SCIENTIFIC RESEARCH OF THE SCO COUNTRIES: SYNERGY AND INTEGRATION

上合组织国家的科学研究：协同和一体化

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与电力行业相关的俄罗斯经济数字化基本模型的开发
DEVELOPMENT OF THE BASIC MODEL OF DIGITALIZATION OF THE RUSSIAN ECONOMY IN RELATION TO THE ELECTRIC POWER INDUSTRY

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本文介绍了数字化背景下经济市场主体活动的基本模型的发展。 他的出发点是使用先前开发的经济系统动态概率模型。 关于电力行业，对俄罗斯经济中使用的边际伪市场定价体系进行了分析。 电力行业经济实体活动的分析和建模结果表明，边际定价对整个国家经济体系的负面影响。 提出了对无效市场实体的直接预算支持的替代版本。

关键词：俄罗斯经济，电力工业，数字化，基础模型，动态概率模型，边际定价

Abstract. *The article presents the development of the basic model of the activity of economic market entities in the context of digitalization. His starting point was the use of a previously developed dynamic probabilistic model of economic systems. With regard to the electric power industry, an analysis of the marginal pseudo-market pricing system used in the Russian economy is carried out. The results of the analysis and modeling of the activities of economic entities in the electric power industry showed the negative impact of marginal pricing on the country's economic system as a whole. An alternative version of direct budgetary support for ineffective market entities is proposed.*

Keywords: *Russian economy, electric power industry, digitalization, base model, dynamic probabilistic model, marginal pricing.*

Introduction

The main goal of reforming the electric power industry of the Russian economy was to attract private investment, create a competitive market with the achievement of stabilization and reduce prices in the foreseeable future. However, the inconsistency of statements about the inflow of private investment was initially obvious due to an order of magnitude gap between the cost of construction

and repair of facilities and the current capitalization of companies, due to the low solvency of the bulk of consumers. As a result of the reforms, the inflow of private investment into the industry remained insignificant, while the prices for supplied electricity increased annually.

Main part

Within the framework of improving the digital model of the Russian economy in relation to the electric power industry, the analysis of the impact of specific pseudo-market marginal pricing, which is rather difficult to identify within the framework of classical economic theories, is of greatest interest. In this article, to analyze the negative impact of marginal pricing, a previously developed dynamic probabilistic model of economic systems was used, which is applicable to the economies of individual countries and their industries [1-4].

Description of the model

First of all, we introduce a number of conditions, namely:

1. By the development of the economic system we mean a monotonically growing, on average, accumulation of capital (resources, information, technologies, etc.), measured in some equivalent (money).

2. We believe that all economic subjects of the market are limitedly irrational. This makes it possible to assess the average and limited variances of deviations of their actions, in contrast to the classically rational.

3. We believe that all economic subjects of the market are diverse, in particular, they make different mistakes.

4. We believe that all economic subjects of the market are non-additive and, therefore, the market is not a sum of subjects, but rather their statistical aggregate, which has cooperative properties, in particular, an assessment of the market value.

5. Taking into account the experimentally verified significant discrepancies of economic measurements and estimates, from indistinguishable adequate mathematical descriptions of irrationality, the probabilistic one was chosen as the simplest [5].

6. In the D-T-D scheme, the resource component of the products involved in the exchange does not matter.

Under these conditions, each economic entity is characterized by capital α_j and an error in its use in exchange transactions ξ_j, and the statistical set of economic entities that forms the market is characterized by a collective assessment of market values <c> as a weighted average for all exchange transactions and, therefore, the corresponding summary error in measuring market values. Then the simplest dynamic digital model of the economic system will appear in the form:

$$\bar{A}_{i+1} = \bar{A}_i - diag(\bar{\xi}_i)\cdot\bar{A}_i + \frac{\bar{A}_i^T\cdot\bar{\xi}_i}{\bar{A}_i^T\cdot\bar{T}}\cdot\bar{A}_i \quad (1),$$

where i – cycle number;

$$[\bar{A}]_j = a_j \tag{2}$$

$$[\bar{\xi}]_j = \xi_j \tag{3}$$

Model (1) describes a closed market with the total capital conservation law. As the most important consequences of (1), we note the condition for the development of the economic system in terms of the growth of the accuracy of measuring market values in i, as well as the stabilizing role of government regulation in the case of an excessive scatter of solutions according to (1) with large values of errors in the use of capital in exchange operations ξ_j.

The simplest option to make the market open would be the introduction of an additional economic entity with certain resources (capital, labor, information, technology, etc.) In this case, (1) is transformed to the form:

$$\bar{A}_{i+1} = \bar{A}_i - diag(\bar{\xi}_i)\cdot \bar{A}_i + \frac{\bar{A}_i^T \cdot \xi_i + \bar{\Pi}_i \cdot \mu}{\bar{A}_i^t \cdot \bar{I} + \Pi_i} \cdot \bar{A}_i \tag{4}$$

$$\bar{\Pi}_{i+1} = \bar{\Pi}_i - \bar{\Pi}_i \mu + \frac{\bar{A}_i^T \cdot \xi_i + \bar{\Pi}_i \cdot \mu}{\bar{A}_i^T \xi + \bar{\Pi}_i} \cdot \Pi_i \tag{5}$$

where $\bar{\Pi}_i$ - resources available to market agents;

μ - parameter characterizing the ratio of the availability of resources to the efficiency of the activities of economic entities.

In the works [1-4] it is shown that the condition for the development of the economic system in the sense of the accumulation of property can be represented as follows:

$$\mu > \xi > = \frac{\bar{A}_i^T \bar{\xi}_i}{\bar{A}_i^T \bar{I}} \tag{6}$$

Considering that the weighted average by prices <c> is itself a random variable, relations (4) - (6) are minimally sufficient to explain the classic market crises and the slowdown in the development of the economic system without attracting investments due to the finite resources of Π.

For a qualitative analysis of the impact on the development of the economic system of various pricing mechanisms, we use the assumption of unlimited resources, namely:

$$\Pi_i \gg \bar{A}_i^T \times \bar{I} = Q_i \tag{7}$$

In this case, expressions (4) - (7) are easily transformed to the form

$$\bar{A}_{i+1} \cong \bar{A}_i - diag(\bar{\xi}_i) \times \bar{A}_i + \mu \bar{A}_i \tag{8}$$

Note that for

$$< \bar{\xi}_{i+1} > - < \xi_i > \ll \mu - < \xi > \tag{9}$$

and uncorrelated residuals

$$< (\bar{\xi}_K \bar{\xi}_i^T) > = diag(\bar{\xi}^2) \tag{10}$$

where $\bar{\xi}^2$ – dispersion matrix, expression (8) has an approximate solution

$$Q_j(i) = Q_j(i) \times \exp\left((\mu - < \xi_i >)i\right) \quad (11)$$

Solution (11) for developed quasi-stationary countries describes, on average, the exponential dynamics of economic growth. Note that in formulas (4)-(11) for all economic entities, the market sets one market value and the deviation from it of personal assessments of actions and inactions equally affects the change in the capital of each subject. We also note that formulas (4)-(11) in the development of a dynamic probabilistic model of economic systems made it possible to solve a number of economic problems. Some of them are described below.

Margin pricing model

To solve this problem, we will divide economic entities into energy producers $(\overline{A})$ and energy consumers $(\overline{B})$ with the transformation of expression (8) to the following form:

$$\overline{A}_{i+1} = \overline{A}_i - diag\left(\overline{\xi}_a\right) \cdot \overline{A}_i + \mu \cdot \overline{A}_i \quad (12)$$

$$\overline{B}_{i+1} = \overline{B}_i - diag\left(\overline{\xi}_b\right) \cdot \overline{A}_i + \mu \overline{B}_i \quad (13)$$

When pricing on a weighted average, which is most consistent with the classical understanding of market value, all of the above formulations remain, but some of the entities - energy producers who evaluate and operate worse than average will lose their capital and become bankrupt.

The marginal system for the formation of pseudo-market values, in essence, presupposes a shift in the price of "energy" for all entities by an amount Δc, which guarantees the *m*-th (last) producer-entity a non-negative value of the capital change at the *i*-th step.

$$\Delta\, a_m = a_{m(i+1)} - a_{m(i)} \geq 0 \quad (14)$$

Then, in (12), there appears a systematic addition of capital for subjects of type (a), determined from the expression:

$$\overline{A}_{i+1} = \overline{A}_i - diag\left(\overline{\xi}_a\right)\overline{A}_i + \mu\overline{A}_i + \Delta\, a\overline{A}_i \quad (15)$$

For subjects of type (*в*) – buyers of energy, this operation will lead to a systematic shift of capital in the negative direction, namely:

$$\overline{B}_{i+1} = \overline{B}_i - diag\left(\overline{\xi}_b\right)\overline{B}_i + \mu\overline{B}_i - \Delta\, c \times \overline{B}_i \quad (16)$$

Margin pricing according to (15)-(16) provides a change in the total capital of the economic system in the following form:

$$Q_{i+1} - Q_i = \overline{A}_i^T \times \overline{I} + \mu\overline{A}_i^T \times \overline{I} - \left(\overline{A}_i^T \times \overline{\xi}_a\right) + \Delta\, c\overline{A}_i^T \times \overline{I} + \overline{B}_i^T \times \overline{I} + \mu\overline{B}_i^T \times \overline{I} - \left(\overline{B}_i \times \overline{\xi}_b\right) - \Delta$$
$$c(\overline{B}_i^T \times \overline{I} = Q_i + \mu Q_i - \left(\overline{A}_i^T \times \overline{\xi}_b + \Delta\right) c(\overline{B}_i^T I - \overline{A}_i^T \times I) \quad (17)$$

Hence, the point of decrease in the rate of development of the economic system $(\Delta\, Q_i < 0)$ will correspond to the condition:

$$\mu - < \xi > - \Delta\, c \times \frac{\overline{B}_i^T \cdot \overline{I} - \overline{A}_i^T \cdot \overline{I}}{Q_i} \geq 0. \quad (18)$$

Taking into account the results of the above analysis, the value of $\mu - < \xi >$ can be approximately equated to the annual economic growth rate (0.03-0.05), and

the capitalization of all economic entities in the electric power industry should be taken within 0.03-0.1 of the total capital of the system. Then from (18) we obtain the upper bound:

$$0{,}05-\Delta\, c\times 0{,}8 \geq 0 \tag{19}$$

Further, you can get a rough estimate of the permissible relative to the average bias in electricity prices in the amount of

$$\Delta\, c \cong 0{,}06 \tag{20}$$

With the existing scatter of the efficiency of the activities of economic entities, and, consequently, the ratio of the standard deviation to the average value of income, relation (19) is practically impracticable and, therefore, the use of a marginal pricing system in the electric power industry guarantees a slowdown in the development of the entire economic system.

Alternative options for supporting ineffective economic agents

As the simplest, let us consider the option of compensation for losses at the expense of the turnover tax $\boxed{(\gamma)}$ for all closing economic entities, which guarantees them against bankruptcy. Model (15) - (16) is transformed to the form (21) - (22):

$$\overline{A}_{i+1} = \overline{A}_i - diag(\overline{\xi}_a)\times\overline{A}_i + \mu\times\overline{A}_i + \alpha\overline{I} - \gamma\times\overline{A}_i \tag{21}$$

$$\overline{B}_{i+1} = \overline{B}_i - diag(\overline{\xi}_b)\times\overline{B}_i + \mu\times\overline{B}_i + 0 - \gamma\times\overline{B}_i \tag{22}$$

with the addition of the condition of preventing the bankruptcy of the entity:

$$(\mu - \xi_m)\times a_m + \alpha - \gamma\times(a_m) = 0,$$

$$\alpha = a_m\times[\mu - \xi_m - \gamma] \tag{23}$$

Then we write the change in the capital of economic entities in the form:

$$Q_{i+1} = Q_{a_i} - \overline{A}_i^T\times\overline{\xi}_a + \mu\times Q_{a_i} + \alpha\times\mu - \gamma\times Q_{a_i} + Q_{b_i} - \overline{B}_i^T\times\overline{\xi}_b + \mu\times Q_{b_i} + Q -$$

$$\gamma\times Q_{b_i} = Q_i + Q_i\times(\mu - <\xi>) - \gamma\times Q_i + \alpha\times\mu \tag{24}$$

Hence

$$\frac{\Delta Q_i}{Q_i} = (\mu - <\xi>) - \gamma + \frac{m\times a_{m(i)}}{Q_i}[\mu - \xi_{max} - \gamma] \tag{25}$$

If $\frac{m\times a_{m(i)}}{Q_i}$ - small value, then the capitalization of the worst economic entity will be significantly less than the average, that is, $m\times a_m \ll \overline{A}_i^T\overline{I}$. This means that relation (25) sets very modest requirements for the tax addition, which are almost always feasible. Consequently, the direct budgetary support required for the normal operation of an economic entity within the framework of the model looks fundamentally better than marginal pricing.

If it is impossible to abandon marginal pricing for political reasons, it is possible that some economic entities leave the electricity generation and supply market, which is reflected in the model by the appearance of *d*-type agents that are neutral to the Δc-shift.

$$\overline{A}_{i+1} = \overline{A}_i - diag(\overline{\xi}_a)\overline{A}_i + \mu\overline{A}_i + \Delta c\times\overline{A}_i \tag{26}$$

$$\overline{B}_{i+1} = \overline{B}_i - diag(\overline{\xi}_b)\overline{B}_i + \mu\overline{B}_i - \Delta\, c\times\overline{B}_i \tag{27}$$

$$\overline{D}_{i+1} = \overline{B}_i - diag(\overline{\xi}_d)\overline{B}_i + \mu\overline{D}_i \tag{28}$$

Then

$$Q_{i+1} = Q_i - < \xi > Q_i + \mu \overline{Q}_i - \Delta c \times \frac{\overline{Q_i} - Q_{a_i}}{Q_i} \quad (29)$$

at $Q_{i+1} - Q_i \geq 0$

With significant Q_i the ratio of the development of the economic system becomes feasible with significantly softer requirements for the value of Δc.

Conclusion

The analysis of the marginal pseudo-market pricing system used in the Russian electric power industry, carried out as part of the development of a dynamic probabilistic digital model of economic systems, showed that even with insignificant displacements from the weighted average estimates, the rate of development of the economic system decreases. If it is necessary to preserve inefficient economic entities producing electricity, it is preferable to use direct budget support while maintaining the market price.

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解决现代世界共产主义与资本主义的矛盾
RESOLVING THE CONTRADICTION BETWEEN COMMUNISM AND CAPITALISM IN THE MODERN WORLD

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文章揭示了作为现代世界主要矛盾的共产主义与资本主义的矛盾——从资本主义向共产主义革命过渡的时代，世界共产主义革命的时代。作者证明，为了中华人民共和国作为现代世界共产主义制度的基础和领导者，越南社会主义共和国、古巴共和国、老挝人民民主共和国、朝鲜人民民主共和国、扩大再生产他们的共产主义本质是必要的，要系统地解决共产主义本质与否定共产主义本身的矛盾，要保证无产阶级专政的保存和发展，制定实现共产主义的目标——全社会成员的全面发展。文章论证了社会主义国家共产主义本质的发展，是现代世界积极解决共产主义与资本主义矛盾的充要条件。只有考虑到经济、政治、军事和一般社会关系的发展，作为解决共产主义和资本主义世界体系之间矛盾的结果和形式，才能理解现代世界正在发生的事情。

关键词：共产主义、社会主义、中国、俄罗斯、上海合作组织、资本主义、帝国主义、矛盾、外交政策中的法西斯主义

Abstract. *The article reveals the contradiction between communism and capitalism as the main contradiction of the modern world - the era of the revolutionary transition from capitalism to communism, the era of the world communist revolution. The author proves that for the further successful development of the People's Republic of China as the basis and leader of the modern world communist system, the Socialist Republic of Vietnam, the Republic of Cuba, the Lao People's Democratic Republic, the Korean People's Democratic Republic, an expanded reproduction of their communist essence is necessary, it is necessary to systematically resolve the contradiction of the communist nature and the moment of denial of communism in itself, it is necessary to ensure the preservation and development of the dictatorship of the proletariat, the formulation and implementation of the goal of communism - the all-round development of all members of society. The article substantiates that it is the development of the communist essence of the socialist countries that is a necessary and sufficient condition for a positive resolution of the contradiction between communism and capitalism in the modern world. What*

is happening in the modern world can be understood only if we consider the development of economic, political, military, and in general - social relations, as a result and forms of resolving the contradiction between the communist and capitalist world systems.

***Keywords**: communism, socialism, China, Russia, SCO, capitalism, imperialism, contradiction, fascism in foreign policy*

The contradiction between the social character of capitalist production and the private form of appropriation was resolved first by the emergence of a monopoly, then a state-monopoly form of production. There are no other stages between this stage in the development of capitalism and communism. But in order to overcome this stage, a social revolution is necessary, which overthrows the dictatorship of the bourgeoisie and establishes the dictatorship of the proletariat.

The modern era of human development is the era of transition from capitalism to communism, which was started by the Great October Soviet Communist Revolution and has been going on for more than a century. From a historical point of view, a century is not much, especially if we compare it with the era of transition from feudalism to capitalism, which lasted more than three centuries, with centuries of the era of transition from slavery to feudalism, all the more so with millennia of the formation of slavery.

And for more than a century, the communist socio-economic formation has been opposing the world capitalist system. The confrontation began from the first years of the formation of communism, when the troops of bourgeois countries: Great Britain (including Canadian and Indian units), France, USA, Japan, Germany, Austria-Hungary, Romania, Poland, Finland, Turkey, Greece, Italy entered the territory Soviet Russia, realizing the interests of its capital, carrying out intervention and inciting civil war. In the mid-30s of the 20th century, the formation of socialism as the first phase of communism was completed in the USSR, that is, in the process of systematic subordination of production to public interests, public ownership of the means of production was created. Thus, for the first time in the history of mankind, a communist society was created.

The victory of the Union of Soviet Socialist Republics in World War II led to the creation of the world communist system. In Europe, communist revolutions took place in Yugoslavia, East Germany, Czechoslovakia, Hungary, Poland, Romania, and Albania. Having defeated the Kwantung Army, the USSR provided a turning point in the stubborn and difficult struggle of the armed forces of the Chinese Communist Party against the Japanese invaders, thereby creating the most important prerequisites and conditions for the victory of the Chinese communists in the struggle against the bourgeois Kuomintang. The world communist system includes the People's Republic of China, the Democratic People's Republic of

Korea, the Democratic Republic of Vietnam, and the Lao People's Democratic Republic.[1]

The world communist system, having emerged as a revolutionary denial of capitalism, is the opposite of the world capitalist system. Coming out of capitalism, communism carries within itself the moment of its denial - "birthmarks of capitalism"[2]. The world capitalist system also contains the moment of its denial - the social nature of production and the organizing working class, the development of which is the condition and prerequisite for the denial of capitalism and the establishment of the dictatorship of the proletariat. That is, each of the world systems, as a side of the opposite, contains the other side as its own moment and therefore itself acts as the opposite. Thus, the opposition of communism and capitalism is not just the unity of opposing sides, but is the unity and struggle of opposites - a contradiction[3].

As long as the world capitalist system persists, it will be in unity and struggle with the world communist system, that is, in contradiction with it. The contradiction between the world communist system and the world capitalist system is the main contradiction of the modern era - the era of transition from capitalism to communism, the era of the world communist revolution. What is happening in the modern world can be understood only if we consider the development of economic, political, military, and in general - social relations, as a result and forms of resolving the contradiction between the communist and capitalist world systems.

The presence of nuclear weapons opposes the fact that this contradiction is resolved by the destruction of world systems by military means. This was possible only when the first communist state was, like everything new, just emerging, weak. But, as you know, this did not happen, also because the working class of France, Great Britain, the USA, Germany showed proletarian solidarity with the struggle of Soviet Russia. The second possibility of the destruction of communist society arose in the Second World War. German fascism, as an open terrorist dictatorship of the most reactionary, most chauvinistic elements of German finance capital, together with its allies (Italy, Romania, Finland, Hungary, Slovakia, Spain), using the resources of the entire continental Western, Northern, Southern and Central Europe, unleashed a war with the USSR with the purpose of seizing territories and destroying socialism. The Union of Soviet Socialist Republics, having no advantages in population size, in production potential, used the planned, mobilization advantages of socialism, relying on the results of socialist industrialization and collectivization, on the advanced communist ideology, Soviet patriotism, inflicted a historic defeat on Nazi Germany and its allies.

1 In 1924, the socialist revolution took place in Mongolia.

2 See: Popov M.V. Planned resolution of the contradictions in the development of socialism as the first phase of communism. L.: Publishing house of the Leningrad State University.1986.

3 Ibid. P. 14.

The USSR, having created in a short time in response to US nuclear weapons its own nuclear weapons and their means of delivery to the United States, and then the world's first thermonuclear weapons, prevented the third world war, saved hundreds of millions of people and humanity as a whole. Thus, the USSR made it practically impossible to destroy communism by capitalism by means of war.

However, after the death of Stalin I.V. the contradiction of socialism - the contradiction of its communist nature and the moment of denial of communism in itself[4] – began to intensify. An expanded reproduction of the moment of denial of communism within itself began. The leadership of the CPSU under the leadership of Khrushchev carried out the decentralization of economic management, liquidated the machine and tractor stations, which ensured the reproduction of public property in agriculture. At the 22nd Congress, the CPSU adopts a new party program, in which it renounces the dictatorship of the proletariat and the goal of communist society - complete prosperity and free, all-round development of all members of society, replacing it with a completely bourgeois "most complete satisfaction of growing needs". Thus, a counter-revolutionary coup took place, which led to the restoration of the dictatorship of the bourgeoisie and began the transition period from socialism to capitalism. This transition was completed in 1991. That is, the political counter-revolution took place in October 1961, and the reactionary, counter-revolutionary transition from socialism as the first phase of communism to capitalism (that is, social counter-revolution in a broad sense) took thirty years.[5]

The restoration of capitalism took place in Albania, Mongolia, Poland, Hungary, Romania, Czechoslovakia, and the GDR. Moreover, Czechoslovakia was divided into two states, and the GDR was annexed by the FRG. Yugoslavia, which was fragmented into many small states, in fact was and remains a capitalist country, in which group private property in the form of ownership of collectives of enterprises predominated.

At present, the world communist system consists of the Democratic People's Republic of Korea, the People's Republic of China, the Socialist Republic of Vietnam, the Lao People's Democratic Republic, and the Republic of Cuba. These countries are socialist because socialist revolutions have taken place in them and the dictatorship of the proletariat has been established. In the DPRK, socialism as the first phase of the communist socio-economic formation has been created, in the other countries of the above, a period of transition to socialism is underway.

The total population of the socialist countries is about one and a half billion people, which exceeds the population of the United States and the most developed

4 Ibid. P. 5 – 26.

5 “When considering such upheavals, it is always necessary to distinguish a material, with natural-scientific precision, a change in the economic conditions of production from legal, political, religious, artistic or philosophical, in short: from the ideological forms in which people are aware of this conflict and struggle with it” K. Marx and F. Engels. Works, 2-nd ed., V. 13, P. 6–7.

capitalist countries dependent on them.

China's gross domestic product (GDP) is 1.27 times that of the United States. It is even more important that the volume of industrial production in the PRC in terms of added value is 1.55 times higher than that in the United States, and in the PRC they produce 11 times more steel than in the USA, and cement - 26 times more.[6] It is the industry that determines the power of the country, its ability to produce a material product that forms the basis of the reproduction of human society, including determining the level of development of medicine and health care in general. The superiority of the PRC industry over the US industry is a prerequisite for the fact that the PRC's armed forces in the near historical future will achieve strategic parity with the US armed forces, which will create conditions for the growth of the PRC's influence in military-political relations. More and more countries striving for political independence from the United States will move closer to the PRC, and this convergence will be based largely on the development of mutually beneficial economic relations. This trend is already being implemented in the Shanghai Cooperation Organization (SCO member states: China, Russia, Kyrgyzstan, Kazakhstan, Tajikistan, Uzbekistan, India, Pakistan with a total population of 3232 million people, which is more than 40% of the world's population, that is, 2.5 times the population of OECD[7]countries).

The growth of the economic and political influence of the leader of the world communist system inevitably aggravates the main contradiction of the era. The relative weakening of the United States as the leader of the world capitalist system, as an imperialist center, no less inevitably causes an intensification of the tendency to mobilize imperialist forces, which act in the following directions of influence:

1) curbing the development of the PRC;

2) containment of Russia as a primary nuclear power, as a partner of the PRC and a potential ally of the PRC;

3) influence on other countries cooperating with the PRC and Russia.

The United States and its subordinate countries are introducing higher customs tariffs against China, bans on technology transfer, and restrictions on the movement of capital. The naval forces of the United States and its allies create pressure on vital communications of the PRC, special services and so-called "non-governmental" organizations stimulate social, including national, conflicts in the PRC, as well as exacerbation of international contradictions, for example, with India.

Given the significant dependence of the PRC on the import of raw materials,

6 I.G. Kalabekov. Russia, China and the USA in numbers. URL: http://chius.ru (appeal date 10.05.2021)

7 URL: https://www.economicdata.ru/union.php?menu=intergovernmental-organization-unions&un_id=54&un_ticker=OECD&union_show=demography&ticker=OECD-TotalPopulation (appeal date 10.05.2021)

the export of finished products, on the receipt of advanced technologies, the presence of national and confessional contradictions, territorial and aquatic disputes and conflicts between the PRC and Japan, India, the Philippines, Vietnam, the US efforts to "contain" the PRC have an impact on the development the leader of the world communist system. Moreover, the influence is twofold. On the one hand, the impact of world imperialism at the current moment actually limits the development of the PRC. On the other hand, the need to overcome this limitation caused by US imperialism necessitates the development of what opposes capitalism as such - that is, the need to develop the communist essence of China.

The People's Republic of China is in the same historical period of development as the Union of Soviet Socialist Republics in the 1920s and until the mid-1930s, that is, in the period of the creation of a socialist society, in the period of transition to socialism. This period was characterized by a diversified economy. The economy of the USSR had the following structures (according to the level of development): *patriarchal* order based on natural economy, *petty-bourgeois* order based on the labor of the owner of the means of production working for the market, *private capitalist* order, *state-capitalist* order, based on state ownership, but working with the aim of maximizing profits outside of state planning, *communist* order of working within the framework the state plan with the aim of realizing the public interest.

In the People's Republic of China, there are all the same structures that are called sectors in China. The patriarchal sector is rapidly decreasing and losing importance, turning into a petty-bourgeois, petty-bourgeois sector has been widely developed since the 80s, the private capitalist sector developed in the same period not so much through privatization, as in Russia in the 90s, but on the basis of various forms of capital accumulation. Moreover, the peculiarity of the Chinese economy is that the private capitalist sector gives rise to another sector - the private monopoly, in which there are enterprises with foreign participation. The PRC's economy is based on the communist and state-capitalist sectors.

The Charter of the Chinese Communist Party, which is the party's program document, says: "It is necessary to continue to preserve and improve the basic economic system for the joint development of different sectors of the economy, among which the public property sector takes the leading place".[8]

Chairman of the People's Republic of China, General Secretary of the Central Committee of the Communist Party of China Xi Jinping, in a speech at a ceremonial meeting on the occasion of the centenary of the founding of the Communist Party of China on July 1, 2021, said: "Only socialism is salvation for China and

8 Statutes of the Chinese Communist Party (adopted with partial amendments by the XIX National Congress of the CPC on October 24, 2017) General Program. URL: http://russian.news.cn/2017-11/03/c_136726536.htm (appeal date 15.05.2021)

only socialism will allow China to develop successfully!".[9]

The sector of "public ownership" should include the communist sector of the economy, which works according to the state plan, works in the interests of the working class and, consequently, in the interests of the whole of society. The state-monopoly sector works with the aim of making a profit, and, therefore, being in unity with the communist sector, which is also state-owned, it is opposite to it in terms of the purpose of production. Thus, there is a contradiction between these sectors, and China's movement towards socialism as the first phase of communism depends on the resolution of this contradiction. As the state planning embraces the state-monopoly sector and its subordination to public interests, this contradiction is positively resolved. The success of this movement will positively affect the resolution of the contradiction between the state and non-state sectors of the economy. In essence, the resolution of this contradiction is the resolution of the contradiction between communism and capitalism within communism itself in its formation. In the PRC, at every medium and large enterprise of various forms of ownership, there are party committees that influence the adoption and implementation of decisions of a production nature, which also allows the private sector to be regulated. This correlates with Lenin's idea: "Not in the confiscation of the capitalists 'property will even be the" nail "of the case, but in the nationwide, all-encompassing workers' control over the capitalists and their possible supporters"[10].

The current stage of development of the People's Republic of China is characterized by a number of features. The first is that development resources are gradually being depleted on the basis of foreign investments and obtaining technologies from abroad, since many industries have already reached mainly the modern technological level and further rapid growth is already impossible on this basis. The second feature is that the United States and its allies will no longer transfer technology as widely to China, which has become its strongest competitor. The United States is already pursuing a policy of "containment" of the PRC. The third feature is that the level of real wages of workers in China, which is still insufficient for the normal reproduction of the labor force, nevertheless significantly increased and exceeded the level of wages in India and a number of other countries, which determines the redistribution of capital to these countries.

Thus, the success of China in economic development necessitates further growth based on the use of such advantages of the PRC, which India, Russia, Brazil, Indonesia, Bangladesh, other less developed countries and even the most developed countries - the USA and the EU - do not have. Moreover, the US, with its aggressive policy, is forcing China to turn to these advantages.

And such an advantage is by no means a "socialist market economy", but the

9 Xi Jinping. Speech at the 100th Anniversary Celebration of the Chinese Communist Party, July 1, 2021. URL: http://russian.news.cn/2021-07/01/c_1310038413.htm (appeal date 30.07.2021)

10 Lenin V.I. Full coll. op. 5-th ed. V. 34. P. 309.

antipode of the market - planning of the national economy of China, concentration of forces and resources on priority areas of society's development. The CPC Charter says: "To carry out a unified planning of the development of cities and villages, regions, economic and social spheres, harmonious development of man and nature, internal development of the country".[11]

Of course, under the conditions of the transition period to socialism, there is a market and the spontaneity it causes, but it exists as a transitory, disappearing, and insofar as it cannot play a decisive role in the progressive movement of the economy. The market was undermined by monopolies already at the beginning of the 20th century. The most developed capitalist countries resort to planning within the public sector and to government regulation and programming of economic development. Without this, the capitalists can no longer exist in the conditions of state-monopoly capitalism.

The People's Republic of China, based on state ownership of land and other natural resources, managing state and collective enterprises, using economic and political influence on private enterprises and organizations, regulating and directing their activities, carries out systematic management of the economic and, in general, social development of the country. For many decades, the Chinese economy has been moving without economic crises, having increased industrial production since 1990 by almost 20 times.[12]

At the same time, the development of China, being on the whole planned, contains a moment of spontaneity, caused by the spontaneity of movement in non-communist sectors of the economy. This spontaneity is the opposite of China's movement towards communism. The struggle against spontaneity is a struggle against capitalism, and as this struggle succeeds, the Chinese economy and society as a whole will grow stronger as the basis and leader of the world communist system.

The planned development of a socialist country corresponds to the essence of communism, and in this sense is valid when it is aimed at realizing the goal of a communist society - complete prosperity and free, all-round development of all members of society.

In "Remarks on the second draft of the Plekhanov Program" V.I. Lenin wrote: "The end of the paragraph is also unsuccessful:" the planned organization of the social production process to meet the needs of both the entire society and its individual members. " This is not enough, Lenin emphasizes. Perhaps the trusts will also provide such an organization. It would be more definite to say "at the expense of the *whole* of society" (because this includes planning and indicates the direction of planning), and not only to meet the needs of members, but to ensure *full well-be-*

11 Charter of the Communist Party of China…

12 I.G. Kalabekov. Russia, China and the USA in numbers. URL: http://chius.ru (appeal date 10.05.2021)

ing and free *all-round* development of *a l l* members of society"[13]. As a result, V.I. Lenin made sure that the Party Program approved by the Second Congress of the RSDLP reads: "By replacing private ownership of the means of production and circulation with public property and introducing a planned organization of the social-productive process to ensure the welfare and all-round development of all members of society, the social revolution of the proletariat will destroy the division of society into classes and thereby liberate all oppressed humanity"http://www.rpw.ru/public/antirev.html - 39[14].

The development of the planned movement of the PRC corresponds to the essence of communism and is a huge advantage in relation to capitalist countries, since it creates opportunities for directing the efforts of hundreds of millions of people and material resources to achieve priority goals. An obvious example of a planned movement is the creation in about 10 years of the world's largest network of high-speed railways, and the construction and operation of this network is not aimed at making a profit, but is solving the problem of social development.[15]

The commitment of the Chinese Communist Party to the welfare of the country's residents is also an advantage of economic development. In the 14th Five-Year Plan, China will further narrow the income gap and improve its social security system. By 2022, China is expected to enter the World Bank's "high-income country" level.[16] It is obvious that the solution of such a problem, given the size of China's population, will lead to an increase in the gap between the PRC's economy and the United States.

Equally important is the fact that an increase in workers' wages necessitates an outstripping growth in labor productivity. Otherwise, there will be a drop in production efficiency, including a decrease in profitability. Consequently, it is necessary to introduce more productive technologies, accelerate equipment upgrades and thorough training of personnel.

The increase in real incomes of the population develops domestic consumption, which is becoming a powerful factor in the development of production and weakening the dependence of the Chinese economy on the deterioration of the conditions for exporting Chinese products due to the US policy of "containing" the PRC.

13 V.I. Lenin. Full coll. op., V. 6, P. 232.

14 The program of the Russian Social Democratic Labor Party, adopted at the II Congress of the Party. Second Congress of the RSDLP. July–August 1903. Protocols. Moscow. 1959. P. 419.

15 China's high-speed trains continue to move forward, overtaking the entire world.

China Radio International. URL: http://russian.cri.cn/life/fashion/396/20190927/359114.html (appeal date 01 June 2021)

16 The long-awaited 14th five-year plan may focus on double reclamation and independence in technology research. PRC today. China today. URL: https://prc.today/dolgozhdannyj-14-j-pyatiletnij-plan-mozhet-sosredotochitsya-na-dvojnom-obrashhenii-i-nezavisimosti-tehnologicheskih-issledovanij/ (appeal date 02.08.2021)

The most powerful factor in the development of the People's Republic of China can and should be the reduction of the duration of the work shift to 7, and then to 6 hours. The process of reducing working hours corresponds to the goal of a communist society - the all-round development of all members of society and is a powerful stimulus for scientific and technological progress, since it necessitates replacing the falling volumes of living labor with materialized ones, that is, introducing new, more productive technologies.

The CPC Charter states that China is and will remain for a long time at the initial stage of socialism; this inevitable historical stage in the implementation of socialist modernization in China, which at one time experienced economic and cultural backwardness, will take at least a hundred years.[17] That is, the Chinese communists program to complete the transition period to socialism by 2049, which is quite reasonable, given the enormity of the tasks of creating socialism in a large country in which there are one billion four hundred million people and which until recently was a backward and dependent country from a historical point of view. The CPC Charter says "by the centenary of the PRC, completely transform China into a modernized socialist power."[18] The Chairman of the People's Republic of China, General Secretary of the Central Committee of the Chinese Communist Party, in a speech at the ceremonial meeting on the occasion of the centenary of the founding of the Chinese Communist Party on July 1, 2021, said: "We, filled with unprecedented enthusiasm, are moving forward towards the goal of fully building a modernized socialist power, scheduled for the centenary of the PRC".[19]

The capitalist world system, as the opposite of the contradiction between communism and capitalism, also has its own negation within itself - the social nature of production, the development of which systematically undermines the private form of appropriation, which is expressed in the development of the general crisis of capitalism. The growth rates of the US and EU economies lag significantly behind the growth rates of China and Vietnam. The most developed capitalist countries are unable to overcome the demographic crisis, crises of overproduction that cause financial crises, crises of public debt. Despite the fact that a significant part of the working class of the most developed capitalist countries is bribed by the bourgeoisie due to the inflow of resources from the less developed countries due to the unequal exchange, direct withdrawal of profits, the receipt of emission income from the issue of dollars and euros, in the USA and the EU there is an exacerbation of the class struggle, as in the form of collective actions of workers, and in converted forms: in the form of a struggle against racial, national and confessional discrimination, the struggle for the environment and other similar forms.

17 See: Charter of the Chinese Communist Party…

18 Ibid.

19 Xi Jinping. Speech at the Anniversary Celebration of the Chinese Communist Party, July 1, 2021. URL: http://russian.news.cn/2021-07/01/c_1310038413.htm (appeal date 30.07.2021).

The transfer of material production from the USA and the EU to other countries, on the one hand, makes it possible to counteract the tendency of the rate of profit to decrease, on the other hand, it weakens the material basis of financial capital in the USA and the EU, the basis of healthy economic growth in these countries, while simultaneously strengthening the material basis other countries. Of course, to a certain extent, the profits received by the US and EU bourgeoisie from other countries support their economies, but at the same time increase the dependence of the US and EU on supplies from other countries.

The USA and the EU, carrying out the export of capital to China, receive a huge amount of profits from the located enterprises, while at the same time contributing to the technological and economic development of China. As China assimilates new technologies and creates its own competitive technologies, the profits of the US and EU monopolies from their enterprises in China will decrease and these monopolies will have to place their capital in other countries, in which the US and EU monopolies inevitably face competition. corporations from the PRC. Consequently, this source of profits for the financial capital of the USA and the EU will decrease.

With the weakening of the positions of the financial capital of the USA and the EU, their desire to restore and strengthen these positions inevitably grows, which leads to an increase in the aggressiveness of the USA as an imperialist center. The customs "wars" against the PRC (accompanied by the increased activity of the US fleet near the PRC and important sea lanes), which were provoked and organized by the United States under the leadership of US President Trump, are only the first attack of aggressiveness towards the PRC. The inevitable aggravation of the contradiction between the center of imperialism - the United States, and the leader of the world communist system - the PRC, as an expression and manifestation of the aggravation of the contradiction between capitalism and communism in the modern world.

In conditions in which the imperialist center is not fully capable of ensuring its dominance in any region or loses control over some region of the world or a separate country, and, especially, when the influence of the communist countries increases, the imperialist center resorts to the implementation of fascism in the external politics. This was the case in Chile, other Latin American countries, Korea, Vietnam, Laos, Cambodia, Yugoslavia, Iraq and even Russia in the fall of 1993. US fascism in foreign policy was implemented in Ukraine, the devastating consequences of which have lasted for more than 7 years. Through the efforts of modern bourgeois-democratic Russia and the people of Syria, it was possible to resist US fascism in foreign policy in Syria.

The strengthening of the communist China and Vietnam, the preservation of the independence and independence of the DPRK, the independent foreign policy

of Russia determines the presence of prerequisites for the United States of America to conduct fascism in foreign policy as the last effective means of imperialism in its struggle to ensure its influence, which is necessary to maximize the income of finance capital. These prerequisites and conditions can turn into real US fascism in foreign policy towards communist China, and the DPRK, and Vietnam, and bourgeois Russia in the event of an economic and military weakening of these countries and the strengthening of the "fifth column" in them, then there are political forces acting in the interests of the US finance capital.

If in the 30s - 40s of the 20th century, the USSR could not, due to the absence of the world communist system and strong allies, prevent the creation of fascist and the conduct of fascism in foreign policy by them, which grew up in the world war, nowadays communist China, Vietnam, Korea, Laos, Cuba, with the leading role of the PRC as the largest economy in the world and one of the three most powerful military powers in the world, are able to prevent the implementation of US fascism in foreign policy towards itself. The military alliance of the People's Republic of China with the largest nuclear power - Russia, is capable of ensuring not only the preservation of the sovereignty of the PRC and Russia, but also the prevention of the implementation of US fascism in foreign policy in countries that have entered into appropriate contractual relations with the PRC and Russia, including within the framework of Shanghai Cooperation Organization.

Conclusion: The world-historical victory of communism in the process of resolving the contradiction between communism and capitalism as a contradiction of the new, progressive, and the old, reactionary is inevitable. At this stage of human development, the fate of the world capitalist system depends on the development of the world communist system, while the preservation and development of the world communist system depends not so much on capitalism, but on how positively the communist countries resolve their internal contradictions, especially how much the Chinese People's The republic resolves the contradiction between the communist and non-communist sectors of the economy, how much the advantages of the planned development of the national economy are used, how much the goal of a communist society is realized - the all-round development of all members of society. http://russian.news.cn/2021-07/01/c_1310038413.htm

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区域经济农工业部门的可持续发展
SUSTAINABLE DEVELOPMENT OF THE AGRO-INDUSTRIAL SECTOR OF THE REGIONAL ECONOMY

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哈萨克斯坦传统上是一个农业工业国家，原始土地的开发使其成为全联盟劳动分工中最大的粮食和肉类生产国之一。在哈萨克斯坦共和国独立期间，突厥斯坦地区的农业部门取得了显著成果：基于市场关系的生产不断增加，生产力提高，生产力得到更新，固定资产和工业基础设施，实现了自给自足。在基本粮食充足的情况下，谷物、油料作物、渔业产品出口大幅增加。农业是哈萨克斯坦经济的重要部门之一。农业部门的发展水平一直并将继续成为哈萨克斯坦社会经济和社会政治稳定的决定性因素。过去十年，为了振兴农村经济，国家和行业采取了一系列措施，以雄厚的财力支持农业和农村地区的发展和支持。

农业作为共和国经济发展的重点领域之一，潜力巨大，储量最大。多样化的气候条件使得这种结构的经济多样化成为可能，这使得农业工业综合体 （AIC） 成为最大的跨行业综合体之一，结合了旨在生产和加工的多个经济部门农业原材料，并从中获取产品，并提供给最终消费者。这是该国

经济的一个分支，包括农业部门中各种农作物和工业的组合。反过来，它们又与农业生产密切相关，从事农产品的运输、储存、加工，供应给消费者，为农业提供必要的设备、化学品和肥料，旨在为农业生产服务。

关键词：哈萨克斯坦区域经济，突厥斯坦地区农业工业综合体，可持续发展，农业生产和食品工业，食品进出口。

Abstract. *Kazakhstan has traditionally been an agro-industrial country, and the development of virgin lands has turned it into one of the largest producers of grain and meat in the all-Union division of labor. During the period of independence of the Republic of Kazakhstan agricultural sector in the Turkestan region achieved significant results: there is a constant increase of production based on market relations, increases productivity, and productivity is updated fixed assets and infrastructure of the industry, achieved self-sufficiency in basic foods, there was a significant increase of the export of cereals, oil crops, fishery products. Agriculture is one of the key sectors of Kazakhstan's economy. The level of development of the agricultural sector has always been and continues to be a determining factor in the economic and socio – political stability of Kazakhstan's society. In order to boost the rural economy over the past ten years, state and industry programs have been adopted to develop and support agriculture and rural areas, supported by solid financial resources.*

As one of the priority areas of the Republic's economy development, agriculture has a huge potential and largest reserve. The diverse climatic conditions made it possible to introduce diversification in the economy of this structure, which allowed the agro-industrial complex (AIC) to become one of the largest inter-industry complexes, combining several sectors of the economy aimed at the production and processing of agricultural raw materials and obtaining products from it that are brought to the end consumer. This is a branch of the country's economy that includes a combination of a wide range of varieties of agricultural crops and industries in the agricultural sector. In turn, they are closely related to agricultural production, which carry out transportation, storage, processing of agricultural products, supply them to consumers, provide agriculture with the necessary equipment, chemicals and fertilizers, and are aimed at servicing agricultural production.

Keywords: *regional economy of Kazakhstan, agro-industrial complex of the Turkestan region, sustainable development, agricultural production and food industry, food export and import.*

Introduction

In order to improve the sustainability of the agro-industrial complex, the State program for the development of agricultural business in the Republic of Kazakhstan for 2016-2020 was adopted. The goals of the tasks of the State program are

to increase the efficiency of agricultural production and marketing of agricultural products and food products, as well as to increase their competitiveness, to ensure the domestic market of the country with domestic agricultural products and food in the necessary volumes and proper quality based on the formation of market mechanisms for managing and developing agricultural business [1].

Along with this, the document specifies the main directions and measures to strengthen national food security:

1. Production of agricultural products, raw materials and food in all categories of farms. Here, efforts should concentrate on improving the structure of acreage; maintaining and improving soil fertility; innovative development of the material and technical base of organizations; introduction of resource-saving technologies and improving product quality;

2. In order to increase the economic availability of products for the population, it is necessary to develop effective mechanisms for motivating and stimulating labor and develop a system of internal food assistance to the population.

At the present stage, the strategy for sustainable development in the Turkestan region, the Republic of Kazakhstan provides for optimizing the use of state support and regulation in the agricultural sector, establishing clear rules for subsidizing agricultural production that comply with the rules of the EAEU and WTO standards, as well as more active use of "green basket» measures. For Kazakhstan, the practical implementation of this approach is due to the activation of the negotiation process for the Republic's accession to the WTO, the functioning and expansion of the EU, as well as the WTO membership of all States.

In the field of trade policy, it is planned to create integrated food systems focused on the production and supply of high-quality food to the population ("healthy nutrition", "functional nutrition", "baby food" programs, etc.), and joint food companies that will integrate competitive specialized production (raw materials, storage, food industry and marketing), scientific and innovative potential (innovative technologies and developments) and promote products to the market of the EAEU and third countries [2-3].

Research methods and materials

The methodological basis of the research is the methods of analysis and generalization of statistical and analytical data on the use of land resources, as well as works of domestic and foreign zones on sustainable land use of land resources of the Republic of Kazakhstan for the study of 15 years [4, 5, 9, 10, 14, 15].

Results and discussion

In recent years, considerable attention has been paid in the Republic to the issues of improving the sustainable development of the agro-industrial complex by improving environmental and economic activities, preserving the potential of natural resources.

By the Decree of the President of the Republic of Kazakhstan dated October

14, 2006 №216, the concept of the transition of the Republic of Kazakhstan to sustainable development for 2017-2024 was adopted [5-7], where it was noted that the most important conditions for increasing the production of agricultural products are polynya and the correct use of land. In this regard, it is very important to analyze the state of land resources and point out ways to improve their efficient rational use.

Analysis of land registration materials for the Turkestan region shows that in recent years, the change in the area of agricultural land has occurred both in time and space unevenly.

In the conditions of the Turkestan region, there are all objective natural and economic conditions in order not only to return the drunken arable land to economic circulation, and to increase them the largest amount of agricultural products.

In farms with sustainable irrigated land use, agriculture is the main source of stable agricultural products regardless of weather conditions, only the heterogeneity of the soil cover is significantly reduced - the productivity of agricultural land. However, the low level of technical condition of irrigation systems, poor equipping them with water-distribution structures, insufficient use of water-saving technologies in paleo make the state and productivity of irrigated lands dependent on the water regime and lead to a reduction in the area of irrigated lands.

Therefore, the deficit of water regimes and the lack of capital investments for the development of irrigated agriculture hinder the possibility of expanding new areas of irrigated land. As a result, over the years of reforming agriculture, the structure of crops worsened, no agro-technical measures were taken, which led to a decrease in the productivity of irrigated lands. Valuable irrigated lands were often used for monocultures, all scientifically substantiated turns were not maintained, the necessary amount of fertilizers was not provided, and water-saving technologies were not followed.

However, in recent years, in some farms, the definition of work to increase the productivity of the used lands has been carried out [6, 8, 5]. But nevertheless aul, there is not enough solution for the level.

The effective use of soil resources 1 seed farming requires fundamental knowledge of the nature of soil, soil-forming processes, based on the study of genesis, geographical soil cover criterion of the territory.

At the present time, these tasks were of even greater relevance. This is due to the new land relations in the Republic and the need to assess the quality of land, often lease or property.

According to the reporting data of the Committee of the Republic of Kazakhstan on land management [5, 7], the process of degradation tends to increase. The processes of desertification of irrigated soils in the deltas of the Syrdarya river are

progressing. In the northern part of the region (Suzak district), chemical, radioactive contamination and technogenic destruction of the soil cover are observed in the places of mining and processing of minerals.

In order to suspend the above negatives on the territory of the Republic, a number of programs were developed by the Decree of the Government of the Republic, within the framework of which the following measures were envisaged [5, 6, 11-13]:

- Inventory and assessment of degraded lands;
- Informing and ensuring the participation of all segments of the population in the process of combating desertification;
- Development and implementation of pilot projects for land restoration;
- Development and implementation of regulatory requirements and economic mechanisms for sustainable land use, ensuring the preservation and restoration of the resource base;
- Ensuring the consolidated implementation of international environmental conventions;
- Reducing the scale and preventing the development of desertification processes and the negative impact of droughts.

All these measures related to increasing the productivity of agricultural lands, the introduction of economic mechanisms to combat degradation were supposed to reduce the scale of the desertification process in the Republic. So, as agricultural lands have a special right to regime and should be protected, aimed at limiting the withdrawal of these lands, preserving and increasing their fertility.

The Dynamics of agricultural production in all categories in the Turkestan region, Republic of Kazakhstan is shown in Figure 1, including livestock products (Figure 2) and crop production (Figure 3), which allow balancing supply and demand for the most important types of products [4].

The special significance of the grain market among all strategically important markets of agricultural raw materials is explained by its exceptional role in ensuring food security in the Turkestan region, the Republic of Kazakhstan. With further intensification of grain farming, partial expansion of acreage and improvement of the structure of crops, the production potential is about 15 million tons of grain.

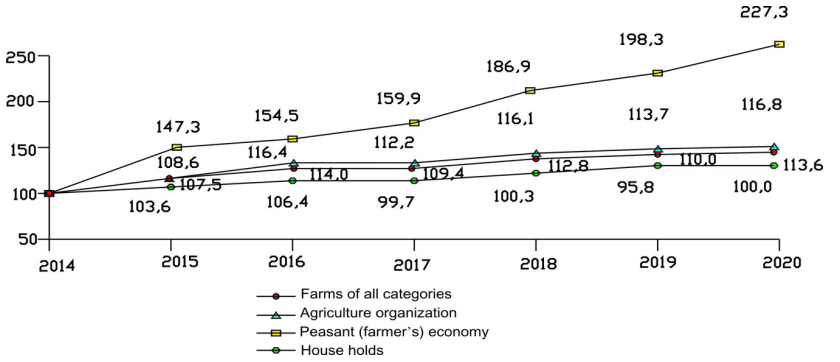

Figure 1. *Dynamics of agricultural production in all categories in the Turkestan region, the Republic of Kazakhstan, in % to 2014*

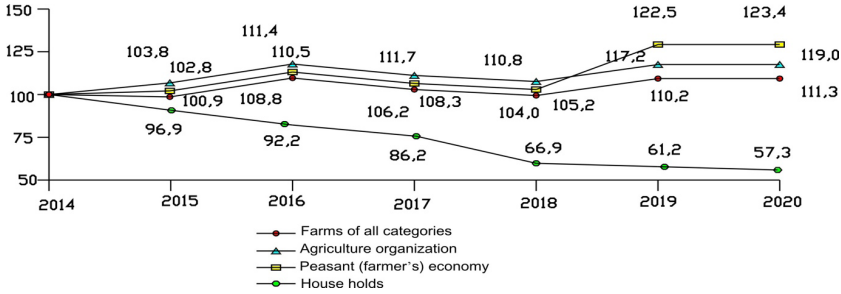

Figure 2. *Dynamics of livestock production in all categories in the Turkestan region, the Republic of Kazakhstan, in % to 2014*

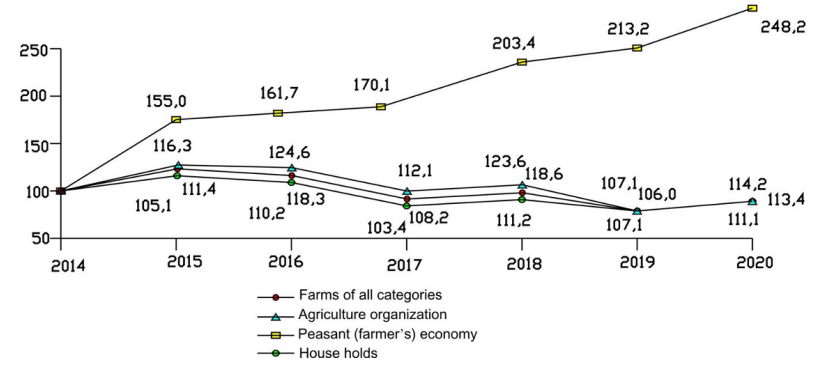

Figure 3. *Dynamics of crop production in all categories in the Turkestan region, the Republic of Kazakhstan, in % to 2014*

Grain crops are cultivated in all regions in the Turkestan region, the Republic of Kazakhstan and occupy a Central place in the industry structure of crop production. In 2020, cereals occupied more than 41% of arable land, but in comparison with 2014, the share of grain crops in the total sown area decreased by 4.5% (Figure 4).

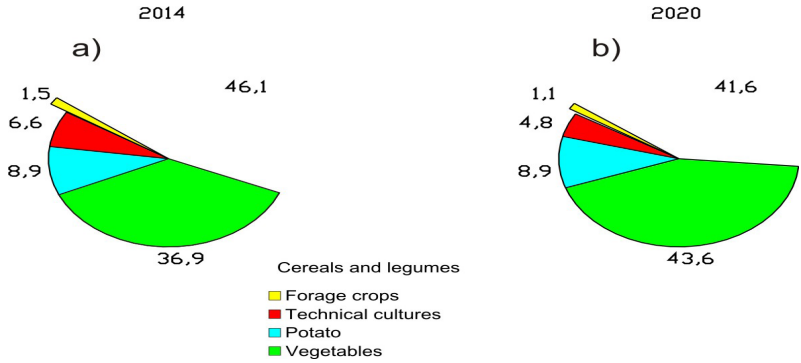

Figure 4. *Structure of crops of the main agricultural crops in the Turkestan region, the Republic of Kazakhstan: a) 2014; b) 2020*

The peculiarity of the domestic grain market is determined by the natural and economic conditions of the country, the production of the main part of grain in multi-industry farms with developed animal husbandry. Therefore, almost half of the grain crop, with the exception of seeds, is used for livestock feed and is not involved in the sphere of commodity circulation.

The main channel for grain sales is public procurement – more than 60%. The basis that forms the domestic grain market and ensures its functioning is the own production of these products.

The dynamics of the gross harvest and yield of grain and legumes in the Turkestan region, the Republic of Kazakhstan is shown in Figure 5.

The data shown in figure 6 show that the gross harvest of grain and leguminous crops in the Turkestan region, the Republic of Kazakhstan in 2020 significantly decreased in relation to 2018-2019, but in comparison with 2019 increased by 529 thousand tons (or 7%). The same dynamics can be seen in the yield of grain crops: in 2020, it increased by 1.7 C / ha (or 5%).

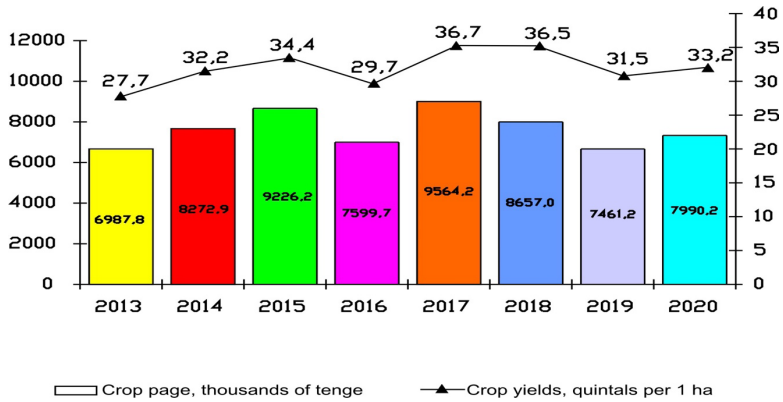

Figure 5. *Dynamics of gross harvest and yield of grain and leguminous crops in the Turkestan region, the Republic of Kazakhstan*

The natural conditions in the Turkestan region, the Republic of Kazakhstan do not allow forming the necessary grain resources by types and directions of its use in accordance with the need. Therefore, in order to ensure the balance of the domestic market, it is necessary to develop grain farming based on the intensification of grain production and processing and to carry out import deliveries in order to meet the demand for grain in the assortment.

The dynamics of agricultural production per capita is shown in Table 1. Analysis of the data shown in Table 1 shows that in the Turkestan region, the Republic of Kazakhstan in 2020 compared to 2019, in General, agricultural production per capita increased by 14.5 %. During this period, the production of the main types of agricultural products per capita increased: sugar beet – by 29.3%, vegetables – by 11.8%, livestock and poultry in slaughter weight-by 1.6%, milk-by 1.2 %.

The processing industry is one of the most promising and developing industries in the Turkestan region, the Republic of Kazakhstan. The role of the processing industry in the development of the economy of the Republic of Kazakhstan in the Turkestan region is that it provides a rational nutrition of the population and allows efficient use of agricultural raw materials.

In 2020, the largest share in the structure of food production is occupied by the production of dairy products - 27.4 %, meat and meat products - 24.2 %, production of ready-made animal feed - 12.8 %, production of other food products (production of bread and flour confectionery, sugar, pasta, etc.) - 14.2 %, production of beverages – 8.3 %, production of flour and cereal products, starches and starch products – 3%. A small share in the structure is occupied by the production of tobacco products – 2 %, the production of vegetable and animal oils and fats-1.9 %, processing and canning of fruits and vegetables – 2 %.

Table 1 - *Agricultural production per capita in the Turkestan region, the Republic of Kazakhstan*

	2018	2019	2020	from 2019 to 2018, %	from 2020 to 2019, %
Production of agricultural products per capita, RUB	1361	1425	1632	104.7	114.5
Production of main types of agricultural products per capita, kg:					
- seed	1009	912	785	90.4	86.1
- potato	663	632	630	95.3	99.7
- sugar beet	507	348	450	68.6	129.3
- vegetables	183	178	199	97.3	111.8
- livestock and poultry (in slaughter weight)	113	121	123	107.1	101.6
- milk	707	743	752	105.1	101.2
- eggs, pieces	407	395	386	97.0	97.7

The dynamics of food production in the Turkestan region, the Republic of Kazakhstan for 2019-2020 is shown in Table 2.

The data in Table 2 show that in the Turkestan region, the Republic of Kazakhstan in 2020 compared to 2014 increased the rate of growth of production of main kinds of food products in bulk: meat and offal food – 42.2 %, beef and veal – 12.4 %, pork – by 13.1 %, poultry – by 76.9 %, dairy products – by 31.9 %, butter – by 19.2 %, cheese – by 30.8 %, flour – by 33.3 %, pasta – 69.2 %, sugar – 3.8% and beer – by 8.3 %.

Table 2 - *Dynamics of food production in the Turkestan region, the Republic of Kazakhstan*

	2014	2019	2020	Growth rate, %	
				from 2020 to 2019	from 2020 to 2014
Meat and food by-products, thousand tenge	746	1021	1061	103.9	142.2
Beef and veal, thousand tenge	234	257	263	102.3	112.4
Pork, thousand tenge	236	248	267	107.7	113.1
Bird, thousand tenge	255	439	451	102.7	176.9
Sausage goods, thousand tenge	317	266	276	103.8	87.1
Canned fruit, thousand tenge	466*	156	142	91.0	30.5
Vegetable oils, thousand tenge	161	262	151	57.6	93.8
Margarine and similar edible fats, thousand tenge	19,5	21,7	17,3	79.7	88.7
Whole milk products (in terms of milk), thousand tenge	1494	1963	1971	100.4	131.9
Butter and milk pastes, thousand tenge	99	114	118	103.5	119.2

Canned milk, thousand tenge	114	92	93	11.1	81.6
Cheeses (other than processed cheese), thousand tenge	146	181	191	105.5	130.8
Flour from grain, vegetable and other vegetable crops, mixtures thereof, million tenge	0,6	0,6	0,8	133.3	133.3
Pasta, thousand tenge	26	39	44	112.8	169.2
Granulated sugar, thousand tenge	816	654	847	129.5	103.8
Beer, million tenge	39,9	40,1	43,2	107.7	108.3

The dynamics of consumption of basic food products in the Turkestan region, the Republic of Kazakhstan per capita is shown in Table 3.

Table 3 – *Dynamics of consumption of basic food products in the Turkestan region, the Republic of Kazakhstan, kg per capita per yea*r

	Standard	2018	2019	2020	Deviation from the standard, +, -			Growth rate, %
					2018	2019	2020	
Meat and meat products in terms of meat	80	88	89	91	+8	+9	+11	103.4
Milk and dairy products in terms of milk	393	252	254	251	-141	-139	-141	99.6
Eggs, pieces	294	288	280	269	-6	-14	-25	93.4
Fish and fish products	18,2	15,6	13,2	12,3	-2,6	-5	-5,9	78.8
Sugar	33	42,3	42,3	38,1	+9,3	+9,3	+5,1	90.1
Vegetable oil	13,2	18,1	18,5	18,3	+4,9	+5,3	+5,1	101.1
Vegetable and melon crops	124	145	145	146	+21	+21	+22	100.7
Fruits and berries	78	76	79	90	-2	+1	+12	118.4
Potato	170	177	170	171	+7	-	+1	96.6
Bread products (bread and pasta in terms of flour, cereals, flour)	105	85	86	82	-20	-19	-23	96.5

The data shown in table 3 show that in the Turkestan region, the Republic of Kazakhstan in 2020 compared to 2018, the growth rate of consumption of basic food products increased: meat and meat products – by 3.4%, vegetable oil – by 1.1%, vegetable and melon crops – by 0.7%, fruits and berries – by 18.4 %. During the study period, the consumption of milk and dairy products decreased by 0.4%, eggs – by 6.6%, fish and fish products – by 0.7%, fruits and berries – by 21.2%, sugar – by 9.9%, potatoes – by 3.4% and bread products – by 3.5 %.

It should be noted that at this stage, the Republic of Kazakhstan of the Turkestan region meets the domestic market demand for milk by 230%, meat by 136%, eggs by 124%, and sugar by 160%. Despite the fact that the level of consumption of basic food products is not limited by the resources of the domestic market, the structure of the diet remains unbalanced. The diet retains an excess of

high-calorie foods, such as sugar and vegetable oil, with a lack of consumption of milk, fish, and bread products. In General, the volume and dynamics of agricultural production correspond to the optimistic level of food security and allow increasing the export of agri-food products. At this stage, food exports account for more than 8 % of Kazakhstan's GDP and more than 15 % of the country's total exports. The main export agri-food products are products of animal origin. The share of exports of dairy products in the production volume is more than 55 %, meat products-about 40 %, white sugar-56.5 %.

Kazakhstan's foreign economic activity in the food market is shown in Table 4.

Table 4 - *Foreign economic activity in the Turkestan region, the Republic of Kazakhstan, on the market of food products, million US dollars*

	2018	**2019**	**2020**	**Growth rate, from 2020 to 2019, %**
Foreign trade in agricultural and food products	10455.4	8901.4	8307.9	79.4
Including				
Export	5606.4	4453.0	4231.6	75.5
Import	4849.0	4448.4	4076.3	84.1
Balance	757.4	4.6	155.3	20.5

The data shown in Table 4 show that in 2020, compared to 2018, the growth rate of foreign trade in agricultural products and food products decreased by 20.6%. during this period, exports of agricultural products and food products decreased by 24.5%, and imports – by 15.95%.

Conclusions. The conducted research allowed us to establish that the main directions of improving the efficiency and sustainable development of the agro-industrial complex in the Turkestan region, the Republic of Kazakhstan are:

- Increasing the productivity of agricultural land by laying the area of irrigated fields.
- Introduction of technological and economic mechanisms to combat agricultural land degradation.
- Production of agricultural products, raw materials and food in all categories of farms and organizations.
- Increasing the economic availability of food for all population groups.
- Increase the competitiveness of production and sales of products.
- Development of scientific and innovative potential for ensuring national food security.

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UDC 343

关于俄罗斯腐败犯罪的现状：COVID-19 传播背景下腐败对经济的影响、统计和分析

ON THE CURRENT STATE OF CORRUPTION CRIME IN RUSSIA: IMPACT ON THE ECONOMY, STATISTICS AND ANALYSIS OF CORRUPTION AGAINST THE BACKGROUND OF THE SPREAD OF COVID-19

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作者对俄罗斯的腐败犯罪状况以及腐败作为一种负面社会现象对国家经济状况和社会领域的影响进行了全面分析，包括在新型冠状病毒感染 COVID-19 传播期间.本文分析了俄罗斯总检察长办公室、俄罗斯调查委员会、俄罗斯内政部、俄罗斯透明国际组织和联邦国家统计局提供的当前腐败领域犯罪的统计指标。作者的观点基于政府机构和服务的官方代表提供的数据。该研究的主要目标是根据官方来源的可靠数据和对 2020-2021 年现实中腐败存在的综合分析，展示俄罗斯腐败犯罪的现状。在研究过程中，研究了反腐败领域的科学文献、规范性文件和司法实践，运用了一般科学和私人科学方法，如理论分析、系统化、构建逻辑结论、比较方法等。在工作的最后部分，作者提出了一些改进俄罗斯反腐败政策的建议，并根据所开展工作的结果得出结论。

关键词：腐败、腐败相关犯罪、统计、分析、指标、经济学。

Abstract. *The author has carried out a comprehensive analysis of the state of corruption crime in Russia and the impact of corruption as a negative social*

phenomenon on the economic state of the state and the social sphere, including during the spread of the new coronavirus infection COVID-19. The article analyzes the current statistical indicators of crime in the field of corruption, presented by the General Prosecutor's Office of Russia, the Investigative Committee of Russia, the Ministry of Internal Affairs of Russia, Transparency International Russia, and the Federal State Statistics Service. The author's point of view is based on data provided by official representatives of government agencies and services. The main goal of the study is to demonstrate the current state of corruption crime in Russia based on reliable data from official sources and a comprehensive analysis of the existence of corruption in the realities of 2020-2021. In the course of the study, scientific literature, regulatory documents and judicial practice in the field of combating corruption were studied, general scientific and private scientific methods were used, such as theoretical analysis, systematization, building logical conclusions, and the comparative method. In the final part of the work, the author gives some recommendations for improving the anti-corruption policy in Russia and formulates conclusions based on the results of the work carried out.

Keywords: *corruption, corruption-related crimes, statistics, analytics, indicators, economics.*

Corruption as a negative social phenomenon affects all spheres of society and is actively adapting to all processes taking place in Russia. There is no period in the history of our state when statistical indicators in the field of corruption crime analytics have been declining rapidly. On the contrary, corruption crimes are qualitatively changing, transforming, acquiring new forms so that the latency of this category of crimes is striking in its scale, and some detected corruption crimes, especially in the field of activities of state and municipal employees, cannot but cause concern due to the huge amounts of bribes, "kickbacks", etc. Unfortunately, it should be stated that corruption, "eating up" the Russian economy from the inside, causing colossal material harm, remains an integral part of the life of Russian society and continues to "adapt" to modern realities.

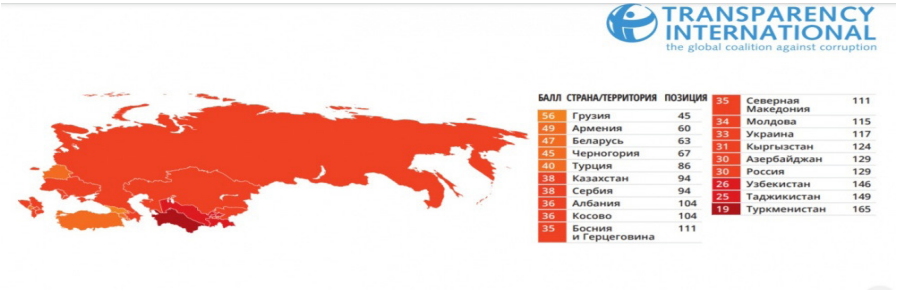
The above confirms the relevance of research related to the peculiarities of preventing, disclosing and investigating corruption-related crimes, and the priority of the listed areas of work of law enforcement agencies, including the Investigative Committee of the Russian Federation, substantiates the practical importance of scientific and methodological developments on combating corruption. In addition, the President of the Russian Federation V.V. Putin at an expanded meeting of the collegium of the Ministry of Internal Affairs of Russia on March 3, 2021, once again noted that further decriminalization of the economy and combating corruption remains one of the highest priority tasks. "It is necessary to more actively identify and suppress the facts of embezzlement of budget funds, including those

allocated for the fight against coronavirus infection, to react harshly to attempts to create shadow schemes and illegal withdrawal of capital abroad", the President of the Russian Federation summed up part of his speech on combating corruption [1].

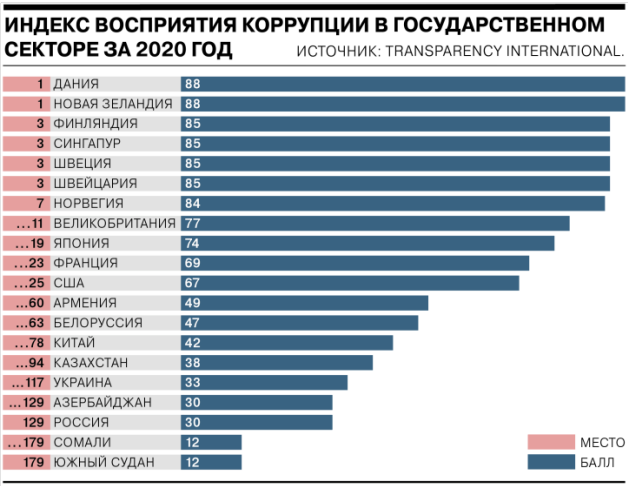
Analyzing the current state of anti-corruption policy, we consider it appropriate to provide some statistical indicators on corruption in Russia. Thus, according to the General Prosecutor's Office of the Russian Federation, corruption continues to grow (+ 1.6%); in 2019, 30,991 corruption crimes were registered. Every year, more corruption-related crimes committed on a large or especially large scale or causing especially large damage are registered (in 2019 - 5408, in 2018 - 5365, in 2017 - 5136). The situation is similar with bribes, mediation in bribery [2]. The total damage from corruption is 55.1 billion rubles, which is 8.8% of the damage caused by all crimes. According to the data of the Prosecutor's Office of the Russian Federation dated February 2, 2021, in 2020 the level of corruption crimes increased by 0.5% [3]. However, the structure of corruption has changed significantly, including due to the spread of coronavirus infection and the remote work format of citizens - in 2020 the number of registered frauds more than doubled (38.6%), in 2019 - 17.2%. And the damage to the state amounted to 58.4 billion rubles (11.4% of the amount of damage caused by all types of crimes) [4].

Interesting is the study of the International Anti-Corruption Movement Transparency International Russia, which annually study in detail corruption phenomena and the state of corruption crime in every country in the world [5].

Some of the results of their work at the end of 2020 are shown in the infographic.



In 2020, Russia fell three lines in the ranking, gaining 30 points and taking 129th place out of 180 (2019 - 126th place out of 180). Note: Countries are ranked on a scale from 0 to 100, with 0 representing the highest perceived corruption level and 100 - the lowest.



The indicator of Russia testifies to a high level of perception of corruption in our country. 30 points equates Russia to Azerbaijan, Gabon, Mali, Malawi, Lebanon, Mexico. Russia has occupied low positions in the rating for many years, which indicates a low level of anti-corruption and the lack of systematic work in the field of anti-corruption policy. Although, it is assumed that such work began in 2008 with the adoption of the Federal Law "On Combating Corruption" [6], and intensified in 2010 with the publication of the National Anti-Corruption Strategy [7].

At the same time, it is fair to say that the reason for the negative dynamics of corruption in Russia and many other countries was the situation associated with COVID-19. So, already in January-July 2020, not 371, but 811 billion rubles (+ 119%) were invested in healthcare [8]. At the same time, a budget of 320.7 billion was planned in 2020, which is twice as much as in 2019 (160 billion). However, in the first half of 2020, regional spending in the healthcare sector exceeded 700 billion rubles.

Huge additional appropriations from the budget could not but affect the state of crime, including corruption. According to the Prosecutor General's Office of the Russian Federation, corruption crimes in the healthcare sector in 2020 amounted to 68.4 percent in relation to other national projects [9]. These figures testify not only to lack of control, but also to low morality and social responsibility of persons who commit corruption crimes and profit from the health of citizens. Thus, at the same time, enormous damage was caused to the economy and the social sphere.

This fact cannot but cause concern on the part of the state and law enforcement agencies. Especially considering that the volume of this study will not be enough to list at least a small part of corruption crimes committed by state, municipal officials related to healthcare and social sphere, officials holding senior positions in the healthcare system, doctors and medical personnel. So, in the summer of 2020, in Vladimir Oblast, the chief physician of the regional clinical hospital received a bribe of 1.5 million rubles for violations during the bidding for the national project "Healthcare" (the object of purchase is a CT scanner), in December 2020, the chief physician of Krai clinical hospital of Zabaikalsky Krai was convicted of a bribe in the form of kickbacks for ensuring the smooth conclusion of contracts for the supply of medical equipment (according to the RF IC, the total amount of the bribe was 13 million rubles) and other high-profile corruption crimes [10].

Returning to the general analysis of corruption crime in Russia and its impact on the economy, let us turn to statistics again. In 2020, the Investigative Committee of the Russian Federation opened 15,217 criminal cases on corruption-related crimes, which is 4% more than in 2019 [11]. According to the Ministry of Internal Affairs of Russia, 23576 crimes of corruption were detected in 2020, which is almost a quarter of the total number of crimes of an economic nature and 0.6% more than in the previous reporting year [12].

Considering the above figures, it is safe to assume that, despite the years of implementation of measures of the state's anti-corruption policy, it was not possible to achieve a decrease in the number of corruption-related crimes. According to the Accounting Board of the Russian Federation, the damage from corruption in Russia is measured in trillions of rubles. Judging by the criminal cases, about 2-3 trillion rubles are being stolen from the budget, - noted Aleksey Kudrin [13]. Based on data from open sources, including arrests of civil servants with seizures of

amounts in billions of rubles (Zakharchenko - 8.5 billion, Arashukov - 30 billion, Lazarev - 3.2 billion, etc.), and, understanding the latency of corruption crime, it can be assumed that the amount of real damage to the country's economy should be estimated at 6-8 trillion rubles. In addition, without going into details, we will list the most notorious corruption crimes (summaries and information about the cases are publicly available on the Internet), for example, the sensational defense service cases, when the cost of damage amounted to more than three billion, and after an investigation it turned out that the final damage is about thirteen billion, the case of the Russian Register or, for example, the Rosagroleasing case, where the state suffered losses in the amount of about thirty billion rubles and other high-profile cases [14].

Note that the federal budget revenue for 2021 is 18.7 trillion rubles [15]. The ratio of the numbers clearly demonstrates the impact of corruption on the economy and is definitely thought provoking.

Over the past decade, while characterizing the emerging socio-political and economic situation in Russia, the negative fact of the active spread of corruption and the strengthening of its introduction into all spheres of the life of the state and society has been consistently stated. Corruption has acquired a scale that really threatens the security of the state, the normal functioning of public authorities, the rule of law, democracy, human rights and social justice. According to VTsIOM, the most corrupt spheres of society are the following (see infographics).

It is important to add that corruption leads to the development of the shadow sector of the economy, which, in turn, causes a decrease in tax collections and the emergence of a budget deficit, which can lead to social problems. Corruption also impedes competition within the country and makes Russian goods less competitive on the world market: it is not the enterprises that are most effective that succeed, but those that have certain agreements with officials. Also, corruption leads to a slowdown in economic growth; differentiation of the population (the rich get

richer, the poor get poorer); this leads to another negative consequence - violation of human rights [16, p. 5].

The foregoing allows us to speak of the need to reform and modernize the state budget management system, strengthen the system of law enforcement agencies of the Russian Federation, strengthen public control over the activities of state (municipal) employees, digitalize the entire public administration system, and increase its transparency [17, p. 320]. Among the most important areas of combating corruption, we highlight the following: regulation of anti-corruption legislation in the field of tenders and public procurement; improvement of measures for the application of uniform methods to enhance mechanisms for resolving conflicts of interest; careful control over the process of providing information on income, expenses and acquired property of state civil (municipal) employees; improvement of measures to combat corruption in the field of business, including the protection of business entities from abuse of office by officials; improving the legal framework of anti-corruption legislation, as well as modernizing relations in the international arena in the field of anti-corruption policy in order to the authority of our country [18, p.202].

In our opinion, in order to implement optimal and effective anti-corruption activities, it is necessary to apply a set of measures taking into account political and ideological measures, socio-legal, economic, as well as organizational and technical measures [19, p.490]. Each measures should represent a single algorithm of actions aimed at combating corruption in the relevant sphere of the life of society and the state and act to achieve a single goal - the eradication of corruption.

Thus, anti-corruption activities in Russia should be based on due attention on the part of interested state bodies to the normative legal regulation of anti-corruption legislation, elimination of conflicts of existing norms, and measures to combat corruption, limited by a certain legal framework, should be regularly supported by not single methods, but by complexes of measures in various sectors and spheres of public and political state life [20, p.148]. In addition, it seems necessary to strengthen control over the implementation of these complexes of measures and the need for full responsibility of state civil and municipal employees for the implementation of anti-corruption policies, as well as strict comprehensive accountability to citizens. Optimization of measures aimed at combating corruption presupposes consistency of regulatory and practical activities, constant updating of the sentences imposed and other measures of a criminal and administrative legal nature. Unfortunately, at the present time it remains to state that statistics in the field of corruption crime shows negative dynamics, and corruption as a phenomenon has successfully adapted to the "information society" and continues to have a negative impact on all spheres of society and the state, especially in the field of economics.

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建立和发展新兴市场国家一体化联盟的经济政策社会块的生态组成部分
THE ECOLOGICAL COMPONENT OF THE SOCIAL BLOCK OF ECONOMIC POLICY FOR SETTING UP AND DEVELOPMENT OF INTEGRATION ASSOCIATIONS OF THE COUNTRIES WITH EMERGING MARKETS

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文章提出了上合组织成员国之间合作的环境问题。 作者强调了这一问题的相关性，以及需要将“环境资本”的概念作为上合组织成员国经济政策社会板块环境成分的理论基础。

关键词：上海合作组织，经济政策，新兴经济体，环境资本，环境教育

Abstract*. The article raises environmental issues of cooperation between the SCO member states. The author emphasizes the relevance of this issue and the need to consider the concept of "environmental capital" as a theoretical basis for the environmental component of the social block of the economic policy of the SCO member states.*

Keywords*: Shanghai Cooperation Organization, economic policy, emerging economies, environmental capital, environmental education*

The need to highlight the environmental component of the social block of the state economic policy for the creation and development of integration associations of countries with emerging markets is due to many circumstances that are conceptually broad enough covered in the works of Russian authors and representatives of foreign organizations [1, 2].

Without considering in detail all these circumstances, we note one of them, namely, the deterioration of the environmental situation over a long period and its negative impact on the human environment in countries with emerging markets. In this regard, the purpose of this article is to highlight the environmental aspect of the formation of a social block of economic policy for the creation and development of integration associations of countries with emerging markets on the example of the Shanghai Cooperation Organization (SCO) and to consider the concept of "environmental capital" as a theoretical basis for solving environmental

problems.

For countries with developing markets, environmental problems are especially acute, since the period of industrialization of economies in these countries and the transfer of "dirty industries" from developed countries left a legacy of a difficult environmental situation, which requires constant attention of all countries participating in the integration associations of countries with emerging markets and significant cost of all types of resources for its improvement in order to move to the "green" agenda.

At present, environmental issues are actively raised by the SCO member states. We consider SCO as a pro-integration association, that is, the directions for further integration movement in the field of economic cooperation, which are currently at the initial stage of agreement by the SCO "family" states. Taking into account the fact that the countries of the SCO "family" occupy more than 60% of the territory of Eurasia, and more than half of the world's population live in these countries, the consideration of the environmental agenda within the framework of this organization is relevant and justified.

The basic document - "Development Strategy of the Shanghai Cooperation Organization until 2025" - states that the SCO member states "will develop cooperation in the field of advanced environmental technologies, renewable and clean energy sources, energy efficiency for sustainable development" [3]. In addition to these areas, the integration policy of the SCO countries is being successfully implemented in such joint projects as waste disposal, ecological well-being of cities, water resources use, phyto-forestry reclamation and others, which are contained in the Action Plan for the implementation of the "Concept of cooperation between the SCO member states in the field of environmental protection for period 2022-2024", which is an organic continuation of another document -" Concept of cooperation of the member states of the Shanghai Cooperation Organization in the field of environmental protection for the period 2019-2021 "[4].

Technical and technological projects in the field of ecology are aimed, first of all, at solving social problems that follow from one of the main goals of the creation of the SCO - increasing the welfare and living standards of the population of the SCO "family" countries. In this regard, it is natural to single out the ecological component of the social block of the economic policy of the SCO "family" states.

The COVID-19 pandemic has shown the closest relationship between the environment and the technological foundations of the modern economy. In 2020, quarantine measures in many countries negatively affected the global economy: according to the UN, in 2020 the world economy contracted by 3.6 percent [5]. At the same time, a positive consequence of lockdowns is that global carbon dioxide (CO2) emissions, as calculated by the World Energy Agency, decreased by 5.8% in 2020, which is five times more than the fall in 2009 that followed the global

financial crisis [6]. The SCO Green Belt program, which is being developed at the initiative of Uzbekistan with the aim of widespread introduction of resource-saving environmentally friendly technologies, is aimed at consolidating the trend towards a decrease in carbon dioxide emissions.

High levels of pollution of soil, water bodies and atmospheric air cause a difficult environmental situation in a number of SCO countries, which directly affects the health of the population. According to official data alone, about 400 thousand people die from lung diseases in China [5]. According to official data from the Ministry of Health, in the pre-pandemic year 2019 in Russia, 45.6% of newly diagnosed diseases were in the respiratory system [6].

Despite the high incidence rates associated with ecology, according to studies by Russian scientists, the best state of the environment among the SCO countries was observed in Russia. This is due to the relatively small amount of emissions of pollutants into the atmosphere of factories, the amount of which sharply decreased during the transformation period (1992-2002), and a large area of forests and inland waters. The worst state of the environment was recorded for Pakistan and Uzbekistan, which is associated with a small volume of use of renewable fresh water resources and a large emission of greenhouse gases [9, p. 63]. In addition, on the territory of the SCO countries - in the countries of Central Asia, there is an ecological disaster zone - the region of the Aral Sea basin associated with its drying up. This area is home to 3.5 million people who suffer from the effects of pollutants and toxins that accumulate at the bottom of the lake and rise into the air.

According to Russian researchers, China ranks third in the ranking of the environmental well-being of the SCO countries, giving way to India, taking into account the later industrialization of this country and the development of production outsourcing, which is actively used by Western corporations [10]. Nevertheless, China, as a world factory, is the world's largest source of harmful emissions: more than 4 billion tons of coal are burned annually, and carbon dioxide emissions into the atmosphere are over 13 gigatons [7].

The SCO countries are characterized by the accumulation of environmental problems in large cities, which negatively affects the social indicators of the quality of life of the urban population. In this respect, the leaders are China (Baoding, Beijing, Xingtai, etc.) and India (Mumbai, New Delhi, etc.). In 2019, the countries of the SCO "family" developed a joint program - the Program for the Development of the Environmental Well-Being of SCO Cities, the implementation of which is part of the cooperation of the SCO member states in the field of not both environmental protection and health protection of the population of SCO cities.

The formation of the environmental component of the social block of the economic integration policy of the SCO countries, as countries with emerging markets, should be based, in our opinion, on a theoretical concept - "environmental

capital".

The concept of "ecological capital" was introduced into scientific circulation by Russian researchers E.D. Platonova and V. Latun, who defined this type of capital as a set of investments in the preservation and improvement of the living environment (life activity), formed knowledge and co-evolutionary connections in the system "Human - Society – Nature" [11].

In the works of researchers, the investment nature of investments is naturally emphasized not only in maintaining the current level of the environmental situation in the SCO countries, since this level does not ensure the environmental well-being of the population of these countries in combination with economic growth. Mainly investments in the environment should be directed to the qualitative improvement of the natural habitat of the population of the SCO countries and the leveling of the environmental damage that was caused to nature for the sake of rapid economic growth.

Currently, investment flows of the leading SCO countries are directed towards creating a "green" economy based on renewable energy sources, achieving carbon neutrality, and reducing greenhouse gas and hazardous waste emissions.

China is one of the world leaders in the development of renewable energy, the implementation of reforestation and reforestation projects, and the achievement of carbon neutrality by 2060. This testifies to China's growing volumes of environmental capital and advanced investment in innovative technologies that allow China to implement the ambitious project "Ecological Civilization of the 21st Century" and move Chinese manufacturing companies to the principles of "Industry 4.0" / "Industry 5.0".

One of the elements of environmental capital is investment in environmental education and upbringing, as well as in the development of scientific knowledge along the line of co-evolutionary development "Human - Nature - Technology". Disciplines on environmental issues are included in the educational programs of primary, general and higher schools of the SCO member states. Many partner universities, united in the SCO Network University (SCO), have created training programs for environmental specialists. Thus, the Institute of Ecology, which trains environmental personnel for the SCO countries and conducts extensive research work aimed at ensuring the conditions for strengthening the environmental well-being of the population of the SCO member states, is successfully operating at the basic university of the SCO - RUDN (Russia, Moscow).

Thus, based on the example of the SCO member states, it can be argued that at present, environmental cooperation is the most important element of the social block of economic policy for the creation and development of integration associations of countries with emerging markets.

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转基因微生物创造和使用的法律规范理论与实践
THEORY AND PRACTICE OF LEGAL REGULATION IN THE CREATION AND USE OF GENETICALLY MODIFIED MICROORGANISMS

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文章讨论了在工业规模上使用转基因微生物 （GMM） 时的安全问题、生物活性物质的生产商、GMM 流通领域的法律监管原则。 对俄罗斯和国际立法要求在构建基于大肠杆菌 K-12 菌株的琥珀酸 GMM 生产商中的实际应用进行了分析。

关键词：转基因微生物； 生物安全； 基因工程；大肠杆菌K-12。

Abstract. *The article discusses the issues of safety when using genetically modified microorganisms (GMM) on an industrial scale, producers of biologically active substances, the principles of legal regulation in the field of GMM circulation. The analysis of the practical use of the requirements of Russian and international legislation in the construction of a GMM producer of succinic acid based on the Escherichia coli K-12 strain is carried out.*

Keywords: *genetically modified microorganisms; biosafety; genetic engineering*; *Escherichia coli* K-12.

The use of advanced technologies in the field of creation and use of genetically modified organisms (GMOs), including genetically modified microorganisms

(GMM), poses complex and urgent issues of biosafety before modern society. On the one hand, the development of genetic engineering methods has ensured the successful solution of many problems in agriculture, industry and medicine, but at the same time, the possibility of editing genomes and changing DNA molecules raises serious concerns regarding the creation of hybrid molecules with new, previously non-existent combinations of genes. As a result, variants of more pathogenic bacteria and viruses may arise that are resistant to currently available antibiotics and other drugs. The introduction of GMM into the environment, in particular into the soil, is highly unpredictable. It is believed that at present 5% of all microorganisms actually existing in nature are known - bacteria, actinomycetes, fungi, yeasts. Consequently, it is impossible to unequivocally determine how GMM will act on as yet unexplored species of microorganisms. When using GMM in animal husbandry, the life cycle of animals and humans must be considered as a whole.

In this regard, the problems of ensuring biosafety come to the fore and are a top priority for all mankind. Legislation in the field of GMM regulation, control over genomic research, risk assessment of the use of genetic editing technologies of organisms, all these issues are the subject of close attention of governments and international organizations that cooperate in the development of regulatory documents and general principles of biosafety. One of the important documents uniting the efforts of many countries in biosafety issues is the Cartagena Protocol, adopted in January 2000 in Montreal and entered into force in 2003. In accordance with the precautionary principle, the purpose of the Protocol is to promote the provision of an adequate level of protection in the field of safe the transfer, handling and use of living modified organisms resulting from the application of modern biotechnology and with the potential to adversely affect the conservation and sustainable use of biological diversity, also taking into account risks to human health and with particular attention to transboundary movements. In 2023, Russia plans to join the Cartagena Protocol on Biosafety, which regulates the interstate flows of GMOs on a global scale. Joining the Cartagena Protocol can give Russia an advantage in terms of increasing its export potential and ensuring the safety of imported agricultural products. However, in order to join an international document, Russia needs to harmonize legislation with international norms, experts say. Obtaining biologically active substances necessary for medicine, agriculture, and industry is a priority task for the microbiological industry of the Russian Federation (RF), as indicated by the active legislative activity of the RF government in relation to the regulation of genetic engineering activities in recent years. In RF, the legal policy in the field of genetic engineering is based on Federal Law № 86-FL, 1996 "On State Regulation in the Field of Genetic Engineering", which, with some changes, is still in effect [1]. Additions and clarifications were made in accordance with Federal Law № 358-FL, 2016 "On Amendments to Certain Legis-

lative Acts of the Russian Federation in terms of improving state regulation in the field of genetic engineering." The need to further update the provisions of Federal Law № 86-FL and bring it in line with international law was announced in 2021 at a meeting of the section "Normative and legal regulation in the field of GMO circulation" of the expert council of the Federation Council Committee on agrarian and food policy and environmental management. It should be noted the important generalizing role of the RF Government decree of 22.04.2019 N 479 "On approval of the Federal Scientific and Technical Program for the Development of Genetic Technologies for 2019 - 2027" [2]. Of great importance in promoting GMM producers to the market of domestic biotechnological industries is the Order of the Ministry of Agriculture RF dated October 30, 2020 N 655 "On approval of the Methodology for the production of molecular genetic research of genetically modified agricultural microorganisms used for breeding and (or) growing on the territory of the Russian Federation"[3]. The order approves new research methods that are necessary for the registration of modified plants, animals and microorganisms. These methods were developed in connection with the Decree of the RF Government № 839 of 2013 "On state registration of genetically modified organisms intended for release into the environment, as well as products obtained using such organisms or containing such organisms, including the specified products. imported into the territory of the Russian Federation"[4]. An important document contributing to the registration of GMOs is the All-Russian Classifier of Transformational Events, 2015 (ARCTE) [5]. ARCTE is used to classify information on the characteristics of transformational events for registration of GMOs intended for release into the environment. Thus, the legislative framework of RF in relation to legal regulation when using GMM is being improved.

A comparative analysis of regulatory documents regarding the rules for regulating the use of GMM in the RF, the United States and the European Union (EU) showed similarities and differences in relation to a number of positions. In the United States, the legal framework is the most liberal and developed in detail; in the EU, increased attention is paid to safety issues, which leads to lengthy procedures for introducing strains into biotechnological production. RF legislation is currently less detailed and often restrictive despite good prospects for the development of the microbiological industry in RF.

The industrial use of microorganisms in the United States is regulated by the Environmental Protection Agency (EPA) and the Toxic Substance Control Act (TSCA) of 1976, which introduced new regulatory rules for microbial biotechnology products in 1997 [6]. This law states that the object of regulation is the organism itself, and not the method of obtaining it. In the EU, control is carried out by the European Food Safety Authority (EFSA), and the main document governing the use of GMM is Directive 2009/41/EC [7]. The regulation of the use of

GMM in the EU and RF is carried out on a different principle, namely, the subject of regulation is the method of obtaining GMM - genetic engineering. In this, US legislation is fundamentally different from EU and RF legislation.

Consider the legal regulation regarding the use of recipient strains, on the basis of which GMMs are created, in the USA, EU and RF. In the US and the EU, there are lists of safe recipient microorganisms recommended for use and creation of GMM based on them. In the US, this is the GRAS (Generally Recognized as Safe) list, in the EU - QPS (Qualified Presumption of Safety), i.e. list of microorganisms generally recognized as safe. Strains that have received the status of GRAS and QPS, as well as producers created on their basis, can be used in biotechnology without additional safety checks of recipients, which contributes to the rapid introduction of strains into industrial production. The principle of selection for inclusion in the lists of safe microorganisms is different. In the USA it is based on the characteristics of the strain, in the EU the selection is based on the species as a taxonomic unit. Therefore, *E. coli* K-12 strains, widely used in laboratories around the world, are non-pathogenic and have lost the ability to multiply in the intestines of warm-blooded animals, are approved in the United States for use in industrial biotechnology as safe recipient strains. In the EU, *E. coli* K-12 is not included in the QPS list because other strains of this species may show pathogenic properties. Under US law, not all genetically engineered strains are regulated by TSCA. If only the genes of the organism itself or closely related species, between which there is a natural exchange of genetic material in nature, were used in the construction of the strain, then such organisms are not considered GMM, since they do not carry foreign heterologous genes and are not transgenes. In the EU and RF, all genetically engineered strains are considered GMM. There is no list of recipient strains safe for use in the Russian regulatory framework. The creation and legislative approval in RF of a list of recipient strains and GMM safe for industrial biotechnology, created on the basis of these strains, is a necessary step for the rapid advancement of genetically engineered producers to the industry market.

Requirements for genetic material introduced into recipient strains are the same in WHO, US, EU and RF regulations. Thus, the introduced genetic material should be of minimum size; not contain genes encoding toxins or virulence; antibiotic resistance genes; sequences with unknown functions; genes affecting the immune system, determining the synthesis of allergens that negatively affect human health; do not increase the survival rate of the microorganism in the environment.

As an example of the practical use of the principles of creating a safe GMM that meets the requirements of Russian and international legislation, at the National Research Center "Kurchatov Institute" - GOSNIIGENETIKA - State Research Institute of Genetics on the basis of the *E. coli* K-12 strain, a GMM strain of *E. coli* K-12 SGM2.0Pyc-int, a producer of succinic acid (SA). The strain contained

in the chromosome a heterologous pyruvate carboxylase gene - *pyc*A from the Bacillus *Subtilis strain*, i.e. was transgenic. To obtain a GMM producer, modern methodologies of precision chromosomal recombination engineering were used in combination with traditional methods of molecular genetics and microbiology.

The original *E. coli* K-12 strain synthesized SA from glucose under anaerobic conditions in an amount of ~ 5% of the total amount of mixed acid fermentation products. In *E. coli* cells, the activity of pyruvate carboxylase required for efficient SA biosynthesis is absent. At the first stage of the genetically engineered design of the SA producer, a plasmid with a heterologous pyruvate carboxylase gene, *pyc*A, from the *Bacillus subtilis* 168 strain, which increased the synthesis of oxaloacetic acid, the SA precursor, was introduced into the original strain. The plasmid contained the gene for resistance to the antibiotic ampicillin, which was used as a selection marker for the selection of cells containing the *pyc*A gene. In addition, a number of genes encoding enzymes involved in other reactions of mixed acid fermentation were removed from the strain, which made it possible to direct the flow of necessary metabolites for the synthesis of SA. An intermediate strain was obtained, designated *E. coli* SGM2.0 [pPYC], with an increased efficiency of anaerobic synthesis of SA [8].

At the second stage of construction according to the norms concerning the characteristics of the genetic material introduced into the recipient strains, the plasmid with the gene for resistance to the antibiotic ampicillin was removed. The *pycA B*. *subtilis* subtilis gene required for SA biosynthesis was integrated into the chromosome of the strain under the control of the strong constitutive P_L promoter of the lambda phage, which ensured a high and constant level of pyruvate carboxylase synthesis. The resulting strain was designated *E. coli* K-12 SGM2.0Pyc-int [9]. To create this strain, more than 20 genomic editing events were performed. The correspondence between the expected and introduced changes in the genome GMM was established using high-throughput sequencing technology using read mapping, genomic assembly, whole-genome and local alignment of nucleotide sequences.

Evaluation of the biosynthetic characteristics of the strain showed that the strain is able to use various carbohydrates for the efficient production of SA, and the proportion of the target compound synthesized anaerobically by the strain reached 88% of all secreted metabolites. This level of synthesis is comparable to that of the best modern SA producers based on *E. coli.*

The next stage consisted in carrying out a comparative analysis of the characteristics of the initial *E. coli* strain K-12 and GMM, obtained under the influence of a number of environmental factors, such as UV irradiation, temperature regime, behavior in water, soil, and wastewater. These indicators are a necessary characteristic of the strain when introduced into industrial production and environmental

monitoring. It was shown that both strains are sensitive to extreme environmental factors. Compared to the original strain, GMM is characterized by a reduced viability under UV irradiation and an increase in temperature. When cultivated in soil, the growth of both strains is significantly inhibited within a week. In the sewage from the Moscow collector, containing in addition to microorganisms and various chemical substances, the process of death of the GMM strain occurs within three days, while the original strain forms separate colonies within a week. The results show that GMM does not compete with obligate microorganisms present in soil and wastewater.

Thus, the E. coli K-12 SGM2.0Pyc-int strain meets international and Russian industrial production requirements, does not contain mobile genetic elements in plasmids, antibiotic resistance genes, is characterized by a high level of biosynthesis of the target product, and its viability in natural conditions was not increased. In accordance with the regulations, the *E. coli* strain K-12 SGM2.0Pyc-int was deposited in the National Bioresource Center of the Russian National Collection of Industrial Microorganisms of the National Research Center "Kurchatov Institute" - GOSNIIGENETIKA.

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低年级学生小组作业的有效性
EFFECTIVENESS OF GROUP WORK OF JUNIOR STUDENTS

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在本文中，作者探讨了学生小组作业在教育和成长过程中的好处。 据作者介绍，现代学习过程的成功结果在于互动小组工作，它可以解决满足大学毕业生要求的多功能问题。 互动式教育符合现代学生的心理特征和价值观。

关键词：小组工作、互动学习、游戏、项目活动。

Abstract*. In this paper, the author explores the benefits of group work of students in the process of education and upbringing. According to the author, the successful result of the modern learning process lies in interactive group work, which allows solving multifunctional problems that meet the requirements for university graduates. Interactive forms of education meet the psychological characteristics and values of the modern generation of students.*

Keywords*: group work, interactive learning, games, project activities.*

Group work is not a new method of pedagogy. However, as a rule, in recent years it was used exclusively in the educational process, its upbringing function played an auxiliary role. Moreover, this tendency was observed both in the general education school and in universities. Modern freshmen are erudite, possessing high cognitive activity, awareness, and at the same time a bright personality. All these positive characteristics often affect the choice of a profession, many of them prefer to be freelancers, prefer not to depend on other people, do not want to work in a team. Unfortunately, this trend is spreading to the teaching sphere as well. Young teachers do not always understand their role in upbringing the younger generation, limit themselves to teaching their subject, and are ready to change jobs when faced with some organizational difficulties. All this is a consequence of the

rating systems, the decrease in the role of upbringing in the training system.

On the other hand, at the present stage of development of society, the role of joint labor in various spheres is increasing. A demanded specialist must have the skills of goal-setting, forecasting, decision-making, organization of execution, control and evaluation of results, as well as the skills of a business communication style [4]. Therefore, one of the requirements of our days is the forgotten for decades the need to unite the team, the ability to work together on the task at hand. Unfortunately, teaching schoolchildren to work in a team is a long process, and teachers of junior courses in universities, forming educational, general cultural and professional competencies, should focus on the development of communication and upbringing competencies. The generation of today's students belongs to the so-called generation Z, whose values and psychological characteristics should be very different from the attitudes of previous generations. The modern teacher is forced to take these circumstances into account in the educational process. Many of the old forms of conducting classes do not find a response among today's freshmen, which makes them look for other ways of presenting the material and activating the work of students.

In recent years, the emphasis in teaching has been on interactivity, i.e. on the ability to communicate and interact with the learning process [10, 11]. A lot of interactive methods have been developed, this is the method of "brainstorming", solving case problems, modeling situations, project activities, etc. [6, 9]. For junior students, play activities, visual information and the speed of its change, multitasking are of great importance. Some teachers are actively introducing distance courses on the Moodle platform into the educational process. Indeed, it allows you to accompany the lecture material with presentations, video materials, game elements. But the section related to practical exercises, in our opinion, is not very successful. He is deprived of the possibility of "live" discussion, joint search for a solution. Interactive tests, of course, can increase the reliability of assessments of educational achievements [1], but for students test tasks are, first of all, a form of control, they weakly motivate cognitive activity, in contrast to practical exercises.

Therefore, it is better to conduct seminars for freshmen in such an interactive form as role play, quiz, reviewing and discussion of video materials, etc., that is, in a dynamic lesson format. Most modern students are comfortable with interactive teaching methods, because they spend a lot of time in cyberspace - a new environment for young people, and it, in turn, is also a space of interaction [5, p. 65].

Interactive methods are better suited to the personality-oriented approach [3, p. 2]. But in addition, many interactive methods imply group work of students in one form or another. Namely, in the game, in group work, the role of team coherence increases, the ability to distribute tasks and end conflicts, i.e. developing those competencies that will be necessary for the graduate in his future life and

profession. It is worth remembering the principle formulated by L. S. Vygotsky [2], which the teacher should always be guided by: in order for the student to really get involved in the work, it is necessary that the tasks that are set in the course of educational activities are not only understandable, but also internally accepted or so that they become meaningful to the student and resonate in his experiences.

Also in group work: the effectiveness of joint work will be in the event that the goal is clear to each participant, accepted by him, if there is a successful distribution of responsibilities and mutual control is in place. Naturally, to teach a junior student to cooperate, come to a compromise, adequately respond to criticism, etc. it is possible, but not within the framework of one or two disciplines, but by joint actions of the teaching staff. And the use of an interactive format for conducting classes is exactly what meets these tasks. Its main feature is the initiative of students in the educational process, which is stimulated by the assistant teacher, then the learning outcome becomes significant for all participants in the process and develops students' ability to independently solve a problem [7].

The role of the teacher in this format of teaching not only does not decrease, but becomes important - the educator. After all, maintaining the norms and rules of interaction in groups, the formation of a comfortable atmosphere of communication at the first stages becomes the task of a competent organizer. It is he who orients students to achieve a result. Because for Generation Z, the question "why?" (Why do I need this or that action? Why participate in the event? Why do I need group work, if I can do it alone and get an assessment?), Then it is the teacher who is called to answer this question. At the same time, the explanation cannot be reduced to obtaining an estimate; such an answer will not contribute to the solution of upbringing problems. It should not be forgotten that the group must go through several phases of its development: 1) the stage of acquaintance, 2) the stage of conflict (struggle for a place in the group), 3) the stage of cooperation and 4) the productive stage, when motivation, focus on results and performance are formed [9]. And the participation of the teacher-moderator at these stages is mandatory.

Of course, not every practical lesson should take place in the form of a game, such extremes should also be avoided, but the group form of work can become the leading one and supplemented by the individual one. Interactivity in these classes will be realized through the interaction of participants in the process with each other, exchange of information, joint problem solving, assessment of the actions of others and their own behavior, immersed in a real atmosphere of business cooperation. Excitement in such classes should be given by complex and extraordinary tasks [9].

However, one cannot ignore the small percentage of students who still prefer individual types of work. Therefore, the work at the seminars should be structured in such a way as to optimally combine different types of work. To create a com-

fortable working atmosphere, at the end of the lesson, together with the teacher, the results on the topic are summed up, and the advantages and disadvantages of the performances are analyzed. At the same time, everyone has the opportunity to critically assess their knowledge, compare it with the knowledge and skills of other students. Here it is appropriate to use the PRES formula [8, p. 35]:

P – Position ("I think that…")

R - Reason ("Because…")

E – Example ("An example can be…")

S – Summary ("Based on this, I conclude…")

Of course, the grading system plays an important role for freshmen. Here it is recommended to use a point-rating assessment: for the main answer or written work or active participation in the discussion, as well as additional points for additions, writing a synopsis, drawing up a table, and other individual tasks that a student can complete. This will allow both to take into account the psychological state of students, and to increase their motivation to work. At the same time, such a system will allow you to combine collective work with personal achievements. The student will not feel his dependence on the group, if he does not agree with some aspects of the work, he can always prove himself or add his points. At the same time, the group form of training and the general goal of the group - to win, to get high scores - stimulates the formation of upbringing competencies.

Thus, seminars will be more effective if they are carried out in the form of a variety of group works, complemented by individual ones. This format of conducting classes will solve several important tasks: deepening knowledge about the subject being studied, developing creative and communicative abilities, forming extraordinary thinking, and the ability to work in a team.

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学生教育模式中的人工智能
ARTIFICIAL INTELLIGENCE IN STUDENT EDUCATION MODELS

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“面对面”、“轮换”、“灵活学习”、“在线实验室”、“自己动手或个人选择”、“在线司机”、“翻转课堂”、“游戏化”等学生学习模式， “自学”和“循环模式” 被考虑。 这些模式在各种形式的教育中得到实施。 这些表格的分类基于与总学习时间相关的学生在线活动的持续时间。 文章描述了人工智能在所列模型中的使用，其中它在学生群体中实施个性化教育的方法论，进行适应性和个性化学习，以及对每个学生的预测分析。 研究人工智能的功能，有助于高校管理人员组织和改进学生的活动。

关键词：远程学习，在线和离线学习，混合和混合学习，学习模型，人工智能。

Abstract. *Such student learning models as "face-to-face", "rotation", "flexible learning", "online lab", "mix it yourself or individual choice", "online driver", "flip class", "gamification", "self-study" and "cyclical model" are considered. These models are implemented in various forms of education. The classification of these forms is based on the duration of online activities of students in relation to the total study time. The article describes the use of artificial intelligence in the listed models, in which it implements the methodology of individualization of education in groups of students, carries out adaptive and personalized learning, as well as predictive analysis of each student. The functions of artificial intelligence are investigated, which help the administration of universities in organizing and improving the activities of students.*

Keywords*: distance learning, online and offline learning, blended and hybrid learning, learning models, artificial intelligence.*

The relevance of the study is due to the fact that the epidemic caused by the coronavirus and spread throughout the world in 2020-2021 stimulated the penetration of artificial intelligence into all spheres of human activity, including education. Most of the students around the world have been transferred to distance

learning to avoid contracting the coronavirus on the way to universities.

Distance learning is associated with such forms of education as "online" and "offline". Online and offline - words of English origin. *Online learning* means that at a given moment in time (here and now) a student is on the Internet at a given address, while he is virtually present at a lecture or participates in a webinar. Using a smartphone or their own computer, students listen to the explanation and/or watch a video broadcast of the teacher explaining a new topic. They chat with a teacher or classmates, sending their message, and you can immediately get a response.

In the word "offline" the preposition "off" means disconnection, therefore, "offline" literally translated from English means "not on the line", that is, to be disconnected from the line at a given moment in time. For students, the offline situation is characterized by disconnection from the Internet or no connection to the line (preset address). *Offline training* means that students are absent from a lecture or webinar at a certain (real) point in time when a lecture is being read or a webinar is being held. But it is assumed that students will definitely get acquainted with the material of the lecture or webinar later in the recording, at a convenient time for them. This recording, at the request of the teacher and the students present or absent for good reason, will be made by the technical staff serving the process of giving a lecture or conducting an online webinar.

However, students, teachers and employers are dissatisfied with the process of studying at universities when it is completely built on online and offline learning. This is due not only to technical issues: laptops, smartphones, the Internet; with possession of information technologies and the ability to work on educational platforms, but also with the tradition of full-time education that has developed since ancient times. Thus, the need arose for a reasonable combination of full-time and distance learning.

Back in 2013, British researchers Brian Tomlinson and Claire Whitteker proposed a *classification of forms of education* that use online technologies [8]. This classification is based on the duration (as a percentage) of student online activity in relation to total study time. Four forms of training have been proposed:

– training in which the Internet is used only to place announcements for student groups about the schedule of classes and exams, about curricula in the subjects studied; this is the so-called web-enhanced technology (or in translation from English - web enhanced learning);

– blended learning or Blended Learning, where online student activities account for up to 45% of all student activities in the classroom;

– Hybrid Learning or Hybrid Learning, where online student activities account for 45% to 80% of all student activities in the classroom;

– distance learning, fully online (completely online, more than 80% is occupied by online activities of students) [8].

The first and second indicated forms of education were not prescribed in detail by the authors B. Tomlinson and K. Wittaker [8]. We believe that web-enhanced technology uses Internet resources for training (Web Facilitated) in a small amount, for example, from 1% to 19% of all students' activities in the classroom. Then the blended learning of students takes from 20% to 44% of the total activity of students in the classroom.

Blended learning is a combination of two components of training: full-time and online training, with a slight priority of full-time training. In *hybrid learning*, online learning takes precedence. These forms of learning are actively used in various learning models such as "face-to-face", "rotation", "flexible learning", "online laboratory", "mix it yourself" or "individual choice", "online driver", "flipped classroom", "Gamification", "self-study" and "cyclical model".

In the "*face-to-face*" model, most of the time is spent on face-to-face training in conducting seminars and practical exercises, and in online training, preparation for testing and control works on the topics covered is carried out.

In the "*rotation*" model, there is "alternation of traditional full-time classroom training with independent online training in an individual mode" [2, p. 39].

In the "*flexible learning*" model, the teacher "from time to time works with small groups or with one student individually" [1, p. 39].

The "*online laboratory*" model allows using augmented reality technology to more clearly present the subject of study, and on virtual simulators you can prepare for control testing.

The "*mix it yourself or individual choice*" model assumes that the student is free to choose the way of teaching: he himself decides which part of the course being studied to supplement or replace with online learning.

The "*online driver*" model corresponds to the complete immersion of students in an online environment, for example, when a teacher lectures in a distance format.

In the *"inverted classroom"* model, students study new material independently, for example, using an Internet resource, students find a topic set by the teacher, try to understand it; the next day, in online training, the teacher talks with students on a given topic in order to find out the level of their knowledge (it is possible to have a face-to-face discussion).

The *"gamification"* model is to involve elements of the game in face-to-face or online classes in order to increase the motivation of students, make the educational material more interesting and exciting.

The *"self-study*" model is focused on independent search and detailed acquaintance of students with additional material on the studied subject, recordings of webinars and lectures by leading teachers, for example, on YouTube.

"*The cyclical learning model* consists of three components: 1. Target com-

ponent: (1) familiarization with the material; (2) working it off; (3) control of the formation of knowledge, skills and abilities. 2. Teaching tools (electronic and non-electronic). 3. Place of study (in the educational institution or outside it)"[1, p. 39].

The application of the presented models for teaching students at universities will be more effective if artificial intelligence (AI) functions are built into them.

The concept of intelligence emerged at the end of the XIX century when psychologists studied the functions of the brain. Psychology professor Philip Rice (USA, Maine State University) wrote: "Intelligence is defined as the innate ability to learn, think, ..., understand and solve problems" [4, p.194]. According to this definition, intelligence is not unique to humans. The adjective "artificial" in relation to intelligence is most often associated as machines created by man, replacing the human mind, and the phrase "innate abilities" means the ability of machines created by people to learn independently, to the ability to act not only according to the program originally laid down in it.

Technicians under the term "artificial intelligence" understand that this is "the automation of intellectual tasks, usually performed by people" [6, p. 27]. The beginning of research on artificial intelligence can be attributed to 1832, when the Russian researcher S.N. Korsakov (1787-1853) described the actions of intelligent machines that serve to mechanize tasks related to mental activity. "Designers and programmers are interested in the problems of merging biotechnology with information technology in order to achieve a specific task" [5, p.14].

Stephen Duggan says: "Perhaps the most important development in the evolution of AI has been the shift from what is called 'local computing', in which users access a computer or network of computers on a local network, to 'cloud' computing with access to computing resources over the Internet. "[3, p.14].

Quite often, AIs are encased in robots. Robots can be programmed to perform a well-defined task. The use of AI in education is focused on group (including small groups) work with students, as well as on individual work with each student separately and on the implementation of support activities to improve the work of universities.

AI can perform many functions in group models of education:

Firstly, it implements the methodology of individualization of education in groups, namely:

– carries out initial diagnostics of students in order to form study groups with approximately the same level of initial training;

– provides students with adapted (depending on their level of training of the study group) video recordings of lectures and webinars of the best teachers on a special Internet channel at their request, at any time convenient for them;

– allows students to interrupt viewing video recordings anywhere, as well as

repeatedly return to watching lectures or webinars that are difficult for students;

– tests students on the topics they study and on selected subjects on special simulators that contain both simple tests and tasks with a free choice of answer for each formed study group;

– forms new study groups based on testing results with the same level of knowledge acquisition to continue training;

– provides digital content of varying degrees of complexity and completeness: electronic textbooks, problem books, reference materials and abstracts, animation and video clips on various academic disciplines, which are addressed at the individual request of the student;

– provides students with the opportunity to independently prepare for group control activities, according to the curriculum for a given training group.

Secondly, it places the content of lesson plans on a mobile phone through a special application for smartphones, with the help of which students can find out the topic of a missed lesson and homework with the identification of the date, group and subject of study.

Thirdly, he consults students in the library of the educational institution, helps them to choose modern literature in book form or on an electronic medium to prepare for writing a term paper or a thesis project.

Fourthly, it checks the provision and implementation by students of home, abstract, term papers and theses.

Matthew Lynch, Ph.D. in educational counseling, has proposed seven options for using AI in the educational process [7], which are aimed at individual work with each student.

Firstly, this is *adaptive learning*, when AI tracks the progress of each student and notifies the teacher about the difficulties that have arisen in understanding the material being studied.

Secondly, this is *personalized learning*, when the AI sets an individual learning rate for the learner, inviting everyone to choose a comfortable pace for presenting material and tasks of increasing complexity.

Thirdly, it is *automatic grading*, where AI mimics the behavior of a teacher checking homework, thereby reducing the teacher's routine. The AI system automatically assesses the learner's knowledge, analyzes his answers, reports almost instantly the assessment results at the level of individual feedback and creates an individual plan to eliminate the backlog in the subject, taking into account the characteristics of the learner.

Fourthly, this is *interval learning*, when the AI determines the moment when the student has forgotten new information, and recommends to repeat it after some time to obtain stable knowledge or competencies.

Fifthly, this is t*he teacher's assessment by students.* To study the opinions of

students about their teachers, AI offers chatbots that use an interactive interface and filter out rather rude comments or personal insults.

Sixthly, this is a *smart campus* - a special computer program that allows you to find an answer to any student's request related to study and life in a hostel.

Seventhly, it is the *control of the educational process*, as an obligatory component of it. AI is designed to eliminate deception. He launches control systems that determine the personality of the examiner and his independence in the performance of mandatory tasks [7].

Stephen Duggan notes that because of its potential, AI provides real advantages in collecting initial student data and predictive analytics. He believes: "Predictive analysis: Analyzing both current (real-time or near real-time) and earlier data to predict meaningful issues,

such as dropout rates and identify students who need timely support. in relation to academic performance or with mental health or well-being problems,

as well as assist in forward planning on a systemic, institutional and individual basis "[3, p. 12].

AI support activity:

– consults and answers questions about the organization of the educational process for specific students with the identification of their persons, course and training group;

– collects statistical data on the amount of time spent on preparing and completing assignments, tests for a specific student, and provides this data upon request to the teacher;

– reveals the complexity of specific educational topics for students, counting the time spent by students on their study;

– helps to update the library fund, as well as identifies the need for foreign sources of information and its translation from the original language by analyzing the statistical data of library robot consultants

– determines the rating of teachers based on references to specific lectures of specific teachers,

– improves the organization of the educational process of the educational institution, processing statistical data and those questions that are collected by robot consultants of the educational process;

– searches for the digital footprint of each university student in the Internet communities and in social networks with a terrorist or suicidal orientation to provide them with timely assistance.

The opportunity is being implemented to deliver grocery orders to university food outlets using a courier robot with a built-in AI system, which is able to plan its route itself, monitoring the chosen path and avoiding obstacles.

The AI facial recognition system helps students in the university canteen to

receive exactly their order in a contactless way, in which a robot arm selects ready-made meals and drinks from a conveyor belt, puts them in a special cell that opens to a specific student who made an order.

Through student clothing or mobile phones with built-in GPS navigation, the AI tracks the location of junior students at the request of their parents. The statistics of the data of the built-in GPS navigator system can tell the parents of these students a lot about the leisure time of their children, as well as tell the administration of the universities about this in order to organize and improve the activities of students in their free time.

In conclusion, we note that education in the 21st century should have an ethical dominant as its core. Designed to be creative and innovative, this education with the use of artificial intelligence technologies must be based on the moral and moral values of the person, as well as the society in which he lives.

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协商管理模式形成背景下的社会资本
SOCIAL CAPITAL IN THE CONTEXT OF THE FORMATION OF DELIBERATIVE MANAGEMENT MODELS

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文章论述了经济转型条件下新管理模式形成的问题。 值得注意的是，管理范式的变化实现了基于非经济互动形式的管理模式的形成。 作者建议将社会资本视为新条件下的一种管理资源，作为一种特定形式的资本，由员工之间社会联系的存在和性质决定，与功能决定的活动没有直接关系。

关键词：管理模式，协商管理，社会资本，社会互动，结构性社会资本，认知社会资本，关系社会资本。

Abstract*. The article deals with the problems of new management models forming in the economic transformation conditions. It is noted that the change of the management paradigm actualizes the management models formation based on non-economic forms of interaction. The author suggests to consider social capital as one of the management resources in the new conditions as a specific form of capital determined by the presence and nature of social ties between employees and not directly related to functionally determined activities.*

Keywords*: management model, deliberative management, social capital, social interaction, structural social capital, cognitive social capital, relational social capital.*

The inefficiency of the transformation of management systems and the instability caused by them cause the need to search for methods of improving industrial relations, ways of transition to new type of management practices in the new conditions of the functioning of the economy. In this regard, sociological science and management practice face problems of an innovative nature: the development of a conceptual model and mechanisms that ensure a harmonious combination of cooperation and interaction in organizational relations. A special place is occupied by the problem of ensuring stable growth of the quality of social relations on the basis of social capital as a resource for effective management of the organization.

In an industrial society production relations finally shed the burden of non-eco-

nomic forms, acquiring relative independence from politics and at the same time receive such a way of regulating economic processes as an anonymous price-regulated market. For the first time economics and politics get the opportunity not to replace each other, but only to limit each other [7, s. 14].

In the modern neo-industrial society, opportunities are being formed to contain social qualitative changes that would lead to the establishment of significantly different institutions, a new direction of production processes, new forms of human existence [8, p. 48]. This containment of social changes is one of the significant achievements of a developed neo-industrial society, "one-dimensional" to determine the direction of their thoughts, especially socio-political beliefs, modeling the types of economic and consumer needs, forms of behavior (primarily social). According to V. V. Zinchenko, "the needs with which an individual identifies himself are, in their essence, a means of domination and subordination in the hands of those who rule and control" [2, p. 266].

The dominant system puts new means of social integration, which open up a wider space for the exchange of activities and the harmonious development of a person, at the service of its corporate interests. As a result, a one-dimensional, uncritically thinking individual is formed, alienated from an objective and – especially – negative attitude to social reality.

These circumstances dictate the need to form new approaches to personnel management, since traditional management methods focused on quantitative indicators of mass production do not provide effective interaction of participants in production processes horizontally and no longer justify themselves. This can explain the significant breakdown of the established and well-established stereotypes of managerial thinking and the formation of a new management paradigm: "not people for the organization, but the organization for people".

Critical socio-economic theory, concepts of subsidiarity and models of deliberative management, developed within the framework of the concepts of modern neo-Marxism and post-Marxism, are focused on the need to analyze the phenomena of power and management/self-government in management models.

Unlike other theoretical concepts and management practices, deliberative management critically analyzes management systems to identify factors that distort organizational communications. In particular, we are talking about cronyism and corporatism, when a manager protects the interests of a narrow group of people, presenting them as quasi-social

In this regard, deliberative management indicates the appearance in this case of one of the forms of ideology, namely, the ideological illusion of universality. As a result, there is a danger of society functioning according to the rules and values of the dominant group (Gemeinschaft). Therefore, as noted by Yu. Habermas, "social theory takes the form of criticism of ideology" [7, s. 20].

Technological progress, which has spread to the entire system of domination and coordination, creates forms of life and power that pacify forces opposed to the system and destroy or destroy any protest in the name of historical prospects for liberation from hard work and domination. The experience of total integration of socio-economic groups on the basis of" consensual consent " [6, p. 31] in neo-capitalist societies makes the boundaries between socio-economic classes more and more conditional.

Management theories are evolving in the direction of "human resource management". The previous "rational", "Taylorist" management models, which were based on strict methods of administrative command management and a vertical hierarchical structure, are, according to V.V. Zinchenko, "effective only in a separate area of production or society in cases of extreme need for the concentration of joint efforts" [2, p. 275].

Of course, modern management does not completely reject the model of rationalism. It remains the methodological basis for the formation of organizational structures, planning, conducting pre-project research, economic calculations, etc. The elements of rigid command control remain overwhelming in certain extreme conditions that require, for example, rapid concentration of efforts on any work site or when solving production tasks (for example, the production of mass standard products). However, in their essence, they stand in the way of establishing partnerships, experimenting, restraining initiative, which ultimately leads to a decrease in the efficiency of both production and social mobility. At the same time, in conditions of increased economic risk, an organic management model is necessary for the formation of effective horizontal and vertical social ties.

Even in the works of E. Mayo, it was noted that the created type of industrial society destroys interpersonal communication, its primary informal form, is bureaucratized, isolating a person, ignoring the world of human emotions. This creates a gap between the technological and economic development of society and its moral and ethical level. In organizations, this leads to their destruction, and in society – to increased social instability and devaluation of socio-ethical values.

A person is able to control himself and act in public solidarity in the case of striving for goals, the achievement of which will contribute to the satisfaction of his individual interests. The next step is the model of "deliberative communicative management" (from the Latin deliberatio – "discussion")

The deliberative management model proceeds from the premise that a decision that is based on a pre-developed and approved formula of actions and decisions cannot be considered truly legitimate. The goal of the deliberative management model is the constant reduction of wage-exploitative relations; the expansion of the system of self-government (both public and at the enterprise level). In this case, the subject of social and labor relations is also the subject (and not the object)

of the management, distribution and control system. In this sense, the idea of a deliberative self-governing way, according to V. V. Zinchenko, "is the opposite of both the command-administrative type of management and the totally deregulated systems" [2, p. 278].

Democratic self-government should be sufficiently flexible, that is, the masses and the individual should be able to freely choose from a variety of alternative projects. The system and society of self-government based on collective and individual autonomy cannot simply borrow capitalist means of production and technologies with their hierarchical structure. The most important tasks of a free society include not only overcoming the social and technical division of labor, but also the conscious transformation of technology. The technology should take into account the problems of autonomy and freedom of the individual, as well as the environment. Technologies that serve exclusively the interests of profit will become superfluous; instead, they will be used by those that the capitalist system does not allow to develop today. The new technologies will be highly decentralized, should be appropriate to the human scale; they can be "looked at" and controlled.

Deliberative management stands for the involvement of the majority of personnel in the daily management activities. With the elimination of managerial dictates, the problem of coordination takes on an absolutely different dimension. The issues will be resolved on the spot by a free agreement. The focus of life will shift from work to the sphere of relationships between people, which will contribute to the formation of a stable, evolving civil society of a new type – a polycentric and synergetic one.

An important resource for changing management models is the social capital of an organization, which we consider as an organizational resource determined by the presence and nature of social ties between employees and not directly related to functionally determined activities [3, p. 97].

Our definition proceeds from the fact that social interaction is an integral part of any organizational and economic activity, at least in the form of relations of economic exchange or the circulation of managerial signals. However, it seems to us that it is not quite correct to define such interaction itself as social capital, since its content specificity will thereby be "blurred". According to Coleman, social capital is "productive, making it possible to achieve certain goals that would be impossible in its absence" [5, P. 98].

Social capital is an independent and valuable organizational resource, a source of organizational advantages and efficiency improvement, which allows us to consider it as an object of purposeful management. In this capacity, social capital can be considered as an object of conscious investment, which is based on the expectation of future benefits from increasing and using it as an accumulated resource.

Social capital, being a complex, multicomponent organizational phenomenon,

has multiple effects on various aspects of the organization's functioning that are significant for its productivity and efficiency. At the same time, social capital is one of the most universal types of capital, like financial and human capital, and unlike industrial, intellectual or natural capital. This means that the management of social capital is a significant area of management in various types of organizations.

Secondly, there is reason to believe that in the modern Russian economy, the objective prerequisites for the formation of social capital are rather unfavorable than in most developed countries. This means that the management of social capital for Russian organizations is a more popular and urgent task than for organizations in countries with a high level of development.

Since social capital management is of practical importance for Russian organizations, it seems appropriate to consider these recommendations at two levels: strategic and instrumental.

Social capital permeates all organizational relationships and work processes, and in no way can be considered as a kind of" non-core asset", which is a burden in relation to the main business processes. The formation of the organization's social capital is its strategic task. In fact, the management of Russian organizations will have to solve the problem that was formulated by E. In the process of studying the phenomenon of conformism – the problem of embedding new forms of relations in a complex system that has its own core and periphery, institutions, organizational mechanisms, and resource base [4]. At the same time, we are talking about the dynamic integration of management practices for the formation of social capital in the conditions of transformation of Russian society and the processes of increasing the "fluidity" of society (according to Z. Bauman).

The list of the main directions of the development of social capital, in order of decreasing importance, is as follows:

- ∑ corporate culture;
- ∑ CSR and social policy;
- ∑ informatization;
- ∑ functional interdependence.

In the field of corporate culture, companies are recommended, first of all, to form an image of an employee-oriented organization. The translation of a system of corporate values in which the company recognizes and respects the interests and needs of employees, as well as the promotion of appropriate organizational practices, has a significant and universal positive impact on the development of all components of social capital.

The Russian business culture is characterized by an exceptionally high role of the goals and values of managers and, accordingly, their perception by employees [1]. Management interested in the development of social capital, taking into account this feature, should symbolically demonstrate and confirm in practice the re-

jection of a purely technocratic, functional perception of employees, recognizing their interests and expectations. Given that employee orientation is not a common type of corporate culture in Russian organizations, following this recommendation requires, first of all, changing the attitudes of senior management, at least at the declarative level.

Russian organizations interested in the growth of social capital can also be recommended to increase the level of openness and reduce the rigidity of control.

In the field of social sphere management, recommendations for the development of social capital are primarily related to the introduction and codification of CSR principles, social policy and the creation of mechanisms for resolving intra-organizational conflicts. These management decisions in practice embody the principles of an employee-oriented corporate culture, as they are perceived in the Russian business culture. In this sense, corporate culture and social policy complement each other, creating a social environment that is perceived as comfortable and promotes positive relationships in the team.

Informatization is an important part of managerial efficiency, but it is only indirectly related to the tasks of developing social capital. The latter is promoted, first of all, by corporate social technologies – means that allow not only and not so much vertical and unidirectional, but horizontal and interactive communications, which are not only formal, but also informal, which reflects one of the most important trends in modern management.

The introduction of corporate social information and communication technologies provides an impact on various components of social capital:

∑ structural (creating new simple contact opportunities and a virtual interaction space for employees);

∑ cognitive (ensuring the formation of a single information and semantic space and creating conditions for overcoming possible differences in the language, perspective and perception of the organizational environment, reducing the importance of many potential communication barriers);

∑ relational (increasing the flexibility of communication strategies and tactics, providing greater transparency of communications, reducing the possible stressful nature of personal contacts).

The informatization of organizational communications is especially valuable for the development of social capital in market and hierarchical relations. The advantages of corporate social information resources are complemented by relatively low implementation costs. Of exceptional importance are the high flexibility and adaptability of social information resources, which allow us to develop solutions taking into account the characteristics of the company and strategic tasks in the field of social capital.

A clear perception of social capital as an independent resource of organization-

al development and an understanding of the value of its balanced development for the formation of new management models based on a progressive management paradigm is of fundamental importance for the successful operation of an organization.

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神话——现代媒体领域假货的先驱
MYTHS – THE PRECURSOR OF FAKES IN THE MODERN MEDIA SPACE

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每一次权力的更替，也是其神话的一次更迭。 寻找一种新的沟通方式，重塑一个神话并不是一件容易的事，可以通过大量的反复试验来解决。 在科学环境中尚未研究过的假货对受众的影响机制的出现，假货前辈问题的成因研究 – 不同系统状态碰撞情况下的神话，识别方法 现代现实中的假货决定了研究的目的。

关键词：媒体空间、新闻提要、千禧年神话、神话重塑、赝品、流行病、Covid-19。

Abstract. *Each change of power is also a change in its mythology. Finding a new style of communication, rebranding a myth is not an easy task, which can be solved through a lot of trial and error. The emergence of mechanisms of the impact of fakes on the audience that have not been studied in the scientific environment, the study of the genesis of the problem of predecessors of fakes - myths in a situation of collision of different systems-states, methods of identifying fakes in modern realities determine the purpose of the study.*

Keywords*: media space, news feed, millenarian myth, myth-rebranding, fakes, pandemic, Covid-19.*

The modern media space functions under conditions of active circulation of fakes. So, one of the most "dangerous" for the health of citizens of the fake, "fresh hedgehog", was the order of the Ministry of Health of the Russian Federation, which appeared in May, allegedly telling about the recommendation to treat coronavirus with alcohol-containing drinks, in particular, vodka. Fake was actively distributed in messengers and was fixed by users in many regions. The delusional message was widely circulated, but the Ministry of Health promptly denied the information[1]. The news feed was supported by a young man from Tyumen, who

1 The Ministry of Health speaks about the treatment of coronavirus with vodka // Tengrinews.kz. : [Electronic resource] – URL: https://tengrinews.kz/kazakhstan_news/o–lechenii–koronavirusa–vodkoy–vyiskazalsya–minzdrav–406151/ (appeal date: 06.06.2021).

introduced himself as an Italian doctor speaking Russian. He voiced the method of treatment with alcohol-containing substances (ingestion and inhalation of steam), referring to the research of American and Japanese doctors, which "the authorities are hiding"[2]. The Covid-19 pandemic became a shock stage in the coverage of space by fakes. Quarantine measures have limited many areas of production, including journalism. Access to information verification was hampered by the mass hysteria of the population. The emergence of mechanisms that have not been studied in the scientific environment for the impact of fakes on the audience, the study of the genesis of the problem of predecessors of fakes - myths, especially in a situation of collision of different systems-states, methods of identifying fakes in modern realities (pandemics) determine the relevance of the study.

90s: strengthening of the myth-making component in media channels

In Soviet society (1917–1991), the millenarian myth dominated, accompanying any sacralization of a 1000-year period of time. The basis of millenarianism is the beliefs, views, theories of a religious, social or political group or movement in the cardinal transformations of society associated with millennial cycles. It corresponded to the logical laws, the logos of communist and capitalist thinking, contained within itself two components: the demiurgic and the trickster. As a result, the use of the functional features of myth-making in society had destructive consequences for the spiritual culture of the entire social organism, the collapsed and plundered Soviet society. Despite the seemingly radical changes that shook the country, society continued to live in the old ideological settings and coordinates. Some elements of the economy, social preferences and moral values have changed, but the myth-constituent of the statehood of the new Russia has remained the same.

The media of all levels persistently and purposefully convinced Russian citizens of the futility of the ideology of the proletariat; consumer myths that simplify reality, level out contradictions, and take away from real problems came into use and took a leading place. Modern political ritual automatically copied foreign models, national archaism. Not the fundamental principles of mythmaking technology, but technological nuances constituted a decisive part in the mythmaking technology of various political forces influencing the modern political process. The newest myths, performing certain functions in the communication space, were modified and, according to the laws of "anti-myth", were reduced to the level of “black and white simplification”, formed in the heat of the struggle against old dogmas, incorrectly, with the help of falsifications. For the practical and universal application of the scheme explaining the impact of myth on the mass consciousness, on the activities of political institutions, there was one obstacle: the

2 Another fake about the treatment of coronavirus: the charlatan calls on to breathe vodka // News: [Electronic resource] – URL: https://www.vesti.ru/article/2407476 (appeal date: 06.06.2021).

researcher who turned it into an instrument of political analysis must a priori agree that the "technique" of mythmaking is fundamentally the same both in totalitarian and in democratic societies, despite the fact that the political process is developing according to a different scenario. Offering a given picture of the world to a person, mythological symbols formed a distorted idea of the surrounding reality, gave negative ideas about good and evil, etc. Accordingly, new mythical images contributed to negative human behavior, nihilistic thinking, since they did not correspond to the realities of social life. The artificially created myth-making really influenced the functioning consciousness, which can never be completely rid of formations mythological in origin. At one time, mythology yielded a leading role to a number of specialized forms of social consciousness, at the turn of the third millennium its revival takes place, but not as a system of world explanation, but as a kind of method of thinking, which is associated more with a destructive than a creative function. None of the proposed official myths was able to take on the full function of the nucleus of the new social ideology in the near future. So, the old melody of the anthem with revived new words, patriotic songs, etc. confirm the idea of the complete absence of a symbolic mobilization system in modern society. With the help of the media, the translators of myths, there was a struggle for the minds of people, in which not every individual was able to grasp the hidden, latent ideological level of a particular party or association. Myth-making and mythologization are becoming a convenient means of realizing a hidden political effect, they play a certain role in the psychological "unloading" of a person, save and protect, help not to lose faith in the rationality of the world. The myth was redefined by introducing into it a new, frank, changing the meaning of the original image, the destruction of the traditional image. It was this position that most accurately corresponded to the crisis worldview, in which the experience of generations was destroyed, instead of individualization, personality degradation took place, traditions were considered as unnecessary for society. This has resulted in so-called "relaxed behavior", which has become a model for media channels. They broadcast a special reality and a special myth, inscribing it into their laws of the genre; they substitute the choice of a particular social concept for the choice between advertising texts.

The 1991 nomenklatura revolution marked the collapse of the authoritarian-bureaucratic system and the collapse of the USSR. During Yeltsin's "bloodless revolution", there was no change of "powers", no fundamentally different ideology was developed. B.N. Yeltsin, being within the old millenarian myth, did not feel the need to find a mythological basis for ideology, he simply gave the old myth a new look, being for a short time a "creator", a remake-trickster of political bricolage.

Political myths were born, died, but none of them received a logical form, did

not grow into a holistic mythology. The birth of the mythologemes "freedom of speech" and "glasnost" was a consequence of the law "On the Mass Media" adopted in October 1991. The press was actively introducing the image of a democratic leader into the consciousness of citizens, accompanying it with the clarification "Yeltsin is freedom of speech". The "freedom of the press" myth was supplanted by the "oligarchic mediacracy" myth. The introduction of the ideology of a democratic social order required relying on sacred thinking. The mechanisms of sacralization were aimed at strengthening the existing political structure. The new myths carried latent meanings that depended on the political moment. The press was perceived as the territory of individuals: E. Yakovlev, V. Korotich, V. Tretyakov et. al. Their images were introduced into the consciousness of the masses as a complex and multidimensional product of their individual psyche and creativity. This is how the myth of "a free journalist" was born.

The manipulators of consciousness did a lot to achieve their goals, since they had various funds received from corporate and government budgets. But they could not prevent the growth of understanding of the true essence of the existing system, since manipulation is incompatible with dialogue and public debate.

The phenomenon of active myth-rebranding in the press has activated the change of the brand of the myth of a political hero and political parties. The brand was set ambitious goals, which included: brand differentiation (strengthening its uniqueness); strengthening the brand (increasing consumer loyalty); increasing the target audience of the brand (attracting new consumers). A successful rebranding took the outdated myth brand to a new level of development, helped it evolve, made it attractive to public attention, and increased loyalty to it[3]. **Researcher G. Pocheptsov asserts: "Neither fakes nor simple information carry a "key"that reveals the truth. The widespread dissemination of false information is associated with the dramatically increased ways of delivering such information, one of the reasons for which was social networks. They broke the mandatory credibility of the messages we dealt with. The number of such information players with their differing goals has grown dramatically.** As a result, the world has become not only more information-dependent than before, but also a variety of information sources have become more accessible. As we gain more information, we have become not only less discerning about the truth, but also less interested in information"[4].

Fake news replaced myth-rebranding

The current propaganda operates in a dialogue mode, its background is a variety of opinions, which it tries to replace with one and only one. It learned to win

3 See: Vasilieva L.A. Myth-making and mythology in print media: retrospective and modernity. Diss. for app. sci. degree of dr. philol. sci. SPbU, 2017.

4 Pocheptsov G. How fakes and myths conquer the reality of the media.// http://noravank.am/rus/articles/detail.php?ELEMENT_ID=18135.20.05 2020

in such ambiguous conditions for her. Features in the processes of information dissemination are as follows:

- false information is disseminated not for the sake of spreading the truth, but for political reasons or for the sake of making money on Internet traffic,

- false information is spread by journalists who do not understand that it is a lie,

- there is always at least a grain of truth in false information, providing it with an element of reliability[5]

The very word "propaganda" began to carry a negative connotation. New designations have been introduced into scientific circulation - "strategic communications", "operations of influence", "strategic narrative". According to G. Pochenptsov, "today there are many truths, and this gives rise to problems not only of the fight against fakes, which are abundant in any conflict situation, from the Russian-Ukrainian conflict to the presidential elections in the United States. The volumes of false information that circulates on an equal footing with fair information is simply off scale today. Today's propagandists are not going to follow the truth at all, they live in a post-truth world. For them, this means that the main component is the correspondence not to reality, but to the model of the world. Hence the "crucified boy" as a classic example of a fake created by Russian television. We have before us a weak mechanism of action; on the contrary, it is very powerful, since all of its narratives strictly follow the model of the master narrative: everything bad - is only with them, everything good - is only with us"[6].

Fakes are a subject of constant discussion, they were information hoaxes, targeted misinformation in the media and social media. That is, the purpose of fake news is to give importance and meaning to the false information. They contain information that the recipient (the object of receipt) must perceive as a fact. According to the statements of the researcher N.B. Berdigulov, the fake is accompanied by a loud sensation, is presented under a "noisy" title"[7]. The sources of fakes are certain myths, especially in a situation of collision of different systems-states. That is, the problem goes beyond the scientific and media discourse, affecting the direct interests of ordinary citizens. Be it "fake", lie, hoax or misinformation, theoretical comprehension of the phenomenon, its structural functions, did not happen immediately. Researcher O.E. Golovatskaya focuses on the lack of an exact semantic definition of the fake news phenomenon. Indeed, the now generally

5 See: Pocheptsov G. Genesis and new forms of propaganda communications in the global information space.№3[321]03.15.2017. Scientific and cultural journal. №3 08. (386). 01.08.20021.//http://www.relga.ru/Environ/WebObjects/tgu-www.woa/wa/Main?level1=main&level2=articles&textid=4910

6 Ibid.

7 Berdigulova, N.B. Factchecking – a new kind of information space // Ilimium-pedagogical zhana methodicalyk journal. – 2019. – № 3–4. – P. 25–28.

accepted definition - information hoax - was introduced into circulation by the Internet encyclopedia "Wikipedia" (without citing the source), but does not have a clear definition in philological textbooks. The term itself was approved in 2018 at a meeting of the Commission of the Public Chamber of Russia[8]. In the same year, an urgent problem appeared, taking into account the exacerbation of false or manipulative information messages. For example, in March 2020, National Geographic Russia released the article "Putin released 500 lions into the streets to enforce quarantine."[9] An emergency message plaque was attached to the photograph of a lion walking alone through the city streets. The image is accompanied by the Live logo and timestamp, giving the impression of a screenshot of a TV news. It was possible to debunk the myth thanks to the social network Twitter - the user turned to subscribers and launched a hashtag, according to which the original source of the photo was found. The lion turned out to be tame, the scene was in Colombia, and a video of a commercial was recorded on it.

Conclusions. The power of the 90s turned out to be weak in terms of "mythologizing" statehood, which it had never been involved in; the Communist Party was responsible for the ideological component in Soviet times. Updated mythological interpretations acted as one of the means of "pulling" reality to the desired level, positive or negative. The myth gains new strength, acquires new qualities, becomes more attractive to society. However, each change of power is also a change in its mythology. Finding a new style of communication, rebranding a myth is not an easy task, which can be solved through numerous trials and errors of many specific people. This renewal is impossible without updating personalities, since totalitarian propaganda acted in a monologue mode and this is the weakest point in the politics of modern Russia, which has a reputation in the world as one of the corrupt states.

The 2017 slogan is "fake news". The main patterns of interaction with the audience can be radically different, and the spread of fake news can be both manipulative disinformation and the spread of fake out of ignorance. Just as fakes launch counter-myths, statesmen try to operate on counter-myths. They see the more positive side of reality, while the population sees the negative. political forces. Fakes have become the most important discourse in the journalistic environment. The problem goes beyond the scientific and media discourse, affecting the direct interests of ordinary citizens.

8 The Public Chamber of the Russian Federation discussed the dissemination of fake information // RAEK [Electronic resource]: https://raec.ru/live/branch/10393/ (appeal date: 08.01.2021).

9 "Putin released 500 lions into the streets to enforce quarantine." Fake news out of control // NatGeo Russia: [Electronic resource] – URL: https://nat–geo.ru/accidents/kitajskij–koronavirus–2020/fake–news–putin–vypustil–na–ulitsy–500–lvov/ (appeal date: 07.06.2021). https://nat-geo.ru/accidents/kitajskij-koronavirus-2020/fake-news-putin-vypustil-na-ulitsy-500-lvov/

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TATIANA LARINA – 俄罗斯女性的理想（基于 A. S. PUSHKIN 的小说“EUGENE ONEGIN”）

TATIANA LARINA – THE IDEAL OF A RUSSIAN WOMAN (BASED ON THE NOVEL BY A. S. PUSHKIN "EUGENE ONEGIN")

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俄罗斯俄罗斯女人　这篇文章的目的是表明普希金斯卡娅·塔蒂亚娜是俄罗斯女人的理想形象，是崇高道德理想的体现，主要的不是她的阶级归属，而是社会最佳品质的体现。一位俄罗斯妇女，她与人民的民族生活密切相关。抚养塔蒂亚娜的真实环境是农村、民间的俄罗斯。塔蒂亚娜的内心世界绝对不符合她生活的日常世界，尽管她并不回避这个世界，也不否认它。普希金展示了女主人公爱她周围整个世界的能力，她的本性正直，对她的原则的忠诚。女主人公对周围的人很好，但她生活的社会并不接受她。塔蒂亚娜认为她在精神上所属的世界是她自己的世界，她想回到那里。塔蒂亚娜的行为就像一个天生就绝对道德的人。在任何情况下都不应违反某些生活规律，包括婚姻忠诚度。在自我牺牲的能力中，忠于自己的话，忠于职责的内在要求，没有弱点，而是塔蒂亚娜的道德力量和美丽，普希金对俄罗斯女性的理想。

关键词：理想，普希金，俄罗斯女人，塔季扬娜·拉琳娜，小说《尤金·奥涅金》

Annotation. *Russian Russian woman The purpose of the article is to show that Pushkinskaya Tatiana is the ideal image of a Russian woman, the embodiment of a high moral ideal, for which the main thing is not her class affiliation, but the embodiment of the best qualities of a Russian woman, her closeness to the national life of the people. The real environment that brought up Tatiana is rural, folk Russia. Tatiana's inner world absolutely does not correspond to the everyday world in which she lives, although she does not avoid this world and does not deny it. Pushkin shows the heroine's ability to love the whole world around her, her integrity of nature, loyalty to her principles. The heroine is kind to the people around her, but she is not accepted by the society in which she lives. Tatiana considers the world to which she belongs spiritually, where she would like to return, to be her own. Tatiana acts like a person who is absolutely moral by nature.*

There are certain laws of life that should not be violated under any circumstances, including marital fidelity. In the ability to self – sacrifice, in loyalty to one's word, to the inner dictates of duty, there is not weakness, but the moral strength and beauty of Tatiana, Pushkin's ideal of a Russian woman.

Keywords: *ideal, A. S. Pushkin, Russian woman, Tatyana Larina, novel "Eugene Onegin"*

Tatyana Larina is the image of a wonderful Russian woman, one of the most charming, bright images of domestic and world literature. Tatiana, in the words of Belinsky, is an exceptional being. All of it is surrounded in the novel by an aura of poetic and moral purity. In her image, Pushkin captured many things that were infinitely close and dear to his heart. Hence the special sincerity, lyrical warmth and penetration in her image.

The famous critic Belinsky V. G. believed that it was "Tatiana-the type of Russian woman" [2]. For Pushkin, Tatiana is in many ways an ideal image. The author does not hide his love for her ("I love my dear Tatiana so much!") [6, p.411]. He repeatedly says about her: "my faithful ideal" [6, p. 502], "Tatiana's sweet ideal" [6, p.503]. Tatiana appears in the novel as the embodiment of a high moral ideal that opposes secular society, everything insignificant, petty, low, an ideal to which Onegin also turns his eyes after the trials he has experienced.

Tatiana is a special heroine who stands out both against the background of her family and against the background of Onegin's image. Such isolation of the hero is characteristic, in principle, for the literature of the era of Romanism. She is not capable of protest, she is nice and patient, but, nevertheless, she is not a product of the society in which she lives. This is how it has developed personally for her, it depends only on her magnificent qualities of character, on her rich, modest inner world [1, p. 103].

The main difference between Tatiana and Onegin is that she is organically connected with the national, national soil not by reason, not by mind, but by her whole being. Tatiana – "Russian soul" [6, p. 423]. This definition captures the main thing. In the whole appearance of Tatiana, in her spiritual qualities, moral principles, many remarkable features of the national character are embodied [6, p. 104, 109], the historically formed type of Russian woman "in its ideal expression" [3, p.309].

The desire to reveal Tatiana's connections with national traditions is noticeable in the novel in everything, starting from the very name of the heroine. It stood out so sharply against the background of conventional book names with its commonness and ordinariness that Pushkin specifically stipulated: "for the first time, we will wilfully consecrate the pages of a tender novel with such a name" [6, p. 377]. This name was dear, first of all, because it was associated with "the memory of a maiden's old days" [6, p. 377].

The novel shows that the characters of Onegin and Tatiana were formed in different conditions, under the influence of opposite circumstances. Unlike Onegin, who was brought up in the conditions of the capital's secular society, prim St. Petersburg salons, where artificiality prevailed in everything, a complete separation from national, folk traditions (in culture, everyday life, morality). Tatiana grew up in a village, in a patriarchal family, where the "habits of the dear old days" were kept [6, p. 382], traditional rituals, habits, customs that had been formed for centuries.

Pushkin does not idealize, does not embellish the landowner's life of the Larins, his stagnation, the serf-like habits of the inhabitants of the manor estate (for example, Tatiana's mother "shaved her foreheads", "beat the maids angrily") [6, p.381]. Not without irony, he tells about the metamorphosis of Tatiana's mother, who was fond of sensitive poems, but then turned into an ordinary economic landowner, devoid of lofty ideals and

aspirations, about her father – Dmitry Larin, who ate and drank in a "dressing gown" and "died an hour before dinner" [6, p.382]. In the family life of the Larins, Pushkin highlights all those "habits of the dear old days" (they "had Russian pancakes" on Shrovetide [6, p. 382], sang folk songs, loved round swings, led round dances, etc.), which were kept, in fact, by the whole village Russia, and this is what is important for understanding Tatiana, the impressions of her childhood and youth.

As G. A. Gukovsky noted, the fact that Tatiana is a landowner's daughter does not yet play a decisive role for Pushkin at the time of the creation of the novel, the social principle in her image is not decisive [4, p.110].

The main thing for Tatiana is not her class affiliation, not that she grew up in a noble family, but the embodiment of the best qualities of a Russian woman in her, her proximity to the national life of the people. The real environment that brought up Tatiana was not so much a manor house, as a village, folk Russia. It is not by chance that Pushkin emphasizes that Tatiana "seemed like a strange girl in her native family" [6, p. 378]. She acutely feels her loneliness in the family, which she confesses in her letter of confession to Onegin:

Imagine: I'm here alone.
No one understands me.
My mind is exhausted.
And I must die in silence [6, p. 399].

The only person spiritually close to her is a simple peasant serf, a nanny, communication with whom has planted many good seeds in the soul of the "district young lady" [6, p.413]. Only with a nanny can she share her innermost feelings and thoughts. The image of a nanny accompanies her all her life, and in the most difficult moments, Tatiana mentally turns to her. Even after becoming a socialite,

Tatiana still remembers the nanny with sadness. In a certain respect, the fate of Tatiana repeats in its own way the tragic fate of the nanny – the sad fate of a Russian woman in the past.

Tatiana has become forever related to rural Russia – she vividly feels the inexplicable charm of her native Central Russian nature (she loved the Russian winter, "loved to warn the sunrise") [6, p. 379], folk customs, traditions, customs are dear to her, close and understandable.

Tatiana believed the legends
Of the common people of antiquity,
And dreams, and card fortune-telling,
And the predictions of the moon [6, p. 424].

The proximity of the Pushkin heroine to the folk-poetic world is especially revealed in the fifth chapter – one of the most important for understanding the novel. Here Tatiana turns to the traditional Yuletide rites – she guesses on rings, listens to folk songs ("And a ring came out to her under the song of ancient days") [6, p. 425].

Tatiana's dream itself is a ritual dream, in which, according to popular beliefs, the bride can see her betrothed [8, p. 135]. It is built on the material of folk tales and songs: here is a miserable hut, a bear, fantastic monsters. The very atmosphere of girlish fears, forebodings, the comparison of Tatiana with the gadayusha Svetlana from the ballad of Zhukovsky is remarkable...

The deepest connection with the national soil, the element of people's life caused Tatiana's remarkable character traits-the strength and depth of feelings (she "loves without joking", "loves without art") [6, p.394], integrity of nature, sincerity, the ability to selflessness, moral purity. The external circumstances of her life change, but the main thing remains unchanged – her charming spiritual appearance. After getting married, becoming a socialite, a princess, she still remains the same old "poor Tanya" in her soul [6, p.499]. The light, with its pomp and tinsel, is deeply alien to her. For her, he is a "rag of a masquerade" [6, p. 501], in which she is forced to suffer in deep solitude. With her heart, she still rushes to another life.

Belinsky V. G. emphasized that " a passionately in love, a simple girl, then a secular lady, Tatiana, is always the same in all positions of her life, a portrait of her as a child... subsequently, it is only developed, but not changed" [2, p. 545].

In the heroine Tatiana, Pushkin creates a two-world, her inner world [6, p. 103] absolutely does not correspond to the everyday world in which she lives, although Tatiana does not avoid this world and does not deny it. Tatiana merges with nature. When a pure feeling of love for Onegin awoke in Tatiana's soul, Pushkin exclaims:

Tatiana, dear Tatiana!
With you now I'm pouring tears;
You are in the hands of a fashionable tyrant

I've already given up my fate
You will perish, my dear ... [6, p. 390].

Most likely, she is a child of nature, part of nature, part of the world around her, but not part of the society in which she exists. This is what speaks of the heroine's duality.

The novel lyrically reveals the inner world of the heroine [6, p. 103] Tatiana, creates a hero, an exceptional hero, in exceptional circumstances. If Tatiana's circumstances are not exceptional, she lives in her village, then society excludes her as its offspring, she managed to preserve the integrity of her nature and remain a special person among her village family.

Tatiana has a very rich inner world [6, p. 103], one can say, religious, which Pushkin never mentions in the work. The heroine is absolutely humble, kind to the people around her, but she is not accepted by the society in which she lives. Tatiana considers the world to which she belongs spiritually, where she would like to return, to be her own, and for Onegin, "his" world is the world from which he wants to escape [5].

Why does Tatiana reject Onegin at the end of the novel?

Tatiana acts like a person who is absolutely moral by nature. There are certain laws of life that should not be violated under any circumstances, including marital fidelity. The love affair that Onegin starts with Tatiana ends quite successfully for Tatiana.

What is Onegin proud of? He preaches a sermon to her in the garden and says that he is acting honestly with her when he does not take her to marry in response to the fact that she herself proposed to him. It was a good lesson, and Tatiana learned it for the rest of her life. It was a mistake, from the point of view of the girl's morality, from the point of view of religiosity and secular morality, the life of a Russian person, especially in the village of that time. Since then, Tatiana does not make such mistakes, she completely obeys her mother, and when her mother takes her to the bride fair, and her aunt offers her a well-deserved man, a military general, much older than her, she does not object. Tatiana decides to submit, as she believes, to God's will, to create her own marriage, getting married, as it was necessary according to religious and moral principles once and for life. And he observes this loyalty.

This can not but delight, so Pushkin retains the splendor, simplicity, wonderfulness, completeness and a certain realism of the image of Tatiana.

Of course, after the rebuke to Eugene
But I am given to someone else;
I will be faithful to him forever [6, p. 501].

Tatiana only wins both in the eyes of the author and in the eyes of the reader. The heroine expresses a quiet protest, a protest against a stagnant society, against

the swamp of village life. The girl lives absolutely independently and is rich in her internal reflections. She is able to love the whole world around her. This ability, this integrity of nature, loyalty to his principles of his heroine is shown by Pushkin in the novel.

Tatiana Larina lived like an orphan in her house, like an adopted daughter.

She is in her own family

She seemed like a stranger to the girl [6, p. 378].

Loyalty to duty for Tatiana is by no means loyalty to the circumstances imposed on her outwardly: after all, she herself, as was noted by Dostoevsky, agreed to get married, that is, she acted consciously. It may have been her mistake, but it's not so easy to fix it now. Tatiana, according to Dostoevsky's famous words, cannot build her personal happiness on the misfortune of another [6, p. 109]: "There is a tragedy here, it is being committed."

It is possible that in another work, in other conditions, the heroine would have made a different decision, and it would have been natural. But it would have been a different heroine. Pushkin's Tatiana could not have done otherwise, it would have contradicted the entire artistic logic of the image, would have destroyed its integrity. Loyalty to duty follows from the peculiarities of Tatiana's mental disposition, it contributes to the norms of not secular, but precisely folk morality, imprinted in folk songs about the female share [7, p.343-346].

In the ability to self – sacrifice, in loyalty to one's word, to the inner dictates of duty, there is not weakness, but the moral strength and beauty of Tatiana, Pushkin's ideal of a Russian woman. It is enough for a moment to imagine the impossible, namely: that Tatiana behaved differently, as her image would immediately fade, lose its poetry, charm.

The meaning of life for Tatiana is compliance with the highest rules of morality, and Tatiana herself, undoubtedly, is the heroine of conscience, the ideal of a Russian woman.

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托尔斯泰小说《安娜·卡列尼娜》中的家庭问题主题
THE THEME OF FAMILY PROBLEMS IN LEO TOLSTOY'S NOVEL "ANNA KARENINA"

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家庭和家庭关系的主题自古以来一直是俄罗斯作家作品的主要主题之一，直到二十世纪末。 托尔斯泰展示了三种类型的家庭：奥布隆斯基家族、列文家族和卡列宁家族。 家庭“幸福”或“不幸”的路径是不同的。这完全取决于男人和女人在建立家庭方面的投资，以及他们对自己和彼此的责任的衡量标准。 在列夫·托尔斯泰看来，只有当丈夫和妻子能够成为彼此的支持和支持时，家庭幸福才会出现。 托尔斯泰L.N.作为研究人类灵魂的杰出心理学家，深知家庭是立业之本，因此在他的作品中不断强调这种社会制度的重要性。

关键词：家庭主题，L.N.托尔斯泰，小说《安娜卡列尼娜》，人际关系

Annotation. *The theme of family and family relationships has been one of the main themes in the works of Russian writers since ancient times and until the end of the twentieth century. Tolstoy shows three types of family: the Oblonskys, the Levins and the Karenins. The paths to family "happiness" or "unhappiness" are different. It all depends on what a man and a woman invest in building their family, what is their measure of responsibility to themselves and to each other. According to Leo Tolstoy, family happiness arises only when a husband and wife are able to become each other's support and support. Tolstoy L. N., as an outstanding psychologist who studied the human soul, understood that the family is the basis of the foundations, so in his works he constantly emphasized the importance of this social institution.*

Keywords: *the theme of the family, L. N. Tolstoy, the novel " Anna Karenina, relationships*

In the traditions of Russian literature, both in modern prose and in the prose of the X1X century, the theme of the family acts as the moral basis of life and everyday life. Many works of classical literature of the XIX century in an open or veiled form permeates the "family thought". One of them is the novel by Leo

Tolstoy "Anna Karenina", in which there are no historical figures or world events.

The author does not give lyrical, journalistic or philosophical digressions in the work. But the discussions caused by the novel after its publication were not limited to purely literary interests due to the fact that the main theme of the work was the theme of family discord.

After completing the work on the novel, L. N. Tolstoy admitted that " the society modern to Anna Karenina is close and understandable to him, in this regard, it was easier for the writer to delve into the feelings and thoughts of the novel's contemporaries, which is of significant importance in the artistic depiction of the existing reality. This is the "all-day" content of the novel "from modern life" [8].

The success of" Anna Karenina " turned out to be huge, it was read in all circles of educated Russian and foreign society. This fact is explained by the central line of the plot. Heroes in search of the meaning of life, its awareness and acceptance. To express the author's thoughts, all significant characters are in the state of this search: characters who lead a thoughtless and desperate existence, characters who are not capable of self-awareness, of passing the life path, of spiritual purification.

What is the reason for the tragedy in the novel? There are many points of view on this score: there are those who believe that the whole thing is in the social conditions of that time, namely, the legal and social complexity of divorce and the public condemnation of adultery; others say that the tragedy is that Anna did not meet a single person who would support her.

Tolstoy L. N. thinks about the problems of family and marriage, especially in 1870, especially the reality that surrounded him contributed to this. In 1872, the unofficial wife of the landowner Bibikov, Anna Stepanovna Pirogova, threw herself under the train. The Tolstoy family knew the deceased well. It is her fate that is reflected in"Anna Karenina".

The idea of the novel is the image of a married woman from high society who ruined herself. Tolstoy wanted to make this woman compassionate, not guilty. The prototype of Karenina was Pushkin's eldest daughter Maria Hartung, who did not accept Tolstoy's courtship and did not throw herself under the wheels.

The novel, on which Tolstoy worked for 4 years, begins with the thought "All happy families are similar to each other, each unhappy family is unhappy in its own way" [6, p. 5]. These words are the "psychological key" to the work: unhappy families are in the center of attention. Then the phrase "Everything is mixed up in the Oblonsky house" [6, p. 5]. The novel begins with the collapse of the family, the destruction of human relations.

The paths to family "happiness" or "unhappiness" are different. It all depends

on what a man and a woman invest in building their family, what is their measure of responsibility to themselves and to each other. It is not by chance

that such an ethical category as "conscience" and "shame" becomes of great

importance in the novel [3, p. 30].

The main problem of the work is revealed by the example of several family couples: Anna-Alexey Karenin, Dolly-Steve Oblonsky, Kitty-Konstantin Levin. Tolstoy shows three types of family: the Oblonskys, the Levins and the Karenins.

The Oblonsky family. The novel begins with a conflict in this family. Stiva cheated on Dolly with a young governess. Dolly can't forgive him. Anna intervened, she manages to restore the fragile peace in the Oblonsky family [3, p. 31]. Tolstoy considers this family unhappy. Dolly has 6 children, and they are constantly experiencing difficult situations.

Stiva is a kind, sociable person, loves life very much, but the role of a family man is not for him. He does not know how to manage money, because of this, his wife and children are always in need. Stiva is prone to hobbies with other women. Dolly is very loyal. She dreams of taking revenge on her husband and comes up with an image of a man in love with her, but she is always busy with the house and children. She is offended by her husband for the fact that he lives cheerfully, and she grew old early because of children and family life. The spouses quarrel and reconcile, they feel happy. All this is thanks to Dolly: she forgave the betrayal, constantly closes her eyes to her husband's lifestyle, is insightful, kind.

At the wedding of Kitty and Levina, she remembers her love for her husband. After a visit to Anna and Vronsky, Dolly reviews a lot for herself: using Anna's example, she sees that happiness is not in money, not in clothes, not in having free time and not in how much her husband expresses his love. Anna has all this, but she is unhappy and full of fears. She thinks with horror about the only child of Anna and Vronsky (the girl Anya), and is glad that she has six of them. This family is not perfect, but they are real people who together overcome obstacles, misunderstandings, negative sides of each other. They know how to forgive, ask for forgiveness and love, raise children and build a life together.

The Oblonskys ' world is a patriarchal Moscow. The Oblonsky family bears the imprint of a traditional Russian family [3, p. 31].

The Levin family. Levin is a landowner, lives in the village, runs a large and complex farm. The ancestral home "was Levin's whole world." He speaks with pride about the patriotism and aristocracy of his ancestors. The period of the ruin of the "noble nests" is coming, Levin understands the inevitability of this system." He is trying to understand the mystery of new social relations and his place in life. Levin is a dreamer, soberly looks at life and fights for his happiness, maintaining mental balance, is close to nature (he is happy when he hears the rustle of dry leaves and sees how the grass grows under them), its natural laws, sees this as the key to his happiness and family well-being.

The marriage with Kitty is happy, they understand each other, but Levin's spiritual needs are beyond the family. The further development of Russia is important

for him. The ideal is a large and friendly peasant family that cares about everything. Levin is looking for the truth of life. The description of Levin's life forms one of the plot lines in the novel, but does not contradict the general idea and composition.

Anna's spiritual torments and Levin's search for truth are interrelated aspects of life in the post – reform era, showing the crisis in the destinies of people and ways to overcome it. Levin can be called a portrait of Tolstoy. The writer invested in Levin his views, manners, a tendency to rebel against generally recognized authorities, sincerity, a negative attitude towards the zemstvo and the court, a passion for farming, relations with peasants, and disillusionment with science. Like Tolstoy, Levin lives in the country, not in the city.

Researchers call Levin's portrait a photograph of Tolstoy's 70s, because only one period of Tolstoy's life was reflected in Levin's experiences. The main thing that distinguishes Tolstoy and Levin is creativity. Instead of creativity, Levin writes an article about workers, it reflects Tolstoy's passion for agriculture, which has already passed during the writing of "Anna Karenina".

The Karenin family. Alexey Alexandrovich Karenin is Anna's husband, a high-ranking statesman, influential in secular society. He is respected for his honesty, decency, and prudence. He is hardworking, purposeful and orderly in his affairs and feelings, lives "on schedule". Work takes up all his time, sometimes he treats his wife and son disdainfully, hides his true feelings. Alexey Alexandrovich loves his family and values it. When Karenin finds out about the connection between Anna and Vronsky, his weakness is revealed – his inability to show his feelings. It depends on generally accepted norms. He does not fight for his love, tries to find a reasonable solution instead of increasing his tenderness for his wife, closes himself in work. Karenin decided to leave everything as it is, but constantly reminds Anna about decency. The family of Anna and Karenin is a European type of family [3, p. 31]. He forgives her and selflessly loves when Anna is in a serious condition after giving birth to her daughter, sincerely cares about her, is ready to raise the daughter of Anna and Vronsky. Anna comes to her senses and leaves him again, he again weakens, although by nature a fighter.

Vronsky, on the contrary, shows character and determination. At the end of the novel, it turns out that Karenin is still a weak person hiding behind a uniform. After Anna's death, his career stops, there is also stagnation in household affairs, until Countess Lidia Ivanovna took up them. He is still a wingman, begins to attend a secret religious circle. After Anna's death and Vronsky's departure, she brings up their daughter.

It should be noted that Anna did not marry Alexey Alexandrovich out of love, and he himself did not have strong feelings for his wife, as well as for everyone around him. Only duty, service, and decency cared about Karenin, and his wife

aspired to love. At first, all the tenderness was concentrated in her son Seryozha, and then Alexey Vronsky appeared in her life, and the heroine could not resist passion. Anna's family collapses like a house of cards when love comes to her, turning into passion [3, p.31].

Anna and Vronsky converge, but the family does not work out, since they both do not have a developed family instinct, which means that they are not able to experience family happiness, which, according to Leo Tolstoy's deep conviction, occurs only when a husband and wife are able to become support and support for each other. Tragic is the finale of an unhappy love [1, p. 155], doomed to suffering from the very beginning [3, p. 30-31]. The collapse of the traditional foundations of the family institute was one of the first in Russian literature established by L. N. Tolstoy. Anna challenged society, and society rejected her, as it was not capable of adopting a style of behavior leading to the collapse of the family. If subjectively Anna's act can be explained by the state of falling in love, then objectively, with the help of her own actions, she undermined the institution of the family.

The novel features two storylines-Anna Karenina and Konstantin Levin.

The first is an unhappy path, the second is a happy one. Tolstoy showed the crisis of [5, p. 360], an old family based on public morality. He contrasts artificial family life with natural relationships.

The author tried to outline ways out of the crisis.

The first way. Anna Karenina deliberately goes to break with her husband, and therefore with the legalized norms of morality in the noble society. The reason is the awakening of a sense of personality and true love. This is a tragedy of the individual and society. Anna defends her right to life, love, happiness without secular shackles. The death of Anna is a lesson of Tolstoy-the teacher. According to the writer, family is the main thing in a person's life. Anna abandoned her husband and child, sacrificed family ties for love. This is her strength and at the same time her sin. Tolstoy believed that it could not have happened to her otherwise. Suicide is an impulse to which she gave herself after a quarrel with Vronsky, a fatal accident.

On the other hand, the motive of retribution. She wants to punish him. The last words to Vronsky: "You will repent of this" [7, p. 333]. Another motive of remorse: Anna sees death as the only way out for Alexey Alexandrovich, Seryozha and for her. At the moment of these thoughts, a candle goes out in the room (Symbol! Love has gone out). And Anna herself is like a burnt-out candle, which no longer has a basis to continue burning and living. Before her death, she was tormented by nightmares about "a dirty ugly peasant in a cap who is doing something over iron" [7, p. 349].

Internally, without realizing it yet, Anna was ready for death. She said to Kitty: "I have come to say goodbye to you" [7, p. 339]. Dolly similarly: "So goodbye, Dolly" [7, p. 340]. Anna rethinks her relationship with Vronsky. The thoughts ad-

dressed to the cheerful company "You will not leave yourself" [7, p. 342, are addressed to her. She has nowhere to go, but she doesn't want to die either. She clings to life, but without a chance: she writes a note to Vronsky, but it does not reach her, goes to visit Dolly, but neither Dolly nor Kitty understand her, can not help. Anna tries to console herself with her love for Seryozha, but she blames herself for having exchanged her love for her son and was able to live without her. She was finished off by a note from Vronsky, written in a careless handwriting. "No, I will not let you torment yourself, "[7, p. 348] - she thought. The thought and memory of the man crushed at the station on the day of her first meeting with Vronsky prompted her to a decision. "There, in the very middle, and I will punish him and get rid of everyone and myself" [7, p. 348]. She crossed herself and rushed between the cars. Anna didn't want to die. She fell on her hands and tried to get up immediately, horrified by what she had done. But it was too late: "something huge, inexorable pushed her into the head" [7, p. 349]. It was fate. Anna felt the impossibility of fighting.

And again Tolstoy is a teacher: you can't resist punishment, you just had to ask for forgiveness. He describes Anna's death cruelly. It is important that even after death, Anna wants to live: "curly hair on the temples" [7, p. 339], "a charming face with a half-open rosy mouth", in "unclosed eyes begging for life, a terrible expression that reminds Vronsky of her words that he will repent" [4, p. 484].

The second way. Levin has everything like Tolstoy. The marriage of Kitty and Levin made him the happiest man, a family man, but his gap in relations with society did not smooth out. He perceives capitalism as a universal disaster, resists its onset. For him, the main thing is the economy. He lovingly fertilizes the land, grows crops. But the feeling that the question of changing the socio-economic structure of the whole country cannot be solved in this way leads Levin into contradictions. He compares his personal life with the life of the peasants and concludes that the solution of problems is based on the rapprochement of the ruling classes with the people. The truth is on the side of the people. Levin's spiritual quest is the path of Tolstoy's reflections on his own life 10 years after "War and Peace". These searches continue the line of Olenin ("Cossacks"), Andrei Bolkonsky and Pierre Bezukhov, with the difference that Levin, unlike his predecessors, looks for the reasons for his own failures not in the absence of useful activities, but in the economic structure of society [2, p.101].

The heroes of the work from the point of view of realizing the meaning of life are divided into two groups. For some, it is the side of life that is important, which absorbs personal desires and needs; others, having passed through complex spiritual searches, come to "detachment", to renounce the individualistic and connect with the supra-individual, which is not realized by the characters of the novel as something concrete, but in the form of an aspiration will inspire Tolstoy's hero to

continue his life path, giving it a sacred meaning.

The moral position about the meaning of the meaning of the life of the heroes of the novel by Leo Tolstoy, mainly personal, universal, individualism and the relationship of the "cathedral" principle is the ideology of the Slavic people and Westerners.

The problem of the meaning of life occupies an important place in the work of Leo Tolstoy. The evolutionary analysis of the hero of the novel "Anna Karenina" proves that this question plays an important role here – by organizing the ideological structure of the book as a whole and individual episodes of the work, it allows us to better understand the peculiar characteristics of the characters and restore the philosophical picture of the mood of that particular era drawn on it.

The novel "Anna Karenina" has a lot of literary evidence of how difficult it was to formulate the idea of choosing the path of cultural and historical development in Russia at that time, in an era of significant social changes. The writer, through his work "Anna Karenina", helped the reader to see the problems of current life and think about possible ways to solve and eliminate them. The author reacted very subtly and sensitively to the negative changes that occurred in the surrounding reality. Naturally, he could not pass by the changes that the family underwent in the era of the XIX century.

Tolstoy L. N. saw a crisis in the surrounding society, the separation of people. And only a family with its unity can resist external problems and help a person find the meaning of life. Therefore, the "family thought" [3, p. 30] occupies a central place in the novel "Anna Karenina".

The author sympathizes with Anna, but she destroyed the family, L. N. Tolstoy condemns this. The novel begins with a description of the Oblonsky family. The father of the family, Steve, Anna's brother, cheated on his wife Dolly with a governess. This man lives easily and cheerfully, justifies all his vices, treason for him is an inevitability, quite explicable by the cooling to his wife, who has become ugly from many births. Dolly is deeply offended by the current situation: she brings up the children, does the housework, surrounds everyone in the house with care. And the husband pays with black ingratitude. However, she had enough spiritual strength to save her family, and for this L. N. Tolstoy admires her.

Konstantin Levin is also caught up in spiritual searches. His thoughts echo those of Anna, he is even on the verge of suicide, but he has found meaning in serving people and society. This hero found happiness in the family as well. At first it seemed impossible: his beloved Kitty Shcherbatskaya, Dolly's sister, was in love with Vronsky, who left her, then the girl suffered, and only after worries and doubts did the heroes unite. At first, they quarreled, could not find understanding, Levin did not even love his son. However, the hero realized that the family contains all the most important things, he must and wants to protect them and love

them. This understanding came to him in an episode with a thunderstorm, when Levin was afraid for his loved ones who were captured by the elements. He managed to understand the value and meaning of life, and his wife and son helped him. The life of Kitty and Konstantin is instructive for many couples who break up after the first quarrel, without even trying to find understanding.

The family of Kitty and Levin at Tolstoy serves as a symbol of the renewal of Russia. It is not by chance that the theme of a harmonious family completes the novel [3, p. 32].

Thus, we can conclude that the collapse of the traditional foundations of the family institution was one of the first in Russian literature established by L. N. Tolstoy. Anna challenged society, and society rejected her, as it was not capable of adopting a style of behavior leading to the collapse of the family. If subjectively Anna's act can be explained by the state of falling in love, then objectively, with the help of her own actions, she undermined the institution of the family.

Tolstoy L. N. is an outstanding psychologist who studied the human soul, who understood that the family is the basis of the foundations, therefore, in his works he constantly emphasized the importance of this social institution.

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急性伴发重度颅脑损伤患者全身外周血管阻力的昼夜节律
CIRCADIAN RHYTHM OF GENERAL PERIPHERAL VASCULAR RESISTANCE IN ACUTE CONCOMITANT SEVERE TRAUMATIC BRAIN INJURY

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在前 25 天，所有 CSTBI 患者组的 GPVR 昼夜节律中索均增加。 GPVR 昼夜节律主要由所有患者的超电 3-4 小时振荡组成。 第9～17天，第3组昼夜节律GPVR指标较第1、2组高13%。 在研究的第二周，第一组的昼夜节律 GPVR 出现倒置，第二组在 14:00，第三组在 13:00。 在第 1、7、5、4、4、5 组中，GPVR 昼夜节律幅度变化的白天波非常明显。 在第 2 组中，每天有 4、5、6、5、5 次波动。 在第 3 组中，每天有 6、4、6、6、4 次波动。 在受伤后的 25 天内，所有年龄组都存在过度循环的血液循环趋势。

关键词：昼夜节律，外周血管总阻力，合并重型颅脑损伤。

Abstract. *In the first 25 days, the GPVR circadian rhythm mesor was increased in all groups of patients with CSTBI. The GPVR circadian rhythm consisted mainly of ultradian 3-4 hour oscillations in all patients. From 9 to 17 days, the GPVR indicators in the circadian rhythm in group 3 were higher than in the first and second groups by 13%. In the 1st group on the second week of the study there was an inversion of the circadian rhythm GPVR, in the 2nd group at 14:00, and in the 3rd group at 13:00. In group 1, 7, 5, 4, 4, 5 daytime waves of changes in the amplitude of the GPVR circadian rhythm were quite distinguishable. In group 2 there are 4, 5, 6, 5, 5 daily fluctuations. In group 3 there are 6,4,6,6,4 daily fluctuations. For 25 days after the injury, the tendency to the hypercirculatory type of blood circulation persisted in all age groups.*

Keywords*: circadian rhythm, total peripheral vascular resistance, combined severe traumatic brain injury.*

Relevance. The frequency and severity of craniocerebral injuries, high mortality (up to 26.8-81.5%) determine the urgency of this problem and require further development of methods for treating TBI and its complications. TBI is more com-

mon between the ages of 20 and 50, that is, during the period of greatest working capacity, 1.5 times more often in men than in women. The TBI problem has social, economic and defense implications. In about 50% of cases, there is a combination of STBI with systemic trauma of varying severity. Currently, mortality with combined STBI reaches 80%, and among survivors - up to 75% of victims remain with severe neurological defects. At present, the opinion of all leading specialists in the field of neurotrauma boils down to the following basic concept: brain damage in STBI is determined not only by the primary impact at the moment of injury, but also by the action of various damaging factors during the next hours and days, the so-called factors of secondary brain damage (SBD), on which the clinical prognosis and outcome of the acute and long-term periods after STBI depend. In this regard, the main task of providing care for STBI at the stage of hospitalization of patients is to prevent SBD [1-5].

Purpose of the work. To study the circadian rhythm of the total peripheral vascular resistance in acute concomitant severe traumatic brain injury.

Material and research methods. The indicators of a comprehensive examination of 30 patients with concomitant severe craniocerebral trauma (CSTBI) who were admitted to the ICU of the neurosurgical department of RSCEMA in the first hours after an accident - 28, catatrauma of 2 patients were studied. According to indications, 29 patients were started on admission to invasive mechanical respiratory support (MRS). Monitoring was carried out by complex hourly registration of parameters of body temperature, hemodynamics, respiration. Mechanical respiratory support was initiated with artificial lung ventilation (ALV) for a short time followed by switching to SIMV. The severity of the condition was assessed by scoring methods according to the scales for assessing the severity of combined injuries - the CRAMS scale, the assessment of the severity of injuries according to the ISS scale. On admission, impaired consciousness in 29 injured patients was assessed on the Glasgow Coma Scale (GS) 8 points or less. Patients were considered in three age groups: group 1 - 19-40 years old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients).

In 28 patients, the clinic was dominated by the diencephalic and mesencephalo-bulbar forms, which, due to a critical disorder of the vital systems (respiratory and cardiovascular), required urgent intensive therapy, and sometimes resuscitation.

Complex intensive care consisted in identifying and timely correction of deviations: MRS, after removing from shock pain-relieving, anti-inflammatory, antibacterial, infusion therapy, correction of protein and water-electrolyte balance disorders, surgical early correction to the extent possible, stress-protective therapy.

Result and discussion.

Table 1. Dynamics of the mesor of the circadian rhythm GPVR, in dyn.c.cm^{-}5.

Days	Group 1	Group 2	Group 3
1	1543±166	1344±171	1474±168
2	1440±58	1509±112	1588±78
3	1396±97	1513±128	1431±80
4	1455±66	1571±116	1582±138
5	1421±68	1415±101	1550±98
6	1417±69	1357±82	1542±67
7	1397±65	1384±106	1487±95
8	1388±74	1322±70	1434±91
9	1313±72	1301±54	1497±122
10	1365±90	1404±86	1560±134
11	1290±116	1281±95	1433±97
12	1193±71	1382±76	1434±154
13	1261±146	1298±77	1409±160
14	1372±81	1395±77	1479±111
15	1322±84	1343±99	1368±98
16	1300±108	1336±74	1523±150
17	1365±127	1285±75	1559±165
18	1427±111	1455±156	1404±132
19	1437±107	1367±116	1529±181
20	1398±129	1398±127	1596±172
21	1369±81	1190±114	1544±132
22	1237±92	1369±100	1591±232
23	1269±59	1270±127	1379±136
24	1234±90	1252±117	1577±165
25	1364±102	1376±124	1453±211

On the first day, the GPVR circadian rhythm mesor was increased in all groups of patients with CSTBI, remaining without significant dynamics during the first 25 days after severe trauma (table 1). The revealed tendency to an increase in the mesor of the circadian rhythm GPVR was an integral factor of the compensatory hemodynamic response aimed at increasing oxygen delivery to cellular structures, primarily the brain, due to the centralization of blood circulation and the effect of drug stress-protective therapy and urgent correction of the identified (functional, clinical and laboratory parameters) signs of violation of homeostasis systems. A more in-depth analysis made it possible to reveal some features in dynamics, age-related differences in structural changes in the circadian rhythms of GPVR.

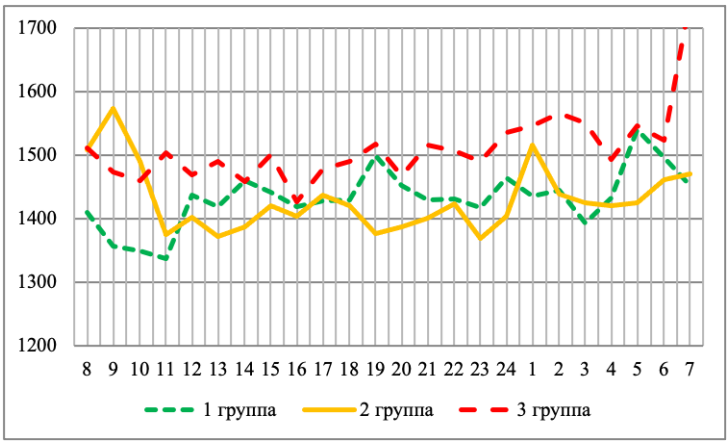

Fig.1. Circadian rhythm GPVR from 1 to 8 days, dyn.c.cm¯5.

As shown in fig. 1, there were no significant differences in age groups in the first week after CSTBI. The GPVR circadian rhythm consisted mainly of ultradian 4 hour oscillations in all patients, in group 1 with acrophase at 9 am, in group 2 at 5 am, in group 3 at 7 am. That is, the normal projection of acrophase was detected only in injured young people (group 1). The average GPVR in group 3 (1511±37) was significantly higher than in group 1 (1432±31) and 2 (1430±38) - by 5% ($p<0.05$, respectively). Thus, in the 1st group in the acute period of CSTBI, despite the increased mesor of the circadian rhythm GPVR on days 1-8, there was a significantly significant decrease in GPVR on average by 5%.

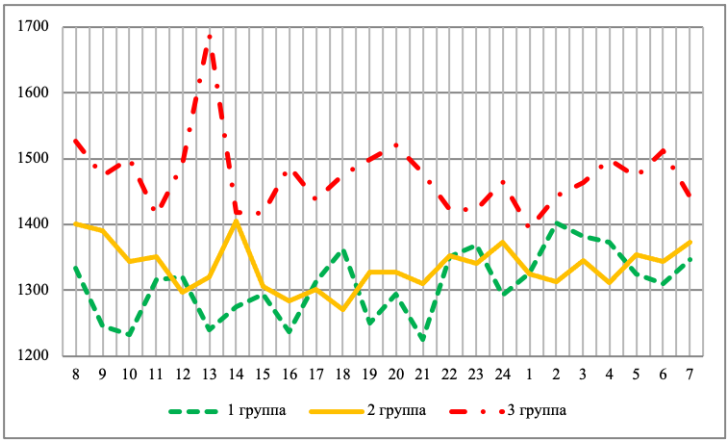

Fig.2. Circadian rhythm of GPVR from 9 to 17 days, in dyn.c.cm¯5

On days 9 - 17, the average daily GPVR curve in group 3 (1474±39) was at a higher level than in groups 1 (1309±42) and 2 (1335±39). That is, the average GPVR values in the circadian rhythm for the period from 9 to 17 days in group 3 were higher than in the first and second groups by 13% ($p<0.05$, respectively). The differences turned out to be significant at 13 o'clock in the afternoon, amounting to 36% ($p<0.05$). Acrophase in group 1 in the second week of the study shifted to 2 am (inversion of the GPVR circadian rhythm occurred), in group 2 at 2 pm, and in group 3 at 1 pm. It should be noted that there was a tendency to decrease the period of ultradian oscillations to 3-4 hour waves, which was more pronounced in groups 1 and 2 (fig. 2).

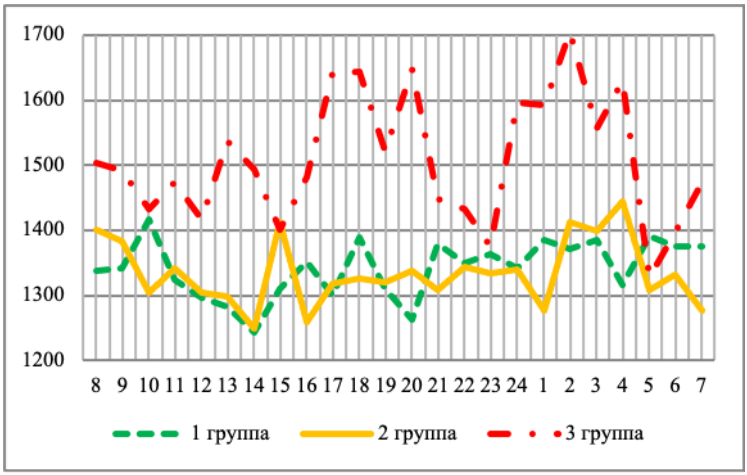

Fig.3. Circadian rhythm GPVR from 18 to 25 days, in dyn.c.cm¯5

A significant difference on days 18 to 25 (fig. 3) was also found in patients of group 3, which was expressed in an increase in the amplitude of ultradian oscillations with the acrophase peak at 2 am by 24% ($p>0.05$), indicating a complete inversion of the circadian rhythm GPVR in patients over 61 years of age. In groups 1 and 2, 3-hour low-amplitude fluctuations prevailed, while in group 3 the amplitude of ultradian rhythms almost doubled, which characterized the pronounced instability of the peripheral vascular tone, more characteristic of the vasopressor effect of drug correction of hemodynamics in conditions of pituitary-adrenal insufficiency. Revealed repeated drops (about 5 times per day) GPVR created extremely unfavorable conditions for the work of the heart muscle, in general, significantly reducing the adaptive capabilities of the heart in conditions of damaging effects on cellular structures, the brain of numerous adverse factors (general intoxication, mitochondrial insufficiency, hypoxia, activation free radical oxidation and others),

which inevitably leads to the development of multiple organ failure syndrome even in conditions of timely correction of homeostasis parameters, which are traditionally controlled in clinical practice.

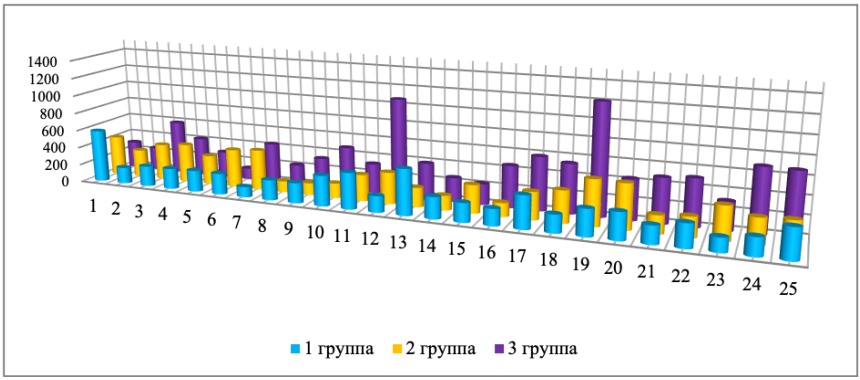

Fig.4 . Dynamics of the amplitude of the circadian rhythm GPVR, in dyn.c.cm^{-}5.

Changes in the amplitude of diurnal fluctuations occurred in a wave-like manner, predominantly following weekly rhythms. So, in group 1, 7, 5, 4, 4, 5 day waves were quite distinguishable. In group 2 there are 4, 5, 6, 5, 5 daily fluctuations. In group 3 there are 6,4,6,6,4 daily fluctuations. Moreover, the greatest amplitude of daily changes in GPVR was observed in group 3 at 12.19 days. Obviously, it is difficult to comply with the main condition for the effectiveness of vasoactive correction - this is the maintenance of a stable tone of peripheral vessels adequate to the consistently increased needs of the brain and other tissues in oxygen.

Table 2. The severity and duration of GPVR acrophase shifts

	norm	moderate shift	inversion
Group 1	12%	40%	48%
Group 2	28%	40%	32%
Group 3	0	56%	44%

As shown in tab. 2, the normal acrophase position prevailed in group 2, occupying 28% of the duration of intensive therapy and was absent in group 3. At the same time, the longest inversion of the GPVR circadian rhythm continued in group 1 (48%), which indicated a significant and longest stress change in the structure of daily biorhythms of GPVR, caused mainly by peripheral vascular spasm in group 1 of a compensatory nature during adaptation in the acute period of CSTBI.

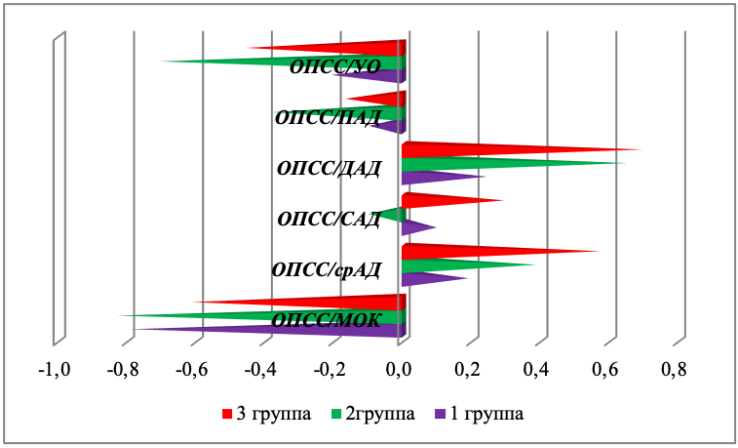

Fig.5. Correlation of GPVR with hemodynamic parameters in the acute period of CSTBI.

A reliably negative correlation between GPVR and IOC (-0.8) was found in group 1, in group 2 - (-0.8) and less pronounced in group 3 - (-0.6), as well as a negative correlation between the GPVR indicator and VO in 0, 2 group (-0.7) was characterized by a tendency towards the formation of a hyperdynamic type of hemodynamics in all the injured. While a positive correlation was noted between GPVR and DBP in 3 - (0.7) and in group 2 - (0.6). The latter makes it possible, by the mesor of the circadian rhythm DBP, to be guided by the state of general peripheral resistance in persons over 41 years old in the acute period of CSTBI. An attempt to identify the features of adaptive changes in the GPVR circadian rhythm depending on the time elapsed from the moment of injury revealed the following.

Table 3. Correlation links GPVR by group

	from 1 to 8 days			from 9 to 17 days			from 18 to 25 days		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group3
GPVR/CO	-0.8	-0.9	-0.7	-0.8	-0.9	-0.5	-1.0	-0.9	-0.6
GPVR/avBP	-0.1	0.4	0.4	0.1	0.1	0.7	-0.2	0.6	0.6
GPVR/SBP	0.0	0.2	0.0	0.0	-0.5	0.4	-0.7	-0.5	0.4
GPVR/DBP	0.0	0.8	0.6	0.2	0.4	0.8	0.3	0.8	0.7
GPVR/PBP	-0.3	0.1	-0.7	-0.4	-0.8	0.0	-0.8	-0.5	0.0
GPVR/SV	-0.3	-0.3	-0.8	-0.3	-0.7	-0.2	-0.9	-0.9	-0.5

A strong negative correlation between GPVR and CO was weakened only in patients of group 3 from 9 to 17 days (-0.5), and from 18 to 25 (-0.6). An inverse

strong dependence of SV on GPVR in the first week was revealed only in group 3 (-0.8), from 9 to 17 days (-0.7) in group 2, in the third week of intensive therapy in patients of groups 1 and 2 (-0.9, respectively). A reliably significant direct correlation between DBP and GPVR indicators appeared in group 2 (0.8) in the first week of treatment, in group 3 in the second week (0.8), and in patients older than 41 years from 18 to 25 days, amounting to 0, 8 and 0.7. Direct dependence of avBP on GPVR was found only in group 3 on days 9-17 (0.7). A strong inverse effect of GPVR on PBP was observed from 1 to 8 days in group 3 (-0.7), from 9 to 17 days in group 2 (-0.8), from 18 to 25 days only in group 1 (-0.8).

Thus, in the most complex adaptation process at different times after injury, different compensatory mechanisms are included, early correlations weaken or disappear, new correlations appear and strengthen. But for 25 days after the injury, despite the increased mesor of the circadian rhythm GPVR and the normal values of the mesor of the circadian rhythm CO, the tendency to the hypercirculatory type of blood circulation persists in all age groups. Apparently, the effectiveness of treatment is in this situation depending on the maintenance of the functional activity of organs, the required level of cellular metabolism with the appropriate delivery of oxygen and the constituents of metabolically active substances necessary in the fight against the energy deficit state, which is inevitable under conditions of severe traumatic stress with concomitant STBI.

Conclusion. In the first 25 days, the GPVR circadian rhythm mesor was increased in all groups of patients with CSTBI. The GPVR circadian rhythm consisted mainly of ultradian 3-4 hour oscillations in all patients. From 9 to 17 days, the GPVR indicators in the circadian rhythm in group 3 were higher than in the first and second groups by 13%. In the 1st group on the second week of the study there was an inversion of the circadian rhythm GPVR, in the 2nd group at 14:00, and in the 3rd group at 13:00. In group 1, 7, 5, 4, 4, 5 daytime waves of changes in the amplitude of the GPVR circadian rhythm were quite distinguishable. In group 2 there are 4, 5, 6, 5, 5 daily fluctuations. In group 3 there are 6,4,6,6,4 daily fluctuations. For 25 days after the injury, the tendency to the hypercirculatory type of blood circulation persisted in all age groups.

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重型颅脑外伤急性期每分钟心输出量昼夜节律动态变化
DYNAMICS OF THE CIRCADIAN RHYTHM OF THE MINUTE CARDIAC OUTPUT IN THE ACUTE PERIOD OF CONCOMITANT SEVERE TRAUMATIC BRAIN INJURY

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受伤后第二周第 1 组中 CO 中尺度的增加与最大程度地动员血液循环以确保在中枢神经系统损伤的继发性发病机制条件下大脑必要的氧合作用有关。心输出量（CO）昼夜节律幅度的变化发生在波长不稳定的波中，每周波动的相位结构变形，以第1组昼夜节律幅度的最高值为主在第 1、13、17、22 天，第 2 组 - 振幅的最大值为 1,19.21 天。第 3 组 - 第 1、19、22 天。 CO 昼夜节律 mesor 的显着较低值显然是由于循环系统在 40 岁以上 CSTBI 急性期适应性重建血流动力学方面的代偿能力有限。在第 2 组患者（41-60 岁）中发现 CO 和 SV (0.87)、CO 和 PBP (0.79) 之间存在强直接相关性。

关键词： 昼夜节律，心输出量，联合重型颅脑损伤

Abstract. *The increase in the CO mesor in group 1 in the second week after injury was associated with the need for maximum mobilization of blood circulation to ensure the necessary oxygenation of the brain under conditions of secondary pathogenetic mechanisms of CNS damage. Changes in the amplitude of the circadian rhythm of cardiac output (CO) occurred in waves with an unstable wavelength, deformation of the phase structure of weekly fluctuations, with the predominance of the highest values of the amplitude of the circadian rhythm in group 1 on days 1, 13, 17, 22, in group 2 - maximum values of the amplitude were at 1,19.21 days. In group 3 - at 1,19,22 days. Significantly lower values of the CO*

circadian rhythm mesor are apparently due to the limited compensatory capabilities of the circulatory system in the adaptive restructuring of hemodynamics in the acute period of CSTBI in patients over 40 years of age. Strong direct correlations between CO and SV (0.87), CO and PBP (0.79) were found in group 2 of patients (41-60 years old).

***Keywords**: circadian rhythm, cardiac output, combined severe traumatic brain injury*

Relevance. The metabolic processes of the brain are adapted to the conditions of rich delivery of oxygen and glucose (with a brain mass of about 2% of body weight, it receives 15-20% of cardiac output), therefore, the brain is practically incapable of anaerobic compensation for a lack of energy, which, under conditions of hypoxia, entails a rapid and irreversible damage to the central nervous system [1,2,3]. After CSTBI, the researchers noted a significant decrease in the cardiac index on the fourth day in the blood oxygen transport system. As a result, this led to a decrease in oxygen consumption and was clinically manifested in an aggravation of the general condition of the patients. Damage to the apparatus for regulating external respiration and blood circulation in severe concomitant trauma with severe craniocerebral injury caused by direct brain injury, subsequent ischemia and edema, it often leads to decompensation in the blood oxygen transport system on the third-fourth day of the post-shock period [4]. Lack of information on the assessment, timely correction of changes in cardiac output prompted us to study one of the priority tasks of intensive therapy for CSTBI in the acute period.

Purpose of the work. To study the circadian rhythm of cardiac output in the acute period of combined severe traumatic brain injury.

Material and research methods. We studied the indicators of a comprehensive examination of 30 patients with concomitant severe traumatic brain injury (CSTBI) who were admitted to the ICU of the RSCEMA neurosurgical department in the first hours after an accident - 28, catatrauma in 2 patients. Continuous hourly monitoring of cardiac output (CO), systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse blood pressure (PBP), average blood pressure (avBP) blood pressure was performed for 25 days after CSTBI. According to indications, 29 patients underwent invasive mechanical respiratory support (MRS) on admission. Mechanical respiratory support began with short-term artificial lung ventilation (ALV) followed by a switch to SIMV. The assessment of the severity of the condition was carried out using scoring methods according to the scales for assessing the severity of combined injuries - the CRAMS scale, the assessment of the severity of injuries according to the ISS scale. On admission, impaired consciousness in 29 injured patients was assessed on the Glasgow Coma Scale (GS) 8 points or less. Patients were considered in three age groups: group 1 - 19-40 years

old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients). Complex intensive care consisted in identifying and timely correction of deviations: MRS, after removing from shock pain-relieving, anti-inflammatory, antibacterial, infusion therapy, correction of protein and water-electrolyte balance disorders, surgical early correction to the extent possible, stress-protective therapy.

Results and discussion. As shown in Table 1, on the first day after the injury, the mesor of the circadian rhythm CO did not differ from the normative data.

Table 1. Dynamics of the mesor of the circadian rhythm CO depending on age

Days	Group 1	Group 2	Group 3
1	4.4±0.4	4.8±0.5	4.8±0.7
2	4.6±0.2	4.5±0.4	4.2±0.2
3	5.2±0.4	4.4±0.3*	4.5±0.3
4	4.9±0.2	4.4±0.3	4.2±0.4*
5	4.9±0.2	4.9±0.5	4.5±0.3
6	5.3±0.5	4.9±0.3	4.5±0.2*
7	5.2±0.4	4.9±0.3	4.7±0.3
8	4.9±0.3	5.0±0.3	4.6±0.4
9	5.3±0.3**	5.1±0.2	4.5±0.4*
10	5.1±0.2	4.6±0.3	4.3±0.4*
11	5.2±0.4	5.2±0.5	4.4±0.3*
12	5.6±0.3**	4.8±0.3*	4.8±0.4*
13	5.7±0.5**	5.0±0.3	4.4±0.4*
14	4.9±0.3	4.6±0.3	4.5±0.3
15	5.1±0.4	4.8±0.4	4.8±0.4
16	5.1±0.4	4.7±0.3	4.5±0.3
17	4.8±0.5	5.3±0.4	4.6±0.4
18	4.7±0.4	4.9±0.4	4.6±0.3
19	4.4±0.3	5.0±0.4	4.6±0.6
20	4.7±0.4	4.9±0.3	4.1±0.4
21	4.9±0.3	5.8±0.5	4.2±0.5
22	5.5±0.4	5.1±0.4	4.4±0.8
23	5.1±0.2	5.3±0.6	4.6±0.5
24	5.3±0.4	5.4±0.5	4.5±0.3
25	4.8±0.4	5.4±0.6	5.0±0.6

*- the difference is significant relative to the indicator in group 1

**- the difference is significant relative to the indicator on the first day

Anti-shock, timely infusion corrective therapy led to the restoration of the mesor of the circadian rhythm of CO already in the first day. As shown in Table 1, the

CO circadian rhythm mesor in all the injured did not differ significantly from the normative data. In group 1, a reliably significant increase in the mesor of the circadian rhythm of CO on days 9, 12, 13 was revealed (by 20%, 27%, 29%, $p < 0.05$, respectively). In groups 2 and 3, there was no significant CO dynamics in the acute period. Comparative analysis showed that in group 2, the circadian rhythm mesors were significantly less than in group 1 on days 3 and 12 (by 15%, 14%, $p<0.05$, respectively). In group 3, on days 4, 6, 9, 10, 11, 12, 13, significantly lower indicators of the mesor of the circadian rhythm CO were found by 14%, 15%, 15%, 15%, 15%, 14%, 22% ($p<0.05$, respectively). Age-related differences in stress-CO reactions, significantly lower values of the mesor of the circadian rhythm of CO in group 3, apparently, are due to the limited compensatory capabilities of the circulatory system in adaptive restructuring of hemodynamics in patients over 40 years of age. The increase in the CO mesor in group 1 in the second week after injury was most likely associated with the need for maximum mobilization of blood circulation to ensure the necessary oxygenation of the brain under conditions of secondary pathogenetic mechanisms of CNS damage.

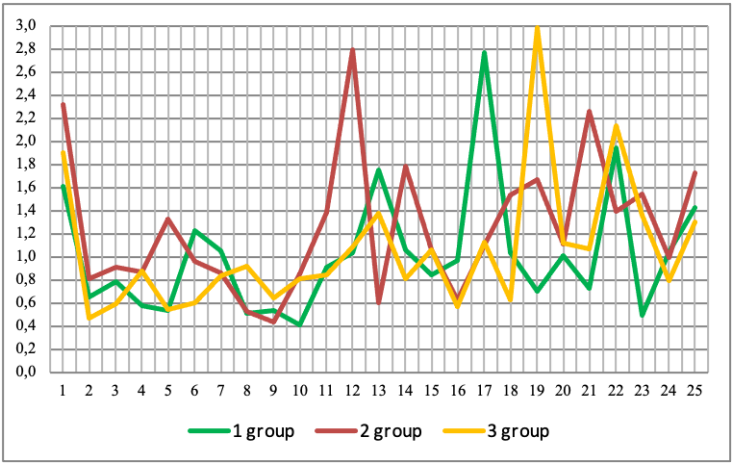

Fig.1. Dynamics of the amplitude of daily fluctuations of CO, l per minute

Changes in the amplitude of the circadian rhythm of CO occurred in a wave-like manner with an unstable wavelength, deformation of the phase structure of near-week fluctuations, with the predominance of the highest values of the amplitude of the circadian rhythm in group 1 on days 1, 13, 17, 22, in group 2 - the maximum values of the amplitude were in 1,19,21 days, in group 3 - at 1,19,22 days. Considering that the stress reaction of hemodynamics is manifested by an increase in the amplitude of daily fluctuations, it can be assumed that the ongoing

intensive therapy on the indicated days was insufficiently stress-protective, despite the fluctuations in hemodynamic parameters within the permissible normative values during the acute period of CSTBI. That is, the compensatory centralization of blood circulation was preserved, aimed at increasing the oxygen supply to the damaged areas of the brain.

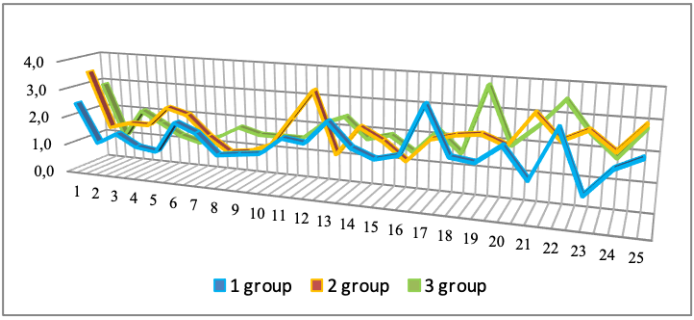

Fig.2. Change in the daily range of CO fluctuations

The dynamics of daily changes in the circadian rhythm (fig. 2) revealed a tendency to increase up to 5.25 l/min in group 1 in the morning 9-11 hours. That is, during the first 25 days, only group 1 patients retained a tendency to maintain the physiological projection of the acrophase of the CO circadian rhythm in the morning hours with an oscillation period of 7 hours, while in groups 2 and 3 this sign of the physiological state of the CO circadian rhythm was absent. It is noteworthy that the 5,6,5-hour CO fluctuations occurred at a comparatively lower level of the CO circadian rhythm mesor in group 3 (4.5±0.1 l/min, $p<0.05$). While the total for 25 days, the mesor of the indicator in group 1 was 5±0.1, in group 2 - 5±0.1 l/min.

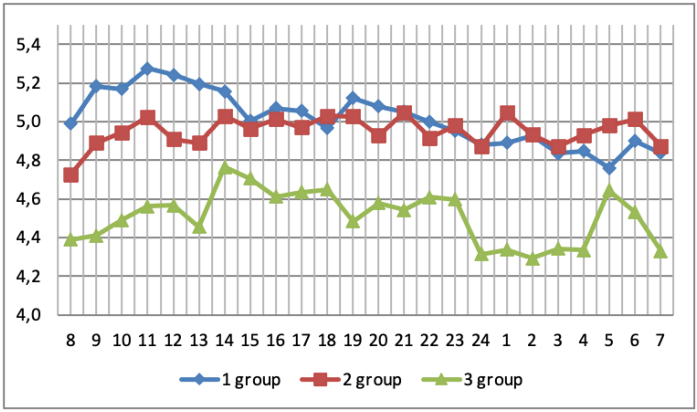

Fig.3. Acute average hourly CO values in the circadian rhythm

Table 2. Changes in the circadian rhythm of cardiac output in the acute period of CSTBI, l/min

Hours	1-8 days			9-17 days			18-25 days		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
8	4.9±0.3	4.5±0.3	4.4±0.2	5.0±0.4	4.6±0.2	4.4±0.3	5.0±0.4	5.0±0.2	4.4±0.6
9	5.2±0.5	4.4±0.6	4.5±0.3	5.3±0.3	5.1±0.8	4.4±0.4	5.0±0.3	5.1±0.3	4.3±0.5
10	5.1±0.1	4.5±0.3*	4.5±0.3*	5.4±0.3	4.9±0.3	4.4±0.4*	4.9±0.4	5.4±0.7	4.6±0.7
11	5.2±0.2	4.8±0.3	4.3±0.3*	5.2±0.5	5.1±0.5	4.8±0.3	5.4±0.7	5.2±0.3	4.6±0.3
12	4.9±0.6	4.5±0.3	4.5±0.3	5.5±0.5	5.1±0.6	4.6±0.3*	5.2±0.6	5.1±0.5	4.6±0.6
13	5.1±0.5	4.7±0.3	4.7±0.5	5.3±0.5	4.8±0.3	4.3±0.4*	5.2±0.5	5.2±0.5	4.4±0.3
14	5.0±0.5	4.8±0.3	4.7±0.6	5.3±0.3	4.7±0.3	4.9±0.5	5.2±0.4	5.6±0.7	4.6±0.6
15	4.9±0.2	5.0±0.7	4.7±0.3	5.2±0.3	4.9±0.2	4.7±0.2	4.9±0.4	5.0±0.7	4.7±0.3
16	5.1±0.4	4.8±0.5	4.8±0.4	5.3±0.4	5.0±0.3	4.5±0.7	4.8±0.3	5.2±0.5	4.5±0.2
17	4.9±0.3	4.6±0.3	4.8±0.5	5.1±0.3	4.9±0.4	4.8±0.4	5.1±0.2	5.4±0.5	4.3±0.3*
18	5.0±0.5	4.7±0.4	4.5±0.4	5.1±0.7	5.0±0.4	4.6±0.5	4.7±0.3	5.4±0.5	4.8±1.1
19	4.8±0.4	4.9±0.3	4.5±0.2	5.5±0.5	4.9±0.4	4.5±0.6	5.0±0.5	5.3±0.4	4.5±0.2
20	4.9±0.3	4.8±0.3	4.8±0.5	5.4±0.6	5.0±0.4	4.3±0.5	4.9±0.6	5.0±0.3	4.7±0.7
21	4.9±0.4	4.8±0.3	4.5±0.2	5.5±0.4	5.0±0.2	4.5±0.4*	4.8±0.5	5.3±0.3	4.6±0.3
22	5.0±0.4	4.7±0.3	4.6±0.3	5.1±0.3	4.9±0.5	4.5±0.3	4.8±0.3	5.2±0.4	4.8±0.5
23	4.9±0.4	4.9±0.3	4.4±0.3	5.1±0.4	4.9±0.4	4.6±0.4	4.8±0.3	5.2±0.5	4.8±0.6
24	4.6±0.2	4.7±0.4	4.3±0.2	5.1±0.4	4.8±0.3	4.4±0.5	4.9±0.4	5.2±0.3	4.2±0.4
1	4.9±0.4	4.6±0.5	4.3±0.2	5.1±0.2	4.9±0.3	4.6±0.3	4.6±0.3	5.6±0.6	4.2±0.6
2	4.9±0.4	4.8±0.6	4.2±0.2*	5.1±0.5	5.1±0.3	4.5±0.3	4.8±0.5	4.9±0.4	4.2±0.4
3	4.9±0.3	4.8±0.5	4.3±0.2*	4.9±0.4	4.8±0.4	4.4±0.4	4.7±0.2	5.0±0.3	4.2±0.4
4	4.8±0.4	4.7±0.5	4.6±0.3	4.8±0.3	5.0±0.5	4.3±0.3	4.9±0.4	5.0±0.5	4.1±0.7
5	4.5±0.2	4.8±0.4	4.5±0.4	5.1±0.4	4.9±0.4	4.6±0.3	4.7±0.5	5.3±0.5	4.9±0.6
6	4.7±0.4	4.8±0.5	4.6±0.3	5.2±0.4	4.9±0.3	4.5±0.1*	4.7±0.4	5.4±0.9	4.6±0.6
7	4.9±0.5	4.8±0.4	4.0±0.3*	5.0±0.3	4.5±0.2	4.6±0.4	4.6±0.4	5.4±0.8	4.4±0.5

*- reliably relative to the indicator in group 1

During the first week of the acute period, hourly analysis of CO in the circadian rhythm did not reveal significant changes (tab. 2). The age-related features of blood circulation adaptation at different times of the acute period of CSTBI were manifested in the fact that in the first week of intensive therapy, a significant difference was revealed in the morning (10.11 hours) in acrophase and at night (at 2.3, 7 hours) - in the bathyphase of the circadian rhythm. CO (fig. 4). Thus, in groups 2 and 3 at 10 a.m. CO was significantly less than in group 1 by 11% (0.6 l/min), $p < 0.05$, respectively. And at 11 o'clock in the morning, only patients of group 3 showed a significantly lower CO by 17% (by 0.9 l/min), $p<0.05$. In group 3, a significantly lower CO indicator was also found at night at 2 am by 14% (0.7 l per minute), at 3 am by 12% (0.6 l/min). At 7 o'clock in the morning, there was significantly less CO than in group 1 by 18% (by 0.9 l /min) in group 3.

During the second week, a significantly significant difference was found between the indicators in groups 1 and 3. Thus, the CO index of patients of group 3 was less than in group 1 at 10, 12, 13, 21, 6 a.m. by 18% (1 l per minute), 19% (0.9 l per minute), 18% (1 l/min), 18% (1 l/min), 13% (0.7 l/min) p <0.05, respectively (fig. 5).

In the third week of the acute period of CSTBI, a significantly significant decrease in CO was revealed only in group 3 at 5 pm by 15% (by 0.8 liters per minute), p<0.05 (fig. 6). Thus, the most significant decrease in CO (tendency to hypodynamic type of hemodynamics) was observed in the first week in group 3 and to a lesser extent in group 2, remaining in group 3 during the third week, indicating the most significant tendency to develop circulatory failure in patients over 61 years old.

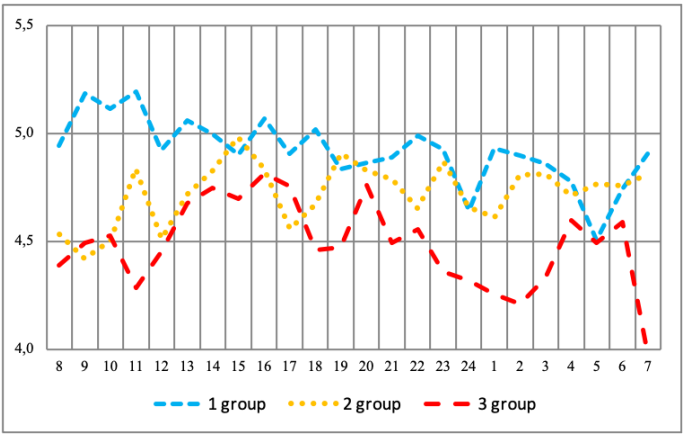

Fig.4. Circadian rhythms CO for 1-8 days, l/min

As seen in fig. 4, in the first week of intensive therapy in group 1, the daily CO wave was represented by ultradian low-amplitude 6-5 hour waves with a mesoorium of 4.9±0.1 liters per minute, acrophase at 9-11 hours. In group 2, the amplitude of fluctuations was somewhat higher with a meso-volume of 4.7±0.1 l/min. In group 3, ultradian waves are less constant with a period of fluctuations from 3 to 6 hours (at night), a mesor of 4.5±0.2 liters per minute. Thus, the mesor of the circadian rhythm CO in the first 8 days in group 3 was significantly less than the indicator of group 1 by 7% (p<0.05). That is, hemodynamics in group 3 from the very beginning differed in the instability of ultradian rhythms, significantly lower CO. The latter was due to age-related failure of adaptive mechanisms, mitochondrial insufficiency, which determines the energy-deficient state of the myocardium in elderly people.

Fig. 5 shows ultradian rhythms on days 9-17 of the acute period. Attention was drawn to a clearer picture of ultradian oscillations of almost the same amplitude in age groups. The age difference was expressed in the values of the mesor of the circadian rhythm CO on days 9-17. Thus, in group 1, CO mesor was 5.2±0.1 l/min, in group 2 - 4.9±0.1 l/min, in group 3 - 4.5±0.1 l/min. The CO mesor index in group 2 turned out to be less than in the first by 6%, in group 3 it was less than in the first by 13% ($p<0.05$, respectively). That is, throughout the entire acute period, the index of the mesora of the circadian rhythm CO in group 3 remained lower than in the first two groups.

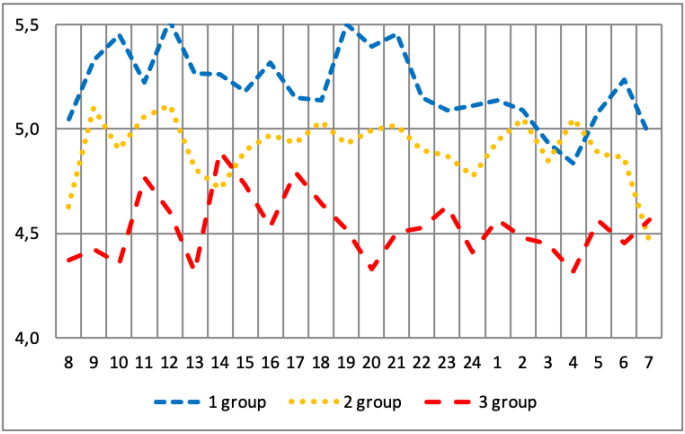

Fig.5. Circadian rhythms CO on days 9-17, l/min

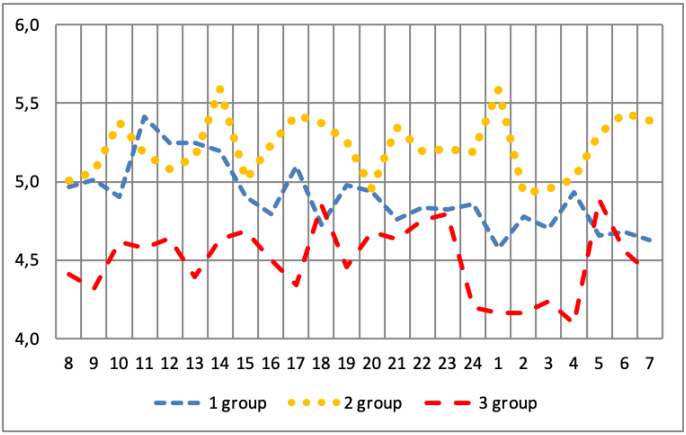

Fig. 6. Circadian rhythms CO at 18-25 days l/min

As shown in Fig. 6, on the 18-25th day of the acute period, the average hourly CO values revealed the oscillatory nature of changes in the circadian birhythm of CO, presented in group 1 by 3-4 hour waves with an acrophase of the circadian rhythm at 11 a.m., a mesor of 4.9 ± 0, 2 l/min. Group 2 was dominated by 4x, 5-hour fluctuations with a relatively large value of the mesor of the circadian rhythm CO (5.2±0.2 l/min). Ultradian waves in group 3 differed in a significantly lower level of the mesor of the circadian rhythm CO (4.5 ± 0.2 l/min) relative to group 2. That is, on the 18-25th day in persons over 61 years old, a tendency to the formation of a hypodynamic type of blood circulation due to heart failure was revealed.

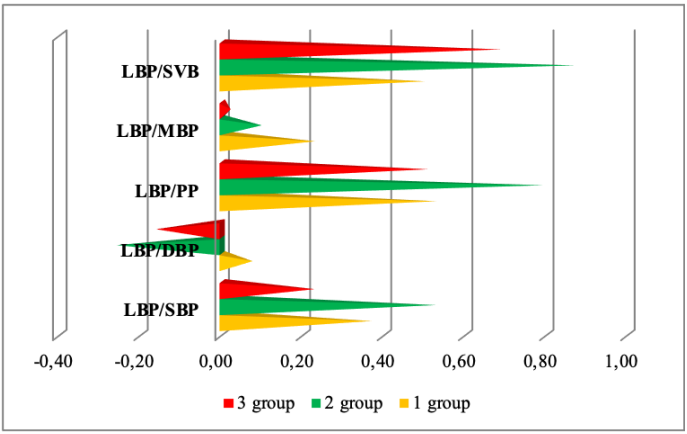

Fig.7. Correlation links of CO

Strong direct correlations of CO and SV (0.87), CO and PBP (0.79) were found in group 2 of patients, a trend was revealed in groups 3 and 1 (fig. 7).

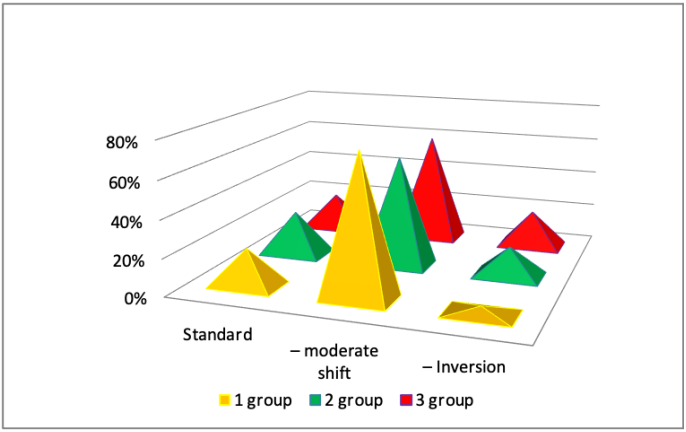

Fig.8. Duration and severity of CO circadian rhythm acrophase shifts in the acute period of CSTBI

Evaluation of the duration and severity of acrophase shifts made it possible to ascertain the prevalence of a moderate degree of displacement of the CO circadian rhythm acrophase peak in all age groups (fig. 8).

Conclusions. The detected increase in the CO mesor in group 1 in the second week after injury was most likely associated with the need for maximum mobilization of blood circulation to ensure the necessary oxygenation of the brain under conditions of secondary pathogenetic mechanisms of CNS damage. Changes in the amplitude of the CO circadian rhythm occurred in waves with an unstable wavelength, deformation of the phase structure of weekly oscillations. Throughout the entire acute period, the CO mesor of the circadian rhythm in group 3 remained lower than in the first two groups. In patients over 40 years of age, the changes are due to the limited compensatory capabilities of the circulatory system in the adaptive restructuring of hemodynamics in the acute period of CSTBI. Strong direct correlations between CO and SV (0.87), CO and PBP (0.79) were found in group 2 of patients.

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动脉高血压——从性别差异看
ARTERIAL HYPERTENSION - A VIEW FROM THE PERSPECTIVE OF GENDER DIFFERENCES

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预防和治疗动脉高血压的个体化方法应该是个体化医疗的基础，同时考虑到性别和性别特征。 在该大学的临床基础上，对 36 名先前诊断为 AH 的男性和 44 名女性进行了检查。 根据人体测量数据、生化血液检查指标、颈总动脉内中膜复合体厚度指标进行比较。 随着血压数字的增加，无论性别如何，腹部肥胖的当量都会增加。 已确定男性不存在亚临床动脉粥样硬化，而女性则相反，这与女性性激素随着更年期开始失去心脏保护作用的理论一致。

关键词：动脉高血压，性别差异，更年期

Abstract*. An individual approach to the prevention and treatment of arterial hypertension should be the basis of personalized medicine, taking into account gender and gender characteristics. On the clinical basis of the university, 36 men and 44 women with previously diagnosed AH were examined. The comparison was carried out according to anthropometric data, indicators of biochemical blood tests, an indicator of the thickness of the intima-media complex of the common carotid artery. An increase in the equivalent of abdominal obesity, regardless of gender, was revealed as the blood pressure numbers increased. The absence of subclinical atherosclerosis in men and the opposite result in women was determined, consistent with the theory of the loss of cardioprotective effects of female sex hormones with the onset of menopause.*

Keywords*: arterial hypertension, gender differences, menopause*

In the recommendations of the ESC/ESH (European Society of Cardiology/ European Society of Hypertension) from 2018, not only metabolic and hemodynamic (heart rate, HR), but also socioeconomic and psychosocial factors are mentioned as risk factors for arterial hypertension [1]. An individual approach to the prevention and treatment of diseases should be the basis of personalized medicine, which takes into account gender and gender characteristics [2]. In studies on the

male population, the highest significance of such risk factors for diseases of the circulatory system as overweight, smoking, and hypercholesterolemia was noted [3,4]. The first myocardial infarction among women is recorded at the age of 65-72 years, and in the male population - from 55 to 65 years old [5-7]. Worldwide, cardiovascular diseases are the leading cause of morbidity, disability and mortality among both men and women [8]. Current research makes sure to take into account potential gender differences that were not previously considered even in the study design, when most of the studies were conducted in middle-aged men.

Thus, despite the prevalence of diseases of the cardiovascular system, both among men and among women, there are undoubted facts indicating significant gender differences in their formation, course, prognosis and prevention.

At the clinical base of the Moscow State University of Medicine and Dentistry, 80 patients with previously diagnosed with AH were observed, of which 44 patients suffered from stage I AH and 36 patients had stage II AH.

In both groups, men and women were comparable in age, absence of concomitant diseases of the cardiovascular system, diabetes mellitus, acute forms or exacerbation of chronic inflammatory diseases. All patients signed written informed consent. The clinical examination included clarification of complaints, clarification of the gynecological history in women, clinical examination, which included measuring blood pressure (BP), heart rate (HR), height, weight, waist and hips, calculating body mass index by the Quetelet index [body weight (kg)/ height(m^2)]. The patients underwent a biochemical blood test: the level of CH, TG, HDLP, LDLP, glucose, creatinine, CRP was determined. The GFR was calculated using the CKD-EPI formula and measured in ml/min/1.73m^2. Doppler ultrasound examination of the extracranial vessels of the neck was carried out in order to assess the state of the vascular wall, its echogenicity, surface with the determination of the IMC thickness of the common carotid artery. During statistical processing, the arithmetic mean of the corresponding parameter and the standard deviation (M±SD) were calculated. The groups were compared using the nonparametric Smirnov-Kolmogorov test (for paired comparisons of indicators within the groups), the differences were considered statistically significant at $p<0.05$.

Results

Table 1. Main anthropometric parameters and metabolic status in patients with AH stage I depending on gender

Indicator	Men of the group (N=11)	Women of the group (N=33)	Reference values
Height (cm)	176.82±3.06	163.49±5.34*	-
Weight (kg)	82.83±10.15	73.70±14.31*	-
BMI (kg/m^2)	26.55±3.16	27.34±4.64	<25

Indicator	Men of the group (N=11)	Women of the group (N=33)	Reference values
WG (cm)	91.00±5.61	83.33±11.73	<102 for men <88 for women
HG (cm)	102.25±2.87	106.30±10.36	-
WG/HG	0.88±0.05	0.78±0.06*	<0.9 for men, <0.85 for women
SBP (mmHg)	130.00±7.82	120.45±14.33	<140
DBP (mmHg)	82.00±6.32	78.48±10.49	<90
HR (bpm)	64.25±7.96	72.42±10.71*	<80 bpm
TCH (mmol/l)	5.48±0.79	5.68±0.91	<5
TG (mmol/l)	1.57±0.85	1.40±0.85	<1.7
Xc-LDLP(mmol/l)	3.18±0.67	3.96±0.83*	<3
Xc-HDLP (mmol/l)	1.43±0.41	1.48±0.42	<1.0 for men, <1.2 for women
Glucose (mmol/l)	5.29±0.93	5.19±0.70	≤5.5
Creatinine (mmol/l)	84.44±8.11	79.26±18.54	<115 for men, <107 for women
GFR (ml/min/1.73m²)	92.33±11.25	76.48±17.79*	>90
CRP (mg/l)	4.33±3.67	1.87±3.21*	<5
IMC (mm)	0.69±0.35	0.95±0.15	<0.9

* - $p<0.05$ between groups of men and women with stage 1 AH

Data on gender comparison of the above indicators in patients with stage I AH are presented in table 1. Despite the absence of significant differences in waist and hip measurements, there is a difference in the WG/HG ratio in men and women - 0.88±0.05 and 0.78±0.06, respectively. At the same time, the significance of the difference in the Xc-LDLP indicator is noteworthy, although in both groups the average level of Xc-LDLP exceeds 3.0 mmol/l. It should be noted that the differences in C-reactive protein are significant. Thus, in men, less pronounced changes in lipid metabolism and in the thickness of the intima-media complex were observed than in women of the same age with AH of comparable severity.

The group of patients with stage II arterial hypertension included 11 women and 25 men (table 2). Analyzing table 2, in both groups there is a tendency to an increase in overweight. Hyperlipidemia due to the atherogenic fraction in men is higher than in women and the thickening of the intima-media complex in women is up to 1.03±0.09 mm than in men (0.84±0.29 mm). However, compared with men, women with a similar disease have significantly less pronounced WG/HG, CRP and glomerular filtration rates.

Table 2. Comparison between groups of women and men suffering from AH stage II in terms of the main anthropometric parameters and metabolic status

Indicator	Men of the group (N=11)	Women of the group (N=25)	Target values
Height (cm)	175.20±4.98	164.64±3.91*	-
Weight (kg)	85.58±11.55	84.27±9.62	-
ИМТ (kg/m²)	27.81±2.98	30.39±3.15	<25
WG (cm)	94.85±6.82	95.73±11.66	<102 for men <88 for women
HG (cm)	102.45±4.87	113.10±9.49*	-
WG/HG	0.93±0.07	0.83±0.05*	<0.9 for men, <0.85 for women
SBP (mmHg)	131.00±12.33	141.36±18.72	<140
DBP (mmHg)	83.04±6.53	91.82±9.82*	<90
HR (bpm)	66.59±9.05	68.82±7.09	<80 bpm
TCH (mmol/l)	5.32±0.93	6.31±1.53	<5
TG (mmol/l)	1.61±0.98	1.29±0.38	<1.7
Xc-LDLP (mmol/l)	3.32±0.88	3.29±0.26	<3
Xc-HDLP (mmol/l)	1.23±0.34	1.31±0.27	<1.0 for men, <1.2 for women
Glucose (mmol/l)	5.28±0.49	5.19±0.47	≤5.5
Creatinine(mmol/l)	89.61±13.73	80.89±9.43	<115 for men, <107 for women
GFR(ml/min/1.73m²)	88.83±15.05	71.33±8.41*	>90
CRP (mg/l)	4.67±2.69	1.30±1.89*	<5
IMC (mm)	0.84±0.29	1.03±0.09	<0,9

* - p<0.05 between groups of women and men with stage 2 AH

Discussion

The Framingham Heart Study was the first study to show significant differences between men and women. The main unchanged risk factors for AH are generally known, age and gender, with most population studies noting that the prevalence of AH increases with age. Under the age of 50, the prevalence of AH is higher among men, while in older age groups this pattern changes, which can be explained by an increase in the number of risk factors that form AH in women [9].

In our study, it was noted that in stage I AH, men had higher blood pressure values than women. Significant differences in diastolic BP in group II AH between men and women should be noted. Thus, as the severity of hypertension worsened with increasing age, there were higher mean values of both systolic and diastolic BP in men than in women.

In our study, patients with stage I AH showed similar results in terms of mass

index. In the group with stage II AH in women, BMI increased to 30.39±3.15 kg/m², while in men this indicator remained practically unchanged (BMI=27.81±2.98 kg/m²). Menopause is associated with an increase in body weight and the development of abdominal obesity [10, 11], so the findings are consistent with the literature.

Metabolic risk factors are more common with high BP than with low BP. In the scientific literature of recent years, more attention has been noted to the indicators of waist volume and the ratio of waist to hips, rather than to body mass index, since these indicators more accurately reflect the presence of abdominal obesity [10]. In the recommendations for arterial hypertension, it is indicated that the limit values of the waist volume - for men, this value was 102 cm and 88 cm for women, and the indicator of the ratio of waist to hips (WG/HG) should not exceed 0.8 regardless of gender [1]. According to our data, in the case of stage I AH in both women and men, the average waist measurement did not exceed the recommended values. It should be noted that the WG/HG indicator was significantly higher in men and exceeded the threshold value of 0.8. In patients with stage II AH, the following data were obtained: in women, both the waist measurement and the WG/HG level exceeded the recommended values. In men, the average values of the waist volume did not exceed the threshold level, while the WG/HG indicator not only exceeded the recommended value, but also turned out to be significantly lower than the analogous indicator in women. Thus, our data are consistent with the literature data that as the blood pressure numbers increase, there is an increase in the WG/HG indicator as an equivalent of abdominal obesity, regardless of gender [2].

Numerous epidemiological studies have shown that there is a clear positive relationship between elevated blood levels of total cholesterol, Xc-LDLP, triglycerides and the risk of atherosclerosis, while Xc-HDLP has a negative relationship [1]. In our work, we obtained data on the similarity of the average total cholesterol between women and men in both stage 1 AH and stage 2 AH. Noteworthy is the fact that all the obtained average values for total cholesterol exceed the recommended level of 4.9 mmol/l. At the same time, the situation with the level of triglycerides turned out to be the opposite - the average values in both sexes, both at the first and at the second stage of AH, did not exceed the threshold value of 1.7 mmol/l.

When analyzing the data on the level of Xc-LDLP in the group with AH stage I between women and men, significant differences were noted. In stage II AH, no significant differences in Xc-LDLP were obtained. There is a similar situation with the level of total cholesterol - in both groups, the average values of Xc-LDLP exceeded the recommended value of 3.0 mmol/l.

In our work, in patients with stage I AH, a similar level of Xc-HDLP in men and women is determined. The mean values in patients with stage II AH are lower than those with stage I, but did not fall to the threshold level for Xc-HDLP less than 1.2 mmol/l.

When assessing the glomerular filtration rate, we obtained the reliability of differences in this criterion by gender in both comparison groups. It should be noted that the mean values in the male population were significantly higher in both stage I AH and stage II AH. At the same time, regardless of gender, as AH progresses, a decrease in GFR is noted.

It is generally known that in the presence of AH in a patient, an increase in the thickness of the IMC at the level of the common carotid artery is observed under the influence of pressure loading not associated with atherosclerosis. According to the 2018 AH guidelines, asymptomatic target organ damage can be considered when a thickening of the common carotid artery wall (IMC>0.9 mm) or plaque is detected in a patient with AH.

In our study, patients with stage I AH in men had significantly lower IMC values than in women with comparable pathology. It should be noted that in the group with stage II AH, men again demonstrated a significantly lower IMC value (0.84±0.29 mm) than women (1.03±0.09 mm). Thus, it is legitimate to assume the absence of subclinical atherosclerosis in the male population.

Analyzing the metabolic parameters of patients with AH, it should be noted that all examined women had increased BMI values corresponding to various degrees of obesity, as well as lipid metabolism disorders corresponding to atherogenic dyslipidemia (increased concentration of Xc-LDLP and decreased Xc-HDLP). Thus, metabolic disorders of varying severity are present even in the early stages of arterial hypertension in women, which is consistent with the theory that the cardioprotective effects of female sex hormones are lost with the onset of menopause [12].

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微生物合成硫化镉纳米粒子的杀菌和光催化性能分析
ANALYSIS OF THE BIOCIDAL AND PHOTOCATALYTIC PROPERTIES OF CADMIUM SULFIDE NANOPARTICLES OBTAINED BY MICROBIAL SYNTHESIS

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本文介绍了使用枯草芽孢杆菌 168 的细胞在微生物合成过程中获得的硫化镉纳米颗粒 (NPsCdS) 的杀菌和光催化性能的分析结果。这种方法简单且环境友好的方法可以获得纳米晶体，其表面涂有由细菌菌株合成的蛋白质分子，并在胶体悬浮液中稳定纳米材料。生物纳米粒子的物理化学特性使其与非生物来源的纳米材料具有竞争力。确定了蛋白质包被的 NPsCdS 对各种类型微生物的测试培养物的杀生物活性。使用波长为 365 nm 和功率为 160 瓦的紫外线辐射，证明了 NPsCdS 对有机染料亚甲蓝和亮绿脱色的光催化活性。

关键词：硫化镉生物纳米粒子，枯草芽孢杆菌 168，蛋白质涂层，杀菌性能，染料光脱色，亚甲蓝，亮绿。

Abstract. *The article presents the results of the analysis of the bactericidal and photocatalytic properties of cadmium sulfide nanoparticles (NPsCdS) obtained in the process of microbial synthesis using cells of the bacterium Bacillus subtilis 168. This methodologically simple and environmentally friendly method allows one to obtain nanocrystals, the surface of which is coated with protein molecules*

synthesized by a bacterial strain and stabilizing the nanomaterial in colloidal suspensions. The physicochemical characteristics of biogenic nanoparticles make them competitive with nanomaterials of abiogenic origin. The biocidal activity of protein-coated NPsCdS against test cultures of various types of microorganisms was established. The photocatalytic activity of NPsCdS with respect to decolorization of organic dyes methylene blue and brilliant green using UV irradiation with a wavelength of 365 nm and a power of 160 W was demonstrated.

Keywords: *biogenic nanoparticles of cadmium sulfide, Bacillus subtilis 168, protein coating, bactericidal properties, photodecolorization of dyes, methylene blue, brilliant green.*

In recent years, significant progress has been made in research aimed at the synthesis and search for the functional application of fluorescent semiconductor nanoparticles of cadmium sulfide (NPsCdS), the optical, electronic, physicochemical, biological and photocatalytic properties of which are of interest for solving a wide range of applied problems [1, 2].

A wide variety of physical, chemical and hybrid methods of production allows to achieve large-scale production of nanomaterials of various chemical composition with adjustable properties, high yield and reproducibility, which is often accompanied by "harsh" technological synthesis conditions using toxic reagents, which negatively affects the ecological state of the environment and health person. Complex, energy-intensive methods for producing nanoparticles pushed the scientific community to search and develop an alternative, "green" approach for the synthesis of NPsCdS nanocrystals, based on the interaction of salts as sources of sulfur anions and Cd^{2+} cations with cells of living organisms, bacteria, fungi, yeast, algae, plant extracts, and the biomolecules secreted by them [3]. Among the variety of biological objects, bacteria are distinguished as the most studied and effective "bioplatforms" for the synthesis of nanomaterials. The main advantage of biogenic nanoparticles, which distinguishes them from industrially synthesized nanocrystals, is the presence of a biolayer, which simultaneously acts as a natural stabilizer, promotes functionalization, biocompatibility of the surface and an increase in the coordination centers of absorption of dye molecules, which characterizes biogenic NPsCdS as independent nanosized biocidal preparations and photocatalysts [4, 5].

This work presents the results of a study of the biocidal and photocatalytic properties of biogenic NPsCdS obtained by microbial biosynthesis using the bacterial strain *Bacillus subtilis* 168 (hereinafter NPsCdS/*Bacillus*). The nanomaterial was obtained by introducing aqueous solutions of Na_2S and $CdCl_2$ salts into a culture liquid containing cells, proteins, and other metabolites of the bacterial strain *B. subtilis* 168 in an equimolar ratio of 2 mM: 2 mM. All stages of the developed

by us bacterial synthesis of NPsCdS/*Bacillus* and their main characteristics - morphology and elemental composition, quantitative and qualitative analysis of the protein coating adsorbed on the surface of nanocrystals, the value of the hydrodynamic diameter (HD) and zeta potential, fluorescence intensity - are described in detail in the previously published us article [6].

As a result of our studies, it was found that NPsCdS/*Bacillus* are nanosized (5±1 nm) spherical crystals with the confirmed presence of the elements Cd and S. On the surface of NPsCdS/*Bacillus*, the only protein flagellin FliC with a molecular weight of 35 kDa was detected, identified as one of the constituent components of the bacterium *B. subtilis* 168 flagella. The presence of flagellin on the surface of nanoparticles determines the HD (200–550 nm) and zeta potential with a negative value from –20 to –27 mV. NPsCdS/*Bacillus* has been shown to fluoresce in the blue region of the spectrum (300–450 nm) at an excitation wavelength of 270 nm [6].

The bactericidal activity of protein-coated NPsCdS/*Bacillus* was assessed by the diffusion method in agar medium against test cultures obtained at the National Bioresource Center of the Russian National Collection of Industrial Microorganisms of the National Research Center "Kurchatov Institute" - GOSNIIGENETIKA: *Bacillus licheniformis* (B-7360), *Rhodococcus rhodochrous* (AC-1093), *Escherichia coli* K-12 (B-3345), *Pseudomonas putida* (B-4492) and yeast *Saccharomyces cerevisiae* (Y-3251). Bacterial strains belonged to gram(+) and gram(-) taxonomic groups. The wells were filled with 50 µl of nanoparticles (3 mg/ml) and incubated at 30–37°C for 24 h, then the diameter of the zones of no growth of test cultures was estimated.

It was shown that the most susceptible microorganisms to the action of NPsCdS are the yeast *S. cerevisiae* (inhibition zone 33 mm). For gram(+) bacteria *B. licheniformis* and *R. rhodochrous*, diameters of growth inhibition zones of 28 mm and 16 mm were observed, respectively. Among gram(-) bacterial cultures, NPsCdS had an inhibitory effect only on *P. putida* (16 mm). Thus, the different sensitivity of microorganisms to the action of NPsCdS/*Bacillus* was established, which can be explained by the structure of the cell walls of microorganisms of various groups and species and, as a consequence, the degree of penetration of Cd^{2+} ions into the cells [7]. At the same time, NPsCdS/*Bacillus* showed the greatest efficiency against test strains belonging to different groups - eukaryotic yeast *S. cerevisiae* and prokaryotic gram(+) bacteria *B. licheniformis*. These results indicate the possibility of using NPsCdS of bacterial origin as biocidal drugs for various medical applications.

The photocatalytic properties of NPsCdS/*Bacillus* were studied using the example of decolorization of organic dyes brilliant green (BG) and methylene blue (MB). The concentration of dyes was 25 ppm, the concentration of nanoparticles was 0.5 mg/ml, UV irradiation with a wavelength of 365 nm and a power of 160 W

for 3 hours. The experiments have shown that there is a difference in the degree of efficiency of photodecolorization of the claimed dyes, depending on their belonging to a certain chemical family. Thus, BG as a representative of the triphenylmethane family was discolored in the presence of NPsCdS by 85%, which is ~ 2.4 times higher than that of the thiazine dye MB, which is more resistant to fading. Despite the insignificant photodecolorization index obtained for MB, it is worth noting that, in the absence of nanoparticles, UV irradiation only leads to 8% discoloration of the dye. These results indicate the need to include NPsCdS in the photocatalysis process in order to achieve greater destruction of dyes of various chemical nature.

The possibility of using NPsCdS/*Bacillus* as a photonanocatalyst in three cycles of BG and MB photodecolorization under the same experimental conditions has been established. The efficiency of photodecolorization of dyes decreased in the third cycle to 40%, but this was enough to continue the process of decolorization of dyes. The reasons for the decrease in the efficiency of decolorization of dyes with repeated use of biogenic nanoparticles may be incomplete removal of dye molecules from the surface of the protein layer of nanoparticles, or the loss of a small part of nanoparticles during their isolation, purification, and resuspension. Thus, we have demonstrated the fundamental possibility of using biogenic NPsCdS/*Bacillus* as photocatalysts for decoloration of dyes of various chemical groups, as well as the possibility of effective threefold photocatalytic decolorization of dyes using UV irradiation of 160 W, which contributes to the further operation of biogenic nanoparticles under real decolorization conditions.

Conclusions. Biogenic NPsCdS/*Bacillus* obtained by microbial synthesis and containing an adsorbed protein layer on the surface, along with physicochemical analogs, can be used as independent biocidal preparations of natural origin, especially against the growth of yeast and bacterial gram (+) cultures, as well as for photocatalytic discoloration of synthetic organic dyes of various chemical families. The possibility of multiple participation of NPsCdS/*Bacillus* in the photocatalysis of dyes under UV irradiation shows the promise of using biogenic nanoparticles for purifying polluted wastewater and maintaining a favorable environmental situation.

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滩涂海藻的生态潜力
THE ECOLOGICAL POTENTIAL OF BEACH-CAST SEAWEED

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给出了海滩抛海藻概念的特征。 描述了海滩海藻的大致成分及其在海岸线上的典型位置。 它描述了根据海岸或海藻返回海洋环境的生命周期阶段对环境的生态影响，包括海藻对海岸线和食物链形成的影响，以及海藻的利用 由动物和鸟类筑巢。 这篇文章介绍了用海滩投掷海藻清洁海滩的后果，包括清洁的负面影响，还提供了将海滩投掷海藻加工成肥料或其他有用产品而不是将其丢弃在垃圾填埋场中的选择。

关键词：风暴海藻，海滩海藻，残骸，大型植物，环境影响，海藻，墨角藻，海带

Abstract. *The characteristic of the beach-cast seaweed concept is given. The approximate composition of beach-cast seaweed and their typical location on the coastline are described. It is described the ecological impact on the environment depending on the stage of the life cycle on the shore or seaweed return to the marine environment, including the effect of seaweed on the formation of the coastline and food chain, as well as the use of seaweed by animals and birds for nesting. The article presents the consequences of cleaning the beaches from beach-cast seaweed, including the negative effect of cleaning, and also offers options for processing beach-cast seaweed into fertilizers or other useful products instead of disposing them in landfills.*

Keywords: *storm-cast seaweeds, beach-cast seaweed, wracks, macrophytes, environmental impact, seaweed, fucus, kelp, anfeltia*.

The terms "storm-cast seaweed" or "beach-cast seaweed" and connected term “beach wrack” refer to macrophyte seaweed washed ashore by a storm as a result of natural death, as well as seaweed released to the littoral by any tidal process, re-

gardless of weather conditions [1, 17]. The most of incoming seaweed are formed due to the detachment of part of the thalli from the rhizoids by wind waves. At the same time, most of the torn off thalli end up on the shore, and only an insignificant fraction of them forms freely drifting seaweed accumulations [2].

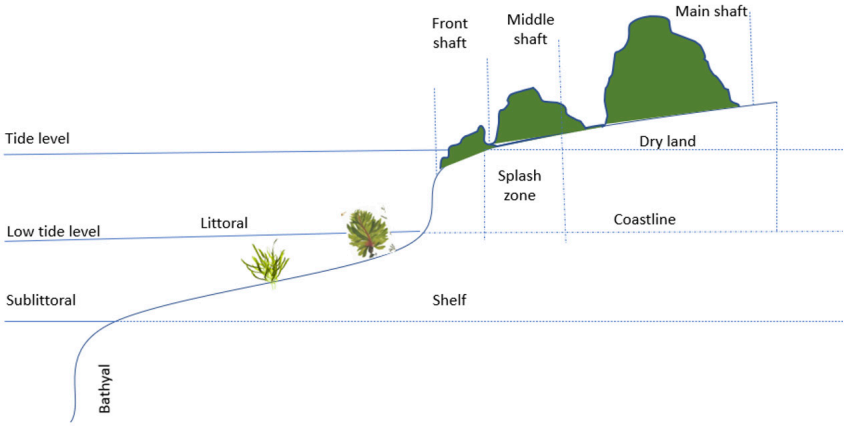

Figure 1. Location of beach-cast seaweed on the coastline (made by the authors).

The beach-cast seaweed wracks are usually located in several (usually three) rows along the coast, with an increase in row width with distance from the coast. The nearest rows are washed away and applied back by constant tides (twice a day in calm weather, the first row of beach-cast seaweed is formed and destroyed by a tidal wave), while the main upper shaft can be destroyed only during severe storms [3].

The shafts of beach-cast seaweed can reach 10 m in width with a height of up to 2 m. It's mass varies widely: from 1.5 to 5 kg/m^2 [4, 5]. Both lower shafts are usually represented by relatively fresh seaweed, while the plant material of the upper shaft is most often at various stages of decay, up to a semi-liquid mass that is absorbed into the sand to a greater or lesser depth. [3, 16].

During the roughness of the sea, not only seaweeds are thrown onto the shore, but also other objects, such as logs, chips, household waste, plastic, metal, glass. In the northern regions of Russia in beach-cast seaweed one can find both marine and terrestrial fauna, the average biomass of which is about 1300 g/m^2. The biomass includes mollusks, arachnids, crustaceans, small bristle worms, millipedes [1].

In the cold seas of Russia, the main beach-cast seaweed can be divided into

two types: the first type is fucus, the second type is anfeltia and kelp. The quality of beach-cast seaweed depends on the degree of infestation with other seaweed and algae, sea grasses, and fauna.

Currently, beach-cast seaweed volume is not prognosed in time, space and magnitude and is not included in the recommended catch [6, 7].

The amount of seaweed discarded is mainly determined by the ruggedness of the coast, as well as by the strength and direction of the prevailing winds. The largest amount of beach-cast seaweed discards occurs on open sandy beaches that adjoin rocky reefs or forests [8, 9].

Environmental Impact of Beach-Cast Seaweed

After being washed ashore, seaweeds are either return to the marine environment during subsequent tidal cycles or remain in the coastal area / onshore. Accordingly, there are two options for their impact on the environment:

1) Seaweeds remaining on the shore are involved in physical processes (such as the formation of dunes, the formation of detritus, become the basis for succession), in food chains (become food for animals, reptiles, birds [10, 28], become a habitat for innovative dune vegetation if it is released to land too far and in general for terrestrial fauna (reptiles live in wracks, birds make nests [11]). Decaying seaweeds are a source of nitrogen for coastal waters due to the relatively rapid release of nutrients during decomposition, which affects primary productivity (phytoplankton) and participates in the food chain [21]. And, of course, it should not be forgotten the significant effect on aesthetic and amenity values [13].

2) When the seaweeds are washed back into the sea, they can:

- float on the surface,
- float in the water column,
- or float near the seabed.

These seaweeds are habitat and food for juvenile fish and herbivores [14], can spread the invertebrates over long distances, they undergo further decomposition, and are used by detrital animals [15].

But only opportunists and species tolerant to hypoxia can remain under the drifting macroalgal mats and it is accompanied by high particulate organic C/N ratios in the sediment under algal plots [22] because of inhibiting photosynthesis through shading. And it should be mentioned that seaweed blooms presence can increase the turbidity [13].

So, the balance between negative (on species richness, eutrophication, turbidity) and positive impacts (food for faunal communities) can be observed.

The consequences of cleaning beaches from seaweeds

The ecological effects of removing coastal seaweeds are poorly described in the literature and can vary greatly from one source to another [10].

Beach-cast seaweed wracks play an important role in both terrestrial and ma-

rine ecosystems. Some beaches where storm seaweeds accumulate are regularly cleaned by hand or mechanically [29], but the impact of human removal of these seaweed on these ecosystems is not well understood.

Beach cleaning can have very significant adverse effects on marine and coastal processes and biodiversity.

The consequences of removing seaweeds can be:

1) threat to sandy coastlines (erosion)

2) the disappearance of macrofauna and birds that hunt macrofauna [18].

3) depriving beach ecosystems of valuable nutrients

4) the impact on the morphology of the beach, since together with the seaweeds, sand is removed from 25-30 m^3/t of seaweed [19].

5) a decrease in the density of epifauna and fish (however, these values are able to recover within two months) [20].

6) Even short-term beaches cleaning results in changes in species composition, and although these beaches recovered within two months, this could affect other species depending on the time of cleaning; for example, if it occurs during a nesting or breeding time for birds or during the time of settlement for fishes. [21].

7) Removing of beach-cast seaweed leads to removal of nutrients contained in the biomass, which would otherwise return to the water environment during decay and realize in eutrophication [26, 27].

Prospects for beach-cast seaweed processing

There are 2 points of view on removing seaweeds from beaches:

1) Criterion 4 of the Blue Flag environmental label states that "seaweeds or other vegetation should be left to decompose on the beach, unless it causes inconvenience" and "Only if it becomes absolutely necessary should seaweeds or other vegetation be removed and then dispose of by composting or use as fertilizer" [23].

The EHS (Environment & Heritage Service) position on beach clean-up recommends leaving algae to decompose on beaches, zone beaches that are regularly cleaned, leaving space for the natural decomposition of algae [24].

2) It is proposed to leave the farthest coastline on the beaches untouched, and to limit beach cleaning in summer or, if necessary, to remove excess material. For example, after the mass fishing [25].

Conclusions

The beach-cast seaweeds using potential is practically not revealed, with the exception of a number of countries where they are mined for personal use as food or raw materials for cosmetology or fertilizers. And the swells of seaweeds rotting in huge quantities on the coasts cause at least aesthetic harm, they are collected, depending on the territory, either by hand or by harvesters and disposed of in the nearest landfills or moved back into the sea by machinery. At the same time,

beach-cast seaweeds have a certain potential for use as a raw material for the production of biofuel, since due to the decay processes [12] that have begun in them, it becomes possible to eliminate several stages of preparation.

It is necessary to study in depth the prospects for the collection and use of storm seaweeds emissions in industry without harming the environment. To do this, it is worth assessing the amount of biomass formed depending on the geographical and climatic characteristics of the emissions, determining the amount of possible removal without damage to the ecosystem and / or the time of collection, as well as the possibilities of processing storm emissions into useful products, for example, into fertilizers or biofuels.

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多孔介质中的超临界对流
SUPERCRITICAL CONVECTION IN A POROUS MEDIUM

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研究了从下方加热的隔热层中的对流。 与层长度的厚度相比，该近似值被认为是大的。 确定不稳定参数。

关键词：瑞利数，层，模拟

Abstract. *Convection in a heat-insulated layer with heating from below is investigated. The approximation is considered large in comparison with the thickness of the layer length. The parameters of instability are determined.*

Keywords*: Rayleigh number, layer, simulation*

Introduction

The foundations of the theory of convection are presented in [1]. General cases of supercritical convection are considered in [2]. The stability of the convective equilibrium of a liquid in a layer heated from below in the case when the thermal conductivity of the masses that bound the layer is finite was studied in [3]. Harl, Jakeman, and Pike considered the symmetric case of arrays of equal thermal conductivity; the boundary value problem was solved for neutral, non-increasing and non-decreasing perturbations in time, and was approximately solved by the Galerkin method. A general formula was obtained for the critical Rayleigh number depending on the wavenumber and the ratio of the thermal conductivity of the liquid to the thermal conductivities of the surrounding massifs. It was shown that in the case of a layer with heat-insulating boundaries (for example, liquid metal between glass plates), the critical minimum wavenumber vanishes, the corresponding critical Rayleigh number is 720. At $R > R_0$ perturbations with wavenumbers α that lie in the interval $0 < \alpha < \alpha_m(R)$

In [4], the onset of convection in a horizontal layer of a porous medium, considered for the first time by Horton and Rogers, was investigated; the experiments they set up yielded results sharply deviating from theory. Kato and Matsuoka showed that in previous works the coefficient of effective thermal diffusivity of a saturated porous medium was incorrectly determined; their experiments gave good agreement with the revised theory. In these works, the case of a highly heat-con-

ducting array surrounding the layer was considered. In this work, the task was to study the dependence of the occurrence of convection on the thermal conductivity of the massif. For a layer with ideally heat-conducting boundaries, the minimum of the neutral curve lies at $a = a_c \neq 0$, so that for small excess of R_0 the instability interval has the form $a_1 < a < a_2$, where a_1, a_2 are close to a_c. In this case, perturbations with multiple wavenumbers $na\,(n = 0,2,3\ldots)$ decay according to the linear theory. The most dangerous are long-wave disturbances. The solution can be constructed as a series in terms of the amplitude of the fundamental harmonic. By analogy with a homogeneous liquid, they were limited to the long-wave approximation; for small $R - R_0$ the value of a_m, is small, the velocity, temperature, and Rayleigh number in the system of amplitude equations for neutral perturbations were expanded in powers of the wave number. The expansion of the Rayleigh number was obtained up to the second order:

$$R_p = 12 + \frac{8}{7}a_m^2 + 0\left(a_m^4\right)$$

and also the general formula for the Rayleigh number.

In [5], the convection of a liquid in a layer of a homogeneous medium was investigated taking into account the nonlinear terms in the equations. A two-dimensional case was considered, the stream and temperature functions depended on the vertical and one of the horizontal coordinates; small excesses of R_0. The method of a small parameter was used, the stream functions, temperatures and the Rayleigh number were expanded in a series in powers of the wave number. The expansion of the Rayleigh number up to the second order is obtained:

$$R = 720 + \frac{2040}{77}a_m^2 + 0\left(a_m^4\right)$$

An equation for the first term in the temperature expansion is obtained

$$\frac{\partial N}{\partial \tau} + \frac{\partial^4 N}{\partial \xi^4} + \frac{\partial^2 N}{\partial \xi^2} + \frac{\partial^2}{\partial \xi^2}\left(N^3\right)$$

where $N \sim \frac{\partial \mathrm{T}_0}{\partial \xi}$

and its solution was found for the stationary case; it was also shown using the small parameter method that this motion is unstable with respect to long-wave disturbances.

In this work, convection in a horizontal layer of a porous medium with heat-insulating surrounding massifs is investigated. The nonlinear gradient term is taken into account in the heat conduction equation, three-dimensional motions are considered. Small excesses of the critical Rayleigh number are considered. In this work, the small parameter method is used; at small supercriticalities $R - R_0$ the wave number, functions of temperature, pressure, and the critical Rayleigh number are expanded in a series in powers of the wave number (it is convenient to exclude the velocity from the equations):

$$R_p = \sum_{n=0}^{\infty} a_m^{2n} R_{2n}; \quad \mathrm{T} = \sum_{n=0}^{\infty} a_m^4 \mathrm{T}_n; \quad \mathrm{P} = \sum_{n=0}^{\infty} a_m^4 \mathrm{P}_n \tag{1}$$

Porous environment

We add nonlinear terms to the convection equations in a porous medium, then the system has the form:

$$\begin{cases} \nabla p - \vec{U} + R_p \mathrm{T}\vec{\gamma} = 0 \\ -\dfrac{\partial \mathrm{T}}{\partial t} + \Delta \mathrm{T} + \vec{U}\vec{\gamma} - \vec{U}\nabla \mathrm{T} = 0 \\ dw\vec{U} = 0 \end{cases} \tag{2}$$

where $\vec{\gamma}$ - unit vector against $\vec{g}$, and

$$R_p = \frac{g\beta L^2 \kappa \mathrm{A}}{\nu\chi}$$

T – temperature deviation from equilibrium distribution $\mathrm{T} = -y + const$; k – permeability coefficient, χ – thermal diffusivity of liquid, ν – kinematic viscosity; unit of length L – layer width, speed is measured in χ/L, pressure - in $\rho_0 \nu \chi/\kappa$.

Let us choose a suitable coordinate system, then the boundary conditions for the heat-insulated layer will be written in the form

$$\mathrm{Z} = 0, \mathrm{Z} = 1 \quad \mathrm{U}_z = \frac{\partial \mathrm{T}}{\partial z} = 0$$

Eliminating the speed from the equations, we get the system:

$$\begin{cases} -\dfrac{\partial \mathrm{T}}{\partial t} + \Delta \mathrm{T} + \nabla p \nabla \mathrm{T} - R\mathrm{T}\dfrac{\partial \mathrm{T}}{\partial z} + \dfrac{\partial \mathrm{P}}{\partial z} + R\mathrm{T} = 0 \\ -\Delta p + R\dfrac{\partial \mathrm{T}}{\partial z} = 0 \end{cases} \tag{3}$$

for this system, the boundary conditions will be:

$$\mathrm{Z} = 0; \mathrm{Z} = 1 \quad \frac{\partial \mathrm{T}}{\partial z} = 0; \quad \nabla \mathrm{P} = -R\mathrm{T}\vec{\gamma} \quad \text{or} \quad \frac{\partial \mathrm{P}}{\partial z} = -R\mathrm{T}$$

An inhomogeneous system of differential equations has a solution if the solvability condition is satisfied [6]; For a given system, the solvability condition is obtained by integrating the expression for $\dfrac{\partial^2 \mathrm{T}_\kappa}{\partial z^2}$, obtained in the κ-th order, over the layer thickness.

To consider processes with different time and space scales, similar to work [4], the method of many scales is used:

functions of pressure and temperature can be represented as depending on a set of variables $t_n = a_m^n t$, where t_1, t_2 etc. – slow times; then the time derivative is:

$$\frac{\partial}{\partial t} = \sum_{n=0}^{\infty} a_m^n t_n$$

(in what follows, we assume that all fast processes have already passed and the functions T, P do not depend, at least, on t_0).

For spatial variables (horizontal), we restrict ourselves to the first order in the series, assuming that in the zero order the functions T, P have no dependence on χ_0, y_0:

$$\xi = a_m \chi, \quad \eta = a_m y$$

Then the derivatives with respect to these coordinates are:

$$\frac{\partial}{\partial \chi} = a_m \frac{\partial}{\partial \xi}; \quad \frac{\partial}{\partial y} = a_m \frac{\partial}{\partial \eta}$$

Let us substitute these derivatives and expansion into the system of equations and into the system of equations . Using the boundary conditions, in order zero, we obtain

$$\mathrm{P}_0 = R_0 \mathrm{T}_0 \cdot z - \frac{R_0 \mathrm{T}_0}{2}; \quad \frac{\partial \mathrm{T}_0}{\partial z} = 0$$

In the first order, we see that the functions T, P do not depend on t_1 ;

$$\mathrm{P}_1 = R_0 \mathrm{T}_1 \cdot z - \frac{R_0 \mathrm{T}_1}{2}; \quad \frac{\partial \mathrm{T}_1}{\partial z} = 0$$

In the second order, using the solvability condition, we obtain: $R_0 = 12$ in the same way as in [4]; functions do not depend on t_2 ;

$$\mathrm{P}_2 = \frac{R_0}{2} \Delta_2 \mathrm{T}_0 \left(\frac{z^2}{2} - \frac{2}{3} z^3 + \frac{z^4}{2} - \frac{z^5}{5} \right) + \frac{R_0}{2} \left[\nabla_2 \mathrm{T}_0 \right]^2 \left(2z^3 - z^4 \right) + R_2 \mathrm{T}_0 z + C_2$$

where Δ_2, ∇_2 - two-dimensional Laplacian and Gradient, C_2 - constant of integration independent of Z,

$$\mathrm{T}_2 = \Delta_2 \mathrm{T}_0 \left(-\frac{z^2}{2} + z^3 - \frac{z^4}{2} \right) + \left(\nabla_2 \mathrm{T}_0 \right]^2 \left(3z^2 - 2z^3 \right)$$

In the third order, the calculations are the same as in the second order. We get:

$$\mathrm{P}_3 = \frac{R_0}{2} \Delta_2 \mathrm{T}_1 \left(\frac{z^2}{2} - \frac{2}{3} z^3 + \frac{z^4}{2} - \frac{z^5}{5} \right) + \frac{R_0}{2} \left[\nabla_2 \mathrm{T}_1 \right]^2 \left(2z^3 - z^4 \right) + R_2 \mathrm{T}_1 z + C_3$$

$$\mathrm{T}_3 = \Delta_2 \mathrm{T}_1 \left(-\frac{z^2}{2} + z^3 - \frac{z^4}{2} \right) + \left[\nabla_2 \mathrm{T}_1 \right]^2 \left(3z^2 - 2z^3 \right)$$

the functions T, P do not depend on t_3 .

In the fourth order, using the solvability condition, we obtain a closed equation

for T_0:

$$\frac{\partial T_0}{\partial t}+\frac{2}{21}\Delta_2^2 T_0+\frac{R^2}{12}\Delta_2 T_0-\frac{6}{5}\left(\nabla_2 T_0 \nabla_2\right)\left[\nabla_2 T_0\right]^2-\frac{6}{5}\Delta_2 T_0\left[\nabla_2 T\right]^2=0 \qquad (4)$$

Since the solution to the linear problem should have the form

$$T_0=\exp(i\xi)\exp(i\eta)$$

then from this we obtain the value of $R_2=\frac{8}{7}$ similarly [3].

To get rid of the coefficients in equation (4), we can introduce the variables

$$\tau=\frac{2}{\sqrt{35}}t,\quad \bar{T}=\sqrt{\frac{63}{5}}\cdot T_0$$

then equation (4) will be written in the form:

$$\frac{\partial \bar{T}}{\partial \tau}+\Delta_2^2\bar{T}+\Delta_2\bar{T}-\left(\nabla_2\bar{T}\nabla_2\right)\left[\nabla_2\bar{T}\right]^2-\Delta_2\bar{T}\left[\nabla_2\bar{T}\right]^2=0 \qquad (5)$$

which can be written in the form:

$$\dot{T}=-div\left(\vec{g}+\Delta_2\vec{g}-\vec{g}g^2\right)$$

where $\vec{g}=\nabla_2\bar{T}$.

In a plane problem, when only one horizontal coordinate is involved, the equation transforms into the following:

$$\frac{\partial N}{\partial \tau}+\frac{\partial^4 N}{\partial \xi^4}+\frac{\partial^2 N}{\partial \xi^2}-\frac{\partial^2}{\partial \xi^2}\left(N^3\right)=0 \qquad (6)$$

where $N=\frac{\partial \bar{T}}{\partial \xi}$, obtained in [5], the same for porous and homogeneous media.

It was shown in [3] that, in the stationary case, equation has a solution

$$N_{CT.}=\sqrt{\frac{2k^2}{1+k^2}}\sin\frac{\xi-\xi_0}{\sqrt{1+k^2}}$$

where k – modulus of the Jacobi elliptic function related to the wave number $\bar{a}=a/a_m$ by the relation $\bar{a}=\frac{\pi}{2K(k)\sqrt{1+k^2}}$, where K($k$)- complete elliptic integral of the first kind, ξ_0 - the constant of integration, hereinafter assumed to be zero. In [3], the stability of stationary motion with respect to long-wave two-dimensional, longitudinal perturbations was also investigated:

$$N=N_{CT.}+\Phi(\xi)\cdot e^{i\beta\xi}\cdot e^{-\lambda^H\tau}$$

The small parameter method was used λ^H and $\Phi(\xi)$ were represented as an expansion in powers of the small wavenumber β. It was shown that the motion is unstable with respect to these perturbations, and in the second order

$$\lambda_2^{\mathrm{H}} = -\frac{\left(1-k^2\right)^2}{\left(1+k^2\right)\left(2\mathrm{E}(k)/\mathrm{K}(k)-1+k^2\right)} < 0$$

for $0 < k < 1$; where $\mathrm{K}(k), \mathrm{E}(k)$ - complete elliptic integrals of the first and second kind.

We can consider the stability of this plane motion with respect to long-wave three-dimensional perturbations, in the case when the wave vector is directed perpendicular to the motion, i.e. the perturbation is periodic in the coordinate η:

$$\begin{aligned} \bar{\mathrm{T}} &= \mathrm{T}_{стац.} + \tilde{\mathrm{T}} \cdot e^{-\lambda\tau} \\ \tilde{\mathrm{T}} &= f(\xi) e^{i\beta\eta} \\ \mathrm{T}_{стац,} &= \int \mathrm{N}_{CT.} d\xi \end{aligned} \tag{7}$$

Substituting (7) into equation (5), we get:

$$-\lambda\tilde{\mathrm{T}} + \Delta_2^2\tilde{\mathrm{T}} + \left(1-\mathrm{N}^2\right)\Delta_2\tilde{\mathrm{T}} = 3\partial_\xi\left(\mathrm{N}\right)^2 \cdot \partial_\xi\tilde{\mathrm{T}} + 2\mathrm{N}^2\partial_\xi^2\tilde{\mathrm{T}}$$

Substituting the expression for $\tilde{T}$ into the resulting equation, we get:

$$-\lambda f + \left(\partial_\xi^2 - \beta^2\right)^2 f - \left[\partial_\xi^2 - \beta^2\left(1-\mathrm{N}^2\right)\right] f = 3\partial_\xi\left[\mathrm{N}^2\partial_\xi f\right] \tag{8}$$

Since N^2 - is a function with a period that is half that of N, then the period , according to Bloch's theorem, is also half that:

$$f\left(\xi + \pi/\bar{a}\right) = f(\xi)$$

Then the solvability condition for the expansion in terms of a small parameter of equation in the k-th order will be obtained if in this order the equation is integrated in the range from 0 to $\pi/\bar{a}$ and the derivatives of $f(\xi)$ are equated to zero; $\lambda, f(\xi)$ are expanded in powers of the small wave number β, as in [3]:

$$f(\xi) = \sum_{n=0}^{\infty} f_n\beta^n; \quad \lambda = \sum_{n=0}^{\infty}\lambda_n\beta^n$$

Substituting the expansion into equation (8), in the zeroth order we have:

$$-\lambda_0 f_0 + \frac{\partial^4 f_0}{\partial\xi^4} + \frac{\partial^2 f}{\partial\xi^2} = 3\partial_\xi\left[\mathrm{N}^2\partial_\xi f_0\right]$$

or by designating $\Phi_0 = \partial_\xi f_0$, we get:

$$-\lambda_0\Phi_0 + \partial_\xi^4\Phi_0 + \partial_\xi^2\left[\left(1-3\mathrm{N}^2\right)\Phi_0\right] = 0$$

This equation coincides with the equation obtained in [3]; the most interesting case is $\lambda_0 = 0$, then, as shown in [4], the equation has a solution:

$$\Phi_0 = 1 - k^2 + 2k^2 cn^2\frac{\xi}{\sqrt{1+k^2}}$$

In the first order, we get a similar equation:

$$-\lambda_1 f_0 + \partial_\xi^4 f_1 + \partial_\xi^2 f_1 = 3\partial_\xi\left[\mathrm{N}^2\partial_\xi f_1\right]$$

In this order for $\lambda_1 = 0$ there is also a solution

$$f_1 = f_0 + const$$

In the second order, we get the equation:

$$-\lambda_2 f_0 + \partial_\xi^4 f_2 - 2\partial_\xi^2 f_0 + \partial_\xi^2 f_2 - \left(1 - \mathrm{N}^2\right) f_0 = 3\partial_\xi \left[\mathrm{N}^2 \partial_\xi f_2\right]$$

From the solvability condition, we find an expression for λ_2:

$$\lambda_2 = -\frac{\int_0^{\pi/\bar{a}} \left(1 - \mathrm{N}^2\right) f_0 d\xi}{\int_0^{\pi/\bar{a}} f_0 d\xi}$$

Explicitly substituting in it $f_0 = \int \Phi_0 d\xi$, and putting the constant of integration equal to zero, we get:

$$\lambda_2 = -1 + \frac{2k^2}{1+k^2} \cdot \frac{\int_0^{\pi/\bar{a}} d\zeta \sin^2 \zeta \left[2\mathrm{E}\left(am\zeta, k\right) - \left(1 - k^2\right)\sqrt{1+k^2} \cdot \zeta\right]}{\int_0^{\pi/\bar{a}} d\zeta \left[2\mathrm{E}\left(am\zeta, k\right) - \left(1 - k^2\right)\sqrt{1+k^2} \cdot \zeta\right]}$$

where $\zeta = \frac{\xi}{\sqrt{1+k^2}}$. Compare λ_2 to λ_2^{H}. Numerical estimates up to two decimal places for $k = 1/\sqrt{2}$ show that $\lambda_2^{\mathrm{H}} = -0{,}36$; $\lambda_2 = -0{,}47$. I.e. $\lambda_2 < \lambda_2^{\mathrm{H}}$, hence, the instability of motion (6) is stronger relative to long-wave transverse three-dimensional perturbations than relative to plane longitudinal.

Convection in a layer with a thickness much less than the length

Equations with nonlinear terms are considered; two-dimensional motions with a small wavenumber are investigated; at small excess of the critical Rayleigh number. The calculations are performed in the same way as in [5], the convection equations are solved using the small parameter method; in this case, a small parameter is the ratio of the layer thickness to its length. In addition, since the medium is porous, the order of the equations decreases by 2, but the boundary conditions also become smaller - on the walls of the massif, the horizontal component of the averaged velocity is not zero. However, the solution is similar to the solution for a homogeneous liquid; the stream function Ψ is also introduced; in the case of an unbounded layer, in the fourth order, a closed equation for $\mathrm{N} \sim \frac{\partial \mathrm{T}_0}{\partial \xi}$, is obtained, which is the same for porous and homogeneous media:

$$\frac{\partial \mathrm{N}}{\partial \tau} + \frac{\partial^4 \mathrm{N}}{\partial \xi^4} + \frac{\partial^2 \mathrm{N}}{\partial \xi^2} - \frac{\partial^2}{\partial \xi^2}\left(\mathrm{N}^3\right) = 0$$

In the case of a bounded layer, the calculations are the same, but

$$R = R_0 + R_2 / L^2; R_2 = (R - R_0) / L^2$$

where L – layer length, measured in layer thicknesses. The equation turns out:

where $\mathrm{K} = \frac{21}{2} L^2 \left(\frac{R}{12} - 1 \right)$,now this quantity plays the role of the Rayleigh number.

The boundary conditions for this equation can be obtained from condition $d\Psi = 0$; streamlines are obtained from equation $\Psi = const$, it is convenient to put $const = 0$, this will not affect the result.

$$\Psi_1 = -\frac{R_0}{2} \frac{\partial \mathrm{T}_0}{\partial \xi} \left(y^2 - y \right); \quad \Psi_2 = -\frac{R_0}{2} \frac{\partial \mathrm{T}_1}{\partial \xi} \left(y^2 - y \right)$$

$$\Psi_3 = -\frac{\partial^3 \mathrm{T}_0}{\partial \xi^3} \left(\frac{3}{5} y^5 - \frac{y^6}{5} + y^3 - y^4 \right) + \frac{\partial}{\partial \xi} \left(\frac{\partial \mathrm{T}_0}{\partial \xi} \right)^2 \left(3y^4 - \frac{6}{5} y^5 \right) - \frac{R_2}{2} \frac{\partial \mathrm{T}_0}{\partial \xi} \left(y^2 - y \right) + 6 \frac{\partial \overline{\mathrm{T}}_2}{\partial \xi} \left(y^2 - y \right)$$

Since $\mathrm{N} \sim \frac{\partial \mathrm{T}_0}{\partial \xi}$, then the boundary conditions will be:

$$\xi = 0, \quad \xi = 1 \quad \mathrm{N} = 0; \quad \mathrm{N}^{11} \sim \frac{\partial^3 \mathrm{T}_0}{\partial \xi^3} = 0$$

The solution of the equation is investigated depending on the number κ; the equation is solved numerically by the finite difference method. For convenience, we split the equation into a system:

$$\begin{cases} \frac{\partial \mathrm{N}}{\partial \tau} + \frac{\partial^2 \varphi}{\partial \xi^2} + \kappa \varphi - 6 \left(\partial_\xi \mathrm{N} \right)^2 \mathrm{N} + 3\mathrm{N}^2 \Phi = 0 \\ \frac{\partial^2 \mathrm{N}}{\partial \xi^2} - \varphi = 0 \end{cases}$$

at $\xi = 0, \xi = 1 \quad \mathrm{N} = \varphi = 0.$

The finite difference scheme for φ has the form:

$$\varphi_i = \frac{\mathrm{N}_{i+1} - 2\mathrm{N}_i + \mathrm{N}_{i-1}}{\mathrm{HX}^2}$$

where HX – coordinate step; the step HX = 0.1 is chosen, i.e. ten knots. An explicit scheme is used:

$$\mathrm{N}_i^{n+1} = \mathrm{N}_i^n - \left[\left(\varphi_{i+1}^n - 2\varphi_i^n + \varphi_{i-1}^n \right) - \left(-\mathrm{K} + 3\mathrm{N}_i^{n^2} \varphi_i^n + \frac{\left(6\mathrm{N}_i^n \left(\mathrm{N}_{i+1}^n - \mathrm{N}_{i-1}^n \right)^2 \right)}{\mathrm{HX}^2} \right) \right] \mathrm{HT}$$

In order for the explicit scheme to be stable, it is necessary to take a step in time

$$\mathrm{HT} = \mathrm{HX}^5$$

It is seen from the linear problem that the solution $\mathrm{N} \sim \sin \pi \xi$, passes through, whence the critical number $\kappa = \pi^2$ is obtained.

At $\kappa < \pi^2$ and at κ – slightly exceeding π^2 the initial distribution has the form of an inverted parabola with a small slope.

At $\kappa < \pi^2$ the movement, as you would expect, quickly fades away; at $\kappa > \pi^2$ the motion grows and enters a stationary regime, and the greater the number of κ, the greater the amplitude of the steady motion. The dependence of the sum of $\sum_i N_i$ over the nodes at the 10^6 step on the number κ shows that if the initial distribution is greater in magnitude than the stationary one, then at $\kappa > \pi^2$ the amplitude of motion decreases to stationary. This work can be used to study convection in stellar-type systems.

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违反洛伦兹不变性作为对称性
VIOLATION OF LORENTZ INVARIANCE AS A SYMMETRY

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给出了对称群的简要分类。 证明了M奇偶性的存在是可能的，并且找到了对应群的特征。

关键词：重整化，规范场，群字符

Abstract. *A brief classification of symmetry groups is given. It is shown that the existence of M-parity is possible, and the characteristics of the corresponding group are found.*

Keywords: *renormalization, gauge fields, group characters*

Introduction

Cosmological inflation is caused by the transition from a false vacuum to a true one with a spontaneous breaking of the *GUT* symmetry.

Let us list the symmetry groups. Charge parity is the multiplicative quantum number of a truly neutral particle, which determines the behavior of its state vector under charge conjugation. During the charge conjugation operation, the wave function of the particle is multiplied by the *C*-parity value, that is, it changes sign (charge odd particle), or remains the same (charge even). The law of conservation of *C*-parity is fulfilled with strong, electromagnetic, and gravitational interactions, in the case of weak interactions, it is violated. The charge parity of the photon is $C = -1$ (with charge conjugation, the electric charges change sign, therefore, the electromagnetic fields, the quanta of which are photons, must also change sign so that the evolution of the system does not change). Due to the conservation of *C*-parity in any electromagnetic processes, it is impossible to convert an odd number of photons into an even number and vice versa (Farry's theorem). Peony decays due to EM $\pi^0 \to \gamma + \gamma$, $C(\pi^0) = C(2\gamma)$, $C(\pi^0) = C(\gamma)C(\gamma) = (-1)(-1) = +1$.

Combined parity, *CP*-symmetry is the product of *C*-charge conjugation, which transforms a particle into its antiparticle, and *P*-parity, the mirror image of a physical system. The strong and electromagnetic interactions are invariant with respect to the *CP* transformation, this symmetry is broken in the process of some types

of weak decay, in the Standard Model - in the quark sector. The *CP*-violation can theoretically be observed in strong interactions, but the *CP*-violating term is here strongly limited by the non-observation in the experiment of the electric dipole moment of the neutron.

Time reversal, *T*-parity is the symmetry of the equations with respect to replacing the time *t* by $-t$, is written as the equality to zero of the commutator of the Hamiltonian operator and the antiunitary time reversal operator.

Consider the Lorentz transformations, select the *z* direction. If we complicate the Lorentz group, an imaginary boost with a boost parameter $i\pi$ will tend to $t \to -t; z \to -z$. Let's perform an additional rotation in the *xy* plane, we get a combination of *P* and *CT*. The combination *CT* appears instead of *T* because the given transformation is unitary, not anti-unitary. Assuming that the operation of complex growth is correct as a symmetry, we get a state that is described by the same laws. Which gives the *CPT*-theorem.

Since the *CP*-symmetry is broken while the *CPT*-symmetry is preserved, it follows that it is not invariable with respect to the *T*-symmetry. The *CPT* theorem states that any Lorentz-invariant local quantum field theory with a Hermitian Hamiltonian must have *CPT* symmetry.

According to the Luders-Pauli theorem, any adequate field theory must be *CPT*-invariant.

The consequence of the *CPT*-theorem is that the particle and antiparticle have exactly equal mass and magnetic moment, their electric charges are equal in magnitude and opposite in sign, spins are equal in magnitude and opposite in direction. In Feynman diagrams, an antiparticle is equivalent to a particle going backward in time, therefore, for example, the Compton effect and annihilation of an electron-positron pair are equivalent and give the same amplitude values.

It is argued that the laws of classical mechanics, classical electrodynamics, quantum mechanics, and the theory of relativity do not change with time inversion.

Physical quantities that change sign with time reversal are *T*-odd, do not change sign - *T*-even. The product of any number of *T*-even values and an even number of *T*-odd values, *T*-even, etc. Coordinate, acceleration, angular acceleration, energy, energy density, force, electric potential, electric field strength, EMF stress tensor, electric charge density are *T*-even. *T*-odd: speed, angular velocity, linear momentum, angular momentum (orbital and spin), power, electromagnetic vector potential, magnetic induction, magnetic field strength, electric current density. Masses, charges and constants not associated with weak interactions are *T*-even.

Accordingly, Newton's second law $ma = \sum_i F_i$,with the addition of rotational motion due to the relationship $r\omega' = a_\tau$ loses *T*-symmetry. In curved space, energy E and momentum P^i

$$E = \int_{V_3} T^{00}\sqrt{-g}d^3x; P^i = \frac{1}{c}\int_{V_3} T^{i0}\sqrt{-g}d^3x$$

are not saved. That is, there is no *T* and *P* symmetry. One can introduce the pseudotensor of the gravitational field $\partial_k[(T_k^i + t_k^i)(-g)^n] = 0$, n – an integer or half-integer. Then

$$\tilde{E} = \int_{V_3} (T_0^0 + t_0^0)(-g)^n d^3x; \tilde{P}^i = \frac{1}{c}\int_{V_3} (T_0^i + t_0^i)(-g)^n d^3x,$$

However, the new energy and momentum are not complete analogs of energy and momentum in Euclidean space, for example, due to the fact that t^{ik} is not a tensor, the overdetermined momentum is not a vector. In addition, the new energy and momentum are not uniquely determined; they depend on how the pseudotensor of the gravitational field is constructed.

Einstein's equations in the Schwarzschild solution, for example,

$-e^{-\lambda}(\frac{\nu'}{r} + \frac{1}{r^2}) + \frac{1}{r^2} = \frac{8\pi G}{c^4}T_1^1$, are asymmetrical with respect to reflection $r \to -r$. Therefore, in strong gravitational fields, the masses of particles and antiparticles and their charges should not be the same.

Symmetry groups *C, P* and *T* of elementary particles are discrete, groups of gauge transformations and groups in general relativity are continuous. However, these symmetries are related. The Lie algebra by a semisimple Lie group is semisimple, in such algebras there arise systems of roots, the reflections corresponding to them generate the Weyl group of the given Lie group - this is a certain group of reflections, one of the Coxeter groups.

Breaking the *CPT*-symmetry automatically leads to breaking the Lorentz invariance.

The Lorentz group contains ordinary spatial rotations and reflections, as well as boosts - transformations of the transition from one frame of reference to another.

*O (*1,3) - the orthogonal group of transformations of the Minkowski space that preserve the origin, that is, they are linear operators, consists of homogeneous linear transformations of the coordinates of the four-dimensional space-time $x_\nu^{'} = \sum L_{\nu\mu}x^\mu$, $x_0 = ct$, $x_1 = x$, $x_2 = y$, $x_3 = z$, leaving invariant form $s^2 = (ct)^2 - x^2 - y^2 - z^2$ and do not change the direction of time. The group includes spatial rotations in three planes, Lorentz transformations, reflections of spatial axes: and all their products. The special Lorentz group *SO* (1.3) is a group of true rotations, a subgroup of transformations, the determinant of the matrix of which is equal to 1 (in the general case, ± 1). The orthochronous Lorentz group $O_\uparrow(1,3)$, the special orthochronous Lorentz group $SO_\uparrow(1,3)$ — similarly, the only one of the four is connected and isomorphic to the Möbius group, $SO\uparrow(3.1) \subset SO(3.1) \subset O(3.1)$.

All irreducible representations of the special orthochronous Lorentz group can be constructed using spinors. The Abelian group of time shifts $Rt \to t + const \in R$ is realized as the group of rotations *S*O(2) of the time plane with coordinates Y1, Y2 (homomorphism onto the group of rotations $R \to SO(2)$). The orthochronous Lorentz group *SO*↑(3.1) does not change the direction of time, which is expressed by the condition $A^0{}_0 \geq 1$. The time reversal operation for elementary particles without spin consists in changing the sign of *t* and simultaneously replacing the wave function with the complex conjugate in the Schrödinger equation: $\Psi(t,r) \to \Psi^*(-t,r)$. For elementary particles with spin, the time reversal operation consists in replacing: $\Psi_{ss} \to \Psi_{s,-s}(-1)^{s-s}$ [1].

The characteristic of the state of a physical system is the vector of states in the Hilbert space. Time-reversal invariance in the Schrödinger representation means that $\Psi_i \to \Psi_f$ implies $\Psi_f^R \to \Psi_i^R$. The time reversal transformation is specified by the following postulates: $\Psi^R = U^T \Psi^*$, where Ψ - is the state vector of the system, the subscript *T* denotes the transposition operation, and the * sign denotes the complex conjugation operation.

It is postulated that the known symmetries of elementary particles originate from a certain symmetry group *G*. At each phase transition, part of this symmetry is lost, the symmetry group changes: $G \to SU(3) \otimes SU(2) \otimes U(1)$. The group U (1) connected describes electromagnetism, *SU*(2) - the weak interaction, in the framework of the Weinberg - Salam model, combined into an electroweak interaction described by the group $SU(2) \times U(1)$. The strong interaction is described by the *SU*(3) group. Models combining the strong with the electroweak - grand unified theories (*GUT*)

Group *U*(1) – is an abelian continuous group of rotations, local gauge transformations, for the wave function of an electron

$$\Psi'(x) = e^{i\vec{a}(x)}\Psi(x),$$

which leaves the Lagrangian invariant under the introduction of a compensating vector field identified with the electromagnetic one. Group elements - rotations by arbitrary angles $\varphi(x)$ around the axis. The fermionic doublet in isospace is transformed using the 2-dimensional Hermitian Pauli matrices σ, acting on the spinor:

$$\Psi'(x) = e^{i\vec{a}(x)\vec{s}}\Psi(x) = SU(2)\Psi(x)$$

$\vec{a}$ - are arbitrary real phases. Gauge fields are massless vector W and Y bosons. Accordingly, for the baryon octet - the *SU*(3) group (not in the space of flavors, but in the space of colors), the compensating fields are colored massless vector bosons - gluons. The gauge transformation is specified by 3 x 3 unitary matrices.

Groups *SU*(2) and *SU*(3) are also introduced in addition to gauge constructions.

For electromagnetic and strong interactions, *P*, *C* and *T* are symmetry trans-

formations, for weak interactions *P* and *C* are not symmetry transformations, but *T* and *PC* are.

The symmetry groups of Lorentz and other groups in general relativity are not gauge ones.

The idea of gauge gravity was put forward by W. Heisenberg and E. Gapon. There are two gauge symmetries for the gravitational field. The first is given by general covariant transformations of tensor quantities. The field of gauge general-covariant symmetry can be easily identified with the connectedness of the gravitational field (Christoffel symbols). Indeed, expressions for the covariant derivative and gauge connectivity transformations resemble those for the Yang - Mills field. However, it is obvious that deviations from the Minkowski metric cannot be identified with the Goldstone components, an infinite continuous manifold cannot be isomorphic to a finite discrete one. Moreover, there is no analogous expression for the metric tensor. An attempt to describe an arbitrary metric within the Higgs scheme leads only to a transition to the tetrad formalism.

The laws of physics are equivalent with respect to transformations of the Galilean group in Euclidean space, in Minkowski space - with respect to the Lorentz group. But strongly curved spaces are described by other symmetry groups, the Bondi-Metzner-Sachs group, etc. Thus, in a curved space, the *CPT* symmetry should be broken.

Negative mass

One of the corollaries of Wightman's axioms is the *CPT* theorem: there is a general symmetry when parity changes, particle-antiparticle reversal and time reversal, as it turns out, none of these symmetries exist by themselves. That is, the coordinate-time space turns out to be connected with the charge space, although the roots of the groups *C* and *P*, *T* are different, have different dimensions.

In this scheme, there is no symmetry with respect to the change in the sign of the mass.

There are versions of inert mass, active gravitational mass (the source of the gravitational field), and passive gravitational mass. Einstein's principle of equivalence requires that inertial mass be equal to passive gravitational mass, it follows from the law of conservation of momentum that active and passive gravitational masses are equal, that is, all three masses are equal to each other.

The Higgs equations admit the existence of negative inert masses. Negative energy density, that is, negative mass, appears in the Casimir effect.

The possibility of the existence of negative mass was suggested by G. Bondi in 1957 [2]. He built models with different negative masses: inert, active and passive gravitational masses. Bondi and Forward analyzed such exotic particles [3]. We are talking about negative gravitational mass, so there will be no contradictions with the Higgs models.

Morris et al showed [4] that the Casimir effect can be used to obtain a local region of space-time with negative mass. Forward also proposed a design for a spacecraft engine using a negative mass, which does not require an influx of energy and a working fluid in order to obtain an arbitrarily large possible acceleration [5,6].

At present, particles with a negative effective inert mass in the Bose-Einstein condensate have been obtained [7]. In [8], it was suggested that if the hypothesis of the existence of negative gravitational mass is accepted, the hypothesis of dark matter is not required.

It was shown in [9] that ordinary and dark matter should be continuously generated in the Universe.

The same assumptions were independently expressed in [10]. This paper combines the idea of negative mass with the idea of continuous and homogeneous mass production in the volume of the Universe (which was first proposed in the 1940s). The Friedmann equations are solved with the appropriate additions, but without taking into account dark energy and dark matter, the law of the expansion of the Universe is found. It turned out that the known laws are reproduced if negative mass is produced with a constant velocity $\Gamma = -3H$, where H is the Hubble constant. In this case, the negative mass density will remain constant during expansion, and it will effectively model the cosmological constant. In this case, the expansion rate and lifetime of the Universe are the same as in the ΛCDM model. The evolution of a dense group of particles with positive mass, immersed in a "sea" of particles of negative mass, was also modeled, which should qualitatively describe the evolution of galaxies at the later stages of the expansion of the Universe. We chose $N_+ = 5000$, $N_- = 45000$. As a result, the density distribution was obtained, which is in good agreement with the observational data - the particle density slowly increases when approaching the center of the galaxy and coincides with the Burkert profile. This solves the "sharp halo" problem that arises in the ΛCDM model.

There is a statement that the only criterion for confirming the presence of negative masses can only be astronomical observations. I. Banik discovered a giant ring of galaxies that scatter, as at the moment of the Big Bang, their arrangement is similar to drops from a rotating umbrella, while the rotation of the ring is not observed [11]. Although, ideally, with negative masses, there should be not a ring, but a ball. However, these galaxies fly away from the Milky Way at a much higher speed than that determined by the standard cosmological model.

The spiral galaxy M81 in the constellation Ursa Major, discovered by Art Hoag in 1950 in the constellation Serpent, is also a ring. In the outer part is a ring dominated by bright blue stars, and in the center is a ball of redder stars that are likely much older. Between them is a gap that looks almost completely dark. In the gap

between the core and the ring, another ring-shaped galaxy is visible, which is much further away. If it is found that the velocities of the center of the rings and the rings themselves relative to the Milky Way are significantly different, this will testify in favor of the presence of negative masses.

However, the existence of negative masses does not have to be confirmed by the presence of large-scale fragments of matter in space, just as the existence of antiparticles does not have to be confirmed by astronomical observations - in view of baryon asymmetry.

Negative masses also arise during the regularization procedure. The mass of a charged particle must include the energy contained in the particle's electrostatic field. For a sharpened charge, it is infinite: $mc^2 \sim q^2 / r$, i.e. possesses infinite inertia, therefore, the charge cannot move at an accelerated rate. But the total mass of the charge includes the sum of electrical energy and "bare" mass. If the "bare" mass is assumed to be negative, it is possible to renormalize the total mass and obtain the electron mass consistent with the experiment, including with a zero radius.

It is logical, in accordance with the principle of equivalence, to assume the existence of negative gravitational mass. The annihilation of matter with negative gravitational mass and ordinary matter is difficult, since substances with negative mass will not be attracted, but repelled from ordinary matter. At the same time, in ordinary fermions, this negative mass is compensated by a positive electrostatic one. The annihilation of gravitational masses should occur with reactions of the $e^- + e^+ \to 2\gamma$, type, since the electrostatic interaction is much orders of magnitude greater than the gravitational one, and the compensated mass appears in the reaction parameters. However, another option is also possible.

Gravity is 10^{36} times weaker than electrical interaction, 10^{38} times weaker than strong, and 10^{25} times weaker than weak interaction. Let us assume that the decay of particles composed of pairs of particles and antiparticles is analogous to annihilation. Let us assume that the particle lifetime corresponds to the coupling constant.

Pi-mesons consist of quarks and antiquarks of the 1st generation, the lifetime of which is 10^{-6} seconds, it is possible that the annihilation time of gravitational mass and anti-mass is – 10^{-6} x 10^{38} = 10^{32}, which corresponds to the estimate of the proton lifetime.

Let us introduce the operator *M*, which converts the gravitational mass into the antigravitational one:

$$M\Psi(m_g) = \Psi(-m_g)$$

The presence of negative masses is associated with the presence of tachyons, which are possible in the CTO.

Consider the expression for the frequency in the formula for the relativistic Doppler effect:

$$\omega = \omega_0 \sqrt{\frac{1 - v/c}{1 + v/c}}$$

When the speed of light is exceeded, the electromagnetic disturbance ceases to have the form of vibrations propagating to infinity. At $v > c$ the frequency becomes imaginary; therefore, the amplitudes of electromagnetic disturbances will decay exponentially without oscillations: $A \sim e^{-\beta t}$, where $\beta = \omega_0 \sqrt{v/c - 1} / \sqrt{v/c + 1}$.

That is, the existence of tachyons is not a theoretical error and not a jump beyond the speed limit; tachyons are damped modes. Exponentially growing solutions are not discarded as non-physical, they indicate the instability of the system.

Therefore, it is logical to assume that

$$M\Psi(m_g) = \Psi(im_g); M^2\Psi(-m_g) \quad (1)$$

Accordingly, M is a point cyclic group isomorphic to C_4, it can be represented as a combination of rotations in the isospace of the group C_2 with the group of mirror reflections in two planes of symmetry, the fourth Klein group C_{2v} appears, which has 4 classes, respectively, 4 irreducible representations that are one-dimensional, therefore they do not coincide with characters, and energy states cannot be degenerate. The characters of the group are shown in the table:

C_{2v}	E	C_2	v_1	v_2
a_1	1	1	1	1
a_2	1	-1	-1	1
a_3	1	1	-1	-1
a_4	1	-1	1	-1

If the unitary operator of charge conjugation is defined by the equality $C^2 = 1$ and the transformation of a particle into an antiparticle $Ca^+ = b^+$, then the mass conjugation operator is defined through the equalities $M^4 = 1$ and (1).

Full symmetry: $CPT \to CPTM$, so all fermions have negative gravitational mass, their antiparticles are positive, and *CPT*-symmetry is broken.

CPT-symmetry breaking is equivalent to Lorentz breaking, which is believed to occur at high energies, such as in ultra-high-energy cosmic rays. In most models, a dedicated frame of reference is constituted, in which the relic radiation has a Planck spectrum.

In some versions of general relativity, the Lorentz invariance is violated, the relation $E = p^2 + m^2$ is replaced by a relation. $E = p^2 + m^2 + p^4 / z; z : m_{Plank} : 10^{19} GeV$ [12]. The corresponding Hamiltonian of a free particle - $H = \sqrt{p^2 + m^2 + p^4 / z^2}$, hence the Lagrangian

$L = -m\sqrt{1 - v^2/c^2} - \frac{p^4}{2z^2 m}(1 - v^2/c^2)^{-3/2}$. Other forms of the Hamiltonian are considered, as well as a model with an additional dimension, in which spontane-

ous violation of Lorentz invariance occurs due to the condensate of vector fields [13]. In the Gross-Neveu model (with the Lagrangian of the Extended Standard Model, SME), an additional vector b is introduced, which violates Lorentz invariance [14]:

$S(\bar{\Psi},\Psi)=\int d^3x[\bar{\Psi}\mathsf{g}_j(\partial_j-ib_j)\Psi+\bar{\Psi}m\Psi-\frac{G}{2N}(\bar{\Psi}\Psi)^2]$. In the theory of Khorzhava, in the modification of general relativity, an additional scalar field, a chronon field, with an excess of the speed of light, etc. is activated.

These constructions seem to be artificial, since in the Riemannian metric the particles move outside the light cone of Minkowski space without the presence of additional terms in the Lagrangian.

Violation of Lorentzi invariance means violation of *CPT*-symmetry, i.e. violation of parity of mass and inequality of masses and charges of particles and antiparticles. *CPTM*-symmetry is also not preserved in these models.

Reflection groups are Coxeter groups [15]. In the one-dimensional case, the product of reflections on the Euclidean plane *t* and *x*, the mirrors of which intersect at the origin, forming an angle π/m, identical to rotation around the origin by an angle $2\pi/m$,i.e. on the 180°. The group $PT = (t, x)$ satisfies the relations $t^2 = x^2 = 1$.

The roots of the groups *P* and *T* are vectors, *P, T* are groups over a field of vectors in the Minkowski space, *C* - is a group over a discrete field of real numbers, where the addition operation is given.

PT and *C* in the coordinate-charge space form the C_{2v} group, that is, the characters of the *CPT* and *M* groups coincide. Accordingly, the *CPTM* transformation, like two successive *CPT* transformations, preserves the sign of the bosons and reverses the sign of fermions.

The threshold for the production of $E=2m_gc^2$ pairs is lower than the threshold for the production of electron-positron pairs, since along with the creation of an electron-positron pair, gravitational masses with opposite signs are also born.

By virtue of Noether's theorem, the groups *C, P, CP*, and *T* correspond to parity conservation laws (time is isotropic); therefore, *M*-parity must also exist. Accordingly, *MT*-symmetry must also exist.

The continuous mass shift group is realized similarly to the standard Lie group of time shifts, $m_s = m + s$, $s \in \sim$. Mass ceases to be a parameter and becomes a function argument.

Conclusion

The question whether it is possible to construct the group *G* as including the *M*-symmetry remains open, since group *M* is not a calibration group.

If the negative mass hypothesis is valid, it could become a competing dark energy hypothesis.

It can be assumed that the asymmetry between particles and antiparticles is

of the same nature as the asymmetry of both masses and anti-masses, and these asymmetries, together with the direction of time and the absence of Dirac's monopole, determine each other.

From which it follows that the stated hypothesis of the existence of negative masses is not related to the Hoyle, Bondi and Gold model of continuous generation of matter in the Universe (at the same time, this generation is possible if we consider the thermodynamics of the expanding Universe [16]).

This moment distinguishes the stated hypothesis from the version of Terletskiy [17] with the creation of quadrigues of particles from the vacuum (positons and negatons). Terletsky does not use the apparatus of group theory, his justification for the impossibility of detecting negatons is doubtful, in addition, in this article, by analogy with an electric charge, we are talking about a negative gravitational mass, but not inert.

It is also worth emphasizing that the negative energy density arising in some Casimir effects is associated with the vacuum states of the fields, but not with the negative mass of the particles.

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关于星际气体的成分
ON THE COMPOSITION OF INTERSTELLAR GAS

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建立了考虑引力场的修正热力学第一定律和考虑反重力的方程。 结果表明，不同气体状态方程的差异导致局部热力学平衡的缺失。 建议Unruh效应产生的光子起到背景辐射的作用，得到了复合时期哈勃常数的近似值。 研究表明，暗物质可以由一种特殊的宇宙尘埃形成。

关键词：熵、重力、膨胀、平衡、温度

Abstract. *The modified first law of thermodynamics with consideration of the gravitational field and the equation for working with consideration of anti-gravity are formulated. It is shown that the difference in the equations of state of different gases leads to the absence of local thermodynamic equilibrium. Photons resulting from the Unruh effect are suggested to play the role of background radiation, an approximate value of the Hubble constant in the recombination epoch is obtained. It is shown that dark matter can be formed by cosmic dust of a special kind.*

Keywords: *entropy, gravity, expansion, equilibrium, temperature*

Introduction

The possibility of using a thermodynamic approach to the Universe runs up against well-known difficulties. A thermodynamic system is a system of many particles that are divided into groups of identical particles (atoms or molecules). These particles are constantly colliding with each other, which allows you to enter the mean free path and the mean square of the velocity. Thermodynamics of solids is based on the presence of several types of identical many particles vibrating about an equilibrium position. The thermodynamics of liquids, including plasma, implies the presence of such relationships as the equation of continuity, heat transfer equations, etc. For a system or two, three, *n* contacting systems, the concepts of equilibrium, thermostat and temperature can be introduced.

There are no collisions in the universe in the thermodynamic sense. One part of space is filled with galaxies, whose masses range from 10^1 billion to 10^3 billion solar masses. In total, there are about $3 \cdot 10^{22}$ stars in the visible part (there are 10^{11} stars in our galaxy), about 10^{11} galaxies. Galaxies merge into clusters, 90%

of galaxies - in clusters. Of these, 10^7 – are superclusters of thousands of galaxies, $2,5 \cdot 10^{10}$ – are galactic groups, $3,5 \cdot 10^{11}$ - are giant galaxies, $0,7 \cdot 10^{13}$ - are dwarf galaxies, and this is only a small part, because 9/10 galaxies are hidden from us. The number of asteroids is uncountable.

Superclusters and individual galaxies form chains (galactic filaments, filaments), for example, the Markarian chain - the largest structures in the Universe, with an average length of 60-80 Mpc. Filoments are filled with very hot (millions and tens of millions of degrees) and very rarefied (1-10 atoms per m^3) gas. According to the standard model of the evolution of the Universe, galactic threads are formed and follow along the network-like streams of dark matter. Other parts of the Universe, voids, hundreds of Mpc in size, are empty. The chains are located between the voids. Chains and voids sometimes form what are called walls, such as Sloan's Great Wall. The Great Wall CfA2, located at a distance of 200 million light years from us, is 15 million light years thick and about 500 million light years long. The wall "Giant group of quasars" has a size of 4 billion light years, the Great Wall of Hercules - the Northern Crown - 10 billion light years. Finally, they suggest the existence of the yet-to-be-discovered Great Attractor, a cluster of many superclusters attracting matter from our sector of the Universe, to which the Milky Way is tending at a speed of 400 km/s.

It was recently discovered that the number of galaxies was previously underestimated by a factor of 10–20. incorrectly determined the rate of formation of galaxies in the early Universe. There are separate cold and warm clouds surrounded by hotter gas, as well as relic black holes.

It is assumed that on a scale of the order of 300 Mpc, the Universe is practically homogeneous and is a set of filamentous clusters of galaxies, between which there are voids.

In the direction of the constellation Eridanus, there is a cold spot, 70 μK colder than the average temperature of the CMB (greater than the rms deviation of the CMB of 18 μK). Its diameter is about 10 angular degrees, it is assumed that it is a supervoid with a diameter of about 150-500 Mpc, which is 2-3 Gpc from Earth.

Internally, the Galaxies are almost collisionless. That is, it is difficult to use the laws of thermodynamics inside galaxies. The galaxies themselves collide more often. If we proceed from the frequency of collisions of molecules in a gas, the frequency of collisions of galaxies is of the order of 10-14 per year, in reality it is two orders of magnitude lower. In addition, collisions of galaxies do not have the character of collisions between molecules; in the event of their merging (merging), the process of star formation is activated in them. Consequently, standard thermodynamics does not apply to galaxy systems.

Part of the Universe is ordinary matter, 5%, of which the mass of neutrinos is 0.1%, part is dark energy, 75%, part is dark matter, 20%. Dark energy cannot

participate in thermodynamic processes in the Universe.

The mass of interstellar gas, including radiation, makes up 99% of all matter in the Universe, 60% of baryonic matter in intergalactic space. Interstellar gas consists of protons, electrons, hydrogen, helium, their ions, and the radiation of stars. It is this part, despite the absence of a heat conduction mechanism, can be considered in some problems as a thermodynamic system.

Interstellar gas

There is no local thermodynamic equilibrium in the Universe, it is impossible to introduce the concept of equilibrium as a whole, since there is no thermostat, therefore, it is impossible to introduce such an intense parameter as temperature. We can only talk about thermodynamics, for example, of electrons, their energy spectrum is described by the Maxwell distribution, about the thermodynamics of relict radiation (the Stefan-Boltzmann equation), about the Boltzmann velocity distribution, about the thermodynamics of gas clouds, for which the first law of thermodynamics can be written.

By the number of particles with non-zero rest mass, cosmic rays are 92% protons, 6% helium nuclei, about), 0.1% -1% of the number of atoms are O, C, N, Ne, S, Ar, Fe, and about 1% is accounted for by electrons. In addition - aliphatic carbon compounds, compounds of a fatty series, similar to resins, formed in some stars. It is believed that 30% of the interstellar carbon that fills outer space may be composed of these fats. In addition, micrometeorites from 1 to 180 μm (cosmic dust) - 1% of the mass of interstellar gas, plus neutrinos from supernovae and relic radiation, the density of which is about 10-34 g/cm3 (0.25 eV/cm^3 or 4 10− 14 J/m^3 or 400-500 photons/cm^3), which is 4 orders of magnitude less than the estimates of the density of matter in the Universe, electromagnetic diffuse background, photons of the visible spectrum, X-rays and gamma quanta. Some galaxies, such as the Milky Way, emit gamma rays in the form of bubbles.

Cosmic rays consist of 43% of the energy of protons, 23% of the energy of alpha particles and 34% of the energy carried by the rest of the particles.

Interplanetary space contains about 10 molecules of hydrogen and helium per 1 cm^3; the intergalactic space contains 10^{-6} molecules per 1 cm^3.

According to other data, the average density of the interstellar medium is less than 1 atom of matter per 1 cm^3 [1, 2].

Thus, the mean free path $l = 1/n\sigma$, where n is the concentration of particles, and σ - is the effective cross section, is extremely large, on the order of 10^{12} m, and the scattering probability $P = r/l$, where r – is the average distance between particles, is vanishingly small. Accordingly, for spherical particles of diameter d, in particular, for hydrogen or helium, the relation $kT = \sqrt{2}\pi nd^2 pl$ following from the Clapeyron-Mendeleev law $pV = nRT$, where the pressure p is of the order of 10^{-14} Pa (the gas-kinetic cross section of elastic scattering of atoms or molecules

through a large angle at thermal energies has a value of the order of $10^{-19}/m^2$).

The ratio is fulfilled if we take other data [3-5], according to which the concentration of interstellar gas particles is $10^3/cm^3$. However, in this case, the mass of the interstellar medium is 1-2 orders of magnitude higher than the estimated mass of the Universe 10^{52} kg, if its radius is about 10^{26} m.

In an ordinary gas, the collision model is just a rough approximation, for example, a molecule does not necessarily hit the wall of the volume, in reality it flies up to it, holds on to it for some time and flies off. In this case, on average, the law of conservation of momentum is fulfilled. Therefore, despite the extremely rare number of collisions of interstellar gas particles, a temperature can be introduced for it, which is proportional to the rms velocity of gas particles $T \sim m\overline{v^2}$, which, unlike stars and galaxies, can exert pressure on the walls of a sufficiently large volume, like a stellar wind.

The temperature of interstellar molecular gas is in the range from -269 to -167°C, in interstellar shock waves (see, for example, [6]) the temperature can exceed 1 billion K, in galaxy clusters typical temperatures are in million K, in In the crowns of galaxies of various ages, over 10 billion years, the temperature increased from 200000 K to 2 million K. At the same time, the temperature of the Boomerang nebula in the constellation Centaurus, located 5,000 light-years from Earth due to rapid expansion, is only 1 K, below the temperature of the relic radiation. Recently, filaments of dense gas from highly ionized oxygen atoms at a temperature of 60 million K have been discovered, which make up 30% of all baryonic matter [7].

The specificity of interstellar gas is, firstly, in the attraction of galaxies, and secondly, in the process of star formation, both processes lead to local heating against the background of the expanding Universe.

Gravitational attraction and gravitational repulsion

By definition, a perpetual motion machine of the second kind is an infinitely long operating machine, which, if put into operation, would turn into work all the heat extracted from the surrounding bodies. The impossibility of realizing a perpetual motion machine of the second kind is postulated in thermodynamics as one of the equivalent formulations of the second law of thermodynamics: in all irreversible processes, the entropy of an isolated system invariably increases: $dS > 0$.

The universe, being an isolated system, does not exchange heat, therefore $\delta Q = 0$, hence, $dS = 0$ and $S = const$. The adiabatic process, in which *S*=-*const*, is reversible. In addition, unlike the expansion of a gas into a void, there is no void in the case of the expansion of the Universe. That is, the idea of the impossibility of a perpetual motion machine of the 2nd kind is limited by local systems.

In [8, p. 64, 119], the law of conservation of entropy in the accompanying one

is formulated, that is, expanding system, $sa^3 = const$, where s - is the entropy density, which decreases with increasing radius a. This confirms the conclusion about the conservation of entropy in the volume of the entire Universe. This, it would seem, confirms the validity of the previous statement. However, it is indicated in [8] that this is a covariant law. But the fact is that *S* is an additive quantity, therefore, this relation is valid for any expanding isolated systems.

Thus, the version of the thermal death of the Universe due to the growth of entropy or the laws of thermodynamics of gases is untenable.

The introduction of only the classical gravitational field violates the 2nd law of thermodynamics (in the well-known problem of heating two balls, on a support and on a thread, see [9]. The law can be preserved, as is proposed in [10], by introducing the energy of the balls into the gravitational field of the Earth into internal energy.Therefore, in general, the internal energy

$$U \to U + \frac{1}{2}\int \rho\varphi dV,$$

Where ρ - is the density, φ - is the potential of the external gravitational field. Then you can write the modified 1st law of thermodynamics:

$$\delta Q = d(U + \frac{1}{2}\int \rho\varphi dV) + \delta A$$

In the Universe, the role of van der Waals forces is played by the forces of gravity. It is possible to represent the pressure in the van der Waals equation as the internal pressure, determined by the Hubble law, as the antigravity force according to Gliner. If we imagine the Universe in the form of a ball, the entire mass of which is in the center, then in the classical case and approximately the work done during the expansion of the Universe:

$$dA = \int_S \rho(\frac{GM}{r^2} + H\dot{r})drds$$

However, the inclusion of the gravitational field does not exhaust the difficulties. The fact is that, on the one hand, the volume parameter does not obey thermodynamic laws, but is set from the outside by the Hubble law; it cannot be argued that the volume increases with temperature.

On the other hand, the system contains internal sources of heat that are switched on and off, for example, in the form of thermonuclear reactions, i.e. the process is not adiabatic.

The contradiction is that any space system, any selected volume in the Universe is not closed, since it gives off heat to a constantly expanding volume, but this emerging volume is "simultaneously" included in the system.

Relict radiation

The relict radiation predicted by Gamow is separated from matter during the epoch of recombination. According to the first estimates of Gamow, the temperature of cosmic radiation is about 3-7 K [11]. In 1955, Tigran Shmaonov experimentally discovered noise microwave radiation with a temperature of about 3 K. In 1964, A. Penzias and R. Wilson discovered the cosmic background of radiation and measured its temperature - 3 K.

By definition, displacement $z = (\lambda - \lambda_0)/\lambda_0$, from Wien's law $\lambda_{\max} = 0,29/T$ we get $T = T_0(1+z)$.. Accordingly, for distant galaxies, the background radiation temperature is higher; using the Keck telescope, spectra of two quasars with redshifts z=1.776 and z=1.973 were obtained, which show that they are irradiated with thermal radiation with a temperature of 7.4±0.8 K and 7.9±1.1 K, which corresponds to the calculated data T(1.776) = 7.58 K and T(1.973) = 8.11 K.

It would seem that thereby Gamow's theory was confirmed.

The temperature of the relict radiation is 2.7 K., while the average temperature of the interstellar gas is 4 K. Let's imagine the space of the Universe as a vessel in which partitions were removed between different gases. The temperature of the gas mixture is determined by the formula:

$$T = \sum_i \frac{p_i V_i}{C_{pi}/C_{vi} - 1} \left(\sum_j \frac{T_j p_j V_j}{C_{pj}/C_{vj} - 1}\right)^{-1} \text{ or } T = \sum_{i \neq j} \rho_i T_j \left(\sum_k \rho_k\right)^{-1}$$

For monatomic gases, when the sum of internal energies does not change, the equilibrium temperature is determined from the easily obtained ratio:

$$T = \frac{\sum_i (T_i m_i^{-1})}{\sum_k m_k^{-1}} \quad \text{or } T = \overline{m_i / Ti} \cdot \overline{m_k}$$

where $\overline{x}$ - is the harmonic mean of x. Meanwhile, the temperature of interstellar space is 4 *K*, while the temperature of the relict radiation is 2.7 *K*, i.e. for billions of years, equilibrium has not been established (see [12], also [13, p. 150-151]). Thus, the temperatures of the CMB and the rest of the interstellar gas should have leveled off.

Usually, among the reasons for the absence of local thermodynamic equilibrium indicate that, for example, the electron and ion temperatures of the interstellar gas can be very different from each other, because energy exchange during collision occurs extremely rarely. In addition, in the interstellar medium, the forward and reverse processes of ionization and recombination are of a different nature, and therefore a detailed balance cannot be established. The small optical thickness for hard radiation and fast charged particles leads to the fact that the energy re-

leased in any region of space is carried away over long distances, and cooling occurs throughout the volume at once, and not in local space, expanding at the speed of sound in the medium. Heating occurs in a similar way, and the heat conduction mechanism is not able to transfer heat from a distant source.

However, all of the above has nothing to do with the balance between the relict radiation and the rest of the interstellar gas, which should have been established over more than 13 billion years.

If the temperature of the relict radiation turned out to be lower, due to the inverse Compton effect indicated by Zeldovich, the energy of relict photons should increase, and over billions of years the temperature of the relict radiation should have become equal to the temperature of interstellar matter.

Expansion of gases

In gas clouds, the temperature can be different for different gas layers. Let *ni* be the number of particles in the *i*-th layer, *ni/Ti* be the optical thickness of the *i*-th layer, the sum of the optical thicknesses equal to the total number of atoms divided by the average temperature, respectively, the average temperature

$$T = \sum_i n_i (\sum_j n_j / T_j)^{-1}$$

Consider the equation of state for the interstellar medium outside clouds and galaxies. At nonrelativistic velocities, due to the low density of matter, the interstellar medium is classical.

The expansion of the Universe is an adiabatic process, the system does not give off heat and does not receive it from the outside. Let us denote the ratio of the specific heats $\gamma = C_p / C_v$. Under the adiabatic expansion of an ideal gas $pV^\gamma = k$, where k – is a constant. In an ideal gas, during adiabatic expansion, the temperature drops depending on the value of $\gamma = C_p / C_v$. From the first law of thermodynamics $\delta Q = c_v dT + pdV$ it is easy to obtain the dependence of the temperature decrease on the volume in the absence of heat transfer: $TV^{\gamma-1} = const$.

That is, for an ideal gas, as the volume increases, the temperature slowly decreases. The equation for the internal energy is: $dE = -kV^{-\gamma}dV$. Hence $E = -kV^{1-\gamma} / (1-\gamma) + c_1$.

The internal energy of a van der Waals gas consists of its kinetic energy (the energy of the thermal motion of molecules) and potential:

$$E = c_v T - kV^{1-\gamma} / (1-\gamma) + c_1$$

Since gravitational forces are many orders of magnitude weaker than van der Waals forces, one can imagine the Universe as an ideal gas. However, the fact is that if we imagine the contents of the Universe as an ideal gas, then its internal energy during expansion does not depend on volume, as was shown by Joule in 1845. In van der Waals gas $(V-b)(p+av^2/V^2) = vRT$. Van der Waals constants *a*

and *b* take into account the attraction between molecules at large distances (constant *a*) and strong repulsion at small ones (constant *b*). This repulsion makes the inner space of the molecule inaccessible to other molecules and reduces the total free volume.

Since there is no penetration into internal spaces in the Universe, the constant *b* can be set equal to zero. Moreover, constant a ceases to be constant: $a \sim 1/\mathrm{r}^2$, $a \to a'$, , and

$$V(p + a'\nu^2 / V^{8/3}) = \nu RT,$$

where *r* – radius of the universe, ν - number of moles, a' - new constant. Those. in the initial stage of expansion, when the $a'/V^{8/3}$, term plays the main role, the temperature drops rapidly. At large volumes, when the 2nd term in the right-hand side is small, the temperature decreases slowly, because pressure decreases with increasing volume.

In the case of adiabatic expansion of van der Waals gas $dT = \frac{a}{c_v}\frac{dV}{V^2}$. I.e. the temperature $T \sim V^{-1}$ falls in inverse proportion to the volume, which clearly does not correspond to reality.

In the Dieterichi $pV = RT\exp(-a/RTV)$, model, which is more adequate for low pressures, i.e. at *b* = 0, the picture is approximately the same: since the interaction between the atoms of a rarefied gas is small, the relation for an ideal gas $pV^\gamma = const,\ \ T = \frac{const}{V^{\gamma-1}}\exp(a/RTV)$ can be used and, taking into account that at large volumes the exponential exponent tends to zero, we see that the temperature slowly decreases with increasing volume in the same way as in ideal gas.

In a real gas, when it expands into a void, the average distance between molecules increases, the forces of attraction do negative work, and the potential energy increases. Since the total internal energy remains constant, the kinetic energy of the molecules, and hence the temperature of the gas, decreases. The slowness of the decrease is due to the weak interaction between the gas particles. Thus, all parts of the interstellar medium cool extremely slowly with the expansion of the Universe, including the relic radiation, but cool in different ways.

The thermodynamics of a photon gas is significantly different, the equation of its state

$$pV = \frac{1}{3}E$$

Since *E* is additive, pressure is independent of volume.

The internal energy of a photon gas is directly proportional to the volume, while the energy of an ordinary gas is proportional to the volume to the power (1-γ).

The density of different components of the medium also changes in different ways. Since*S* = *const*, from the equations $dE = pdV$ and $\rho = E/V$ we

obtain the dependence of the density on the radius of the Universe (or the scale factor) $d\rho + 3(p+\rho)dr/r = 0$; for the radiation density $\rho \sim r^{-4}$, since the energy is inversely proportional to the wavelength $E \sim 1/\lambda \sim 1/r$, for the rest of the gas $\rho \sim r^{-3}$.

Therefore, with the expansion of the Universe, the photon gas and the rest of the interstellar gas should have different temperatures.

Fulling - Davis - Unruh effect

Unruh's photon gas appears every moment of time and cannot come into equilibrium with the environment. Therefore, one could assume that the measured CMB is in fact the Unruh radiation.

By virtue of the principle of relativity, the Milky Way is the same galaxy as the rest - it is also moving away with acceleration from other galaxies. In such a case, the Milky Way must be pierced by radiation. By virtue of the principle of relativity, the temperature of Unruh radiation is the same at any point in the Universe. All galaxies located at distances less than the radius of the Universe make a smaller energy contribution to the Unruh radiation.

The temperature of the observed Unruh radiation is expressed by the same formula as the temperature of Hawking radiation, but depends not on surface gravity, but on the acceleration of the reference frame *a*:

$$T = \frac{\hbar a}{2\pi kc} \approx 4 \cdot 10^{-21} \cdot a$$

The energy of the photon gas is - $E = \frac{8\pi^5 k^4}{15c^3\hbar^3} VT^4$, the number of photons is - $N = \frac{2k^3\varsigma(3)}{c^3\hbar^3\pi^2} VT^3$ · We use Hubble's law $v = Hr, a = H^2 r$, where r - is the radius of the Universe. Let us estimate the energy of the modern photon Unruh on Earth, taking the Hubble constant equal to 10^{-18}:

$$E_{Унру} = \frac{E}{N} \approx 4,2kT \approx \frac{2\hbar H^2 r}{\pi c} \sim 10^{-52}\,Дж \qquad (1)$$

The angular acceleration of the rotation of the disk of the Milky Way gives the energy of the Unruh photon of the order of 10^{-34} J, the acceleration of the rotation of the Local Group - by several orders of magnitude less. The era of inflation lasted from 10^{-42} to 10^{-36} seconds. At this time $10^{42} сек^{-1} > H > 10^{36} сек^{-1}$, the radius is about 10^{-2}. Let us take a smaller value, then at the end of the inflationary epoch the energy of the Unruh photon is about 10^{30} J.

Let's estimate the energy of the relic radiation:

$$E_{реликт} = \hbar\omega \sim 10^{-22}\,дж$$

If we choose a period of 380000 years, when the radiation separated from

matter, and even the moment after the Dark Ages 550 million years from the Big Bang, then, integrating Hubble's law, it is easy to see that the energy of Unruh's photons is not much different from the modern one, since the exponent with a small value the Hubble constant is close to unity.

You can find a time point when the density of interstellar gas abruptly becomes so low that collisions with photons become critically rare. This is the time of the formation of stars in 550 - 800 thousand years, but even after this period of time, if we consider the size of the Universe in accordance with the Hubble law, the energy of Unruh's photons has hardly changed. However, the Unruh mechanism generated particles during the entire period of the expansion of the Universe. That is, there should be parameters H and r intermediate in magnitude, at which the energy of the Unruh photon is equal to the energy of the relict photon.

Obviously, high-energy Unruh photons should have disappeared due to the formation of multiple pairs of particles, but the question arises about the disappearance of the spectrum of low-energy photons, which should be continuous. They are removed if the value of the Hubble constant has decreased in an extremely short period of time.

380000 years after the Big Bang, the redshift is - $z \sim 1000$, the temperature of the relict gas is in equilibrium with the rest of the environment - $T \sim 3000K$, the density of the relict gas is about $4 \cdot 10^{11}$ /cm^3.

Since at the moment of separation of radiation from baryonic matter, the radiation temperature is 3000 K, and the dimensions of the Universe were about 1000 times smaller than the modern ones, from the assumption that the temperature of the Unruh gas is in order of magnitude to the temperature of the relict gas, it is possible to estimate the intermediate value of the Hubble coefficient at the moment of time 380000 years from the Big Bang:

$$H_{recombination} \approx 4 \cdot 10^{-5} c^{-1}$$

Thus, Unruh photons can play the role of background radiation with a temperature of 2.7 K.

The evolution of the Universe is represented as follows: white dwarfs will cool down to 1 K in 10^{17} years. After 10^{19} years, neutron stars will cool down to 30 K. After 10^{32} years, matter will decay into photons and neutrinos. The most massive black holes at the centers of galaxies will evaporate within 10^{96} years. But this is an incomplete picture.

According to Hubble's law, galaxies scatter with acceleration. It has decreased by tens of orders of magnitude during the epoch of inflation, but since the epoch of 5-6 billion years, the magnitude of the acceleration is slowly increasing. The further away the galaxy is, the higher its speed becomes. With acceleration, the Fulling-Unruh effect arises, the creation of pairs of particles from a vacuum.

The Milky Way is just like the rest of the galaxy - it is also accelerating away from other galaxies. In this case, when the acceleration of the Milky Way reaches a certain value, the galaxy will be permeated with radiation. Based on the Hubble law, the acceleration $a = H^2 r$, $r = r_0 \exp(Ht)$, taking into account that the modern radius of the Universe is $r: 10^{27}$, and assuming for the assessment that the Hubble constant increased uniformly over 7 billion years to the present value of 10^{-18}, we can calculate when the acceleration reaches the indicated level: $t^2 \exp(10^{-36} t): 10^{64} c^2$, whence $t: 3 \cdot 10^{24}$ yours. That is, after the cooling of white dwarfs and neutron stars, but long before the disintegration of matter, galaxies will begin to gradually heat up.

Dark matter

Dark matter, which makes up about 25% of the mass-energy of the Universe, does not participate in electromagnetic interaction, therefore, it is inaccessible to direct observation, manifests itself only in gravitational interaction and affects the expansion rate of the Universe. The concept of dark matter was introduced to explain the problem of hidden mass in the effects of anomalously high rotation speed of the outer regions of galaxies and gravitational lensing; they involve a substance whose mass is much greater than the mass of ordinary visible matter. Dark matter is thought to be composed of Weakly Interacting Massive Particle (WIMP), hypothetical weakly interacting massive particles. The WIMP mass should be at least several tens of times greater than the proton mass $M_p = 10^{-27}$ kg. At the same time, wimps are not included in the Standard Model. Stable neutralinos are also considered in supersymmetric theories. In various unconfirmed experiments, a possible signal from WIMPs with a mass of the order of 4-19 M_p was observed.

Dark or absorption nebulae, types of interstellar clouds, are not dark matter, they are so dense that they absorb visible light from emission or reflection nebulae (such as the Horsehead Nebula) or stars (such as the Coal Bag nebula), behind. Stars are born in the inner parts of dark nebulae, and other active processes take place. However, it is possible that a special kind of cosmic dust can form dark matter.

Space dust particles range in size from a few molecules to 0.2 microns. Solar system dust includes cometary dust, asteroid dust, Kuiper belt dust, and interstellar dust passing through the solar system. The density of the dust cloud through which the Earth passes is approximately 10^{-6} dust particles per m^3. According to various estimates, from 5 to 300 tons of cosmic matter, including dust, enter the Earth's atmosphere per day. Dust particles interact with electromagnetic radiation, the nature of the reflected radiation depends on the particle size, cross section, structure, refractive index, wavelength of electromagnetic radiation, etc. The density of interplanetary dust particles in the Earth's stratosphere is 1-3 g/cm^3 with an average value about 2.0 g/cm^3. Near-star dust is composed of CO molecules, sil-

icon carbide, silicates, polycyclic aromatic hydrocarbons, ice, and polyformaldehyde. Frequent components of dust particles are graphite, aluminum oxide, spinel, etc., which condense at high temperatures from the cooled gas that occurs during stellar winds or during decompression of the inner part of a supernova.

The Schrödinger equation refers to the energy of an electron in the electric field of the nucleus. If we replace it with a gravitational one, then the gravitational Bohr radius –

$$r_{grav}(n) = (\frac{n\hbar}{\pi})^2 (GMm^2)^{-1}$$

For a proton and an electron, the first Bohr radius is greater than the radius of the Universe, 10^{28} m. If we assume that quantum properties manifest themselves at distances of the order of the 1st Bohr radius 10^{-10} - 10^{-11} m, then

$$2a + b = -(43\text{-}44),$$

where a and b – exponents, for example: $m \sim 10^{a}$. The terms can take the following values: - 15 and - 13, - 16 and - 11, or - 16 and -12, - 15 and -14, etc., which are included in the range of cosmic dust masses - from 10^{-16} kg to 10^{-4} kg. That is, in cosmic dust there should be connected states that do not emit electromagnetic waves, since dust particles are neutral, and for the transition from orbit to orbit they interact not with the electromagnetic, but with the gravitational vacuum.

Compounds of the macromolecule type, as well as formed under the action of van der Waals intermolecular interaction, dipole-dipole, the potential energy of which decreases with radius $U_{orient} : -1/r^6$, dipole-dipole induced ($U_{ind} : -1/r^6$), London dispersive and dispersive Slater - Kirkwood ($U_{disp} : -1/r^6$) with different coefficients proportionality and in the first type with a dependence on temperature, cannot be dark matter, since they are capable of emitting and absorbing electromagnetic waves.

It is possible that such dark matter regions of cosmic dust arise due to mass separation by the centrifugal force arising from the rotation of galaxies, thus separating them from the rest of the cosmic dust.

Conclusion

The modified 1st law of thermodynamics allows one to take into account the contribution of dark matter to local thermodynamic processes. The expression for work allows you to calculate the contribution of antigravity to the internal energy of the Universe. An analysis of the equations of thermodynamics shows that the cooling of the interstellar medium in the Universe slows down with expansion. Taking Unruh photons into account makes it possible to expand the scope of the thermodynamic approach to the Universe. If the assumption about Unruh's photons as radiation is correct, then the observed background cannot be one of the confirmations of the theory of a hot Universe. If the assumption of connected states in cosmic dust matches reality, it could be a step towards constructing quantum gravity.

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部分运算在信息系统描述中的应用
ON THE APPLICATION OF PARTIAL OPERATIONS FOR THE DESCRIPTION OF INFORMATION SYSTEMS

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信息系统的表示基于各种代数方法。 图的代数理论，包括部分图，是基于代数方法的使用，因此对部分代数作用理论的详细研究很感兴趣。

关键词：部分图、图、半群、双环半群、代数作用、同余、同态。

Abstract. *The representation of information systems is based on various algebraic methods. The algebraic theory of graphs, including partial graphs, is based on the use of algebraic means, and therefore there is an interest in the detailed study of the theory of partial algebraic actions.*

Keywords: *partial graphs, graphs, semigroups, bicyclic semigroups, algebraic actions, congruence, homomorphism.*

Abstract description of information systems [7] is a common method for mathematical, logical description of the functioning of information systems. This description is represented by a set of levels of abstract description, and the generally accepted levels are: symbolic (linguistic), set-theoretic, abstract algebraic, topological, logical-mathematical, information-theoretical, dynamic, heuristic (intuitive). Abstract description of the information system [7] at the appropriate levels allows: to evaluate the indicators that characterize various properties of the IP; to choose the optimal system structures; to select and maintain optimal values of the IP parameters; to solve other problems of quality assurance and optimization.

As you know, one of the ways to study a particular algebraic system is to decompose it into subsystems from a sufficiently studied class. In the theory of semigroups, expansions into the union of pairwise disjoint sub-semigroups or, sometimes, pairwise intersecting at a common zero are widely used. The works of A. Clifford, V. Mann, M. Petrich, R. Croiseau, D. Howie, L. N. Shevrin, A.V. Kelarev and many others are known in this direction.

The main object of the study is the class of categorical semigroups that allow

decompositions into the union of Brandt semigroups with a common zero. Note that every statement about semigroups with zero implies as an obvious consequence some statement about semigroups without zero, if we assume that in the semigroup under consideration zero is external.

The study of semigroups that are the 0-union of Brandt semigroups seems relevant, since in the class of semigroups with zero, the Brandt semigroup is the most natural analogue of the concept of a group. For example, Wechler and Fichtner use Brandt and Ehresmann groupoids to describe the symmetry of crystals, and the zero extension of the fundamental groupoid of any undirected graph is also a direct union of Brandt semigroups. Another example. Let $M=\{M_i \mid i \in I\}$ be the set of pairwise non-intersecting non-empty sets. Then the set of all bijections whose domain of definition and domain of value belong to M (these domains may coincide), with respect to the usual superposition of maps, is a partial groupoid whose zero extension is a semigroup that is the 0-union of Brandt semigroups. For example, as M, we can take – the set of open faces (without edges) of a polyhedron, in particular, - some crystal.

The formulations of the results obtained become much shorter, and their proofs are significantly simplified if, instead of the semigroup with zero under study, we consider the partial groupoid that is obtained from this semigroup by removing zero.

The main method of research in this work consists in using an operation on classes of partial groupoids, which is close to multiplying classes of complete groupoids, first considered by A. I. Maltsev. In these terms, we can also consider the concept of graded algebra.

To solve this problem on partial $\mathfrak{I}$ groupoids with certain associativity-type conditions, we study congruences whose adjacent classes are Brandt groupoids. On the partial groupoids we study, the only congruence satisfying this requirement is the Green equivalence . By revealing the various properties of this equivalence and the subsequent transition to the zero extension of the considered partial groupoids, the goal set in this paper is achieved: the structure of categorical semigroups at zero, which are the 0-union of Brandt semigroups in terms of partial semilattices , is described.

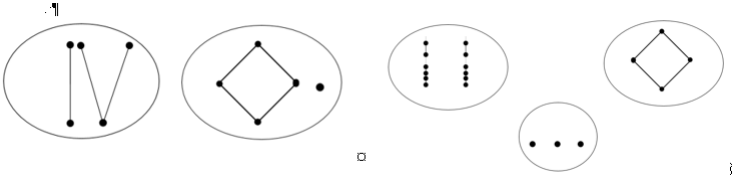

Figure 1 – Examples of partial semilattices

The concept of a catenary semigroup was introduced for geometric purposes by V. V. Wagner [1]. A semigroup is a strongly associative partial groupoid $(S;\cdot)$ i.e. a partial groupoid is a semigroup if and only if one of the products $(x\cdot y)\cdot z$, $x\cdot(y\cdot z)$ is defined in S , it follows that the other is also defined, and the equality holds

$$(x\cdot y)\cdot z = x\cdot(y\cdot z) \tag{1}$$

If the product $u\cdot v$ is not defined in S, then we write $u\cdot v=\varnothing$.

Obviously, a partial groupoid $(S;\cdot)$ is a semigroup if and only if its zero extension [2] $S^0 = S\cup\{0\}$ is a semigroup. Therefore, every property of semigroups entails an obvious consequence for semigroups (with zero).

An idempotent commutative semigroup is called a partial semilattice.

An idempotent partial groupoid is called an antichain if the condition $xy\neq\varnothing$ always implies $x=y$

A partial groupoid $(S;\cdot)$ is called catenary if the condition $x\cdot y\neq\varnothing\neq y\cdot z$ always implies $(x\cdot y)\cdot z\neq\varnothing\neq x\cdot(y\cdot z)$.

The condition of catenarity of a partial groupoid of a groupoid S is equivalent to the condition of categoricity at zero of its zero extension S^0.

The accepted semigroup terminology is preserved [6] for arbitrary semigroups as well. For example, the terms regular, inverse, simple, completely simple semigrupoids, etc. are clear. A completely simple inverse semigrupoid is called a Brandt groupoid.

For arbitrary classes Σ,Γ of semigrupoids, we denote $\Sigma*\Gamma$ by the class of all semigrupoids S on which there exists such a congruence τ that $S/\tau\in\Gamma$,, and every closed in S τ-class belongs to Σ. Every semigrupoid of the class $\Sigma*\Gamma$ is called Γ-semigrupoid of Σ-semigrupoids. The paper considers the structure of catenary semigrupoids, which are idempotent commutative semigrupoids of Brandt groupoids. A special case of the result obtained in this work is one of the main theorems in [4].

Notation: ***A*** – class of antichains; ***B*** - class of Brandt groupoids; ***I*** -class of semilattices; ***Q*** -class of catenary partial semilattices; ***M*** -class of inverse Clifford semigrupoids in which the ideal Green $\mathfrak{J}$ equivalence is a congruence; ***K*** is the class of those semigrupoids $S\in\boldsymbol{M}$ for which the binary relation

$$\lhd=\{(\alpha,\beta)\in S/\mathfrak{J}\times S/\mathfrak{J}\,|\,\alpha\circ\beta=\alpha\}$$

satisfies the condition

$$(\gamma\lhd\alpha\,\&\,\gamma\lhd\beta)\rightarrow(\gamma\lhd\alpha\circ\beta) \tag{2}$$

Theorem 1.

Q=I*A

It is proved in [3] that semigrupoids of class ***K*** and only they are catenary partial semilattices of Brandt groupoids, i.e. ***K=B*Q***, whence, by Theorem 1, ***K=B*(IA)***.

Naturally, the question arises about the structure of catenary semigrupoids of class ***K***. The solution of this question is the purpose of this work.

Theorem 2.

A semigroup *S* of class ***K*** is catenary if and only if for any $\alpha, \beta \in S/\mathfrak{Z}$, such that $\beta \lhd \alpha$ and any idempotent $e \in \mathsf{a}$ there is a unique idempotent $f \in \beta$ such that $f \leq e$.

The solution of this problem in a purely semigroup language presents significant difficulties. This is caused by the following circumstance. The decomposition of a semigroup *S* into sub-semigroups with a common zero does not determine not only congruences on *S*, but even equivalences. An attempt to isolate zero, considering it a separate class, is untenable: the decompositions of S under consideration are such that the binary relations corresponding to them on the partial groupoid *S*\{0}, being congruences, are not strong congruences, and therefore their zero extensions (using the pair (0,0)) are not congruences on the semigroup S. That is why the language of partial actions is preferable to the language of complete actions.

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使用仿生神经网络进行聋人手势语音识别
USAGE OF BIO-INSPIRED NEURAL NETWORKS FOR THE DEAF SIGN SPEECH RECOGNITION[1]

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本文提供了一种基于使用仿生神经网络来识别聋人手语的原创方法。主要思想是区分手语中的运动，这是典型的动态手动手势和运动-插词。给出了运动检测模型及其架构的描述。运动检测由神经网络组织的时空方案定义。前两层选择边缘。为此，基于 Gabor 滤波器和双曲正切的使用开发了神经网络。运动直接隔离在神经网络的第三层（MT-神经元）上。 MT 神经元允许您区分线性运动和旋转。展示了运动检测模型的实验研究结果，证实了预期的假设及其解决手势语音识别问题的有效性。

关键词：手语，手势识别，仿生神经网络，神经元运动

Abstract. *The article offers an original approach to the recognition of sign speech of the deaf based on the use of a bio-inspired neural network. The main idea is to distinguish movement in sign language, which is typical for dynamic manual gestures and movements-epenthesis. The description of the motion detection model and its architecture is given. Motion detection is defined by the spatio-temporal scheme of the neural network organization. The first two layers select the edges. For this purpose, a neural network was developed based on the use of a Gabor filter and a hyperbolic tangent. The movement is directly isolated on the third layer of the neural network (MT-neuron). The MT-neuron allows you to distinguish both linear motion and rotation. The results of an experimental study of the motion detection model are presented, which confirm the expected hypotheses and its effectiveness for solving the problem of gesture speech recognition.*

Keywords: *sign language, gesture recognition, bio-inspired neural network, neuron movement.*

1 The reported study was funded by RFBR and DST according to the research project No. 19-57-45006.

Introduction

There are about 150 national sign languages of the deaf in the world. The task of recognizing sign speech is relevant due to the lack of translators and their high cost. In practice, neural network approaches are used, but they also have their limitations [1]. Accurate recognition of sign speech is complicated by such phenomena of gesture display as dynamism, overlap, etc.The solution to this problem can be the use of motion recognition methods. For traditional neural networks, including those trained using deep learning, if the network is not trained for a certain motion vector, it will not detect it. In computer vision, the problem of motion analysis is most often solved by applying the optical flow equation. When training neural networks to detect motion, we can also talk about using the optical flow equation, or rather, the basic mechanism for determining the direction of change in the brightness of pixels. Neural networks are also widely used in this task. Most often, reccurent networks, such as GRU [2, 3], LSTM [4, 5], are used to motiod detection. There is also a solution to the problem using convolutional neural networks [6-8], most often this is the ResNet model underlying FlowNet [9] and FlowNet 2.0 [10]. Several attempts have been made to simulate the motion detection neuron (MT-neuron) from the visual cortex. The most common model is the Heeger model [11, 12], which is analyzed in detail in [13]. In this paper, an alternative approach based on biological similarity is proposed.

Edge detection

In the visual cortex, motion analysis begins in the primary visual cortex. In the proposed model, the motion detection is carried out on the third layer of the neural network. The first two layers select the edges. For this purpose, a neural network was developed [14], based on the use of a Gabor filter and a hyperbolic tangent. The images coming to the input are represented by the L* component of the CIE space L*a*b*. On the first layer, lines of a certain orientation are detected. The second layer is responsible for selecting combinations of lines, including corners. Each layer contains 3 types of neurons that differ in the configuration of receptive fields. At the same time, the connections between the layers are organized in a special way. Each neuron of the second layer (U_{C2}) is connected only to two neurons of the first layer (U_{S1}). Thus, the neurons of the second layer allow you to detect lines and angles (in the case of the Gabor filter) and quadrilaterals (in the case of a hyperbolic tangent).

To lines detection, neurons are used, the receptive field of the size of 7*7 pixels of which is set by the Gabor filter.

$$G_{1,2} = exp\left(-\frac{x'^2+\gamma^2 y'^2}{2\sigma^2}\right)\cos\left(2\pi\frac{x'}{\lambda}+\varphi\right), \quad (1)$$

where $\frac{\sigma}{\lambda} \approx 0{,}56$, φ – phase offset (0 – dark line on a light background, -π – light line on a dark background), γ – ellipticity (=0.1), λ=3, $\theta \in [0{,}170]$.

Each neuron is sensitive to a line of a certain orientation with a deviation step

of 10 degrees.

The neurons of the second layer are a weighted sum of the signals of the first layer with a sigmoidal activation function.

Motion detection

Motion detection sets the spatio-temporal organization of the motion detection neural network. Movement, in this case, is the sequential activation of several edge selection neurons located in the same direction in a certain neighborhood over time, i.e. with a change of frame. Thus, the MT neuron can give the direction of movement α and its speed v. The MT neuron, like the previous neurons, is created for each type. The connections of the MT neuron with the U_{C2} neurons of the corresponding type determine its receptive field. To determine linear motion, the receptive field of the MT neuron ($U_{MT}^{\{l\}}$) includes a sequence of U_{C2} neurons in the α direction. To determine the rotation, the receptive field of the corresponding MT neuron ($U_{MT}^{\{r\}}$) is accompanied by connections with neurons located in the same center of the receptive field, but having different orientations θ. The rotation detection neuron is created twice for different directions of rotation.

$$U_{MT}^{\{l\}}(x,y,p,v,\alpha) = \sum_{x,y,t} U_{C2}(x,y,\theta,p) * w_{xy}(t) \quad (2)$$

$$U_{MT}^{\{r\}}(x,y,p,v,\alpha) = \sum_{\theta,t} U_{C2}(x_0,y_0,\theta,p) * w_{\theta}(t) \quad (3)$$

The weights of MT-neurons are set using the product of Gaussian and Mexican Hat wavelet, the first is responsible for the spatial characteristic, the second sets the attenuation coefficient of the link weight over time.

$$w_{xy}(t) = exp\left(-\frac{x'^2+\gamma^2 y'^2}{2\sigma^2}\right) * exp\left(1-\frac{t^2}{2\sigma^2}\right) exp\left(-\frac{t^2}{2\sigma^2}\right) \quad (4)$$

$$w_{\theta}(t) = exp\left(-\frac{\theta^2}{2\sigma^2}\right) * exp\left(1-\frac{t^2}{2\sigma^2}\right) exp\left(-\frac{t^2}{2\sigma^2}\right) \quad (5)$$

A uniform filling of such a neuron, i.e. a stationary dark area in the entire size of the receptive field, will not give the required activation, fig.1. In this case, the attenuation coefficient obeys a certain law of change t: at the beginning of the movement in the receptive field t = [0,1,2], when the neuron $U_{C2}(x_2,y_2,\alpha,\rho)$ is activated, the vector t will have values t = [-1,0,1]. At the end of the receptive field, the vector t will have values t = [-2,1,0]. In this regard, the value of the attenuation coefficient will change.

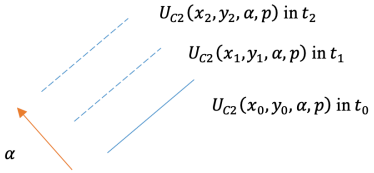

Fig. 1. Scheme of the MT neuron work

The Mexican hat wavelet is used to reduce activation when filling the receptive field of the MT neuron with a textural periodic image.

Experiments

For an experimental test, we will run the movements of different angles to check the activation of U_{C2} neurons, in the direction of 45 degrees. Fig. 2-4 show the frame-by-frame activation of MT neurons. Ideally, there should be a thin line, but due to the low resolution, there is a false activation within 10-20 degrees (σ=0.5).

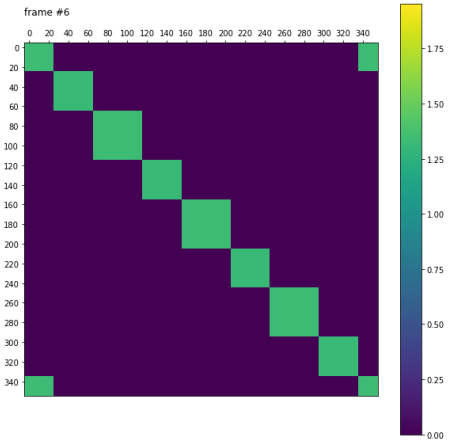

Fig. 2. First frame (*start motion, vertically - the angle of movement, horizontally-the response of MT-neurons*)

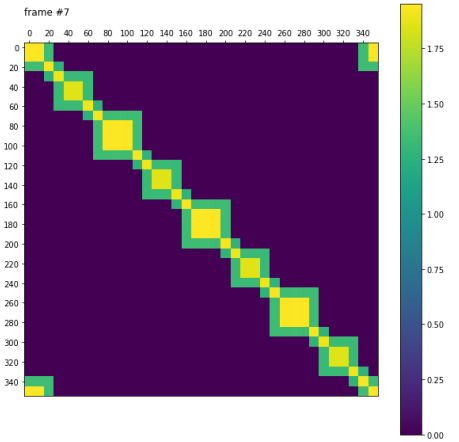

Fig. 3. Second frame (*vertically - the angle of movement, horizontally-the response of MT-neurons*)

Fig. 4 shows that the maximum activation is achieved on the second frame, then there is a fade, which confirms our assumption. Attenuation is necessary so that the MT neuron does not fire on stationary objects.

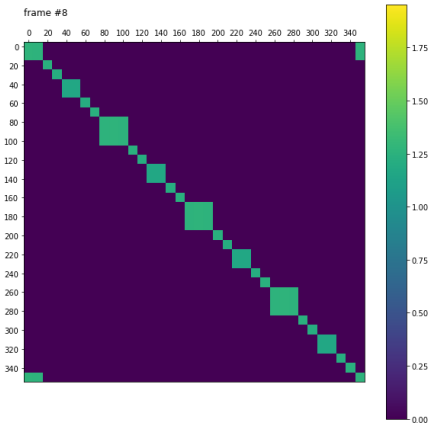

Fig. 4. Third frame (*end motion, vertically - the angle of movement, horizontally-the response of MT-neurons*)

In general, the longer the movement lasts, the more accurately its direction is determined.

If we increase the size of the receptive field of the space-time vector from 3 to 7, the accuracy of determining the direction of movement increases, fig.5-6.

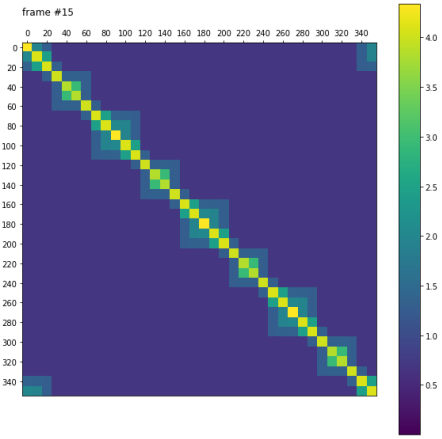

Fig. 5. Fourth frame (vertically - the angle of movement, horizontally-the response of MT-neurons)

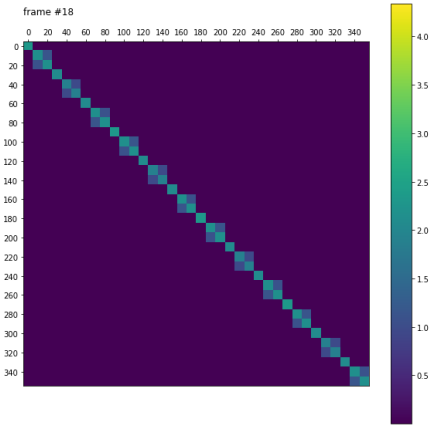

Fig 6. Seventh frame (*end motion, vertically - the angle of movement, horizontally-the response of MT-neurons*)

Conclusions

To recognize the sign language of the deaf, it is proposed to use a biologically similar neural network. The basis for its application is the presence of dynamic manual gestures and movements in sign language-epenthesis. Motion detection is defined by the spatio-temporal scheme of the neural network organization. The first two layers select the edges based on the use of the Gabor filter and the hyperbolic tangent. The movement is directly isolated on the third layer of the neural network (MT-neuron). The MT-neuron allows you to distinguish both linear motion and rotation. The experimental study of the motion detection model confirmed the expected hypotheses and its effectiveness for solving the problem of gesture speech recognition.

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运用数学模型研究区域固定资本投资对其社会经济发展的影响
INVESTIGATION OF THE INFLUENCE OF INVESTMENTS IN FIXED CAPITAL OF THE REGION ON ITS SOCIO-ECONOMIC DEVELOPMENT USING MATHEMATICAL MODELING

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本文致力于分析该地区社会经济发展对固定资产投资的依赖。 已确定最依赖投资的固定资本（FC）的主要组成部分。 提出了一种构建数学模型的方法，考虑了以下因素：该地区的人口、其大小和位置。

关键词：社会经济系统管理，固定资产投资，投资吸引力，数学模型。

Abstract*. The article is devoted to the analysis of the dependence of the socio-economic development of the region on investments in fixed assets. The main components of fixed capital (FC), which are most dependent on investments, have been identified. A method for constructing a mathematical model is proposed, taking into account factors: the population of the region, its size and location.*

Keywords*: management of the socio-economic system, investment in fixed assets, investment attractiveness, mathematical model.*

Introduction

A region is a system consisting of interconnected parts that form an integral unity [1]. The main parts of the system are material production and social sphere, balanced among themselves, therefore the region is a socio-economic system [2]. Making effective management decisions for the socio-economic system is the main promising economic task of Russia [3]. The socio-economic development of a region depends on its socio-economic potential: various resources that ensure

the satisfaction of the individual and collective needs of society [4]. It is generally accepted that fixed capital (FC) is capital assets involved in the entire production cycle [5]. Investments in FC represent various investments for the construction and reconstruction of fixed assets facilities [6]. We will evaluate the development of the region by the value of the gross regional product (GRP) [7].

Relevance of this study is determined by the task set before Rosstat: the development of an assessment of the impact of investments in FC on the socio-economic development of the region [8], because the mathematical assessment is insufficiently developed and it is required to create more universal models for an optimal economic strategy.

The subject of research is the process of researching the dependence of the level of investment in fixed assets of the region on its socio-economic development.

Research object is the process of constructing a mathematical model of the dependence of the influence of various investments in fixed assets on the dynamics of the economic development of the region.

The purpose of the work is the development of a mathematical model, taking into account the population of the region, its size and other factors.

Practical significance work: the proposed model can be used in automated decision support systems. And the methodological approach to constructing a model can be applied in further research and calculations.

Formulation of the problem

Figure 1 shows the schematic interaction of the socio-economic system with the external environment.

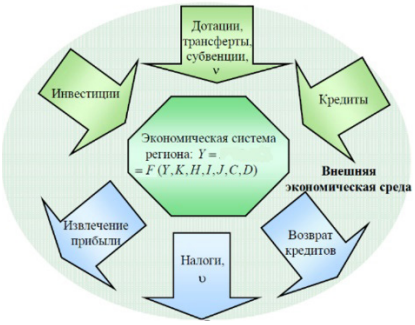

Fig. 1. Diagram of the socio-economic system

As a result of the study of the subject area, the main components of the mathematical model of the economic system of the region were identified. Each component is characterized by a specific set of factors. At one of the stages of

building the model, the factors that have the greatest impact on the GRP as a result of incoming investments were selected, and the degree of this influence was assessed (the significance of the selected factor). The studies were carried out by the methods of regression and correlation analyzes [8]. All elements of the model are quantitative. Significant factors are presented in table 1.

Table 1. Significant factors of the main components of the mathematical model

Components	Composition (factors)
Labor (H)	X_1 – Percentage of the working-age population (at the end of the year) in relation to the entire working-age population of the region, %. X_2 – Percentage of workers with higher education, %.
Innovative (K)	X_3 – Technological innovation as a percentage of total costs. X_4 – Research expenditures, million rubles.
Financial (I)	X_5 - The resulting financial income from the activities of organizations (million rubles). X_6 - Number of companies with financial and insurance activities X_7 - The size of the contribution physical. persons in credit companies of the Russian Federation, rubles. X_8 - The number of small businesses per 10000 people.
Industrial (Y)	X_9 – Gross product per capita, rubles X_{10} - The volume of goods, works, services created by the region's industries, million rubles.
Infrastructure (J)	X_{11} - Railway network of the region, km of tracks per 10000 km^2 of territory. X_{12} – The number of goods transported by machine transport X_{13} – Length of highways (km of roads per 10000 km^2)
Agricultural development (C)	X_{14} –share of agriculture,%
Budget (D)	X_{15} – Tax receipts to the regional budget, million rubles.

When conducting the research, the authors used data from official statistical sources listed on the website of the Federal State Statistics Service for 2020 [9] on investments in 84 regions, as well as data on the population in these regions [10].

Statement of the research problem: to estimate the dynamics of GRP (dependent variable of the model) from investments in fixed assets per capita, taking into account the selected indicators.

Building the model

At the first stage of the study, a sample of empirical data was formed, a fragment of which is presented in table 2.

Table 2

Фрагмент исходных данных и удельных инвестиций по регионам

Регионы	Инвестиции, миллиардов руб.	Население, тыс. чел.	Инвестиции, тыс. руб./чел.
1	2	3	4
Пермский край	283,78	2,61	108,69
Кировская область	72,23	1,27	56,78
Нижегородская область	295,25	3,21	91,85
Оренбургская область	212,04	1,96	108,02
Пензенская область	89,37	1,32	67,80
Самарская область	293,73	3,18	92,28
Саратовская область	162,12	2,44	66,42
Ульяновская область	79,73	1,24	64,38
...	...	...	...

As a model, the authors propose to consider the regression equation [11]. An example of such an equation is given for the production component of the socio-economic system (1).

$$Y_i = a_0 \prod_1^n x_i^{a_i} \varepsilon^i \quad (1)$$

Y_i — gross regional product by constituent entities of the Russian Federation;
ε^i – error of each system component.
a_i – degree of significance of each factor (x_i).
$i=\overline{1,\ n}$.
The values of calculation errors for each parameter are shown in table 3.

Table 3. Errors for model parameters [12]

Parameter	Y	K	J	I	H	C	D
Error	7.14	4.80	9.75	9.18	6.5	9.24	8.85

Since there were not very many data for statistical analysis (84 regions), the statistical significance of the constructed model was assessed using Fisher's criterion for the probability of selection errors of factors p=0.05. F=125.207, which indicates the reliability of the mathematical model.

Analysis of the built model

Despite the simplified approach to choosing the regression equation for all parameters of the system (each parameter can vary according to its own law, which requires a separate study), the authors obtained reliable results when testing the model.

The assessment of the adequacy of the model was carried out on the example of predicting data on the VLOOKUP for the North Caucasian Federal District [12]. The check consisted in constructing a forecast of the independent variable (VLOOKUP) and comparing its value with the value from the control sample - data from open sources. The result is shown in fig. 2.

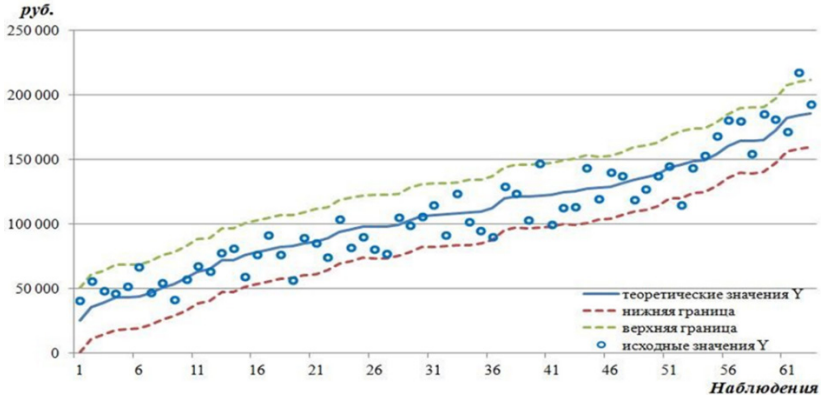

Fig. 2. The result of checking the adequacy of the constructed model

Only three points did not fall into the confidence interval: the per capita VLOOKUP value for the Stavropol Territory (217566 rubles), for the Republic of Ingushetia (114911 rubles) and the Republic of Dagestan (56813 rubles) [13].

Conclusion

In conclusion, conclusions can be drawn according to the results of the selection of significant factors that the most dependent on investment, and therefore, the parameters most influencing the socio-economic development of the region are the production, infrastructure, budget and development of agriculture (fig. 3).

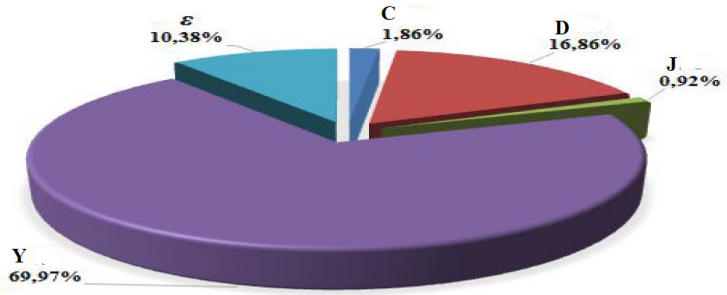

Fig. 3. Significant parameters for the development of the region's economy

The example of an algorithm for constructing a mathematical model can be applied to simulate the behavior of each parameter of the economic system shown in fig. 1 separately. As a result of solving the system of equations consisting of six equations, it may lead to a more accurate description of the behavior of the system, but the process of computing will become more time consuming, which in turn will increase the error of calculations.

As a result of the study, the authors received an adequate mathematical model that shows the impact of investments in the main capital of the region on its socio-economic development.

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研究初始压力脉动值下的井压

STUDY OF WELL PRESSURE AT PULSATING VALUES OF INITIAL PRESSURE

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脉动由发生器以施加到井的初始压力值产生。 根据这些脉动，井压和由此产生的石油产量也会发生变化。 本期主要研究井压和石油产量的变化。

关键词：油藏井，拉普拉斯变换，流体运动，气体运动，连续性方程，初始压力值

Abstract*. Pulsations are generated by the generator at the values of the initial pressure applied to the well. Depending on these pulsations, the well pressure and the resulting oil production also change. In this issue, changes in well pressure and oil production are studied.*

Keywords*: reservoir-wells, Laplace transform, fluid movement, gas movement, continuity equation, initial pressure values*

1. Introduction

In order to increase the permeability and productivity of oil production, pulsations are created in the values of wellhead pressure and initial pressure. The elastic waves generated by the generator help to clean the pores of the formation from blockages and gas bags, while increasing the permeability of the formation and oil refining. When penetrating to the depth of the formation, it can release the energy stored under the influence of the rocks inside, and activates the previously located parts of the oil, thereby increasing the extraction of oil from the formation. In addition, by moving in the pores of the rock, elastic waves change the nature of the pressure distribution in the layer and increase its permeability [1,2-6,7].

2. Statement and solution of the problem

The pulsations in the pressure values of the well vary with the following regularities. [8]

By generating pulsations through the generator, the value of the initial pressure of the well changes with the following regularities.

$$P_0(t) = \Delta P_{01} + \frac{\Delta P_0}{2} - \frac{4\Delta P_0}{\pi^2}\sum_{m=1}^{n}\frac{\cos\left((2m-1)\frac{\pi t}{T}\right)}{(2m-1)^2}, \quad (1)$$

$$P_0(t) = \Delta P_{01} + \frac{2\Delta P_0}{3} - 3\Delta P_0\sum_{m=1}^{n}\frac{\cos\left(2\pi m\frac{t}{T}\right)}{\pi^2 m^2} + \frac{\Delta P_0}{\pi}\sum_{m=1}^{n}\frac{3\cos\left(2\pi m\frac{t}{T}\right)\left(\cos\left(\frac{2\pi m}{3}\right)+\cos\left(\frac{4\pi m}{3}\right)\right)}{2\pi m^2}, \quad (2)$$

$$P_0(t) = \Delta P_{01} + \frac{2\Delta P_0}{\pi} - \frac{4\Delta P_0}{\pi}\sum_{m=1}^{n}\frac{\cos\left(2\pi m\frac{t}{T}\right)}{4m^2-1}, \quad (3)$$

$$P_0(t) = \Delta P_{01} + \frac{\Delta P_0}{2} - \frac{\Delta P_0}{\pi}\sum_{m=1}^{n}\frac{\sin\left(2\pi m\frac{t}{T}\right)}{m} \quad (4)$$

$r_T = 3\cdot 10^{-2}\,м;\ a = 10^{-1}c^{-1};\ \mu = 10^{-3}\,Pa\cdot c;\ h = 10\,м;\ k = 10^{-13}\,м^2;\ \rho_{liq} = 4\cdot 10^2\ кг/м^3;$

$l = 2000\ м;\ \chi = 0.17\frac{m^2}{c};\quad P_c(0) = 1{,}2\cdot 10^7\ Па;\quad \Delta P_{01} = 11\cdot 10^6\ \text{Па};\ P_{wellhead}(0) = 1\cdot 10^6\ Па;$

$P_k = 1{,}4\cdot 10^7\ Па;\ P_{атм} = 10^5\ Па;\ R_k = 100\,м;\ \pi = 3{,}14;\ C = 1000\ м/с;\ g = 10\,m/c^2$

$r_c = 7.5\cdot 10^{-2}\ м,\quad B(x_v) = 0.114;\quad b_v = 0{,}0002048;\quad Q_{gaz}(0) = 1407{,}724120\,kg/see;$

$Q_{mix}(0) = 1407{,}72571\,kg/\sec;\ Q_{fil}(0) = 0{,}00159217410\,kg/\sec.$

3. Calculation of well pressure

According to reports in the literature, the well pressure was found as follows [9-15].

$$\overline{P}_c = 2\pi h\rho_{liq}\frac{k}{\mu}\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\cdot\frac{\Delta P_{cy}^2}{\Delta P_{c1}}(s+2a)(s+b_v)((s+a)^2+\omega_i^2)\cdot\frac{1}{s\psi(s)} -$$

$$-4\pi h\frac{k}{\mu}\rho_{liq}B_v\left(x_v\frac{r_c}{R_k}\right)\cdot\Delta P_{cy}\frac{(s+2a)((s+a)^2+\omega_i^2)}{\psi(s)} +$$

$$+2\pi h\rho_{liq}\frac{k}{\mu}P_c(0)\cdot\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\cdot\frac{\Delta P_{cy}}{\Delta P_{c1}}(s+2a)(s+b_v)((s+a)^2+\omega_i^2)\cdot\frac{1}{s\psi(s)} -$$

$$-4\pi h\frac{k}{\mu}\rho_{liq}B_v\left(x_v\frac{R_k}{r_c}\right)\cdot P_c(0)\frac{(s+2a)((s+a)^2+\omega_i^2)}{\psi(s)} +$$

$$+\frac{f_k}{l}\cdot(s+b_v)\cdot((s+a)^2+\omega_i^2)\cdot\frac{\overline{P_0}}{s\psi(s)}+\frac{f_k}{l}\cdot i\pi\cdot(s+b_v)\frac{1}{\psi(s)}\cdot\left[s\varphi_i(0)+\dot{\varphi}_i(0)+\right.$$

$$\left.+2a\varphi_i(0)-\frac{2}{\pi}(sP_c(0)+\dot{P}_c(0))+\frac{4}{\pi}P_c(0)-\frac{2}{\pi}\overline{\ddot{P}}_0-\frac{4a}{\pi}\overline{\dot{P}}_0\right]+$$

$$+\frac{f_k Q_{qaz}(0)(s+b_v)((s+a)^2+\omega_i^2)}{\psi(s)}+\frac{f_t\overline{P}_{wealhead}(t)(s+b_v)((s+a)^2+\omega_i^2)}{l\cdot\psi(s)}+$$

$$+\frac{f_t\pi(s+b_v)}{l\cdot\psi(s)}\cdot\left[s\varphi_{i1}(0)+\dot{\varphi}_{1i}(0)+2a\varphi_{1i}(0)-\frac{2}{\pi}\overline{\ddot{P}}_{ycт}-\right.$$

$$\left.-\frac{4}{i\pi}\overline{\dot{P}}_{wealhead}+\frac{2}{\pi}(sP_c(0)+\dot{P}_c(0)+\frac{4a}{\pi}P_c(0)\right]-\frac{f_t Q_{mix}(0)(s+b_v)((s+a)^2+\omega_i^2)}{\psi(s)} \quad (5)$$

Where

$$\psi(s)=F(s)\cdot\left[(s+a)^2+\omega_i^2\right]+2\frac{f_k}{l}(s+b_v)+4a\frac{f_k}{l}(s+b_v)s+$$

$$+2\frac{f_t}{l}(s+b_v)s^2+4a\frac{f_t}{l}(s+b_v)s$$

,

$$F(s)=2\pi h\rho_{liq}\frac{k}{\mu}\frac{1}{\ln\left(\frac{R_k}{r_c}\right)}\cdot\frac{\Delta P_{cy}}{\Delta P_{c1}}(s+2a)(s+b_v)-4\pi h\frac{k}{\mu}\rho_{liq}B_v\left(x_v\frac{R_k}{r_c}\right)\cdot s\cdot(s+2a)+$$

$$+\frac{f_k}{l}(s+b_v)+\frac{f_t}{l}(s+b_v)$$

$Q_{mix}(0)$ and $Q_{gaz}(0)$ found in the following expressions

$$Q_{mix}(0)=Q_{gaz}(0)+\frac{\rho_{liq}Q_{fil}(0)}{2\pi r_c h},\quad Q_{fil}(0)=2\pi h\frac{k}{\mu}\frac{P_k-P_c(0)}{\ln\frac{R_k}{r_c}}$$

$$Q_{gaz}(0)=\frac{P_0(0)\cdot\exp(g\frac{\rho_{am}}{P_{am}}l)-P_c(0)}{\exp(g\frac{\rho_{am}}{P_{am}}l)-1}\frac{\rho_{am}g}{2aP_{am}}$$

We return the original by writing the given parameters and the (1) value of P_0 in the expression of $\overline{P}_c$.

Then we get the mathematical expression for the well pressure.

$$P_c = 1{,}20000095 \cdot 10^7 - 0{,}101659082\sin(0{,}5233333333t) - 1{,}20287618\cos(0{,}5233333333t) + \\ + 6{,}564371819 \cdot 10^{-86}(-4{,}288471004 \cdot 10^{83} - 1{,}571997176 \cdot 10^{80}\cos(0{,}5233333333t)) \cdot \\ e^{-0{,}00020453760007t} + 1{,}471082102 \cdot 10^{-134}(1{,}814216776 \cdot 10^{11}(-9{,}806749185 \cdot 10^{123} + \\ + 7{,}73937399 \cdot 10^{122}\cos(0{,}5233333333t))\cos(0{,}9071083878t) + (2{,}649328293 \cdot 10^{135} - \\ - 1{,}618013171 \cdot 10^{135}\cos(0{,}5233333333t))\sin(0{,}9071083878t))e^{-0{,}03764469709t} + \\ + 5{,}923393961 \cdot 10^{-63}(1{,}122404995 \cdot 10^{65} - 6{,}629550319 \cdot 10^{64}\cos(0{,}5233333333t))e^{-29{,}69372812t} \quad (6)$$

The time dependence graph of the mathematical expression of pressure (6) is given in Figure 1.

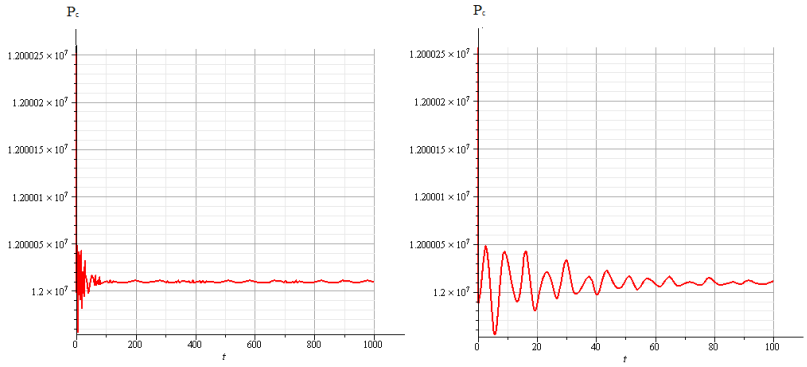

Figure.1. Time dependence graph of well pressure at pulsating value given by formula (1) of initial pressure at large and small moments of time

In the next step, we replace the given parameters and the (2) value of P_0 in the expression of P_c and return to the original. By making calculations, we can get the mathematical expression for the well pressure.

$$P_c = 1{,}20000998 \cdot 10^7 - 0{,}4307094\sin(1{,}04666666t) + 1{,}601099781\cos(1{,}04666666t) + \\ + 8{,}205465704 \cdot 10^{-87}(-3{,}488663038 \cdot 10^{84} - 1{,}415230277 \cdot 10^{81}\cos(1{,}04666666t))e^{-0{,}0002045376007t} + \\ + 2{,}806956989 \cdot 10^{-134}(1{,}81426776 \cdot 10^{11}(-5{,}912989613 \cdot 10^{123} + \\ + 4{,}564491463 \cdot 10^{122}\cos(1{,}04666666t)) \cdot \cos(0{,}9071083878t) + (1{,}747116929 \cdot 10^{135} - \\ - 9{,}542641716 \cdot 10^{134}\cos(1{,}04666666t))\sin(0{,}9071083878t))e^{-0{,}03764469709t} + \\ + 2{,}689945938 \cdot 10^{-64}(3{,}071000901 \cdot 10^{66} - 1{,}642844847 \cdot 10^{66}\cos(1{,}04666666t))e^{-29{,}69372812t} \quad (7)$$

The time dependence graph of the mathematical expression of pressure (7) is given in Figure 2.

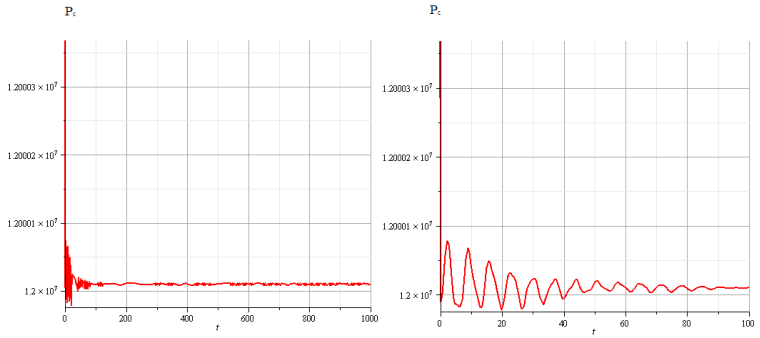

Figure 2. Time dependence graph of well pressure at pulsating value given by formula (2) of initial pressure at large and small moments of time

We replace the given parameters and the (3) value of P_0 in the expression of $\overline{P}_c$ and return to the original. Now we get the following mathematical expression for the well pressure

$$P_c = 1{,}20000981 \cdot 10^7 + 1{,}489160058\cos(1{,}046666667t) - 0{,}4005966715\sin(1{,}046666667t) +$$
$$+ 8{,}205465704 \cdot 10^{-87}(-3{,}478339312 \cdot 10^{84} - 1{,}316285485 \cdot 10^{81}\cos(1{,}046666667t))e^{-0{,}00020453760007t} +$$
$$+ 2{,}806956989 \cdot 10^{-134}(1{,}814216776 \cdot 10^{11}(-5{,}847890011 \cdot 10^{123} +$$
$$+ 4{,}245368375 \cdot 10^{122}\cos(1{,}046666667t)) \cdot \cos(0{,}9071083878t) + (1{,}684044749 \cdot 10^{135} -$$
$$- 8{,}87574889 \cdot 10^{134}\cos(1{,}046666667t)) \cdot \sin(0{,}9071083878t)e^{-0{,}03764469709t} +$$
$$+ 2{,}689945938 \cdot 10^{-64}(2{,}964035811 \cdot 10^{66} - 1{,}5279866549 \cdot 10^{66}\cos(1{,}046666667t))e^{-29{,}69372812t} \quad (8)$$

The time dependence graph of the mathematical expression of pressure (8) is given in Figure 3.

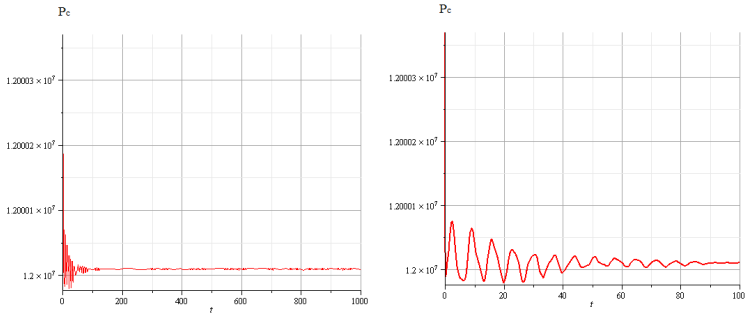

Figure 3. Time dependence graph of well pressure at pulsating value given by formula (3) of initial pressure at large and small moments of time

In the next step, we replace the given parameters and the (4) value of P_0 in the expression of $\overline{P}_c$ and return to the original. We can get the mathematical expression for the well pressure.

$$P_c = 1{,}20000909 \cdot 10^7 + 0{,}3004475035\cos(1{,}046666667t) + 1{,}116870044\sin(1{,}046666667t) +$$
$$+ 4{,}102732852 \cdot 10^{-86}(-6{,}73549954110^{83} - 1{,}974428229 \cdot 10^{80}\sin(1{,}046666667t))e^{-0{,}0002045376007t} +$$
$$+ 1{,}403478495 \cdot 10^{-133}(1{,}814216776 \cdot 10^{11}(-1{,}02772708 \cdot 10^{123} +$$
$$+ 6{,}368052566 \cdot 10^{121}\sin(1{,}046666667t))\cos(0{,}9071083878t) + (1{,}898457944 \cdot 10^{134} -$$
$$- 1{,}331321234 \cdot 10^{134}\sin(1{,}046666667t))\sin(0{,}9071083878t))e^{-0{,}03764469709t} +$$
$$+ 1{,}344972969 \cdot 10^{-63}(3{,}635438265 \cdot 10^{65} - 2{,}291979824 \cdot 10^{65}\sin(1{,}046666667t))e^{-29{,}69372812t} \quad (9)$$

The time dependence graph of the mathematical expression of pressure (9) is given in Figure 4.

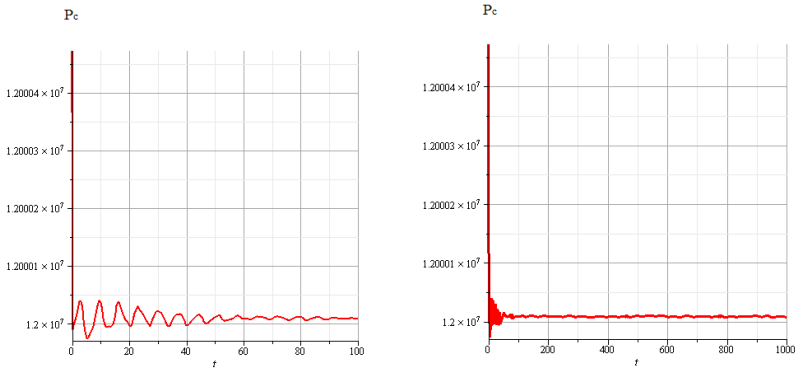

Figure 4. Time dependence graph of well pressure at pulsating value given by formula (4) of initial pressure at large and small moments of time

In the same way, we can study the dynamics of the increase in oil production in the case of pulsating prices of initial pressure.

4. Conclusion

It can also be seen from the graphs and calculations that when the value of the initial pressure fluctuates, so do the values of the well pressure. This affects the amount of oil extracted from the well. Studies show that there is an increase in the price of oil production obtained when the initial pressure creates pulsations in the price.

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使用含水乙醇作为热机燃料作为水燃料乳液的类似物

USING WATERED ETHANOL AS FUEL FOR A HEAT ENGINE AS AN ANALOGUE OF WATER-FUEL EMULSIONS

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考虑了使用生物乙醇燃料（包括 E85 燃料）的优点和问题。 拟采用环氧丙烷作为E85乙醇燃料的“触发器”，将显着促进冷机发动，增加醇类燃料的相稳定性。 这使得堡垒生物乙醇的使用率达到 80% 左右。 此外，一方面，它降低了对乙醇中水分含量的要求并减少了其产量，另一方面，它起到了水燃料乳液的类似作用。

关键词：生物乙醇，环氧丙烷，相稳定性，辛烷值，蒸发

Abstract. *The advantages and problems of the use of bioethanol fuels, including the E85 fuel, are considered. It is proposed to use propylene oxide as a "trigger" for E85 ethanol fuels, which will significantly facilitate the launch of the cold engine and increase the phase stability of alcohol fuel. This allows the use of bioethanol Fortress 80% about. And above, on the one hand, it reduces the requirements for the moisture content in ethyl alcohol and reduces its production, and on the other, it acts an analogue of water-fuel emulsions.*

Keywords: *Bioethanol, propylene oxide, phase stability, octane numbers, evaporation.*

The use of bio-ethanol fuels is currently gained, although the idea of alcohol fuel is far from Nova. So another Henry Ford on his famous Ford-T car provided a power system for three different fuels: gasoline, kerosene and alcohol. It was still at the dawn of motorization at the very beginning of the 20th century. Henry Ford considered the use of ethanol by a promising direction for American farmers, since the raw material for alcohol was mainly agricultural products and waste of these products [1].

Although today most cars are working on oil fuel, the use of bioethanol is becoming increasingly due to primarily the advantages that alcohol fuel gives.

So alcohol fuel is a renewable resource, which can be obtained from almost any vegetable raw materials. Alcohol fuel can significantly reduce harmful emissions with exhaust gases. This applies mainly to CH, CH and NO_X. In addition, the use of bioethanol allows to significantly reduce greenhouse gas emissions CO_2, since it is considered that when combustion of bioethanol is distinguished as much carbon dioxide as it is absorbed by plants from which ethanol was produced during their growth.

An important advantage of alcohol fuel is its high octane number, which reaches 129.5 by the study method and 101.3 by the engine method, respectively [2]. It is clear that the maximum full of these characteristics will be implemented when using 100% alcohol, so actually occurs in Brazil, where the alcohol fuel is widely used. In more northern latitudes, the use of E100 fuel becomes problematic, since the alcohol evaporates worse than the automotive gasoline, then at a temperature plus, 10°C problems may arise with the engine start. This problem is solved due to the addition of gasoline alcohol or light-boiling hydrocarbon fractions, as a result, such a "starting fraction" and ensures the start of the engine at low temperatures. The most famous alcohol composition is an E85 alcohol fuel (in Russia it is marked as ED75-ED85 according to GOST R 54290-2010) [3]. This alcohol fuel is divided into summer and winter. Summer contains 74% ethanol and 17-6% of hydrocarbons and simple aliphatic esters as a "launcher faction". Winter contains 70% ethanol and 17 - 30% hydrocarbons and simple aliphatic esters as a "starting faction".

To use such fuel as E85, a special car nutrition system is needed to adapt to a specific amount of alcohol in the mixture. In practice, such a system is implemented in FFV cars (Flexible Fuel Vehicle). Today, such cars produced a large number. They can work both on gasoline, alcohol, and on any proportion of alcohol with gasoline and at the same time their price is slightly higher than basic cars.

When mixed alcohol with gasoline, especially in the presence of moisture and at low temperatures, you can encounter solutions between alcohol and hydrocarbon parts. Alcohol and hydrocarbons have low phase stability and the larger the moisture and below the temperature, the lower the phase stability. This problem is solved through the use of ethanol with low moisture content. Typically use bioethanol with a fortress of 98% and even higher. Such dehydration dehydration significantly increases the cost of alcohol.

To solve this problem, we offer not hydrocarbons as a "starting part", but a simple cyclic ester - propylene oxide [4]. Propylene oxide (PO) is a simple cyclic ester with a boiling point of 34.2°C and a density of 859 kg/m^3 at 200°C. Propylene oxide solves at the same time two problems - it is facilitated by starting the engine at low temperatures due to the low boiling point of the "starting part" and preventing the separation of alcohol and the "starting part". Experiments have

shown that even when using alcohol with a fortress of 80% vol. bundle does not occur until minus 65°C. Thus, it is possible in alcohol compositions to use even raw alcohol, whose fortress is 88% about., Which will significantly reduce the cost of alcohol [5].

On the other hand, one can intentionally enter water into alcohol compositions in order to obtain an analogue of water-fuel emulsions.

In order to be convinced of this, the speed characteristics of the VAZ-2108 car were removed (sports car with an increased engine compression) during its work on various fuels. The tests were carried out at the LPS 2020 power stand. The purpose of the test was the determination of power on various types of alcohol fuel. The results are presented in figure 1.

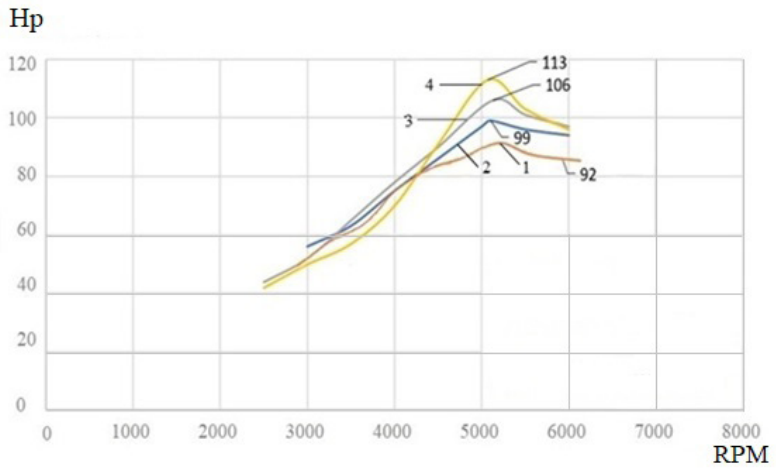

Figure 1. – Speed characteristics of the VAZ-2108 car on various types of alcohol fuel: 1- gasoline AI 98, 2- gasoline AI 98 + 5% propylene oxide, 3-ethanol fortress 95% + 5% propylene oxide, 4- ethanol Fortress 80% + 5% propylene oxide

As can be seen from the figure, we have the following results. First, Po helps increase power. So, on gasoline AI-98 with the addition of 5% Po, the maximum power was 99 l.s., while on the base gasoline AI-98 - only 92 l.s. Secondly, the power on alcohol fuels with the addition of PO turned out to be higher than on high-octane gasoline AI-98. It is clear that the conditions for combustion were not the same, since the settings of the on-board computer changed, taking into account the achievement of the best characteristics for each of the fuels, but the fact that bioethanol fuel can exceed the power of traditional gasoline. Thirdly, the

best result in power was achieved on a highly flooded alcohol, with a moisture content of 20%. This finally proves that when using Po as a "starting faction" on water-related problems, you can forget and boldly use the usual ethyl alcohol with a fortress of 95%, while if excessive moisture is in the fuel tanks, it is not scary because it The total amount is unlikely to exceed 20%.

From the traditional point of view, everyone knows that water and fire are ontooganists, that is, the water is extinguished by fire, but experts know that the water introduced into the engine in the desired quantity has a positive effect on the combustion process and contributes to the increase in power and reduce fuel consumption. The question is only on how to submit water into the engine. Some feeds the water separately into the cylinders using special devices for this, others add water directly into fuel, which in turn requires more and special emulsifiers that prevent separation of water and fuel. Such fuels were called water-fuel emulsions. Water-fuel emulsions are known for both engines with spark ignition and diesel engines. An approximate amount of water introduced into fuel is 10 - 20%. The use of bioethanol fuel, where the alcohol is used as an alcohol with a fortress of 80%, and as a "starting fraction" of propylene oxide, is an excellent analogue of the classical water-fuel emulsion. Only, there will be no problems with the phase stability of fuel, that is, it will not be smeared through the use of PO instead of hydrocarbons as a "launcher faction".

The use of water, if we are talking about classical water-fuel emulsions, gives the following advantages [6, 7]:

1. Reduced intake air temperature.
2. A sharp increase in the detonation fuel resistance (including low-quality and low-fusion).
3. Reducing harmful emissions by 60-80%.
4. Increased power by 15-20% and torque by 25-30%.
5. Reducing fuel consumption.
6. Cleaning inlet, combustion chambers, valves, pistons, turbines and spark plugs.

When water injected in a strictly dosed volume, provided that the water is sprayed with drops of less than 0.1mm, the engine begins to work otherwise. Water has a huge heat capacity, the water cools the collector and intake air, which becomes more densely, and, it means that more oxygen will fall into the engine and more fuel burns completely, and this is a direct path to increasing power. According to studies, the increase in power is 10-15% for gasoline combustion engine and 20-30% for diesel engines. Water, falling into a hot combustion chamber, evaporates and increases in volume of 1700 times, the pair pressure helps to move the pistons, i.e. Perform work, resulting in the engine torque increases. Couple cleans the exhaust manifold, valves, combustion chamber, pistons, turbines from Nagara,

It turns out that with the injection of water you constantly wash the engine from the inside. Water injection increases the detonation fuel resistance, it means that you can use cheaper fuel without harm to the engine. Water injection saves fuel. According to some given, fuel consumption is reduced from 10 to 20%, depending on the type and power of the combustion engine.

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海船营运能效评估
ASSESMENT OF OPERATIONAL ENERGY EFFICIENCY OF SEAGOING VESSEL

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气候变化问题严重制约了海运业的发展。 首先，这涉及航行中运行能效系数的强制性规划和计算，以减少二氧化碳排放。 随着高硫船用燃料禁令的出台，从2020年1月起，情况更加恶化，船东不得不放弃部分利润，以应对船舶能效的限制。 本文从改变交叉口速度的角度研究了船舶运输作业对船舶能效运行系数的影响。

关键词：海船，二氧化碳排放，能源效率，运行速度。

Abstract. *The problem of climate change imposes significant restrictions on the development of maritime shipping. First of all, this concerns the mandatory planning and calculation of the operational energy efficiency factor on the voyage in order to reduce CO_2 emissions. With the introduction of a ban on high-sulfur marine fuel, from January 2020. the situation has worsened even more, which requires shipowners to give up part of the profits in favor of meeting the limitations on the energy efficiency of the vessel. This paper investigates the influence of the transport operation of the vessel, from the point of view of changing the speed at the crossing, on the operational coefficient of the energy efficiency of the sea vessel.*

Keywords: *sea vessel, CO_2 emissions, energy efficiency, operating speed.*

Climate change is considered today as the most serious threat (from the standpoint of risks restraining economic growth) for all states. With the adoption of the Paris Climate Agreement on December 12, 2015, all parties agreed on a common set of goals to tackle the problems associated with global warming. These goals include the long-term goal of keeping the global average temperature rise below 2°C above pre-industrial levels and continuing efforts to limit temperature rises to 1.5°C above pre-industrial levels [1]. Another important goal is the ability of countries to adapt to the negative impacts of climate change. Of course, both

climate change itself and the proposed energy policy in the near future will impose significant restrictions on global economic growth and foreign trade. Global socio-economic trends, population growth, income growth and increased urbanization inevitably lead to an increase in demand for electricity, transport and other energy-intensive services. The unprecedented growth of the global economy over the past century has led to an increase in the use of commodities and associated greenhouse gas emissions. Higher greenhouse gas emissions, in turn, accelerated climate change, which negatively affected the production of goods.

Today, there is an established opinion in the scientific community that global warming, as well as extreme and unfavorable climate changes, are caused by an increase in the concentration of greenhouse gases in the Earth's atmosphere. In particular, the concentration of CO_2 in the atmosphere has increased by 31 percent since the beginning of industrialization (i.e. since the second half of the twentieth century), and CO_2 emissions account for the largest share in greenhouse gas emissions. At the same time, the largest emissions come from the burning of oil, natural gas and their derivatives. Global emissions from human activities by sectors of the economy are presented in table 1.

Table 1. Greenhouse gas emissions by economic sector [1]

№	Emission source	interest
1	Electricity and heat production	25
2	Land use	24
3	Industry	21
4	Transport	14
5	Other energy	10
6	Buildings and constructions	6

The climate change debate revolves around finding ways to reduce human-related CO_2 emissions. Under these conditions, it is estimated that the coronavirus pandemic could save many lives by improving urban air quality [2]. Due to the pandemic, a large number of enterprises are forced to change the logistics of supplies, which in the short term is associated with a decrease in foreign trade in global markets. However, since 1990, the total radiative forcing causing global warming has increased by 43%, with CO_2 accounting for about 80 percent of the increase [3].

Maritime transport is at the heart of global supply chains and economic interdependence with shipping and ports, which are estimated to account for over 80 percent of global merchandise trade by volume and over 70 percent of the total value of goods. According to IMO estimates, greenhouse gas emissions from ships in 2012 accounted for about 2.2 percent of anthropogenic carbon dioxide emis-

sions in the world [4]. Today, emissions from international shipping are already about 4 percent, and by 2050 their volume may be (according to forecasts) more than 50 percent [4]. Experts estimate that a range of technical and operational measures can improve the energy efficiency of ships and reduce greenhouse gas emissions by 75 percent.

After the entry into force of the relevant amendments to Annex VI of the International Convention MARPOL 78 on the Prevention of Pollution from Ships, energy efficiency measures have become legally binding in the maritime industry, for ships of 400 gross tonnage or more, from 1 January 2013. The ship must have an Energy Efficiency Management Plan (SEEMP), which may be part of the ship's safety management system or ISO 14001 environmental management system. This plan should aim to reduce CO_2 emissions from ships through better fuel efficiency and voyage planning. For this, the EEOI operational energy efficiency index is calculated and compared with the EEDI constructive energy efficiency index for new ships. The indices have the same physical meaning - the ratio of CO_2 produced during the voyage (voyages) to the amount of the vessel's transport work for a certain period:

$$EEOI = (MTEP_f \times CF) / A_f, \quad (1)$$

Where MTEPf – is the factual fuel consumption in operation by all consumers, t; A_f – the actual transport operation of the vessel in t x miles; CF – dimensionless conversion factor of fuel consumption to CO_2 emissions.

Of course, of the greatest interest for shipping is the issue of determining the factors affecting the change in the operational energy efficiency index.

To determine the main operational parameters affecting the operational energy efficiency index, we carried out field experiments at the trans-Pacific crossing of the RO-RO vessel – "GALAXY ACE" with a gross tonnage of 59.583 reg.t. Operational measures have been identified that can improve the energy efficiency of the vessel by reducing CO2 emissions at the sea crossing without equipment modification (see fig. 1) by managing transport operations and vessel speed while planning voyages efficiently.

Total Fuel consumption and CO_2 emissions

Parameter	Value
Total fuel consumption	2322.65 m tonnes
Fuel consumptions assigned to on laden	2269.30 m tonnes
Total CO_2 emissions	7291.9579 m tonnes
CO_2 emissions from all voyages between ports under a MS jurisdiction	1940.88 m tonnes
CO_2 emissions from all voyages which departed from ports under a MS jurisdiction	3000.12 m tonnes
CO_2 emissions from all voyages to ports under a MS jurisdiction	2179.92 m tonnes
CO_2 emissions which occurred within ports under a MS jurisdiction at berth	171.04 m tonnes
CO_2 emissions assigned to on laden	7120.9178 m tonnes

DISTANCE TRAVELLED, TIME SPENT AT SEA AND TRANSPORT WORK

Parameter	Value
Total distance travelled	23177 n miles
Regular navigation	23177 n miles
Total time spent at sea	1554.82 hours
Regular navigation	1554.82 hours
At anchorage	0 hours
Total transport work (mass)	96553994 m tonnes · n miles

ENERGY EFFICIENCY

Parameter	Value
Fuel consumption per distance	100.2136 kg / n mile
Fuel consumption per transport work (mass)	24.0555 g / m tonnes · n miles
Fuel consumption per distance on laden voyages	Missing source values! kg / n mile
Fuel consumption per transport work (mass) on laden voyages	23.5029 g / m tonnes · n miles
CO_2 emissions per distance	314.6204 kg CO_2 / n mile
CO_2 emissions per transport work (mass)	75.5221 g CO_2 / m tonnes · n miles
CO_2 emissions per distance on laden voyages	Missing source values! kg CO_2 / n mile
CO_2 emissions per transport work (mass) on laden voyages	73.7506 g CO_2 / m tonnes · n miles

Figure 1. Transport work and ship energy efficiency

The volume of fuel consumption at the crossing was accurately described by the formula:

$$Q = Q_T (V/V_T)^3, \quad (2)$$

Where: Q - actual fuel consumption in t/day.;
V - operating speed, knots (see fig. 2);
Q_T - fuel consumption corresponding to the technical speed in t/day.;
V_T - technical speed, knots.

It can be seen from formula (2) that for marine diesel engines the level of fuel consumption depends significantly on speed. For example, a decrease in operating speed from 16 to 11 knots leads to a 2/3 saving in fuel consumption per day. When the vessel's speed decreases, one should take into account the fact that incomplete combustion of fuel and an increase in the toxicity of exhaust gases may occur. With an increase in the load on the main engine and the speed of the vessel, the concentration of harmful substances in the exhaust gases decreases. Therefore, the specific amount of exhaust gases, referred to power, mainly depends on the operating mode of the engine and its type and has the character of a hyperbolic dependence.

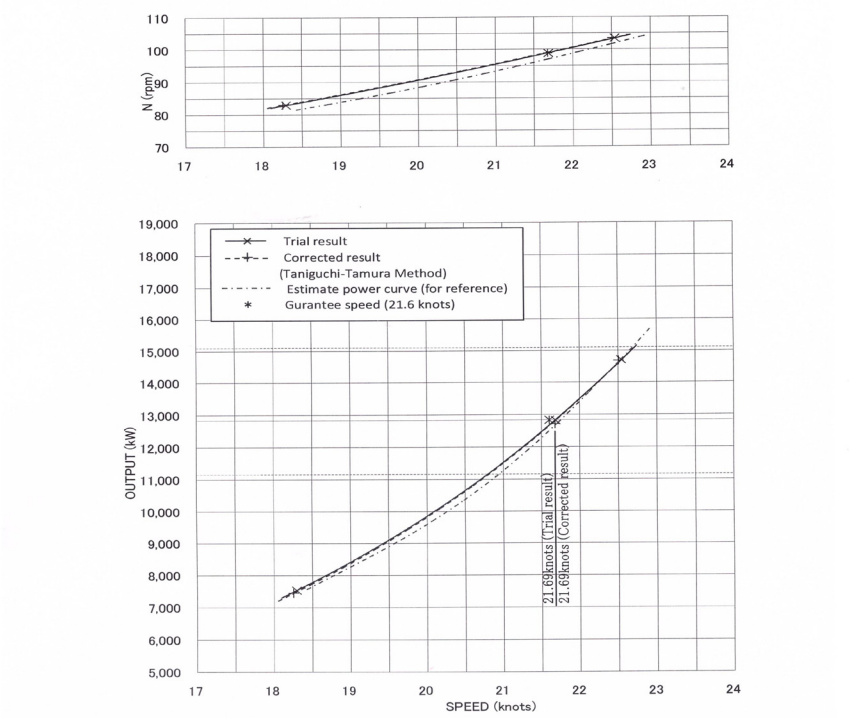

Figure 2. Specification of the vessel

Calculations of the operational coefficient of the ship's energy efficiency according to the formula (1) showed quite good results (see fig. 1).

For the purpose of analyzing the significant factors affecting the operational energy efficiency of a sea vessel, we transform formula (1) using the concept of material flow – M_p (tons of cargo per day), we get the following expression:

$$EEOI = CF \times [(Q \times V) / (M_p \times T)], \quad (3)$$

where: T- flight time per day

Conclusions

From (3) it can be seen that with an increase in the range and a decrease in speed, the energy efficiency of a sea vessel increases. Field experiments have shown that reducing the speed alone can increase the operational energy efficiency of a marine vessel by up to 34 percent. Such decisions are usually made when transporting large consignments of relatively inexpensive bulk cargo (for bulk carriers and tankers), or when the price of marine bunker fuel for container ships rises, in order not to decommission ships. Additional factors that improve the operational energy efficiency of a marine vessel in operation can be optimization of the route of passage and the removal of the vessel for departure.

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NOTES

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