Experiments of the formation of vortices during the expansion of a liquid that has received additional kinetic energy

"Thus, a trickle cannot have either a beginning or an end inside the liquid; it must, therefore, have a beginning and an end at the free boundaries of the liquid or be closed" [1, Ch. 2, §2].

Physical experiment 4. Tea leaves are poured into a vessel with solid and transparent walls and a flat bottom. We close the vessel and unwind. Tea leaves under the action of centrifugal force and friction force will move along the vessel

wall. The air environment for this experiment is sufficiently rarefied and its influence can be ignored.

Physical experiment 5. Fill a vessel with solid and transparent walls with water to the brim. Let's place several tea leaves as movement markers. Close the container tightly with a lid. Shake the vessel vigorously several times and place it on the table. The tea leaves, having received kinetic energy, will move randomly and settle under the influence of gravity.

Physical experiment 6. Fill a vessel with solid and transparent walls with water to the brim. As movement markers, we will place several tea leaves randomly scattered at the bottom. Close the container tightly with a lid. Let's put the vessel on a rotating circle. Let's unroll and stop. We see that the tea leaves are grouped in the center of the bottom of the vessel.

Physical experiment 7. Let's repeat experiment 6 with a vessel in the form of a parallelepiped. The result is the same, the tea leaves are grouped in the center of the bottom of the vessel. True, the spread from the center is greater. This is explained by the faster destruction of the rotational movement of the liquid after the vessel stops rotating.

In experiments 6, 7, the liquid begins to rotate together with the vessel and behaves like a solid body. All molecules receive the same angular velocity, and the linear velocity increases from the center to the periphery. After the rotation of the vessel stops, fluidity and viscosity begin to appear in the liquid. Friction against the walls of the vessel will reduce the speed of rotation of the liquid molecules from the walls of the vessel to the center. All liquid molecules in the vertical direction are affected only by the gravitational force and it is equal for all molecules, so it is impossible for molecules to move up and down along a closed curve with the same speed at the corresponding points on the curve. This means that in these experiments there are no closed curves of motion in the vertical plane. In experiments 6, 7, the movement of the liquid is carried out by centrifugal forces, one can say in its pure form. Usually, the movement of a liquid is caused by the rotation of a solid object in a vessel. For example, a spoon in a glass. The end result is the same, the tea leaves are grouped in the center of the bottom of the vessel.

Let us clarify the definition of "a liquid has a free surface". This means that above the surface of the liquid there is a space with a gaseous substance.

The movement of particles of liquid and gases is affected by the uneven distribution of kinetic energy, gravity, and friction.

Physical experiment 8. Fill a vessel with solid and transparent walls with water by about 3/5 and close it hermetically. The vessel will be shaken randomly with force for some time. Quickly put on a fixed surface. Stream lines appear. Part of the current lines tends to close on itself. The formation of a vortex from the chaotic movement of molecules is observed.

If experiment 8 is repeated in a vessel with a square cross section, no vortex formation is observed. It follows that for the formation of a vortex, 1) a sufficient amount of kinetic energy of the liquid molecules is required, 2) additional space, 3) a guiding force on the curvature of motion.

To obtain a vortex for an incompressible fluid with a pressure drop, condition 2 is necessary.

The experiments were recorded on video. The video file is located at [4].

Derivation of formulas for calculation and modeling of vortices

It is known that inside the vortices the pressure decreases towards the center, which means that there is a decrease in the density of the liquid, but not due to compression, due to expansion. The faster a liquid moves in a volume of space greater than the volume of the liquid, the less force holding the molecules of the liquid together. Until the break. A horizontal buoyant force appears, an analogue of the Archimedes force

$$F_{p_i} = a_i \rho_i V_i \quad (1)$$

where:

ρ_i - liquid density in the i-th layer;

V_i - volume of the i-th layer;

F_{p_i} - buoyant force;

a_i - acceleration.

If the acceleration is constant, then formula (1) goes into formula (2)

$$F_{p_i} = \rho_i a V_i \quad (2)$$

We have two quantities affecting the motion of the molecules of an excited ideal fluid on a plane, the intrinsic momentum of the molecule and the horizontal buoyant force. From Newton's laws, it is known that for curvilinear motion, the action of at least two forces is necessary. In a two-dimensional plane, a vortex would be obtained from concentric circles of streamlines that coincide with the trajectories of the movement of liquid molecules.

In three-dimensional space, the Archimedes force, which arises under the influence of gravity, has been added.

$$F_{a_i} = \rho_i g V_i \quad (3)$$

The chaotic movement will go into nested cones of rotation, top down. Since the lateral surface of each cone has the same density, the streamlines can form any second-order curves along the conic sections of the cone. Note that there are no closed curves in the vertical conic section. The attenuation of the vortex will occur due to the dissipation of energy with the environment.

Conic sections are curves of the second order, therefore, the movement along them can be calculated by differential equations of curves of the second order [3]. In the above experiments, the vessels are symmetrical about the vertical axis, so the streamlines on the surfaces of the cones will also be symmetrical about the vertical axis. This involves the use of a differential equation of second-order curves about the center.

$$\ddot{\varphi} = \frac{2*e^2*cos(\varphi(t))*sin(\varphi(t))*(\dot{\varphi})^2}{1-e^2*cos(\varphi(t))^2} \quad (4)$$

When deriving equation (4), the generalized force Q was used. In the real motion of a fluid, the generalized force is the sum of forces, $Q = F_a + F_p + F_t$, fig. 5, where F_a is the Archimedes force, F_p is the buoyancy force from the outer layer, F_t is the friction force, v is the velocity of the particle *M*.

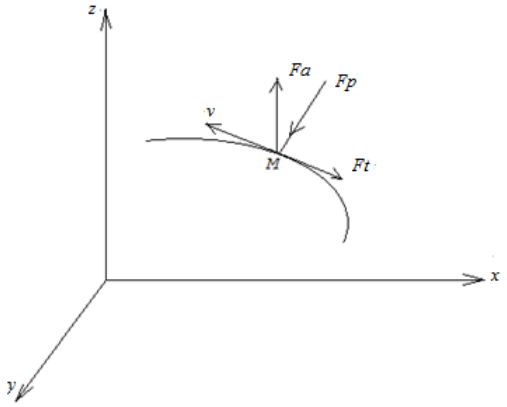

Figure 5.

The demonstrated experiments make it possible to simulate and study the movement of fluid in the laboratory. The system of equations (5) makes it possible to numerically calculate the motion of a fluid in a vortex.

$$\begin{cases} \ddot{\varphi} = \frac{2*e^2*cos(\varphi(t))*sin(\varphi(t))*(\dot{\varphi})^2}{1-e^2*cos(\varphi(t))^2} \\ F_{p_i} = \rho_i a V_i \\ F_{a_i} = \rho_i g V_i \end{cases} \quad (5)$$

$i = 0,1,...,N$; N – the number of vertical liquid layers in the vortex.

For a real calculation, it is necessary to write down the system of equations in terms of coordinates.

Conclusion

1. The first type of fluid movement in nature is impossible in an ideal form. Requires a rigid closed vessel. In inanimate nature, the topological movement of liquid is possible and must be taken into account when magma moves inside the planet. In living nature, if we consider the walls of organic cells to be sufficiently solid, then the movement of the intracellular fluid can also be considered as the movement of a fluid due to the elastic deformation of its particles.
2. General differential equation of curves of the second order [(18), 1]

$$\ddot{\varphi} = 2 * f\left(r(\varphi(t))\right) * \sin(\varphi) * \dot{\varphi}^2$$

does not limit the choice of the radius function. You can find a function that will describe the motion in the vertical plane in the gravitational field.

3. In nature, such a movement is observed - “According to the classical theory, water particles participating in wave motion in deep water describe an orbit that has the shape of a circle. The height of the wave is equal to the diameter of this circle. At the International Oceanographic Congress in Moscow, Academician VV Shuleikin showed the inaccuracy of this theory. Based on a long-term study of the motion of suspended particles in the wave basin of the Hydrophysical Institute of the Ukrainian Academy of Sciences in the Crimea, it was found that even at a depth exceeding the height of the wave, water particles move in an ellipse” [2].
4. 3. Experiments 4-8 are physical, but in this form it is difficult to find them in nature. There is no clear boundary between the vortex and the external environment. The processes of formation of a liquid or gas region with increased kinetic energy do not occur so unambiguously. However, these experimental limitations make it possible to investigate the formation of streamlines and buoyancy force (1) and possibly reveal other properties of fluid motion.
5. In the description of Experiment 7, the impossibility of closed vertical streamlines was proved. A. Einstein probably understood this and suggested that the effect of friction equalizes the velocities of liquid mole-

cules in vertical closed streamlines, fig. 6. However, this hypothesis is not supported by either calculations or experiments [5].

Figure 6.

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DOI 10.34660/INF.2023.58.43.090

物体在能量恒定的介质中动能的变化。亚里士多德-姆彭巴效应
CHANGE IN THE KINETIC ENERGY OF A BODY IN A MEDIUM WITH CONSTANT ENERGY. ARISTOTLE-MPEMBA EFFECT

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抽象的。已经开发出一种用于计算由恒定能量介质中的弹性球组成的物体的动能的算法和程序。一个计算机程序已经写好了。物理实验是在恒温空气介质中对物体进行冷却。显示了程序和实验的时间表的定性一致性。

关键词：动能；算法;实验。

Abstract*. An algorithm for calculating and a program for the kinetic energy of a body consisting of elastic balls in a medium with constant energy has been developed. A computer program has been written. Physical experiments were carried out on the cooling of bodies in an air medium with a constant temperature. Qualitative coincidence of the schedules of the program and experiments is shown.*

Keywords: *kinetic energy; algorithm; experiment.*

Introduction

At the end of the 17th century, Isaac Newton studied the cooling of bodies. Experiments have shown that the cooling rate is approximately proportional to the temperature difference between the heated body and the environment. This fact can be written as a differential equation:

$$\frac{dQ}{dt} = \alpha A(T_s - T), \qquad (1)$$

where Q is the amount of heat, A is the surface area of the body through which heat is transferred, T is the body temperature, T_S is the ambient temperature, α is the heat transfer coefficient depending on the body geometry, surface condition, heat transfer mode and other factors.

As can be seen from formula (1), there are many uncertain factors in the heat transfer coefficient. If such factors as the geometry of the body, the state of the surface, the heat transfer mode are indicated and can be measured, then such factors as the frequency of oscillation of molecules in solid and liquid substances, or the speed of molecules in gases are not indicated, because in the 17th century, the molecular-kinetic properties of matter were not yet known.

Molecular-kinetic theory (abbreviated as MKT) is a theory that arose in the 19th century and considers the structure of matter, mainly gases, from the point of view of three main approximately correct provisions:

1. all bodies are made up of particles: atoms, molecules and ions;
2. particles are in continuous chaotic motion (thermal);
3. particles interact with each other by absolutely elastic collisions.

The insufficiency of the kinetic theory of matter, which prevailed in the 19th century, was first noted by Nikolai Nikolaevich Pirogov. He showed that the law of distribution of the velocities of gas molecules in their chaotic motion established by the English physicist Maxwell (which helps to calculate what proportion of molecules has a particular speed) is valid only when the gas occupies an infinitely large volume. In order to correctly display the distribution of velocities of molecules in a gas occupying a certain finite volume, Pirogov showed, it is necessary to take into account the action of the walls of the vessel on the molecules of the gas, which tends to equalize and order this movement ... [1,2,3].

William Thomson posed and solved the problem of half-space cooling. “Let a homogeneous medium fill a half-space bounded by the plane x - 0. At the initial moment of time t = 0, the temperature of the medium is the same everywhere and is equal to T_0. The temperature on the surface of the medium is kept constant all the time and is equal to $T_1 \neq T_0$. ..... “[4] . Further, it is assumed that at the initial moment at the boundary of the medium, the temperature experiences a jump. Then the problem is formalized by a differential equation and solved.

1. Model of the exchange of kinetic energy of a body consisting of absolutely elastic particles with the environment.

Let us consider this problem from the standpoint of the MKT, taking into account the statement of N. N. Pirogov about the interaction of the molecules of the initial substance with the molecules of the environment.

As you know, heat is transferred in three ways: 1) kinetically, 2) by convection, 3) by radiation. To exclude convection, we assume that the body under study consists of a solid or a fluid at rest. Due to the insignificance of the effect of radiation in the experiment, we will not take into account the radiation. We also assume that elastic collisions occur between molecules.

After all the above restrictions, we formulate the following problem.

Let us place one layer of perfectly elastic balls (b) on the plane. We get a two-dimensional problem. The balls have the same constant oscillation frequency v_b. Let us single out in the plane a rectangle filled with absolutely elastic balls (r)

with the initial oscillation frequency $v_{r0} > v_b$. The left side is open and borders on the environment. The other three sides are absolutely solid walls. The masses of all balls are equal. Table. 1.

At each moment there is an equiprobable oscillation in one of the four directions, there is an exchange of impulses. Since the zero column belongs to the environment, its oscillation frequency is restored. The balls inside the rectangle receive the oscillation frequency v_{r0} or v_b.

Find the equalization time of the oscillation frequencies of the balls inside the rectangle with the environment.

Table 1

0	**1**	**2**	**3**	**.**	***n***	
		j		.		
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	***i***
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	
b	*r*	*r*	*r*	.	*r*	
				.		

Solution.

Consider options for the exchange of impulses in the problem posed. Each ball has a 1/4 chance of hitting one of the four sides. It is assumed that the vibration of the walls << the vibration of the inner part of the rectangle. This makes it possible to consider always the counter impact of the inner balls with the walls. Upon impact to the upper and lower sides, an exchange of momentum occurs between the molecules of the body. When hitting the upper and lower walls of the rectangle, an elastic rebound occurs. It follows from this that the sum of impulses in the column will not change, without losing the generality of the solution, we represent the rectangle in the problem in the form of one row of balls, Table 2.

Table 2

0	**1**	**2**	**3**	**.**	***n***	
		j		.		
b	*r*	*r*	*r*	.	*r*	

Time will be measured in cycles (steps) of a computer program cycle.

Using the method of induction, we obtain an algorithm for calculating the number of cycles of the probability of the existence of the initial momentum $p_i(r_j)$ of the ball with the speed v_r in the *j* column on the *i* cycle. *i = 0, 1, 2, ...*

Task 1. $p_0(b_0) = 1 \leftrightarrow p_0(r_0) = 0,\ p_0(r_1) = 1,\ p_0(r_2) = 1$

Table 3

0	1	2
b	*r*	

$p_1(r_1) = \frac{3}{4}$

$p_2(r_1) = \frac{1}{2}p_1(r_1) + \frac{1}{4}p_1(r_0) + \frac{1}{4}p_1(r_2) = \frac{1}{2}\frac{3}{4} + \frac{1}{4}0 + \frac{1}{4}1 = \frac{5}{8}$

$p_2(r_1) = \frac{1}{2}p_1(r_1) + \frac{1}{4}p_1(r_0) + \frac{1}{4}p_1(r_2) = \frac{1}{2}\frac{3}{4} + \frac{1}{4}0 + \frac{1}{4}1 = \frac{5}{8} p_3(r_1) = \frac{1}{2}p_2(r_1) + \frac{1}{4}p_2(r_0) +$

$\frac{1}{4}p_2(r_2) = \frac{1}{2}\frac{5}{8} + \frac{1}{4}0 + \frac{1}{4}1 = \frac{9}{16}$

Task 2. $p_0(b_0) = 1 \leftrightarrow p_0(r_0) = 0;\ p_0(r_1) = 1;\ p_0(r_2) = 1;\ p_0(r_3) = 1$

Table 4

0	1	2	3
b	*r*	*r*	

$p_1(r_1) = \frac{3}{4};\ \ p_1(r_2) = 1$

$p_2(r_1) = \frac{1}{2}p_1(r_1) + \frac{1}{4}p_1(r_0) + \frac{1}{4}p_1(r_2) = \frac{1}{2}\frac{3}{4} + \frac{1}{4}0 + \frac{1}{4}1 = \frac{5}{8};$

$p_2(r_2) = \frac{1}{2}p_1(r_2) + \frac{1}{4}p_1(r_1) + \frac{1}{4}p_1(r_3) = \frac{1}{2}1 + \frac{1}{4}\frac{3}{4} + \frac{1}{4}1 = \frac{1}{2} + \frac{3}{16} + \frac{1}{4} = \frac{8+3+4}{16} = \frac{15}{16}$

$p_i(r_2) = \frac{1}{2}p_{i-1}(r_2) + \frac{1}{4}p_{i-1}(r_1) + \frac{1}{4}p_{i-1}(r_3)$

Task 3. $p_0(b_0) = 1 \leftrightarrow p_0(r_0) = 0;\ p_0(r_j) = 1, j = 1, 2, 3, \ldots;\ k\ -$ number of columns;

$p_i(r_j) = \frac{1}{2}p_{i-1}(r_j) + \frac{1}{4}p_{i-1}(r_{j-1}) + \frac{1}{4}p_{i-1}(r_{j+1}), i = 1, 2, 3, \ldots;\ n\ -$ number of cycles (2)

Task 4. In tasks 1-3, the probability of collision of neighboring balls depending on the direction of impact was calculated and the speed (frequency) of the collision was not taken into account. This means that in each cycle of formula (2) the probability will decrease by a certain amount proportional to the frequency of collisions with balls of lower kinetic energy.

Let's introduce frequency (speed) into formula (2).

$$ps_n(r_k) = p_n(r_k) - s * (1 - p_n(r_k)),$$

where $1 > s > 0$ - coefficient of influence of speed on probability, $ps_n(r_k)$ - new probability.

$$\begin{cases} p_i(r_j) = \frac{1}{2}p_{i-1}(r_j) + \frac{1}{4}p_{i-1}(r_{j-1}) + \frac{1}{4}p_{i-1}(r_{j+1}) \\ ps_i(r_j) = \frac{1}{2}p_{i-1}(r_j) + \frac{1}{4}\left(p_{i-1}(r_{j-1}) - s * \left(1 - p_{i-1}(r_{j-1})\right)\right) + \frac{1}{4}\left(p_{i-1}(r_{j+1}) - s * \left(1 - p_{i-1}(r_{j+1})\right)\right) \\ i, j = 1, 2, 3, ... \end{cases} \quad (3)$$

According to algorithm (3), a computer program was written for two identical bodies, consisting of elastic balls, with different initial speeds, in the same environment. The file with the executable program [6].

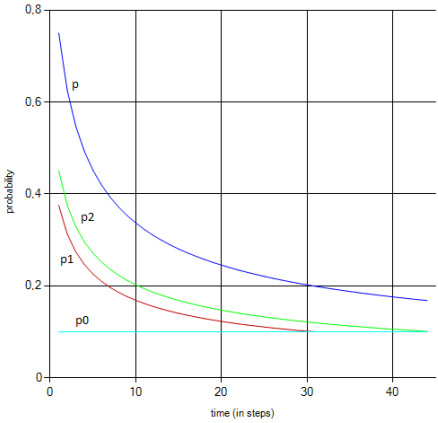

Figure 1.

p0 - the probability of the initial momentum of the balls of the environment.

p are the momentum probabilities of a given ball (here, first from the left).

p1 are the probabilities of the momentum of the given ball (here, the first from the left), taking into account the oscillation frequency s1.

p2 is the probability of the momentum of the given ball (here, the first from the left), taking into account the oscillation frequency s1.

s1 > s2.

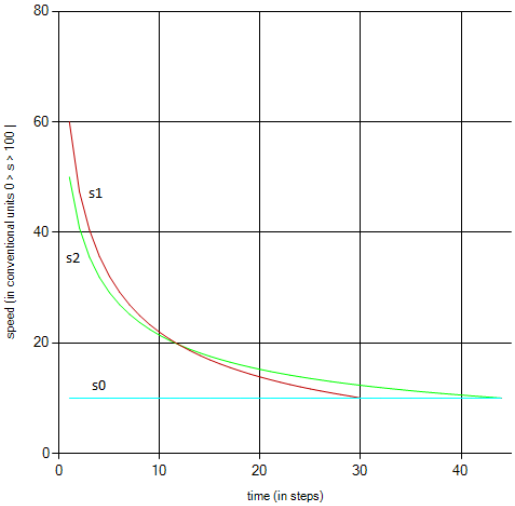

Figure 2.

s0 - conditional initial speed of the balls of the environment..
s1 is the speed of the given ball.
s2 - speed given.
s1 > s2.

From graphs 1, 2 we see that the greater the initial speed of the balls, the faster the alignment of the speed of the balls inside the rectangle with the speeds of the balls of the environment.

It follows from the MKT that the temperature and intensity of molecular motion are proportional.

1. Physical experiments according to the conditions of the algorithm.

Experiment 1

Two plastic balls (ping-pong) with a diameter of 40 mm. The balloons are filled with 29 ml of water. Holes for temperature sensors are drilled in the balls, Fig, 6. Air temperature ≈ -15.7°C. Temperature registration time interval 2 min.

Таблица 5

NN	T1	T2
1	39,6	32
2	34,2	25,7
3	30,8	22,8
4	28,7	21,2
5	26,3	19,2
6	25	18,1
7	22,5	16,2
8	20,3	14,5
9	18,8	13,4
10	17,4	12,2
11	15,8	11
12	13,7	9,3
13	12,4	8,3
14	10,6	6,9
15	9	5,6
16	8,2	5
17	6,7	3,9
18	5,9	3,4
19	4,8	2,3
20	3,3	1,3
21	1,8	0,1

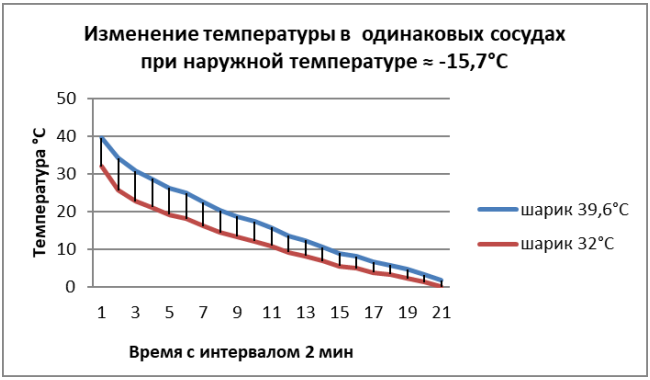

Figure 3.

Experiment 2.

Repeat experiment 1. Changed ambient temperature to -8°C. Temperature registration time interval 1 min.

Таблица 6

1	47	42.8
2	43.6	39
3	40.3	35.9
4	36.6	32.7
5	33.3	29.9
6	30.3	27
7	27.9	24.7
8	25	21.6
9	22.7	19.8
10	20.7	18
11	18.6	16.2
12	16.7	14.5
13	14.7	12.6
14	12.9	11.1
15	11.4	9.7
16	9.9	8.3
17	8.4	7
18	7.1	5.9
19	5.9	4.8
20	4.8	3.8
21	3.2	1.6
22	2.3	0.4
23	1.4	-0.2
24	0.8	-0.3
25	0.2	-0.3
26	-0.5	-0.3
27	-1	-0.3
28	-1.5	-0.1
29	-2.7	-0.3
30	-2.6	-0.2
31	-3.1	-0.1
32	-3.5	-0.2
33	-0.2	-0.1
34	-0.2	-0.2
35	0.2	-0.2
36	0.2	-0.2
37	0.2	-0.2

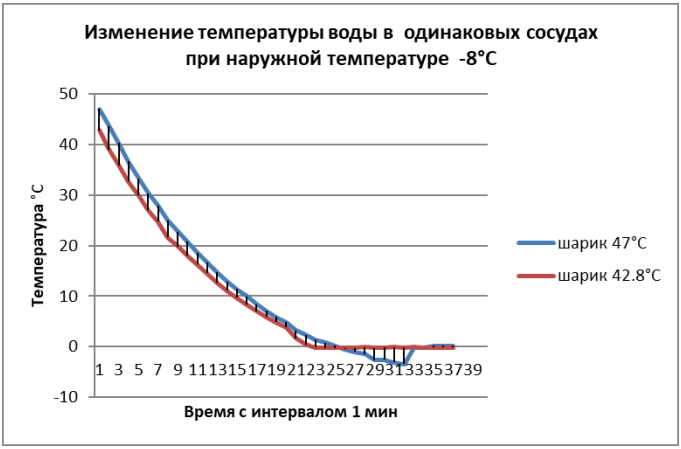

Figure 4.

Water has a non-monotonic dependence of temperature and density, so it is necessary to take into account the rigidity and shape of the vessel. Water turns into ice. Ice has a lower density. The space of movement of water molecules is limited by the size of the vessels (plastic balls), which does not allow a monotonous con-

tinuation of the exchange of kinetic energy between water and the environment. The role of thermal radiation is growing. The proposed algorithm takes into account only the exchange of kinetic energy.

Experiment 3

Two aluminum cylinders with a diameter of 20 mm, a height of 40 mm. The cylinders are drilled with 24mm recesses. Thermal sensors are inserted into the recesses, , Fig, 6. Air temperature ≈ -16.4°C. Temperature registration time interval 2 min.

Table 7

NN	T1	T2	NN	T1	T2	NN	T1	T2	NN	T1	T2
1	55,7	42,6	16	-8,5	-8,5	31	-14,2	-13,8	46	-16,4	-16
2	43,5	34	17	-9,6	-9,6	32	-14,2	-13,9	47	-16,5	-16
3	34,7	26,7	18	-10,5	-10,4	33	-14,2	-13,9	48	-16,5	-16
4	26,4	20,3	19	-11,2	-11	34	-14,2	-13,9	49	-16,5	-16
5	20,2	15,5	20	-11,9	-11,6	35	-14,3	-14	50	-16,5	-16
6	15,1	11,4	21	-12,3	-12,1	36	-14,5	-14,2			
7	10,8	7,9	22	-12,8	-12,5	37	-14,8	-14,5			
8	7	4,6	23	-13,2	-12,8	28	-15,2	-14,8			
9	3,5	1,7	24	-13,4	-13,1	39	-15,4	-14,9			
10	2,1	1	25	-13,6	-13,3	40	-15,8	-15,3			
11	0,8	-0,6	26	-13,8	-13,5	41	-15,9	-15,5			
12	-1,6	-2,7	27	-14	-13,6	42	-16,1	-15,6			
13	-3,8	-4,6	28	-14,1	-13,7	43	-16,2	-15,8			
14	-5,8	-6,2	29	-14,1	-13,8	44	-16,3	-15,9			
15	-7,2	-7,4	30	-14,2	-13,8	45	-16,4	-15,9			

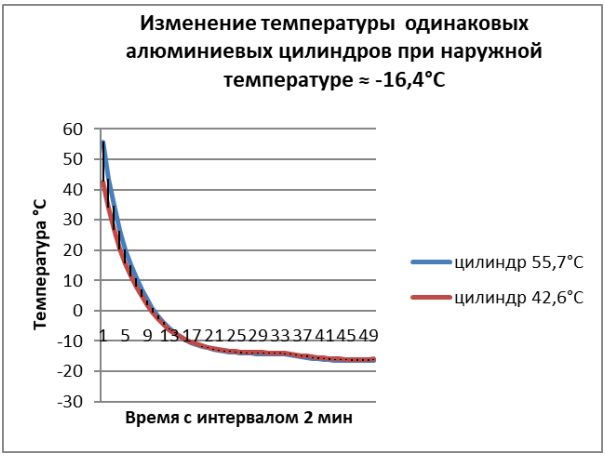

Figure 5.

Metal is a good conductor of heat. In this experiment, the working fluid is in a solid state. Atoms do not move in a solid. The exchange of energy with the environment occurs directly between the molecules of the body and the molecules of the environment.

Conclusions

This article proposes an explanation for the faster cooling of a body with a higher temperature compared to a similar body with a lower temperature. As the experiments show, this property should be observed in all substances, with appropriate initial parameters, and not only in water.

From the graphs of the experiments and the graphs of the computer program, one can see a qualitative coincidence of the change in temperature in physical experiments and the change in kinetic energy in computer models. In experiments No. 2, 3, the point of intersection of Aristotle - Mpemba [5] is observed.

To obtain a practical formula, it is necessary to paint the algorithm on a three-dimensional space, introduce appropriate amendments to the algorithm. To do this, it is necessary to conduct a series of experiments with various substances.

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DOI 10.34660/INF.2023.64.86.091

构建此类对象系统的两个示例

TWO EXAMPLES OF CONSTRUCTING A SYSTEM OF OBJECTS OF THIS KIND

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抽象的。根据 Urmantsev 的系统通论 [1]，构建了对象系统。在第一个和第二个示例中，素数集被视为对象系统。物体之间的关系就是素数之差。揭示了间隔对的周期性。在以下示例中，物体系统的集合是行星质心距太阳的距离。物体之间的关系是物体之间不同种类的距离差异。基本上，以水星为例，振荡的周期性、年周期以及周期的各个点、近日点和远日点都被揭示出来。

关键词：对象系统；质数;间隔；轨道；期间。

Abstract. *In accordance with the General theory of systems of Urmantsev [1], systems of objects are constructed. In the first and second examples, the set of primes is considered as a system of objects. The relation between objects is the difference of prime numbers. The periodicity of pairs of intervals is revealed. In the following examples, the set of the system of objects is the distances of the center of mass of the planets from the Sun. The relationship between objects is different kinds of difference in distances between objects. Basically, on the example of Mercury, the periodicity of oscillations, both annual periods, and individual points of the period, perihelion and aphelion, were revealed.*

Keywords*: Object-system; prime numbers; intervals; orbits; periods.*

Introduction

"*The object* — of any material or ideal nature — is the subject of thought (for example, the biosphere or inference); and not only things, but also properties and relationships: quantity and quality, preservation and change, essence and phenomenon (for example, interaction and friendship, electrical conductivity and drought resistance, humor and satire ...).

An object-system is a unity built on relations (in a particular case, interactions r of the set {Ros}, conditions limiting these relations - the laws of composition - z of the set {Zos} from the «primary» elements *m* of the set $\{M_{os}^{(0)}\}$, selected according to the bases and the *a* set $\{A_{os}^{(0)}\}$ from the universe U. Moreover, the sets

{Zos}; {Zos} and *{Ros}; {Zos}* and *{Ros)* and *{Aos}* can be empty or contain one, two, ... , an infinite number of identical or different elements." [2].

"A system of objects of a given — i-th — kind is, in essence, a system of objects-systems of the same kind. Moreover, the words «of the same or given kind» mean that each of the objects. systems has common generic features (the same quality) - each of them is built from all or part of the primary elements *m* of the set $\{M_i^{(0)}\}$ in accordance with part or all of the relations *r* of the set $\{R_i\}$, with part or all of the laws of composition z of the set $\{Z_i\}$ implemented on the considered system of objects of this kind. As for a system object, for a system of objects of a given kind, the sets *{Z}; {Z}* and *{R}; {Z}* and *{R)* and *{A}* (in this case, — $\{M_i^{(0)}\}$) can be empty or contain one, two, ..., an infinite number of elements.

An example of a system of objects of this kind is the periodic system of chemical elements" [2].

"We must try to identify the objects under study as object-systems and at the same time, without fear of any accusations, boldly build systems of objects of the same kind. The results of such an approach will more than pay for the labor expended." [2].

I. The set of primes as a system of objects

For the relation between objects we take the difference of prime numbers.

We assign three parameters to each prime number. The first and second are the difference of this number with the two nearest prime numbers. The third parameter is the occurrence number of the combination of the first and second parameter in the series. We find the maximum (Imax) from the first and second parameters. Create a table with the size (Imax * Imax). We fill the table with the third parameter in accordance with the first and second parameters, i.e. the first parameter is the row number, the second is the column number. The table shows the frequency of filling. In rows and columns, every third number is empty. Combinations of the first and second parameters are obtained in two ways.

Option 1 - the first parameter is the difference of the given prime number with the previous prime number, the second parameter is the difference of the next prime number with the given prime number, table 1. Here is a set of prime numbers up to 32000.

Table 1

0	1	2	3	4	5	6	7	8	9	10	11	12
1	0	120	97	0	103	67	0	33	23	0	14	8
2	118	0	148	65	0	33	47	0	22	28	0	7
3	102	127	143	86	58	75	42	21	31	21	22	7
4	0	61	77	0	49	28	0	18	21	0	16	5
5	95	0	62	54	0	41	27	0	13	8	0	4

6	61	39	79	26	28	31	19	10	25	2	5	6
7	0	53	42	0	24	12	0	14	5	0	4	2
8	30	0	24	16	0	15	15	0	3	4	0	0
9	30	32	23	12	27	15	4	5	5	1	1	4
10	0	24	11	0	15	5	0	7	0	0	5	1
11	22	0	21	12	0	7	2	0	5	0	0	0
12	4	10	10	1	4	5	1	2	3	3	1	1

Only the upper right side of the spacing tables is shown here. Full tables for this series have a size of 35 x 35.

Option 2 - pairs of differences of prime numbers are taken sequentially, table 2.

Table 2

0	1	2	3	4	5	6	7	8	9	10	11	12
1	0	57	54	0	47	37	0	16	13	0	6	6
2	54	0	75	36	0	18	28	0	10	14	0	1
3	50	63	71	42	25	35	19	13	12	8	14	5
4	0	34	37	0	23	15	0	8	8	0	6	1
5	48	0	41	30	0	18	15	0	5	3	0	3
6	27	20	41	14	9	17	12	6	14	1	2	2
7	0	24	18	0	10	5	0	4	3	0	2	2
8	17	0	11	7	0	5	12	0	3	1	0	0
9	16	15	12	7	17	6	1	2	2	0	1	3
10	0	10	6	0	12	3	0	5	0	0	3	1
11	11	0	11	6	0	3	0	0	3	0	0	0
12	3	7	7	0	1	3	0	0	0	1	0	0

The frequency is the same in both cases.

Prime numbers with three parameters are written to the primesInterval3.txt file.

The tables are displayed and written to the tabInterval1.txt and tabInterval2.txt files.

The program text file and the executable file are located at [4].

3 option. In [11,12,13], tables of prime numbers are also constructed intuitively. The modes of prime numbers are taken as the relation between objects.

II. Distance between space bodies as a system of objects

Philosophy considers motion and matter in a broad sense. This article investigates the mechanical movement of material points.

F. Engels states: «... movement is unthinkable without matter.» It is difficult to disagree with this statement. However, mathematics makes it possible to distinguish the mechanical movement of material points into a separate category with its own properties. Some properties are considered in [10].

Here we consider the movement of a cosmic body relative to the focus in which the second body is located. The movement along the ellipse is asymmetrical. When moving from aphelion to perihelion, the distance from the body to the focus decreases, and when moving from perihelion to aphelion, it increases. Some properties of this asymmetry are revealed below.

In astronomy, a table of the celestial coordinates of the Sun, Moon, planets, and other astronomical objects calculated at regular intervals, such as at midnight every day.

In addition to the coordinates and dates of observation, the tables contain distances between space objects.

In the examples below, the data is taken from the NASA website [5]

To get a data table, the site suggests using the HORIZONTS program.

Algorithm for constructing a system of objects

We choose a space body that has a closed orbit.

We set a time interval greater than the period of rotation of the body in orbit.

We reveal the period of appearance of the selected body at the same point of the orbit, P_1-- A -- P_2, where (P) is perihelion, (A) is aphelion. Naturally P_1 and P_2 have different dates.

From the resulting table, we take the sequence of distances from the body to the focus of rotation.

First option

To construct a system of objects of this kind, we represent the sequence of distances in one period as two sequences of half-periods. For the relationship between objects, we take the difference of time-symmetric pairs of distances. This means that the point P_1 + 1 day corresponds to the point P_2 - 1 day, P_1+ 2 - P_2 - 2, etc.

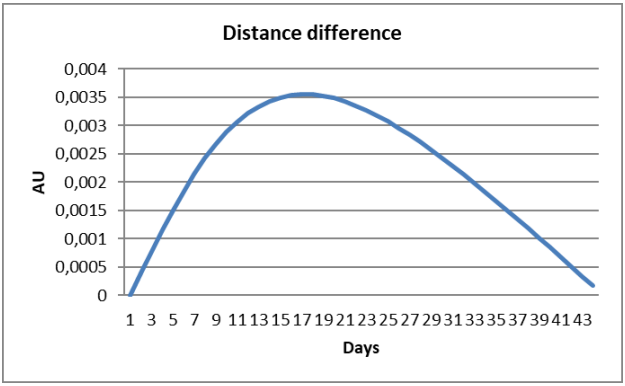
Table 3

	Converted date and distance from perihelion to aphelion		**Date and distance from perihelion to aphelion**		**Difference**
	date	R_1	date	R_2	R_2 - R_1
1					
2					

Mercury

Table 4

1	2000-Aug-10 00:00	0,30753	2000-Aug-10 00:00	0,30753	0
2	2000-Aug-09 00:00	0,307655	2000-Aug-11 00:00	0,308048	0,000392
43	2000-Jun-28 00:00	0,466466	2000-Sep-22 00:00	0,466636	0,00017



Graph 1

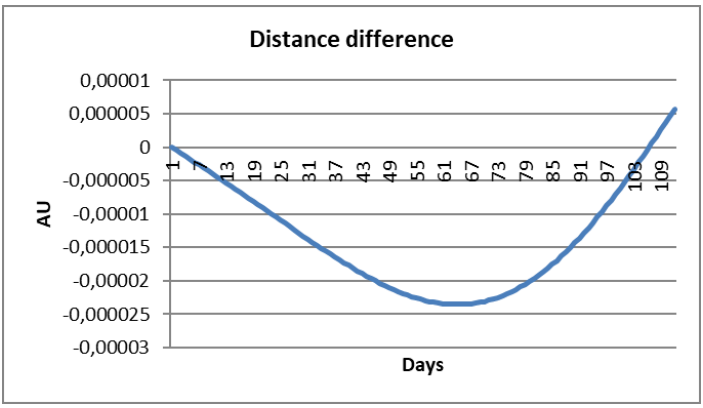
Full table 4 is presented in the file full_period2_Mercury_Sun.xlsx [6]

Venus

Table 5

1	2001-Oct-05 00	0,71841143	2001-Oct-05 00	0,71841143	0
2	2001-Oct-04 00	0,718413602	2001-Oct-06 00	0,718413156	-4,45894E-07
112	2001-Jun-16 00	0,728241358	2002-Jan-24 00	0,728247066	5,70797E-06

Full table 5 is presented in the file full_period2_Venus_Sun.xlsx [6]



Graph 2

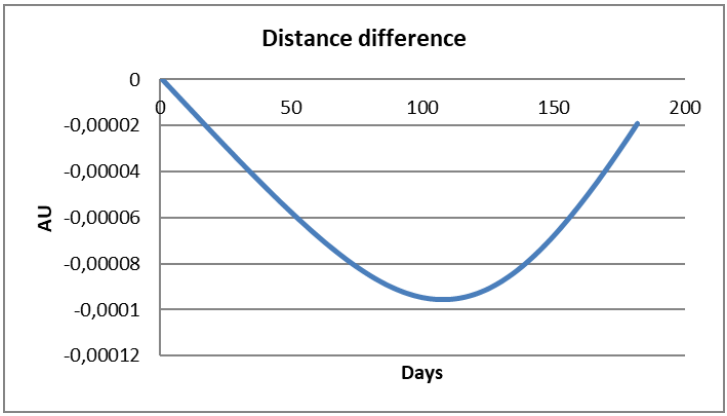
Earth

The NASA HORIZONS program provides Earth motion data in two versions
1. Earth-Moon barycenter

Table 6

1	2012-Jan-04 00	0.983303	2012-Jan-04 00	0.983303	0
2	2012-Jan-03 00	0.983307	2012-Jan-05 00	0.983305	-1.2E-06
182	2011-Jul-07 00	1.016716	2012-Jul-03 00	1.016697	-1.9E-05

Full table 6 is presented in the file full period2_EarthMoon_Sun.xlsx [6]



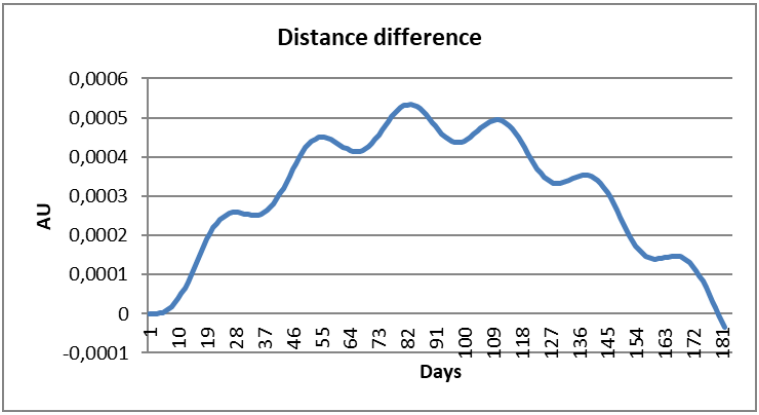
Graph 3

2. Geocentric

Table 7

1	2012-Jan-05 00	0.983284	2012-Jan-05 00	0.983284	0
2	2012-Jan-04 00	0.983287	2012-Jan-06 00	0.983287	-1.99E-07
					+
					+
182	2011-Jul-08 00	1.01671	2012-Jul-04 00	1.01667	-3.54E-05

Full table 7 is presented in the file full period2_Earth_Sun.xlsx [6]



Graph 4

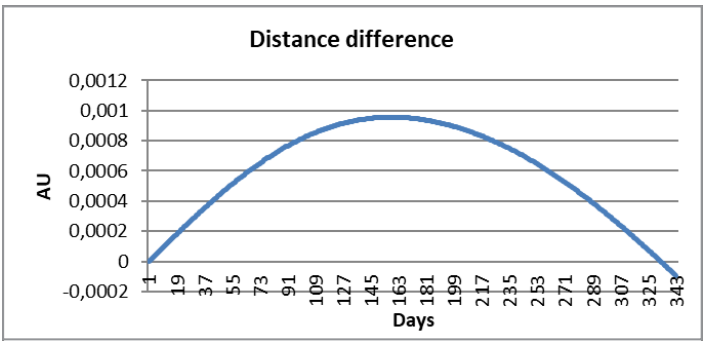
On graph 4 we see the influence of the moon.

Mars

Table 8

1	2005-Jul-18 00:00	1,38129748	2005-Jul-18 00:00	1,381297483	0
2	2005-Jul-17 00:00	1,38129969	2005-Jul-19 00:00	1,381309766	1,0071E-05
343	2004-Aug-10 00:00	1,66611663	2006-Jun-25 00:00	1,66602365	-9,29802E-05

Full table 8 is presented in the file full period2_Mars.xlsx [6]



Graph 5

The fluctuation of the distance of the giant planets has a more complex shape. For the primary analysis, we will consider the orbits of the first four planets. Graphs 1-5 show the violation of symmetry, the equality of the length of half-periods. The difference between the movement in a closed orbit relative to the focus is that in one half-cycle the body approaches the focus in the second half-cycle it moves away. However, from graphs 1-5, it is difficult to argue that this property affects the violation of the symmetry of motion, since the asymmetry changes sign.

On the example of Mercury, we will show that the resulting asymmetry reveals a new symmetry, more precisely, periodicity. Let us construct a sequence of the difference of half-periods for a time interval of a large number of periods. For example, let's take the time 1970.01.01 - 2020.01.01. The Search_for_negative_sequences.exe[6] program shows that in this interval there are 207 periods and 13 cases of changing the sign of the distance difference, graphs 6-7.

Mercury

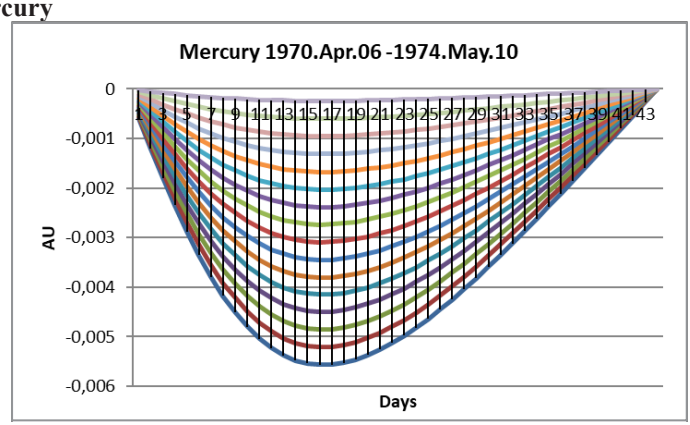
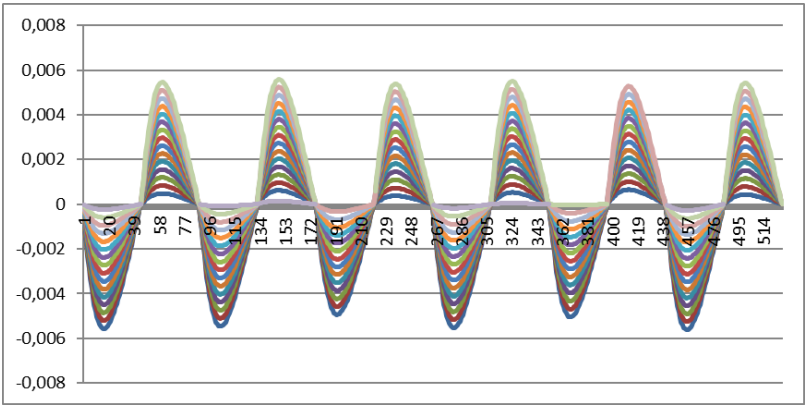


Chart 6

The data table for graph 6 is presented in the file Mercury_radius_difference1.xlsx [7]

Mercury 1970.Apr.06 -2013.Nov.08

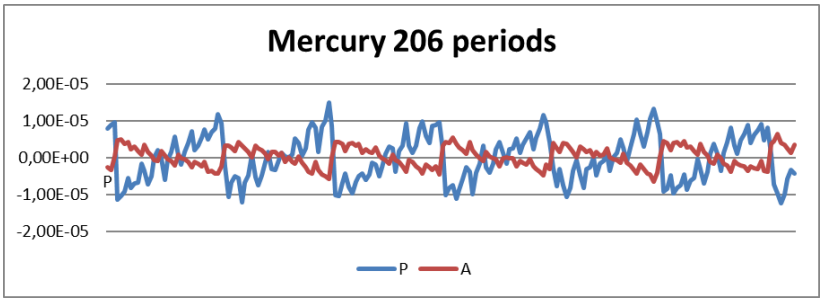


Graph 7

The data table for graph 7 is presented in the file Mercury_radius_difference1-12.xlsx [7]

Second option

To build a system of objects of this kind, the sequence of distances of the same points, perihelion and aphelion. For the relationship between objects, we take the difference in the distances of a point in successive periods, graph 8.



Graph 8

P - perihelion distance difference, P_2 - P_1,..., P_n - P_n-1

A - aphelion distance difference, A_2 - A_1,..., A_n - A_n-1

The data table for graph 8 is presented in the file mrdppdaa.xlsx [7]

Search_for_negative_sequences program.

Conclusion

We obtain similar results if we use astronomical tables from the site [8]. The data format on this site is different from the format of the site[5], so the reading section in the program has been changed, [9].

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DOI 10.34660/INF.2023.55.39.092

多功能、环境经济型永久和临时居住微村的建筑和规划解决方案
ARCHITECTURAL AND PLANNING SOLUTION OF A MULTIFUNCTIONAL ENVIRONMENTAL AND ECONOMIC TYPICAL MICROVILLAGE FOR PERMANENT AND TEMPORARY STAY

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抽象的。本文讨论了生态经济微型住区的建筑和规划解决方案，该解决方案以十二生肖的形式制成，可以在世界任何地方键入和使用，适用于各种定居者的永久和临时居住- 度假者、游客、军人、建筑商等。

关键词：微聚落、建筑和规划解决方案、十二生肖、卫星城、寺庙、宗教、Suasti、生态、经济、和谐、风水、健康、中医、非传统、度假者、旅游、疗养院、军事军营。

Abstract. *The article discusses the architectural and planning solution of an ecological - economical micro-settlement, made in the form of signs of the Zodiac, which can be typed and used anywhere in the world, both for permanent and temporary stay of a wide range of settlers - vacationers, tourists, military, builders, etc.*

Keywords*: micro-settlement, architectural and planning solution, signs of the Zodiac, satellite city, temple, religion, Suasti, ecology, economy, harmony, Feng Shui, health, Chinese medicine, non-traditional, vacationers, tourism, sanatorium, military barracks.*

The draft design of the MEETMFPaTS represents 12 buildings made in the form of zodiac signs, arranged in a circle and having the outlines of the corre-

sponding signs in plan (Fig. 1). The practical implementation of buildings, from the point of view of building technologies, is not difficult.

In the central part of the micro-settlement there is a religious building, which includes Temples of 4 main religious directions: Christianity, Islam, Buddhism and Judaism, which will be divided and at the same time united by the cross-shaped sign of Suasti (Fig. 2).

Buildings, in addition to giving them an unusual architectural form [1-3], are planned to be made from environmentally friendly, local natural materials. A distinctive feature of the complex is the introduction of about 50 Know-Hows into its implementation [4], and, most importantly, the use of the huge potential of balneological and alternative medicine, that is, the rejection of expensive and not always effective (and even harmful) services modern medicine.

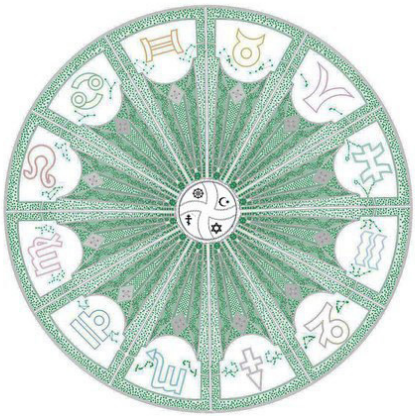

Figure 1. *MEETMFPaTS Master Plan*

1. VOLUME-PLANNING DECISION OF MEETMDPiVPL:

1.1. The placement of the buildings of the complex in the form of zodiac signs that carry an occult meaning (in a similar way, in the form of 12 branches, the first metro stations in Moscow are located. The fortress wall located in the central part of the capital of Cyprus, the city of Nicosia, has an identical appearance).

1.2. In the central part of the complex, it is planned to place a religious building, divided into four parts by the Suasti sign - the Symbol of movement, the cycle of Life on Earth. In each segment of the Suasti sign, which rotates clockwise (unlike the Nazi swastika, which has a pattern of movement in the opposite direction), temples of four world religions will be united: Christianity, Islam, Buddhism and Judaism, which simultaneously have a dividing line in the form of a cruciform

sign. Similar temples of 3 religions take place in the city. Astrakhan (Russia), Constantino (Algeria), etc.

1.3. Between the Temple complex and the rest of the territory of the micro-settlement, it is planned to implement an annular water barrier, through which four bridges will be thrown (to each Temple, respectively).

1.4. The versatility of the settlement lies in the fact that it can be used as:

1.4.1. Sanatorium - resort health complex with accommodation for vacationers in buildings corresponding to their zodiac sign;

1.4.2. Hotels with similar (clause 1.4.1) accommodation for visitors;

1.4.3. A workers' camp being built near the future metropolis (as, for example, Russia's planning for the construction of megacities in the Siberian region), for the purpose of temporary residence of city planners;

Figure 2. *Model of the building of the zodiac sign "Libra" and the awards that were awarded to the components of the project under development.*

1.4.4. Transformation of the Workers' Town into a satellite city, after the construction of the metropolis is completed;

1.4.4. Barracks for military personnel;

1.4.5. Year-round health-improving and sports children's camps;

1.4.6. Bases for holding various scientific conferences, symposiums and other public events;

1.4.7. Tourist base for family and group holidays. Each building is supposed to accommodate tourists and vacationers who have "their" corresponding sign of the zodiac (with the exception of individual rooms intended for collective or family vacations).

1.5. It is well known that the signs of the Zodiac are combined into four groups - Fire, Earth, Air and Water. Therefore, when organizing leisure activities for the inhabitants of the complex, human ecology will be taken into account, that is,

people assigned to any one of these groups will be recommended to spend their leisure time together, taking into account zodiacal compatibility.

1.6. As building materials used both in the construction of buildings and in the design of interiors, there will be rocks, trees, flowers and colors corresponding to the sign of the Zodiac. In order to reduce the impact of magnetic fields on vacationers, it is planned to exclude the use of metal during the construction of the buildings of the complex. It is not excluded the use of modern 3D - construction technologies, taking into account the requirements of environmental components.

1.7. It is recommended to design buildings with a height of no more than 3 floors, which will avoid the negative impact of magnetic fields on the inhabitants of buildings;

1.8. The requirements of geo-urbanism will be fully taken into account, that is, how much green territory will be taken away from Nature by the building, the same amount of area is to be restored on the flat roof of buildings, where lawns, dwarf trees, fountains, walking paths and small architectural forms are supposed to be placed.

1.9. In accordance with the zodiac constellations, rest regimes (including active ones) and nutrition (correspondence of the food taken to the sign of the Zodiac) will be scheduled.

1.8. The volumetric and planning solution of the premises of the MEETMF-PaTS will be made taking into account geopathic zones, that is, Hartman and Curie networks, the presence and accounting of which is currently beyond doubt. Also, during the construction of the complex, Energy Concentration Devices (ECDs) developed by scientists from Sevastopol, which are capable of diverting geopathic zones from the protected object, will be used. One of the defining requirements is the compliance with the location of the premises and the placement of equipment, taking into account the requirements of Feng Shui.

1.9. Coloring of buildings, rooms, roof coverings, taking into account the color of vegetation and rocks in accordance with the signs of the Zodiac and in order to be able to generate natural air movement.

1.10. The use of local natural factors is expected to the maximum extent: taking into account the terrain; availability of water sources; accounting of flora and fauna of the area; natural mineral springs; the possibility of supplying drinking water to the premises; operation of fountains without the use of pumping equipment (like the Peterhof fountains in St. Petersburg), etc.

2. HEALING COMPONENTS OF THE MICROPOLIS.

The aggravation of the diseases of mankind observed in recent years is primarily due to the weakening of the human immune system due to violation of the ecological situation, deterioration in the quality of food and a decrease in the volume of physical exercises performed by people of mental labor.

In connection with the foregoing, the project under development assumes the choice of a construction site and the maximum use of favorable natural factors of the area (the presence of potential reserves of environmentally friendly spring waters, water arteries, sunny days, the presence of greenery, the fertility of the soil, the identification of healing mineral springs, therapeutic clay, accounting air exchange of the area (ventilation), the possibility of hiking, air purity and much more.

A huge number of medicines developed by mankind in recent years are not always more effective (and often more harmful) than existing folk methods of treatment that have been passed down from generation to generation for hundreds and thousands of years. Therefore, there is a need to unite, on a competitive basis, specialists with modern medical knowledge and traditional healers.

As examples, we give only the main components of non-traditional approaches used in the diagnosis and treatment of various diseases:

2.1. Diagnosis of the human aura. Official medicine is forced to reckon with the results of computer diagnostics of diseases by the human aura, which fully reflects the weak areas in his body.

2.2. Finally, the secret of the Pharaoh's cylinders has been revealed, made by the Russian physicist Kovtun, who theoretically substantiated and practically began to manufacture cylinders made of copper and zinc for sale and medical use. When the cylinders are compressed in the hands, the energy in the patient's body is aligned, on which his well-being completely depends. Recently, specialists have begun to produce more efficient Pharaoh cylinders made of gold and silver. But, nevertheless, in order to increase the efficiency of this method, the design of the cylinders requires some refinement.

2.3. Directly with the alignment of the energy fields of a person, cleaning the energy channels in his body in a certain area, the acupuncture technique used for thousands of years, which is identical to the work of the Pharaoh's cylinders, is connected (the word "Pho + ra +oh" in Greek means "A man eating the sun" [5]).

2.4. Human energy can be connected with cosmic energy through the pyramids (the word "pyramid" in Greek means "zero energy", therefore, in the pyramid, wheat grains retained their vegetative properties after 5 thousand years!), about the miraculous properties of which we know relatively little. Therefore, it is necessary to continue work on the use of pyramid therapy, which has found distribution in Cuba.

2.5. Endocrine (diabetes) and hypertensive diseases (especially high blood pressure) are closely related to human energy. Therefore, our task is to restore a person's contact with Mother Earth, which has a negative charge, and air has a positive charge. The presence of shoes and various floor coverings reduces the direct contact of a person with the Earth, so there is an imbalance in the energy of

a person, which ultimately leads to diabetic diseases. In the field of restoring this imbalance, it is necessary to conduct appropriate research.

2.6. At present, no one denies the restoration of the harmony of a living organism, including the body and soul of a person, with the help of sound, music, as well as color and light, which is used all over the world and will be fully implemented in the MEETMFPaTS project.

2.7. The effectiveness of leeches (hirudotherapy with accurate determination of acupuncture points), the use of various homeopathic remedies, no one denies either, but all this must be put, as they say, “on stream”.

2.8. In Russia, in the resort city of Essentuki, there is a unique museum of active mechanotherapy, the equipment of which is the prototype of modern fitness clubs, but differs from them in greater efficiency. Therefore, with the help of appropriate physical exercises and loads, including occupational therapy, many diseases can be avoided and the health of mankind can be fully restored.

2.9. Yoga exercises, the experience of which has been confirmed by thousands of years of practice, as well as auto-training exercises, are currently underdeveloped. Therefore, in the projected micro-polis, the healing properties of yoga exercises will be fully used.

2.10. Currently, many diseases are cured using knowledge in the field of traditional medicine, but this is practiced only by individual healers, which we intend to «unwind» to the fullest with mandatory supervision and issuance by official medicine (according to the results of medical tests performed before and after treatment) , the corresponding conclusion about the effectiveness of treatment.

2.11. Elderly people during their lives have repeatedly experienced the power of thought (evil eye, damage, etc.), therefore, in the proposed micro-polis, both individual minerals and conspiracies from the evil eye, etc. will be used as necessary.

3.12. Naturally, the most important thing is the mental, internal healing of a person, which can be favored by religious buildings on the territory of the complex. For this, in the central part of the complex there is a Temple of the four main world religions: Christian, Muslim, Buddhist and Judaic, which not only has a beneficial effect on the spiritual state of a person, but also allows respect for other religions, educates people in respect for each other, because we are all children of the Creator!

3. APPROBATION AND PECULIARITIES OF THE PROJECT MEETMFPaTS.

The MEETMDPiVPL project, the original name of which was “Sanatorium - Resort Astronomical-Astrological Complex of Balneological and Alternative Medicine” (SRAACBAM) was covered in 15 scientific articles, presented at various Symposiums (the components of the project were awarded the Grand Prix,

Gold and Silver medals at the International Exhibition - congress HIGH TECHNOLOGIES. NEW TECHNOLOGIES "NEW HOUR". Steel development for the hour of change" (Sevastopol, 24-26 September 2009), at the 1X MOSCOW INTERNATIONAL SALON OF INNOVATIONS AND INVESTMENTS (Moscow, 2009); » and etc.

The proposed project of a micro-settlement is unique not only in its architectural, planning and volumetric solution, but also has a wide range of functional purposes and generally addresses the issues of protecting human health. The project of a micro-settlement can be typed, made using 3D technologies in construction and erected in any climatic region of the Earth.

CONCLUSIONS:

1. For the first time in architecture, the building complex of buildings was given the forms of all the signs of the Zodiac.

2. For the first time, it is planned to erect buildings of a micro-settlement from environmentally friendly building materials and related infrastructure (plants, flowers, colors, design solutions, etc.) in accordance with the type of zodiac sign that the building represents.

3. A complex of buildings is proposed, which over a long service life can change its functional purpose (for example, move from a working settlement to a satellite city or a sanatorium-resort institution, a recreation center, etc.).

4. For the first time, the mass use of non-traditional (relative to Russia) methods of treatment (needle-, gerudo, phyto-, muzo-, labor-, pyramido- and other types of therapy) that have justified themselves for many hundreds and thousands of years has been proposed.

5. The project provides for the use of a complex of the latest operational diagnostic methods using computer diagnostics on the human aura, as well as with the existing traditional methods of Chinese medicine (osteopathy, Yogi exercises, etc.), taking into account the contraindications of official medicine.

6. The proposed project MEETMFPaTS) can be made using the latest 3D technologies and typed for construction anywhere on the planet Earth.

7. The high efficiency and economy of a micro-settlement as a medical institution is achieved through the use of building materials in the region of a specific construction site and the replacement of expensive equipment and medicines with folk and Chinese methods tested for thousands of years.

8. The creation of at least one such micro-settlement as a sanatorium-treatment base can be used as a research center to attract proven Chinese and traditional healers to study the methods of alternative medicine.

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DOI 10.34660/INF.2023.40.50.064

通过振荡水流在平底上形成脊
FORMATION OF RIDGES ON A FLAT BOTTOM BY OSCILLATING WATER FLOW

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抽象的。提出了长谐波在平坦沙质底部形成脊的实验研究结果。我们提出了一种假设，将沙上平行脊的形成与波相第一和第三四分之一流动抑制区底层中出现的一系列涡流的影响联系起来。漩涡在形成的瞬间抓住沙子，在周围流体的压力作用下移动，突然起飞，立即冲到底部，失去沙子，形成堤坝。涡旋参数的计算与脊的几何形状非常吻合，这证实了所提出的假设。

关键词：涡流、波浪引起的底部变形、粘性层、涡流动力学、脊形成。

Abstract*. The results of an experimental study of the formation of ridges on a flat sandy bottom by a long harmonic wave are presented. We propose a hypothesis linking the formation of parallel ridges on sand with the influence of a chain of vortices arising in the bottom layer in the zone of flow inhibition in the first and third quarters of the wave phase. The vortex grabs the sand at the moment of formation, moves under the influence of the pressure force from the surrounding fluid, abruptly takes off and immediately rushes to the bottom, where it loses the sand, forming the embankment. Calculations of vortex parameters agree well with the geometry of the ridges, which confirms the proposed hypothesis.*

Keywords: *vortices, bottom deformation by wave, viscous layer, vortex dynamics, ridge formation.*

Introduction

Under a long harmonic wave, regular ridges, called ripples, are formed on the liquid surface at the smooth erodible bottom of a reservoir. The ridges grow when exposed to the wave, then the growth stops - an equilibrium phase with oscillating flow is formed. These ridges significantly affect the hydrodynamic characteristics of the wave flow by increasing the bottom roughness, changing the steepness of the surface wave [1] and scouring processes in the near-bottom region [2]. Dozens of laboratory and in-situ studies [e.g. 3-4] and a large number of theoretical

works using numerical modelling [5] have been carried out in order to obtain the characteristics of ridges. Since [6], wave-formed ridges have been divided into rolling-grain ridges (rolling-grain ripples) and vortex ridges (vortex ripples). The first type of ripple is caused by the action of steep waves when there is an intense movement of sediment. No relationship between the size of the ripples and the parameters of the wave on the liquid surface was found in the experiment, and such ripples are called anorbital ripples. The second type, "vortex" ridges, occurs when linear waves form vortices only over the downstream side of the ridges' crests. It was established in experiments that the size of "vortex" ridges is determined by the parameters of orbital motion of an elementary volume on the liquid surface during the passage of a wave with orbital diameter d and wave height H

$$d = 2a = \frac{H}{sh(kh)}, \quad k = \frac{2\pi}{\lambda} \qquad (1)$$

where a,- is the orbital amplitude and λ is the wavelength, h is the depth of the fluid layer with an unperturbed surface. Such ridges are called orbital ridges. A number of dimensionless parameters, such as the Shield number θ and the displacement parameter ψ, have been proposed to distinguish between orbital and non-orbital ridges:

$$\theta = \frac{0.5 f_w U_{\max}^2}{((\rho_s - \rho)/\rho) g D_{50}}, \quad \psi = \frac{U_{\max}^2}{((\rho_s - \rho)/\rho) g D_{50}} \qquad (2)$$

where ρ and ρ_s the density of water and sand, $U_{\max} = akC$ – velocity of orbital motion of a unit volume of liquid on the water surface, C - phase velocity of the wave, D_{50} – median diameter of bottom particles, g - gravity acceleration, f_w – wave impedance determined by the empirical expression [7]:

$$f_w = \begin{cases} \exp\left[5.213\left(\frac{5D_{50}}{d}\right)^{0.194} - 5.977\right] & \frac{5D_{50}}{d} > 1.57 \\ 0.3 & \frac{5D_{50}}{d} \le 1.57 \end{cases} \qquad (3)$$

In a number of works, to determine the type of sand ridges formed by the wave, the ratio of d / D_{50} [8]. When exposed to intense waves of high steepness $d / D_{50} > 5000$ the distance between equilibrium ridges depends on D_{50} and does not depend on the wave parameters - the ridges are anorbital [8]. The size of ridges can be both proportional to the size of bottom particles and inversely proportional at different stages of equilibrium conditions formation. When $2000 < d / D_{50} < 5000$ the distance between the ridges depends on both

the particle size and the wave height, such ridges are called suborbital ridges. If $d / D_{50} < 2000$, then the distance between the ridges of the ridges S is proportional to the wave amplitude, such ridges are called orbital ridges. In a number of experimental works for equilibrium ridges the value of $S / d = 0.65$. The abundance of predictors using different parameters, as well as significant deviations between the predictions they give, indicate that the problem of predicting the characteristics of ridges formed by waves is still far from a final solution. The main reason is the lack of a reliable physical model of the interaction of an oscillating fluid flow with the eroding underlying surface. The known models are based on linear analysis of the stability of laminar motion of oscillating flow to infinitesimal sinusoidal perturbations on the bottom surface [10]. The results of such analyses in some cases allow predicting the loss of stability, but do not give the dimensions of new forms of stable perturbations - ridges, which can be recorded in the experiment. The solution of the nonlinear problem is determined by the form of finite perturbations, which is given in advance. With this approach, one can search for the perturbations most dangerous for the stability of laminar motion. The lack of data on the nature of the initial perturbations and the mechanism of their generation make this task difficult to fulfil.

In oscillating flow, bottom scouring occurs only in the zone of decreasing flow velocity in the direction of motion, where there is an inverse pressure gradient. Prandtl believed that in such a flow, vortices should appear near the bottom due to periodic stopping of the viscous layer of flows under the action of the reverse pressure gradient and friction force. A great number of works are devoted to the study of these vortices [11]. In [12] in a series of experiments, it is shown that at the time of formation of the structure is a chain of vortex filaments stretched along the transverse axis, the vortices deform and move by interaction with the flow and solid walls. It was shown in [13-14] that vortices periodically appear above the viscous layer, and their formation is due to the loss of stability of plane-parallel motion during periodic deformation of the mean velocity profile. It can be assumed that the same mechanism of interaction between the flow and the eroded bed works at the initial moment of time in the oscillating flow. The purpose of the present work is to verify this hypothesis. The verification is based on the results of experiments and data published in the literature.

Parameters of initial ridges in oscillating fluid flow

We will assume that the formation of ridges under a running long wave on the water surface is determined by the same mechanism of flow-bottom interaction as in a stationary flow with an inverse pressure gradient. According to [12], ridges are formed only in the zone where the flow velocity decreases in the direction of

motion. In oscillating flow, this condition is fulfilled in two wave phases: from the crest to the undisturbed surface, where the flow velocity has a positive sign, and from the trough to the undisturbed surface, where the flow velocity is negative. In the same zones, the derivative of the horizontal velocity by x is negative. We will assume that in these zones the variable values of the background flow velocity and velocity gradient can be replaced by their mean values. Further, we will use the results of [12] to calculate the parameters of ridges at the bottom of the channel under the wave. In this work, a semiempirical expression linking the distance between vortices is derived S_{ed} and the formative period T_{ed} with the following steady-state flow parameters: flow velocity in the homogeneous part of the vertical profile *u(y)*, velocity derivative along the *x*-axis $u_x = \partial u / \partial x < 0$, flow velocity at the upper boundary of the viscous layer δ at the initial moment of time $u_\delta(0)$, dimensionless friction coefficient C_f:

$$S_{ed} = T_{ed}\frac{u_\delta}{5} - \frac{\delta}{2C_f}\ln\left(1 + u_\delta \frac{2C_f}{25|u_x|\delta}\right), \quad T_{ed} = \left(\frac{2\delta}{u_\delta |u_x| C_f}\right)^{1/2} \operatorname{arctg}\left(\frac{u_\delta}{5}\sqrt{\frac{2C_f}{u_\delta |u_x| \delta}}\right) \quad (4)$$

In an oscillating flow, the flow velocity is determined by the orbital motion of a unit volume of fluid at the water surface. The amplitude of the orbit is determined by (1), and the horizontal component of the velocity at the water surface at a fixed moment of time is equal to

$$U_{zop} = U_{\max}\cos(kx) = \frac{kH\sqrt{gh}}{2sh(kh)}\cos(kx), \quad U_{\max} = akC \quad (5)$$

where H is the height of the wave at the water surface, $C = \sqrt{gh}$ phase velocity of long waves. It can be assumed that at a given moment of time in the wave phases in which the orbital flow velocity decreases in the direction of motion (at positive and negative sign of the flow velocity), chains of vortices elongated along the transverse axis will be formed in the bottom layer. Vortices in the detachment zone will capture and carry away sand, forming a chain of grooves. If the assumption is correct, the distance between the vortices will be equal to the distance between the grooves $S_{ed} = S$ and can be calculated according to (4).

To test this assumption, a series of experiments were carried out in a laboratory open channel 3.5 m long, 15 cm wide, in which a long wave was generated on a water layer of depth *h* = 4 cm, Froude number equal to 0.97. The parameters of the wave flow are given in Table 1.

Table 1

	h, cm	*C*, cm/s	*T*, s	*H*, cm	λ, cm	*δ*, cm	$U_{\max}$, cm/s	u_x, c^{-1}
exp	4	62.6	0.67	0.5	42	0.5	4.0	- 0.07
[16]	40	198	1.50	7	300	0.3	15.4	- 0.05

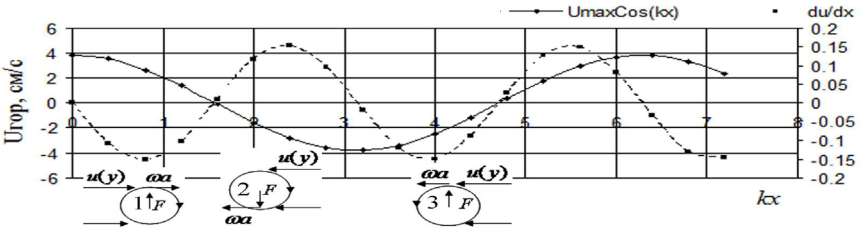

Figure 1. *Horizontal component of velocity as a function of wave phase. Scheme of vortex displacement under the influence of background flow (1 - upward ascent, 2 - descent to the surface, 3 - upward ascent)*

Fig. 1 shows the dependences of the horizontal flow velocity and its derivative on the phase *kx*. In accordance with the proposed hypothesis, for a given moment of time, vortices can be formed in the first and third quarters of the phase, where the derivative of the $u_x < 0$. For calculations of vortex chain parameters we took the maximum value of orbital velocity u = 4 cm/s and the mean value of velocity derivative $|u_x| = 0.07$ s^{-1}. The other parameters included in (4): $C_f = 0.2$ for sand grains with a medium diameter $D_{50} = 0.03$ см, $u_\delta = 0.5U_{\text{rop}}$. Calculation according to (4) gives the value $S_{ed} = 1.1$ cm, and the period of vortex chain formation $T_{\text{ed}} = 3.9$ s. In the experiment, the process of vortex chain formation over the initially flat bottom during the wave passage was recorded (Fig. 2).

In the vortex detachment zone, parallel grooves elongated along the transverse coordinate *z* appeared. The averaged value of the distance between the grooves $\overline{S} = 1.2$ cm (Fig.3). Good agreement between calculated and experimental values $S_{ed} \approx \overline{S}$ (within the confidence interval of 0.2 cm for a confidence level of 0.67) confirms the assumption made.

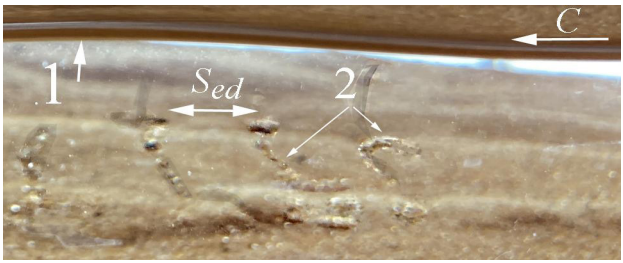

Figure 2. *Rise of vortices with trapped sand during the passage of the first quarter of the wave phase. 1 - water surface. 2 - vortex filaments.* S_{ed} *= 1.1 cm.*

Figure 3. *Initial ridges in the experiment. S = 1.2 cm. Top view*

Embankment formation

The eddies do not remain in the formation zone near the bottom, but move along the cycloid under the pressure force from the background flow, moving upwards in the positive *y*-axis direction. Vortices rotating clockwise move in the positive *x*-axis direction. Counterclockwise rotating vortices formed in the negative orbital velocity zone are displaced in the negative x-axis direction [15]:

$$\dot{\eta} = -\frac{\mu u_\delta}{5\omega}\sin(\mu t),\ \dot{\xi} = \left(\frac{\partial u}{\partial y} - \omega\right)\eta,\ |\omega| = \frac{1}{2}\frac{\partial u}{\partial y} = \frac{2u_\delta}{5\delta},\ \mu = \sqrt{\left|\left(\frac{\partial u}{\partial y} - \omega\right)\omega\right|} = \sqrt{3}\frac{2u_\delta}{5\delta}, \quad (6)$$

where ξ and η are the horizontal and vertical coordinates of the vortex centre. The vertical velocity of the vortex changes sign at the moment $t_1 = \frac{\pi}{2\mu} = 0.5$ s at the point of maximum ascent. However, the vortex does not have time to reach it, as it appears in the zone of the background current sign change after a quarter of the wave period at the moment of $t_2 = \frac{T}{4} = 0.17$ s. As shown in the diagram at the bottom of Fig. 1, a change in the sign of the background flow velocity leads to a

change in the sign of the pressure force on the vortex from the surrounding fluid. As a result, the vortex rushes downwards towards the underlying surface where it loses the sand trapped in the formation zone (Fig. 4).

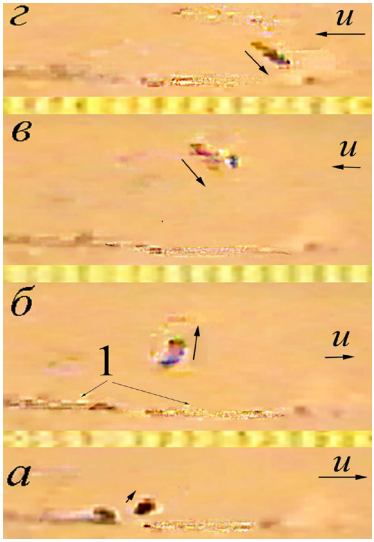

Figure 4. *Vortex trajectory. Video frames, time interval 0.08 s, u - direction of the background flow velocity, 1 - sand surface, arrows show the vortex velocity direction, scale divisions - 0.1 cm*

The eddies carry sand captured in the formation zone and lose it in the landing zone, forming a mound between neighbouring grooves, which changes the velocity distribution along the x-axis. The zone of maximum flow inhibition coincides with the position of the groove formed by the first vortex. When the sign of the background flow changes, the fluid flows over the embankment and a new vortex is formed in the flow expansion zone above the groove. A system with positive feedback arises, which causes the growth of ridges, preserving their initial size at the initial stage of formation. The experimental data show that the position of the initial grooves remains unchanged until the height of the ridges reaches the viscous layer thickness δ. This result was confirmed experimentally in [16], which investigated the formation of ridges on an initially flat bottom on which shallow grooves were applied. Under the influence of long waves, ridges were formed on sand, the geometry of which was determined only by the wave parameters and did not depend on the shape of the initial furrows. In [16], the characteristics of waves forming ridges are given in Table 1. The data allowed us to perform calculations of

vortex characteristics according to (4) for [16] and compare them with the shape of the resulting ridges. The calculation allowed us to obtain the distance between the vortices S_{ed} = 3.64cm, the distance between the ridges fixed in the experiment S = 3.34 cm (Fig. 3, b). The good agreement of our calculations with the experimental data [16] confirms the proposed hypothesis.

Conclusion

A long harmonic wave at the surface of a fluid layer forms vortex filaments extended along the transverse axis of the flow in the bottom layer of orbital flow. The vortices appear in the braking zones of the orbital motion at a fixed moment in time. In the first quarter of the phase of the wave running along the x-axis, the vortices rotate clockwise, while in the third quarter they rotate anti-clockwise. Under the influence of the Zhukovsky force from the surrounding fluid, the vortices rise upwards and rapidly rush downwards as the sign of the orbital flow changes.

At the moment of formation, the vortices capture sand, creating a chain of parallel grooves. The eddies lose sand in the area between the initial grooves, creating an embankment. The change in the sign of orbital motion accounts for the symmetry in the shape of the embankment. The distance between vortices and between grooves coincide and persist until the height of the ridges exceeds the initial viscous layer thickness with a linear vertical velocity profile.

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上合组织国家的科学研究：协同和一体化

国际科学大会的材料

2023 年 8 月 9 日。中国北京

编辑A.A.Siliverstova
校正A.I.尼古拉耶夫

2023 年 8 月 9 日。中国北京
USL。沸点：98.7。 订单253.流通500份。

在编辑和出版中心印制
无限出版社