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CONTENT

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RECOMMENDATIONS FOR IMPROVING MANAGEMENT APPROACHES AT PJSC GAZPROM ENERGOHOLDING BASED ON THE RESULTS OF THE ANALYSIS OF PRODUCTION ASSETS

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Abstract*. In the article, the directions of development of PJSC "Gazprom energoholding" are formed based on the results of the analysis of production assets, recommendations are proposed for the sectors of activity, taking into account the specifics of the operation of the enterprise. The need to strengthen the management aspects in terms of the management of production funds of energy sector enterprises is justified.*

Keywords*: effective management, production funds, Gazprom Energoholding, development of the energy sector*

Introduction

Modern economic circumstances dictate new conditions to enterprises in various fields of activity, including in the field of energy saving; in order to ensure competitiveness and take a solid market position, enterprises and companies need not only to quickly adapt to innovations, but also regularly monitor and control their own activities, and develop strategies aimed at improving operational efficiency. The rational use of fixed assets also plays an important role in the effective operation of the enterprise, since this factor is reflected in a variety of indicators that form the total profit from the enterprise (cost, profitability, etc.). It should also be noted that the effective use of fixed assets contributes to the acceleration of their turnover, as a result of which the risk of physical and moral deterioration of goods is minimized; in addition, the effective use of the organization's fixed assets indicates the high quality of the products sold, since in the conditions of modern market competition, it is high-quality products that are in great demand of the population, meet the needs of the consumer and, as a result, are quickly sold.

The fixed assets of the enterprise are the most important element of the production process; the availability, condition and efficiency of the use of active and passive funds directly affects the final financial result of the company. Rational use of fixed assets is reflected in the production of more products and contributes to the achievement of maximum profit by the company, in addition to this, the cost of products sold and the labor intensity of the production process are reduced.

The purpose of the study is to establish the optimal directions for the development of the activities of PJSC "Gazprom energoholding" through the rational management of fixed assets - the most important element of the effective activities of the organization, reflecting the production capacity, the technical level of the organization.

As part of the analysis of the management processes of the company's fixed assets using the example of PJSC "Gazprom energoholding", let us consider what contributes to an increase in the rate of return on assets:

1. Carrying out repair work of existing equipment;
2. Complete replacement of old equipment with modern;
3. Increase of the shift ratio and the use of production areas;
4. Increase in the volume of active fixed assets of the organization;
5. Intensive use of active and passive funds of the organization.
6. Use of innovative technologies in the organization and implementation of the production process;
7. Formation of a favorable climate for the staff of the organization;
8. Reducing the time spent on training on new equipment;
9. Reducing equipment downtime.

At the moment, more and more adapted enterprises appear on the Russian market that use innovative technologies in their activities and can compete with PJSC "Gazprom energoholding", so it is especially important for the company in question to direct its efforts to improve the efficiency of using fixed assets. PJSC "Gazprom energoholding" has a sufficient number of both active and passive fixed assets, and indicators (composition, movement and efficiency of fixed assets are within the normal range). However, there is no tendency to increase the indicators of capital productivity, capital intensity and capital-labor ratio.

Materials and methods

The main threat to be minimized by PJSC "Gazprom energoholding" is the possible appearance on the market of new competitors using innovative equipment in their activities [2]. It is the innovative technology that can ensure an increase in product productivity, improve the quality of products sold, and accordingly, this factor should be taken into account when developing recommendations for improving the use of fixed assets at PJSC "Gazprom energoholding". The list of measures to improve the efficiency of using fixed assets at PJSC "Gazprom energoholding" is presented in table 1.

***Table 1** – Measures to improve the efficiency of using fixed assets by PJSC "Gazprom energoholding"*

Measure	Result
Annual preventive maintenance of existing equipment	Extending the life of machinery and equipment, reducing the spendings on new equipment
Introduction of innovative equipment into the production process	Minimizing the risk of new competitors appearing on the market, increasing the company's production capacity, producing more products with less labor costs
Use of land plots	Providing more labor productivity
Renting company vehicles	Increase in product costs, additional profit
Decrease in the residual value of fixed assets	Reduction of taxation % on real estate
Professional development of the staff	Rapid mastering of new equipment by employees

In addition, within PJSC "Gazprom energoholding", preventive measures are very rarely carried out for equipment and machinery, which leads to rapid wear and tear, breakdowns, as a result, the company's active funds are not used rationally; within the framework of this graduate work, it is recommended to carry out annual or semi-annual prophylaxis in order to maintain the equipment in proper condition [4].

Results and discussion

The introduction of innovative equipment is necessary for PJSC "Gazprom energoholding" in order to maintain its leading market position. As a result of the use of innovative equipment in the production process, the productivity of employees will increase, which will affect the increase in production and the receipt of greater profits by PJSC "Gazprom energoholding". For the rapid development of innovative equipment by the working staff, it is recommended to send employees on a mandatory basis for advanced training, which will allow the use of new equipment in the production process as soon as possible. PJSC "Gazprom energoholding" owns several unreported land plots, it is recommended to use these facilities in order to expand the company and increase production capacity [1, 3]. Also, PJSC "Gazprom energoholding" does not use the entire volume of active funds in its activities, namely, vehicles are often idle and not used by the company, as a result, active funds are not used in the production process, and the company invests financial resources in them. In order to eliminate this problem, it is recommended to lease these active funds. In addition to the above measures, it is recommended to reduce the residual value of the main active and passive funds of PJSC "Gazprom energoholding", this measure will affect the reduction of the tax rate paid by the company in question for real estate.

Also, in the process of researching international and Russian experience in fund management, an unfavorable tendency was revealed for Russian companies, including energy companies, to enter the shadow economy; in order to eliminate this goal, it is necessary to amend the tax system at the legislative level, since a wide range of different types of taxes and high tax rates provoke companies to hide income and the volume of fixed assets. Recommendations for minimizing and eliminating the problems of the Russian taxation system are reflected in table 2.

***Table 2** – Problems of the Russian taxation system and ways to minimize them*

The problem of the taxation system of the Russian Federation	**Solving the identified problem**
Instability and unpredictability of the tax system	Revision of tax legislation in order to minimize or completely eliminate the identified contradictions; Elimination of ambiguities and inaccuracies of the current tax legislation of the Russian Federation, development of additional clarifications of the taxation system
High level of taxation, the presence of many tax rates and types of taxes	Integration of tax liabilities, simplification of the taxation system, Minimization of the tax burden
Increase in the number of benefits	Restructuring the taxation system, simplifying the taxation system through the integration of tax deductions and their legislative consolidation
Insufficient stimulation of the economic sector	Developing tax incentives
Controversy of tax legislation	The introduction of digital technologies in this area in order to automate all processes and centralized storage of all tax documents, as a result, this innovation will ensure the availability and transparency of the taxation system, and also reduce the time to find the necessary information, in addition, there will be no need to request the necessary documentation from business entities of the Russian Federation
Failure to meet the expectations of taxpayers and their interests	Orientation of the tax system to the needs of the constituent entities of the Russian Federation
Practical use of the fiscal type of taxation	Reforming the taxation system in accordance with the international systems of economically developed countries
Tax evasion of business entities	Improvement and strengthening of control over objects of taxation, introduction of innovative technologies in the field of taxation in order to prevent, monitor and control all taxation processes

The developed measures to optimize tax legislation and the taxation system in the Russian Federation are advisory in nature, however, their implementation in practice will simplify many taxation processes, ensure the satisfaction of the population and entrepreneurs with the current taxation system, minimize the risk of tax evasion, as a result, the economic level of the Russian Federation will increase. [1]. As of 2021, many cities of the Russian Federation are going through a process of digital transformation, which is natural, since the bulk of state investments and finances are invested in cities. The processes of digital transformation are accompanied by the creation of more comfortable living conditions for the population, the introduction of innovative technologies, and an increase in the quality of life of society. The trend towards an increase in the population of cities contributes, accordingly, to an increase in demand for the consumption of various goods and services, for the use of electricity and other resources. Along with this, there is an infrastructural transformation of cities, due to the growth of the world economy and competition, which imposes additional requirements on the existing mechanisms for the use of resources [7].

The introduction of innovative technologies into all processes of the enterprise allows to increase the comfort of work, since the lack of capacity is reduced, many processes are automated, and information is stored centrally. To date, many countries have managed to implement the Smart City in everyday life, and have also highlighted a number of advantages: optimization of the transport system, energy efficiency, automation and simplification of many intra-system processes (payment of bills, booking tickets), and improved living standards. A striking example of the introduction of smart technologies (Smart technologies are technologies that were previously based on information and knowledge, which are transformed into procedures based on interaction and exchange of experience) in Russia, can be considered the functioning of the electronic reception of citizens (any resident of the Russian Federation can write to Internet reception, after considering the application/complaint, the letter is sent to the appropriate structure (prosecutor's office, court, bailiffs, education department, etc.), where a decision is made regarding the appeal). The electronic reception has greatly simplified the life of the population, saved the time that previously residents had to stand in queues, all documentation began to be stored centrally, in electronic form, which reduced the time to search for the necessary certificate, application. It is also important to note the fact that digital technologies not only simplify life, but also act as a guarantor of security (for example, the technology of face recognition, fingerprints, protects various social groups from the leakage of personal information). According to the opinion of many domestic authors, including L.S.Kiseleva, there are several problems in the implementation of innovative technologies. The first problem is that all innovations can be perceived as a narrow task of introducing a "next" information

system, as a "next" electronic document flow. However, it is important to understand that automation is not a one-time task, it is a concept that contributes to the transformation of many processes [8]. It should be noted that the digitalization process seems to be not only a measure of necessity, but is also inevitable in the 21st century. Every year, the flow of various information increases, respectively, for rational use, all information must be structured. The practical application of automation is reflected positively not only in individual areas of activity, but also has a positive effect on the economy as a whole.

Based on this trend, it seems rational to introduce innovative technologies and products into the scope of activities of PJSC "Gazprom energoholding" in order to automate the processes of structuring information, monitoring and controlling indicators of financial results and the volume of fixed assets. Also, it should be noted that automation will solve many of the company's problems, including the problem of taxation and reporting, and will allow the company manager to make informed decisions. Together, these measures will affect the efficiency of the use of fixed assets by PJSC "Gazprom energoholding", a tendency for capital intensity, capital-to-labor ratio and capital productivity will be formed, the company will take a different market position for many years, minimize the risk of new competitors appearing on the market, as a result of which PJSC "Gazprom energoholding" "will be able to achieve the main goal that practically all modern companies set themselves - getting the maximum profit from their own activities.

Conclusion

Thus, the active and passive funds of the organization, regardless of its field of activity, reflect the level of competitiveness of the organization, its stable market position, respectively, it is especially important to conduct regular financial analysis of indicators for the reporting period. Financial analysis is carried out in stages, based on the accounting documentation of the enterprise. Distinguish between external and internal financial analysis, while the internal analysis of the financial results of the organization seems to be more complete for many auditors. The basis of the informative base for the analysis of the composition, movement and efficiency of fixed assets is the accounting statements for the reporting period, the statutory documentation of the organization, etc. When conducting financial analysis, many indicators of an organization are examined, such as profitability, liquidity, capital productivity, capital-labor ratio; if in the process of analysis deviations of these indicators from the norm are revealed, the auditors, together with the head of the organization, develop measures to optimize the use of fixed assets.

Companies and enterprises of the electric power industry have a significant impact on the economy of the state, form the trust of international relations, contribute to the long-term nature of international treaties, respectively, the head of a company in this field of activity, through the structural departments of the orga-

nization, must monitor, control and manage all processes of the organization (organizational processes, selection personnel, motivation of employees, timely payment of taxes, indicators of financial results, the effectiveness of the use of fixed assets and much more). It is important to understand that the provision of the population with electric power resources depends on the management decisions of the organization. The fixed assets of the organization, being movable and immovable property, form the cost of goods and services sold and are reflected in the financial position of the company. The effectiveness of the use of fixed assets guarantees the achievement of the organization's goals and objectives, the implementation of plans. At the moment, in the Russian Federation there are many legislative acts regulating the activities of organizations in the electric power industry, respectively, each enterprise in this area must carry out activities in strict accordance with the legislation, regulatory legal acts of the Russian Federation. Summarizing the above, we state that PJSC "Gazprom energoholding" is the undisputed leader in the electric power industry throughout Russia. The well-coordinated work of all structural divisions and the professionalism of the employees affected the efficiency of the company's functioning, its competitiveness and stable position.

Analysis of the composition, movement and efficiency of the fixed assets of PJSC "Gazprom energoholding" showed that the company in question is sufficiently provided with fixed assets, at its disposal are various buildings, inventory, equipment [9]. The indicators of the efficiency of the use of fixed assets are within the normal range, however, no significant growth was observed over the period under review.

At the same time, the efficiency of the use of fixed assets is due to the growth of all indicators, respectively, the company PJSC "Gazprom energoholding" should direct its efforts to increase these indicators. As a result of the study, it was revealed that PJSC Gazprom energoholding possesses a sufficient number of both active and passive fixed assets.

The main threat to be minimized by PJSC "Gazprom energoholding" is the possible appearance on the market of new competitors using innovative equipment in their activities. As it was revealed during the analysis of the efficiency of the use of fixed assets by PJSC "Gazprom energoholding", preventive measures for equipment and machinery are very rarely carried out within the company, which leads to rapid wear and tear, breakdowns, as a result, the active funds of the company are not used rationally; within the framework of this thesis, it is recommended that annual or semi-annual preventive maintenance is carried out in order to maintain the equipment in proper condition.

The introduction of innovative equipment is necessary for PJSC "Gazprom energoholding" in order to maintain its leading market position. As a result of the use of innovative equipment in the production process, the productivity of employees

will increase, which will affect the increase in production and the receipt of greater profits by PJSC "Gazprom energoholding". For the rapid development of innovative equipment by the working staff, it is recommended to send employees on a mandatory basis for advanced training, which will allow the use of new equipment in the production process as soon as possible. As of 2021, many cities of the Russian Federation are going through a process of digital transformation, which is natural, since the bulk of state investments and finances are invested in cities. The processes of digital transformation are accompanied by the creation of more comfortable living conditions for the population, the introduction of innovative technologies, and an increase in the quality of life of society. The trend towards an increase in the population of cities contributes, respectively, to an increase in demand for the consumption of various goods and services, for the use of electricity and other resources. Along with this, there is an infrastructural transformation of cities, due to the growth of the world economy and competition, which imposes additional requirements on the existing mechanisms for the use of resources. The introduction of innovative technologies into all processes of the enterprise allows to increase the comfort of labor activity, since the lack of capacity is reduced, many processes are automated, and information is stored centrally.

Based on this trend, it seems rational to introduce innovative technologies and products into the scope of PJSC "Gazprom energoholding" activities in order to automate the processes of information structuring, monitoring and control of indicators of financial results and the volume of fixed assets. Also, it should be noted that automation will solve many of the company's problems, including the problem of taxation and reporting, and will allow the company manager to make informed decisions.

PJSC "Gazprom energoholding" owns several unreported land plots, it is recommended to use these facilities in order to expand the company and increase production capacity.

Also, as part of the analysis of the composition, movement and efficiency of PJSC "Gazprom energoholding" fixed assets, it was revealed that the company in question does not use the entire volume of active funds in its activities, namely, vehicles are often idle and not used by the company, as a result, active funds are not used. in the production process, and the company invests in them financial resources. In order to eliminate this problem, it is recommended to lease these active funds.

In addition to the above measures, it is recommended to reduce the residual value of the main active and passive funds of PJSC "Gazprom energoholding", this measure will affect the reduction of the tax rate paid by the company in question for real estate. Also, in the process of researching international and Russian experience in fund management, an unfavorable tendency was revealed for Rus-

sian companies, including energy companies, to enter the shadow economy; in order to eliminate this goal, it is necessary to amend the tax system at the legislative level, since a wide range of different types of taxes and high tax rates provoke companies to hide income and the volume of fixed assets.

Together, these measures will affect the efficiency of the use of fixed assets by PJSC "Gazprom energoholding", a tendency for the capital intensity, capital-to-labor ratio and capital productivity indicators to grow, the company will take a different market position for many years, minimize the risk of new competitors on the market, as a result of which PJSC "Gazprom energoholding" "will be able to achieve the main goal that practically all modern companies set themselves - getting the maximum profit from their own activities.

References

1. Danilov A. I. improvement of methods for assessing the effectiveness of innovation and investment projects to create assets with a long life cycle.

2. Buevich A. P., Kondratyeva A. S. Financing of environmental protection in the context of the implementation of the environmental policy of PJSC "GAZPROM" // Innovative economy: prospects for development and improvement. – 2020. – №. 4 (46).

3. Tarnavsky O. A. Combining professions as a tool for optimizing the business process "transport support" of the companies of the GAZPROM group on the example of LLC "GAZPROM ENERGO" // Technical and technological problems of service. – 2020. – №. 3 (53). – P. 77-83.

4. Efimova M. R., Korolkova N.A. Improvement of the system of statistical indicators of the state and development of the fuel and energy complex of the Russian Federation // Questions of statistics. – 2019. – V. 26. – №. 12. – P. 27-38.

5. Eremenko O. V. Innovative methods of cost management in oil and gas production segments. – DirectMedia LLC, 2019.

6. Muravitsky D. Yu. Increasing the solvency and financial stability of enterprises in the energy sector: diss. – Siberian Federal University, 2019.

7. Eremin N. A., Stolyarov V.E. Gas well as a key object of a digital field // Automation, telemechanization and communication in the oil industry. – 2019. – №. 9 (554). – P. 5.

8. Sheveleva G. I.Peculiarities of property redistribution in the Russian electric power industry //Baikal Research Journal. – 2020. – V. 11. – №. 4. – P. 13.

9. Markov A. O., Vidyaev I. G. Optimization of production processes at enterprises of the oil and gas industry (for example, PJSC "GAZPROM") // apni. ru Editorial board. – 2021. – P. 84.

10. Onokoi V. V., Lebedeva L.N., Korneeva M.N. Metrological support in the implementation of business processes of LLC "Gazprom energo" // Gas Industry. – 2019. – №. P2 (786).

11. Dmitrievsky A. N., Eremin N. A., Stolyarov V. E. On the issue of digitalization of gas production processes // Bulletin of the Tula State University. Geosciences. – 2019. – №. 2.

12. Gorgisheli M. V. Transformation of business models of generating companies in the Russian market: prosumerism as a driving force // Bulletin of the Samara State University of Economics. – 2019. – №. 8. – P. 30-37.

13. Skobelev D. O., Stepanova M. V. Energy management: reading 2020. Guidelines for energy management for industrial enterprises // M.: "Colorit" Publishing House. – 2020.

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NEURAL NETWORKS IN THE INTELLECTUAL SUPPORT OF MANAGEMENT DECISIONS

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Abstract. *The article analyzes artificial neural networks as an advanced direction in the field of creating artificial intelligence, as well as an effective technology in the intelligent provision of management decisions in organizations. The process of evolution of intracorporate management systems is considered on the example of a knowledge management system. Scientific forecasts for the further development of intellectual support for management decisions are presented.*

Keywords: *information systems, intellectual information technologies, neural networks, management decisions.*

In the conditions of modern digital transformation of the economy, intelligent information technologies used to select optimal solutions to the problems are particularly relevant. The activities of the management of commercial companies are related to the need to make decisions of various complexity daily. Today, an important factor in improving the efficiency and normal functioning of the company is the rational organization of management and planning processes. This allows you to improve management and improve the quality of the managerial decisions, and also provides an information base for a promising analysis of situations.

One of the main problems when creating an information environment is the choice of a knowledge representation model. It is the model of knowledge presentation that defines the architecture, the capabilities and properties of the system, as well as the methods of acquiring knowledge of the intellectual system. Currently, a number of basic models of knowledge presentation and their modifications are known - this is a presentation using the facts and rules, calculus of predicates, as well as neural, semantic networks, frames [6, p. 183].

Machine support algorithms for managerial solutions can be used in many areas, as a rule, where the automation of solving challenges is necessary for which the knowledge and experience of a person is customary. To date, neural networks

are widely used. Neural networks are one of the directions of research in the field of artificial intelligence, based on trying to reproduce the human nervous system. Namely: the ability of the nervous system to learn and correct errors, which should allow to simulate, although it is sufficiently rude, the work of the human brain.

Historically, there are three main directions in modeling artificial intelligence systems [5, p. 39]:

As part of the first approach, the object of research is the structure and mechanisms of human brain, and the ultimate goal is to disclose the secrets of thinking. The necessary stages of research in this direction are the construction of models based on psychophysiological data, conducting experiments with them, nomination of new hypotheses regarding intellectual activity mechanisms, improving models.

The second approach as an artificial intelligence considers the second approach. Here we are talking about modeling intellectual activity with the help of computing machines. The purpose of the work in this direction is to create algorithmic and software for computing machines, which makes it possible to solve intellectual tasks not worse than a person.

Finally, the third approach is focused on the creation of mixed man-machine, or, as they say interactive intelligent systems, at the symbiosis of the possibilities of natural and artificial intelligence. The most important problems in these studies are the optimal distribution of functions between natural and artificial intelligence and the organization of the dialogue between man and the machine.

Solving specific tasks is preceded by the preparation of data for the neural network. In practice, it is a preprocessing of data that is the most time-consuming element of neural network analysis. Moreover, the use and design of the basic principles and methods of predicting data is even more important than the development of actually neural network algorithms. The process of solving applied tasks, including the presentation of knowledge for the neural network, the preparation of the data is fully laid on the developer's shoulders.

The knowledge is understood as stored information or models used by man or machine for interpretation, prediction or reaction to external events [11].

Questions of knowledge include, in particular, the following: what information should be stored and how to present this information physically for its subsequent use. Thus, based on the nature of the knowledge, the method of their representation is determined by the goal. Regarding real applications "Intellectual" systems can be argued that the success of the solution depends on the good idea of knowledge. This also applies to neural networks as a separate class of intelligent systems. The form of representation of the input signals may be different. This leads to the fact that the development of acceptable neural network solutions becomes a creative process [3; 7; 14; 16].

In today's information flow, it is very difficult to take the right decision to consider a certain question. Neural technologies are used in solving such tasks in which there is no clear algorithm, accurate actions or formal rules that allow you to obtain the desired result without any difficulty. Decision making is a task that does not have certain rules. In solving this issue, it is important to make the right choice that it is often very difficult. The managerial solution is a choice that the manager must do in the process of implementing the management functions and solving specific organizational tasks. This decision is designed to ensure the promotion of landmarks, goals. Therefore, the most effective is the choice that will be implemented and will make the greatest contribution to the achievement of the ultimate goal [2].

In essence, the management decision is a creative, volitional action of a management entity, which is based on the knowledge of objective laws in the field of operation of a managed system and analysis of information on its operation. This action consists in choosing a goal, program and methods of the team's activities to resolve the problem or change in the goal [9, p. 45].

In the conditions of occurring changes in production and technologies, people, their intellectual capital, knowledge and professional competence become the main resource for organizational development. In the modern information economy, such assets of the company as knowledge are of particular value. According to the Japanese organization theorist Ikudziro Nonaki, for the economy, where we can only say about uncertainty, knowledge is the only correct source of reliable competitive advantage [13].

As knowledge is the main asset of the company, they must be used as much as possible to improve the welfare of the company. Analysis of the evolution of internal corporate management systems shows that data processing preceded information systems, and the successor of the latter was the Knowledge Management system. Knowledge management as a system involves an integrated approach to finding, collecting, evaluating, restoring and disseminating all company information assets. These can be databases, documents, policies, procedures, as well as knowledge and experience of individual employees. For timely adoption of optimal solutions in a rapidly changing market, it is vital not only to have, but also reasonably use all the knowledge gained in the company.

According to the professor of e-business and knowledge management in the Syracuse of the University of Yogish Malhotra, knowledge management contributes to the setting and solving the right tasks, instead of the right solutions of the tasks themselves [4].

Knowledge management intersects with strategic management where it is about long-term conservation of competitive advantages. The task of knowledge management is to expand the powers of the organization and the creation of pre-

requisites for the company's successful activity. In this interconnection, knowledge management is understood as a certain business concept, according to which the organization is considered as a set of knowledge, where knowledge is resources that need to be managed.

But knowledge management system is not the last link in this chain. In modern conditions, the company's management must predict the coming processes, to warn all possible troubles and be aggressive. The management approach must be bold and creative, so as not to limit the intracorporate management processes by the framework of knowledge management systems.

The future of knowledge management systems are legitimately associated with super-sufficient solutions [8]. When classifying the processes occurring in the Company, allocate the corresponding types of managerial solutions [15]:

- the processes of using the existing potential for the production of products, performing work and services and, accordingly, tactical decisions regarding the use of the available potential of the production base;
- processes of creating, building and upgrading the potential of the company and, accordingly, the strategic most important decisions regarding the processes of formation (creation, replenishment, changes) of the potential;
- processes that ensure the creation and development of the company's reproduction base itself and, accordingly, super-strategic solutions that determine the potential for the development of the reproductive base.

For the life of the company as a whole, the system and decision-making mechanisms are important. It is from these components that the company depends on which funds will be allocated for development.

The basic principle of economic reforms of successful Western countries is the validity of the decisions made. This principle is implemented through scenario calculations of the effects of decisions made, including using economic and mathematical models working on the principle of "what will happen if ...".

One of the promising instruments for a quantitative assessment of the actions of the government currently actively used abroad is a new class of economic and mathematical models - computable models of general equilibrium, known in foreign literature as Computable General Equilibium Models (CGE Models). This is a new direction in the applied economy, which allows you to find approaches to solving a wide range of human behavior modeling problems in a socio-economic environment [1]. Sophisticated economic and mathematical models are offered (agent-oriented models) of economic entities of the macro level and micro-level agents with a large set of certain properties whose behavior is limited rational. The ultimate goal of the process to create such models is to track the influence of fluctuations of agents acting on the micro level, on the macro level indicators.

The state of modern control is not a prolongation of what was once or was already used in solving certain problems, but a completely new intellectual, informational and moral phenomenon [10]. The following key management trends are distinguished (fig. 1.) [12].

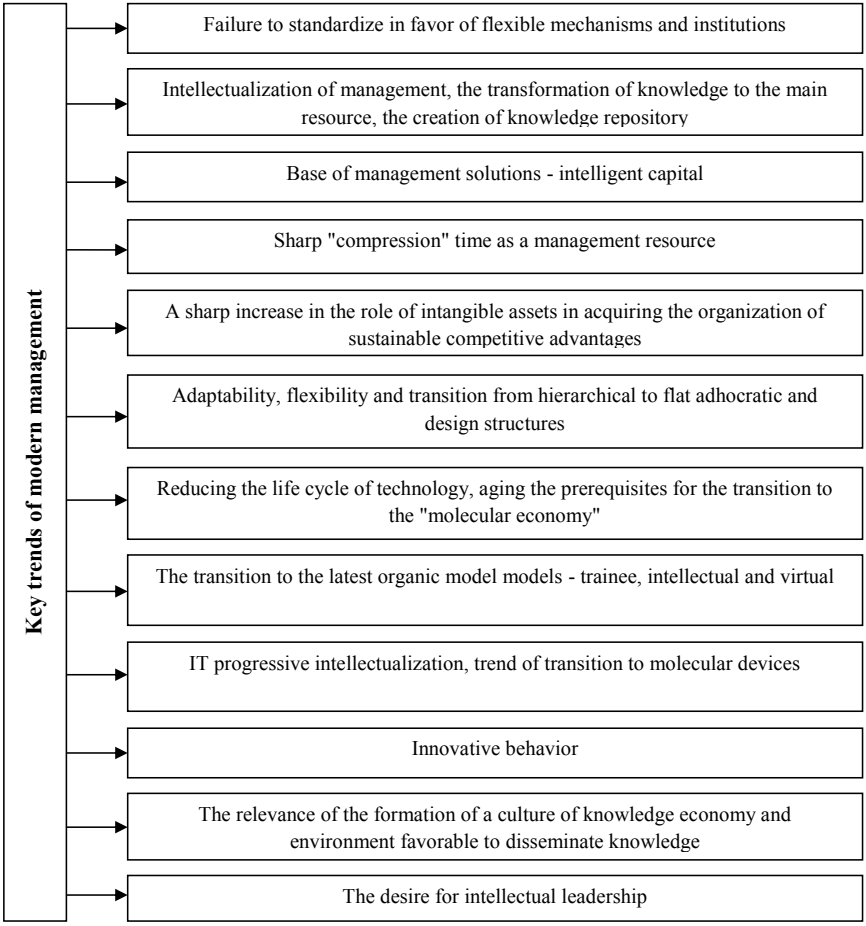

Fig. 1. *Key trends of modern management*

Researchers, breaking up a business into four areas: processes and technologies, product, organization and strategy, believe that it is in this order that most companies will begin to use the capabilities of adaptive technologies [10, p. 291].

Thus, the introduction, application and development of neural network technologies to manage the work of a specific company can lead to improved productivity and reduce the timing of the self-sufficiency of funds spent on the development of information technologies for supporting management and planned solutions.

References

1. Bakhtizin A.R. Agent-oriented economy models. - M.: CJSC "Publishing House" Economics", 2008. - 279 P.

2. Borisov A.B. Large economic dictionary. - M.: Book World, 2003. - 895 P.

3. Bestens D.E., Van den Berg V.M., Wood D. Neural Networks and Financial Markets. Making decisions in trading operations. - M.: TVP Science Publishing, 1997. - 254 P.

4. Weber A.V., Danilov A.D. Shifrin S.I. Knowledge-technologies in consulting and management of the enterprise. – SPb.: Science and Technology, 2003. - 171 P.

5. Vinogradova E.Yu. Methodological foundations of study of neural networks // Manager. 2014. № 2 (48). P. 39-43.

6. Vinogradova E.Yu. Methodology for designing a neural network to support the adoption of management decisions // Bulletin of the ISEA. 2011. № 4 (78). P. 182-186.

7. Yezhov A.A., Shumovsky S.A. Necrocomputer and its application in economics and business. - M.: Finance and Statistics, 2004. - 268 P.

8. Kleiner G.B., Polterovich V.M. Elements of the theory of reforms. - M.: CJSC "Publishing House "Economics", 2007. - 447 P.

9. Kozlovsky A.V., Mityushnikova A.I. Adoption of management decisions and risk management in the conditions of a digital economy // Bulletin of the University. 2020. № 3. P. 45-51.

10. Meyer K., Davis S. Living organization / Transl. from English - M.: Publishing house "Good book", 2007. - 368 P.

11. Methods of neuroinformatics: coll. sci. op. / ed. A.N. Gorbanya. - Krasnoyarsk: KSTU, 1998. - 205 P.

12. Milner B.Z. Innovative development: economics, intellectual resources, knowledge management: monograph. - M.: INFRA-M, 2021. - 624 P.

13. Nonaka I., Takeuchi H. The company is a creator of knowledge. The origin and development of innovations in Japanese firms. - M.: Olymp-Business, 2011. - 384 P.

14. Rutkovskaya D., Pilinsky M., Rutkovsky L. Neural networks, genetic algorithms and fuzzy systems / Transl. from Polish - M.: Hotline-Telecom, 2006. - 452 P.

15. Business strategies: analytical reference book / ex. ed. G.B. Kleiner. - M.: "Conseco", 1998. - 335 P.

16. Khaikin S. Neural networks. Complete course. - M.: Williams, 2006. - 1105 P.

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STRUCTURAL AND FUNCTIONAL CONSTRUCTION OF LIFE SUPPORT OF THE REGIONAL SYSTEM

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Abstract. *The relevance of the problem under study is due to the search for reserves of the country's economic development, contributing to its advancement to an information-innovative society with a multi-sector socially-oriented economy, providing world standards for the quality of life and the sphere of living. The purpose of the article is aimed at improving the structure of the economy of the country and its regions, ensuring the efficiency of its functioning, the effectiveness of invested labor and capital. The leading approach to the study of this problem was the structural and functional construction of the regional system, the involvement of economic potential in the practice of management, due to regional opportunities.*

Keywords: *region. regional paradigm, competitiveness, principles of the regional system, regional opportunities, life support of the region.*

The formation of a new regional paradigm should be built taking into account the functioning of the life support system, the characteristics of its development.

Considering life support as an objective process related to significant stable relationships that have a direct impact on human life, his reproduction, the formation of conditions for existence and activity, it becomes necessary to determine the patterns of life support of the population, its characteristics.

As such patterns we put forward:

- the life support of the population living in the territory is the basis for the development and functioning of regional systems;

- the formation of life support for the population of the territory is a reflection of the internal conditions and relations arising in the regional system, as well as the result of the influence of external factors and connections of the large system, which can be represented by the world community, and the life support system of the population living in the territory, determined by the peculiarities of regional formation, the specifics of the regional economy, the forms and methods of its or-

ganization, as well as the conditions for the development of the regional economy.

The principles of forming a new regional paradigm for sustainable development of territorial systems include system-wide and specific principles.

The need to take into account the first group of principles is due to the consistency and general purpose of territorial entities, and it is obvious that the entire system is built depending on the target setting. We classify the principles of sustainability, efficiency and complexity as specific principles [1].

Sustainable regional development presupposes the observance of the triad, consisting of economic and social development and the preservation of the conditions of ecological balance within the boundaries of the territorial system.

The second specific principle is the principle of efficiency. It essentially stipulates one of the main conditions for the successful functioning of territorial systems, their competitiveness.

The third specific principle is the principle of complexity, according to which all regional systems, including the sphere of life support, should be built taking into account the use of the economic potential of the region, seeking to obtain a possible result through the involvement of regional resources in the turnover.

The construction of a life support system, in which the well-known system-wide principles of the formation of regional systems and the selected specific principles operate, determines the rationality of such a construction, contributes to the improvement of this process.

Highlighting the patterns and principles of the formation of regional systems makes it possible to determine the assessment of their functioning. It is proposed to use the criteria formulated in accordance with the presented principles. Sustainability, efficiency and complexity are considered as criteria for such an assessment.

The economic situation in Russia largely depends on how the socio-economic performance of regional systems is formed, which are a reflection of the main relations and connections of the limited space of the territory.

The regional system is being formed in the field of combining economic, social and environmental spheres, which also applies to life support.

The subsystems of the regional system are the economy of the region, societies, the natural environment.

The spheres of economy, societies and ecology, combined in one territory, are conditionally distanced from each other.

The division of the problems of the regional economy into social, economic and environmental does not mean that the solution of social problems is assigned to societies, economic - to the economy of the region, and environmental - to the ecological environment of the region [2].

The solution of these problems is interdependent and progress in solving one

of them makes it possible to come closer to this and, conversely, any deterioration of the situation in any of the spheres inevitably leads to an aggravation of the situation in the other two.

In Russia as a whole, there is a relatively stable balance of social, economic and environmental parameters, although in some regions there is an inconsistency in the levels of social and economic activity and ecological balance.

In terms of the level of efficiency, positive trends have recently emerged, which are mainly associated with an increase in social and economic parameters of life support, which, to a certain extent, are influenced by the level of functioning of regional systems.

The construction of a life support system in a territory in which the well-known system-wide principles of the formation of regional systems and the highlighted specific principles of sustainability, efficiency and complexity operate, makes it possible to cope successfully with the mission, formulated in the goal of the life support system.

Moreover, the rationality of such a construction is determined by specific principles, since each of them contains relative criterion parameters for the formation of the system, which must be guided by in the process of life support.

Failure to fulfill the condition of sustainability leads to a crisis of the regional system, thereby making its functioning problematic.

The imbalance of sustainability due to the economic component does not provide funds for the maintenance of the social and environmental spheres. The ecological imbalance, as a rule, has social consequences and is resolved at the expense of the economic component.

Social imbalances undermine the conditions for social stability and, ultimately, can affect adversely economic growth. Consequently, adherence to the principle of sustainability of regional life support is mandatory in the functioning of regional systems, since it contains the factors of stable regional development.

The exclusion of the principle of the effectiveness of regional life support is tantamount to the denial of objectively effective economic laws and patterns.

The prevailing realities indicate the aspiration in any type of economic activity, in production, in entrepreneurship, to improve performance, increase efficiency, and increase the return on investment.

That is why, in market conditions, the development of the life support system is based on relations of economic interest.

In modern conditions, increasing the efficiency of the functioning of regional systems underlies their survival and competitiveness [3].

Ignoring the principle of complexity means denying the importance of a fuller use of the resources of the region, including the internal regional resources of life support.

In our opinion, the involvement of regional resources in the economic turnover should be based on the principles of their complex application, and only such use of them is justified.

At the same time, these needs are divided according to the characteristics identified in accordance with the definition of sustainability (social needs, economic needs and the observance of ecological balance).

Social needs include social protection, health care services, education and training services, cultural services, physical education services, etc.

Economic needs embody the material security of the population, which is characterized by its income, wages, pension and others.

Compliance with the ecological balance is ensured by environmental protection measures, the operation of treatment facilities, etc.

The structural elements of the system, linked into a single reproductive process in the region, which is a constantly renewed process of life support, participate in the exchange process, the production process and the distribution process.

The diagram shows the circuit, the change in the phases of reproduction:

- exchange,
- consumption,
- production,
- distribution.

In the process of life support, the satisfaction of the needs of the population, the restoration of the used labor resource in economic activity is transformed into the viability of the entire population and the working capacity of the employed population, which are subsequently switched to economic activity.

The continuity of the reproduction process implies the continuity of the entire life support system in the region. Otherwise, the lack of stability in the functioning of the entire life support system violates the constancy of regional reproduction, undermines the potential of the region.

The lack of the necessary social, economic and ecological balance, the lag of the individual components of this triad means the depression of regional systems.

First of all, it is necessary to develop and improve the legislative and regulatory framework for the development of the country's regions, which provides for overcoming the depression of small cities in Russia.

According to this, a complex of special legislative and regulatory documents for the rational development of regional systems is needed.

Along with this, a number of regulations and documents should be adopted to develop measures for withdrawing depressed regions, which include small towns, from the current state and providing conditions for economic recovery in these regional systems.

Apparently, it is necessary to develop special documents on depressive small

towns, for example, to define conceptual provisions for the withdrawal of small towns from the state of depression in order to provide a mechanism for overcoming depressiveness, depending on the specifics of the development of these cities.

To create conditions for the revitalization of economic activity in crisis regions, it is necessary:

• determination and assessment of their economic potential,

• taking into account the financial base for the development of these regions,

• analysis and assessment of the degree of involvement and use of regional resources in the economic turnover, an attempt to design the use of all regional opportunities in the future.

In this regard, the development of forecast options and scenarios of the future can become an important tool for getting out of the state of depression in small towns.

The involvement of forecasting methods in assessing the choice of ways to overcome the crisis of small towns will allow developing a system in which measures of state support for depressed regions of the country can be provided by including sources of functioning, budgetary and extra-budgetary funds, and here the opportunities and participation of local financial resources, initiatives of entrepreneurial structures operating within the considered regional formations are determined.

In this regard, it is necessary to take into account possible sources of funding for measures to overcome depression, to determine the most favorable course of events, to know the directions leading to an undesirable result and, moreover, to provide steps to avoid this.

The search for opportunities for enhancing economic activity using the existing potential and involving new resources of the regions, apparently, should be directed towards expanding the scale of small business use. Moreover, there is a positive experience of this kind both in our country and abroad [4].

First of all, in solving this issue, it is necessary to promote the development of entrepreneurial initiative carried out within the framework of the rule of law.

For this purpose, work should be carried out on the formation of programs that provide the basis for the socio-economic situation in the region, consider the most promising directions for the development of its economy, identify possible adjustments to the economic complex. It is the adjustments of the economic complex that clarify the need to create or build up socio-economic structures with a focus on increasing the level of complexity of the region's economy, which increases the return on the used regional resources.

To support the regions actively, including small towns, measures are being developed that directly relate to the development of regional labor markets, increase the level of employment of the able-bodied population.

These may include activities that require certain capital investments, which is associated with an increase in investment attractiveness, namely:

- the creation of new enterprises and the opening of new jobs;
- development of small private business;
- implementation of regional projects;
- increase in unemployment benefits;
- ensuring the mobility of the labor force, the formation of a competitive employee;
- training and retraining of personnel necessary in modern conditions, dictated by the demand for labor, including training in the skills of independent individual entrepreneurship;
- raising public awareness of job vacancies.

Thus, the regional development of the life support of the regions justifies the need for tactical approaches to solving the main task of building a perfect model of sustainable development in Russia, where the solution of the problems of socio-economic development of regions, overcoming the structural imbalances of territorial entities and getting them out of the state of depression is of particular importance. The development of directions for support and giving them an impulse for self-development is associated with the improvement of the spheres of life support of the regions.

References

1.Yakobson L.I. The public sector of the economy: economic theory and politics: a tutorial. - M .: State University - Higher School of Economics, 2017. - 368 p.

2.Kaplan, R.S., Norton, D.P. Strategy Maps. Converting intangible assets into tangible outcomes // Harvard Business School Press. - Boston, 2014. - Vol. 16, Issue: 9/8. - P. 519-520.

3. Sheveleva R.N. On the issue of assessing the quality of life of the population // Regional economy: theory and practice. - 2018. - No. 14 (149). - P. 67-76.

4. Kostyleva L.V. Spatial aspects of socio-economic differentiation of the region's population // Economic and social changes: facts, trends, forecast. - 2017. - No. 3 (7). - S. 82-92.

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INTERNATIONAL LAW AND THE LEGAL BASIS FOR ELECTIONS IN FINLAND. PARTICIPATION IN ELECTIONS OF CANDIDATES FOR DEPUTIES WHO WERE PREVIOUSLY SENTENCED TO IMPRISONMENT FOR COMMITTING CRIMES AS A VIOLATION OF THE FUNDAMENTAL CONSTITUTIONAL RIGHT OF VOTERS

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Abstract. *The article examines the legal basis of constitutional law and guarantees of electoral rights to direct expression of the will of the people on the basis of universal, equal and direct suffrage by secret ballot of Finnish citizens and permanently residing foreigners included in the voter lists. In the municipal elections in Finland on 13 June 2021, a total of 268 convictions were handed down to elected politicians during the period 2016-2021 for committing crimes under the Finnish Criminal Code. In the previous municipal elections in 2017 in Finland, elected politicians were found guilty in 301 criminal cases between 2012 and 2017. Despite the fact that the comparison shows an improvement in the criminal statistics of the deputies elected in 2021, as well as a decrease in the severity of the crimes committed, it is necessary to amend the legislation prohibiting the participation in elections for persons sentenced to imprisonment for committing serious crimes. The article emphasizes the important role and participation of the Finnish media in the investigation and disclosure of public data on the crimes of parliamentary candidates and elected politicians and leading government officials in state and municipal bodies.*

Legal democracy in Finland needs effective legal mechanisms capable of preventing abuse and criminalization of public authorities, the legitimacy of which is based on public confidence. By creating these legal mechanisms, the legislator must establish increased requirements for the reputation of candidates for public office so that voters have no doubts about the moral and moral and ethical qualities of the elected representatives of government and the legality of their actions as carriers of public authority.

Keywords. *Constitutional rights, international law, legal democracy,*

criminalization of public power, passive suffrage.

The first restrictions on universal suffrage were introduced in the Parliamentary Charter of the Grand Duchy of Finland in 1906[1], when several groups of the population were deprived of the right to vote. The ban applied to those in military service who were under guardianship who had not paid state tax in the previous two years, transferred their property to creditors (in force until 1928), convicted of vagrancy in the previous three years (in force until 1972) and those who were found guilty in the sale and purchase of votes during elections during the preceding elections six years (was abolished in 1976).

Analyzing the history of Finnish legislation, it should be noted that the Criminal Code of the Grand Duchy of Finland in 1889 provided for punishment for the loss of civil confidence. Thus, those sentenced to imprisonment as an additional punishment were sentenced to indefinite or fixed terms (from 1 to 15 years) for the loss of civil confidence. A person who lost civic confidence did not have the right to vote or run in municipal and provincial elections. The convicted person could not be appointed to a state or municipal office or be elected a member of municipal councils. Loss of civic confidence was also recorded in church records and in the register of civil registration and was noted in the certificate of service. The Law on the Abolition of Additional Punishments, which entered into force on 1.7.1969, abolished punishment for the loss of civil confidence[2].

The first law on elections to the Grand Duchy of Finland did not include a ban on the participation in elections of those previously convicted of crimes committed, only obliged the election commission to carefully check the electoral lists, mark voters who did not have the right to vote and delete them[3].

In modern Finland, the procedure for the preparation and conduct of municipal elections is determined by the Electoral Law (Vaalilaki, § 11. 10.4.2015/410) in accordance with the general principles established by the Constitution[4] defining constitutional rights and guarantees of electoral rights to the direct expression of the will of the people on the basis of universal, equal and direct suffrage by secret ballot of registered Finnish citizens and permanent residents on the basis of a valid residence permit. In January 2016, the law on municipal elections came into force[5]. In the context of the fight against coronavirus and the measures taken in

[1]Suomen Suuriruhtinaanmaan Valtiopäiväjärjestys. 26/1906. Annettu Pietarhovissa, 20 p:nä heinäkuuta 1906. Kustantaja Yrjö Weilin, Helsinki. 1906.

[2]Laki eräiden lisärangaistusten poistamisesta 10.1.1969/1. URL: https://finlex.fi/fi/laki/ajantasa/1969/19690001.

[3]Suomen Suuriruhtinaanmaan Vaalilaki. Annettu Pietarhovissa, 20 p:nä heinäkuuta 1906. https://www.finlex.fi/fi/laki/alkup/1906/19060026024.

[4]Finnish Constitution. Article 14. The right to vote and the right to participate in public life.

[5]Kuntalaki 10.4.2015/410. URL: https://www.finlex.fi/fi/laki/ajantasa/2015/20150410.

accordance with the Emergency Situations Law, the Law on the postponement of the 2021 municipal elections was adopted on March 28, 2021[6].

According to the Constitution, state power in Finland belongs to the people, which is represented by Parliament. According to article 14 of the Constitution, every Finnish citizen who has reached the age of eighteen has the right to vote in national elections and in referendums. The exercise of human and civil rights and freedoms should not violate fundamental rights, everyone is equal before the law (Article 6), the state guarantees equality of human and civil rights and freedoms regardless of gender, age, origin, language, religion, beliefs, opinions or other characteristics.

The constitutional provisions relate to article 25 (b) of the International Covenant on Civil and Political Rights,[7] by virtue of which every citizen must have, without any discrimination and without unreasonable restrictions, the right and the opportunity to vote and be elected in genuine periodic elections held on the basis of universal and equal suffrage by secret ballot and ensuring the free expression of the will of voters, and Article 3 of Additional Protocol No. 1 to the Convention for the Protection of Human Rights and Fundamental Freedoms, which, proclaiming the right to free elections, provides for the obligation of the state to hold elections at reasonable intervals by secret ballot in conditions that ensure the free expression of the will of the people in the choice of legislative bodies[8].

Active suffrage to elect and passive to be elected to government bodies and local self-government bodies are an element of the constitutional status of the voter and an element of the public-law institution of free elections in the formation of independent public authorities designed to guarantee human and civil rights and freedoms.

According to the Constitution, the right to stand for election is a fundamental right and public authorities are obliged to ensure the realization of fundamental and human rights. At the same time, the presence of a criminal record is not a basis in Finland to prohibit the exercise or restriction of the passive electoral right of citizens previously sentenced to imprisonment. The consequence of this was the participation in the municipal and parliamentary elections of a significant number of previously convicted candidates for deputies, including for attempted murder, sexual crimes against minors, robbery, extortion, the use and sale of narcotic and psychotropic substances, theft and other economic crimes, which is incompatible

[6]Laki vuoden 2021 kuntavaalien siirtämisestä 256/2021.URL:https://www.finlex.fi/fi/laki/alkup/2021/20210256.

[7]International Covenant on Civil and Political Rights. Adopted on December 16, 1966 by resolution 2200 (XXI) at the 1496th plenary meeting of the UN General Assembly. URL: http://www.consultant.ru/document/cons_doc_LAW_5531/.

[8]Protocol No. 1 to the Convention for the Protection of Human Rights and Fundamental Freedoms. Paris, March 20, 1952, as amended on May 11, 1994) ETS N 009. URL: http://www.echr.ru/documents/doc/2440801/2440801.htm.

with the activities of elected deputies in the management of state affairs in government bodies and in municipal authorities.

In accordance with the provisions of section 4 of the Law on Parties (10/1969) and section 9 (2) of the Law on Associations (503/1989), the names of candidates from party lists are entered on the electoral lists. Party lists of candidates are approved at a meeting no later than 31 days before the start of the elections.

The conducted research shows that the parties do not check the criminal history or information about the preliminary investigation of suspicions of criminal offenses of the candidates for deputies and is based only on the information provided by the candidates. In order to ensure the legal safety of voters, journalists conduct their own investigations based on the materials of the decisions of the courts and the preliminary investigation. But, unfortunately, voters learn reliable information about the criminal past of candidates for deputies after the publication of electoral lists from the media, when it is no longer possible to make changes. The crimes committed by candidates for deputies, especially grave ones, undoubtedly affect the voters' assessment of the candidate's reputation for an elective public office and determine the degree of public confidence in the institutions of representative democracy, including confidence in the inviolability of the supremacy and legal democracy in Finland.

The UN Convention against Corruption and Transnational Organized Crime, as well as the Council of Europe Criminal Law Convention on Corruption, emphasizing the threat these phenomena pose to the stability and security of society, democratic institutions and the rule of law, oblige the state to prevent relevant crimes, in particular by introducing in relation to persons with a criminal record, restrictions for a certain period (taking into account the severity of the danger of the crime committed) of the right to hold a public office in government bodies, including those formed on the basis of electivity.

The topic of participation of convicted parliamentary candidates, basic guarantees and protection of electoral rights and the right to participate in a referendum is a subject of controversy among legal scholars in Finland, as well as an investigation by journalists with the publication of detailed materials of criminal cases of MPs on party lists.

Thus, in the municipal elections in Finland on June 13, 2021, in the period 2016-2021, a total of 268 convictions in criminal cases were handed down to elected politicians.

In the previous 2017 municipal elections in Finland, elected politicians were found guilty in 301 criminal cases between 2012 and 2017. 99 politicians were sentenced to prison terms or suspended sentences. The degree of intoxication of 2.5 ppm of alcohol or more was recorded in seven politicians, and the maximum alcohol level of 3.25 ppm was recorded in the Finnish politician in 2017.

According to the information provided to journalists by the Ministry of Justice of Finland to the Parliament of the country, out of 2,468 candidates, 125 have been convicted of various crimes over the past eight years. Between 2012 and 2019, candidates already had 173 criminal convictions for 74 different crimes. The most frequent violations during this period were road safety (26), bodily harm (23), driving by a driver in a state of intoxication (29), fraud (8).

The list of candidate crimes also includes five serious crimes in the field of accounting and four serious crimes related to the illegal circulation and sale of narcotic drugs or psychotropic substances[9].

For example, the Pirate Party of Finland candidate Kim Holviala, who received 536 votes in the 2019 parliamentary elections, was sentenced to 3.5 years in prison on 11.2.2019 for aiding in a serious crime related to drug trafficking, while awaiting a review of the case. at the court of appeal at large. On 13.1.2020 the Court of Appeal issued a sentence of imprisonment for a term of 4 years.

Parliamentary candidate Sami Salonen was sentenced to 3 years and 6 months in prison for attempted murder and threats of murder or grievous bodily harm. The maximum punishment among female candidates to Parliament was determined by the county court for Minna Engström for a period of 1 year and 4 months conditionally for a serious economic crime, and additionally issued a ban on entrepreneurial activities until the end of 2021[10].

Between 2016-2021, the number of accusations against candidates for deputies of the True Finns party increased from 530 in 2017 to 675 in 2021. The largest number of all 228 charges against candidates from all parties of beating or other violent actions that caused physical pain, 101 politicians from the True Finns party were brought against, as well as 84 grave charges for driving under the influence of alcohol. fraud 32, violation of accounting 31, in violation of traffic rules 31 related to illegal drug trafficking 13, in large-scale fraud 11, under articles for possession of firearms and ammunition, in 7 thefts, in bad faith of a large-scale debtor 6, abuse of office 6, embezzlement 5, sexual acts against minors 2, robbery on an especially large scale 1 and other charges of crimes provided for by the Finnish Criminal Code.

56 convicted politicians from the "True Finns" party made up 41% of the list of all candidates for deputy. Next on the list are 15 candidates for deputies from the SDP, 14 from the Center Party, 12 from the Coalition Party, 7 from the Left Union and 7 from the "Green Union" party[11].

[9]Marko-Oskari Lehtonen. Eduskuntaan pyrkii 125 rikoksesta tuomittua ehdokasta - IL selvitti tuomiot: tapon yritys, vapaudenriisto, huumerikoksia. 3.4.2019.

[10]Jilkine V.A. The phenomenon of corruption, its origin in the Grand Duchy of Finland and the level in modern Finland. Materials of International Conference. August 15, 2019. Beijing, China 2019, pp. 69-77.

[11]Tuomo Pietiläinen. Helsingin Sanomat. HS selvitti: Perussuomalaisten ehdokkaat saaneet rikos-

For example, when the branch of the Green Union party in Tampere announced the start of a preliminary investigation on suspicion of organizing prostitution of a candidate for deputy, the Chairman of the Green Union party and the Minister of the Interior Maria Ohisalo on May 27, 2021, tweeted that the candidate hid from party information. According to the law, it is no longer possible to remove a candidate from the list at this stage, but the "Green Union" stopped his election campaigning and the candidate does not enjoy the confidence of the party[12].

An MP from the "True Finns" party of the Vantaa branch committed a drug offense in February 2020 by ordering cannabidiol and cannabidiolic acid capsules of hemp juice from the Netherlands. Jiri Keronen of the "True Finns" party was convicted in 2018 of drug use and was sentenced to a fine.

Tomi Teuvo Ilmari Hämäläinen, 31, from the list of "True Finns", in January 2018, the Turku Court of Appeal upheld a county court sentence of two large theft and unintentional concealment of a crime. According to the court's verdict, in 2015 and 2016 Hämäläinen robbed an apartment and stole a firearm. The court noted that the thefts were carefully planned and sentenced to imprisonment for one year, one month and 15 days.

Johan Kristian Engström, elected as a reserve member of the Pyhäjärvi Municipal Council, was sentenced in 2019 to a one-year suspended sentence for committing large-scale theft and two petty thefts. According to the court's verdict, Engström illegally entered the apartment and stole 62,000 euros in cash. Engström was also convicted of two counts of stealing wine from the Alko store.

From the general electoral list, four candidates for deputies of municipal councils received court convictions for crimes of a sexual nature against minors under the age of sixteen and for violations of the sexual inviolability of minors.

A candidate from the list of the "True Finns" party received a suspended sentence of 1 year and 10 months. The county court found the 62-year-old candidate Raimo Kalevi Helenius guilty of a serious crime of sexual abuse of a minor, insult, embezzlement and forgery in March 2017. Helenius confirmed that he concealed the verdict from the True Finns party.

Two True Finns candidates received suspended prison sentences for sex offenses against minors, and a Coalition Party candidate was fined in 2018 for sexual exploitation of a minor.

In November 2018, MP candidate Markku Tapio Niemi was sentenced to 1 year and 8 months in suspended prison and 70 hours of forced labor for sexual assault and coercion of an adult. The candidate hid the court's verdict from the party, but after the publication of information in the Helsingin Sanomat newspaper, Niemi announced his refusal to run, but after the approval of the lists by the election

syytteitä selvästi eniten – Hakukone kertoo, mistä rikoksista syytteitä on nostettu eri puolueiden ehdokkaille. 2.6.2021.URL: https://www.hs.fi/politiikka/art-2000007981496.html.

[12]Maria Ohisalo. 27.5.2021. URL: https://twitter.com/mariaohisalo/status/1397986007258218498.

commission, the candidacy can no longer be withdrawn[13].

One of the elected reserve deputies was twice convicted by a court decision of drunk driving under aggravated circumstances[14].

The chairman of the Coalition Party from Vantaa municipality Markus Aarnio and candidate for parliament in 2021 was sentenced in October 2017 by a court to 4 months in prison for driving under the influence of 3.25 ppm alcohol[15].

An analysis of Finnish electoral regulations allows us to conclude that it is necessary to amend the legislation prohibiting the inclusion of candidates with convictions of the courts on the electoral lists of municipal elections. In conclusion, the important role and participation of the Finnish media in the investigation and disclosure of public data on the crimes of parliamentary candidates and elected politicians and leading government officials in state and municipal bodies should be emphasized.

The court decisions made with publication in the media did not prevent the politician and civil servant Pekka Tiainen from running in the municipal elections in 2021, 2012 and 2008, in the presidential elections in 1992, in the parliamentary elections in 2007 and 2011, and in the 2009 European Parliament. On 18.4.2008 the Helsinki Court of Appeal sentenced Pekka Tiainen, former adviser to the Ministry of Employment and Economy, the Ministry of the Interior and the Ministry of Social Affairs and Health, to pay damages in the amount of 1.2 million euros. By a decision of the Helsinki Court of Appeal in March 2017, Pekka Tiainen was found guilty of financial crimes and sentenced to four months in prison[16].

Legal democracy in Finland needs effective legal mechanisms capable of preventing abuse and criminalization of public authorities, the legitimacy of which is based on public confidence. By creating these legal mechanisms, the legislator must establish increased requirements for the reputation of candidates for public office so that voters have no doubts about the moral and moral and ethical qualities of the elected representatives of government and the legality of their actions as carriers of public authority.

[13]Tuomo Pietiläinen. Neljä kuntavaaliehdokasta tuomittu lapseen kohdistuneista seksuaalirikoksista – tekijät ehdolla perussuomalaisten ja kokoomuksen listoilla.28.5.2021. URL: https://www.hs.fi/politiikka/art-2000008008507.html.

[14]Tuomo Pietiläinen. HS. Kunnanvaltuustoihin valittiin yli 30 rattijuopumuksesta tuomittua – HS selvitti uusien kuntapäättäjien tuomioita. 18.6.2021. URL: https://www.hs.fi/politiikka/art-2000008053571.html.

[15]Tuomo Pietiläinen. Kovimpia tuomioita seksuaalirikoksista saaneet jäivät valtuustojen ulkopuolelle. HS. 13.6.2021.

URL: https://www.hs.fi/politiikka/art-2000008051176.html.

[16]Tuomo Pietiläinen. Kovimpia tuomioita seksuaalirikoksista saaneet jäivät valtuustojen ulkopuolelle. HS.13.6.2021. URL: https://www.hs.fi/politiikka/art-2000008051176.html.

References

1. Tuomo Pietiläinen. Kovimpia tuomioita seksuaalirikoksista saaneet jäivät valtuustojen ulkopuolelle.

2. Tuomo Pietiläinen. Neljä kuntavaaliehdokasta tuomittu lapseen kohdistuneista seksuaalirikoksista – tekijät ehdolla perussuomalaisten ja kokoomuksen listoilla.

3. Tuomo Pietiläinen. HS. Kunnanvaltuustoihin valittiin yli 30 ratti-juopumuksesta tuomittua – HS selvitti uusien kuntapäättäjien tuomioita. 18.6.2021.

4. Jilkine V.A. The phenomenon of corruption, its origin in the Grand Duchy of Finland and the level in modern Finland. Materials of International Conference. August 15, 2019. Beijing, China 2019.

5. Marko-Oskari Lehtonen. Eduskuntaan pyrkii 125 rikoksesta tuomittua ehdokasta - IL selvitti tuomiot: tapon yritys, vapaudenriisto, huumerikoksia. 3.4.2019.

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LEGAL STATUS OF INNOVATIVE SCIENTIFICALLY-TECHNOLOGICAL ORGANIZATIONS IN THE SPHERE OF MILITARY-INDUSTRIAL COMPLEX

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Abstract. *This article is devoted to the study of the legal status of foreign innovative scientific and technical organizations in the field of the military-industrial complex. It has been proven that the American DARPA (Defense Advanced Research Projects Agency) is the flagship of world scientific thought in the defense industry. The structure and main directions of DARPA research are revealed. It has been substantiated that the key research results have been created in such areas as robotics, biomedicine and network technologies. The legal status of the Defense Technologies Agency (Agency) as a key subject of legal relations in the sphere of the defense industry of Ukraine has been substantiated. An approximate structure of the Agency, the key directions of its activities until 2030 and the foundations of the organizational and legal status of the Agency are proposed. It has been proven that DARPA studies have a dual purpose: their results are applicable both in the military and in the civilian sphere, in particular in the fight against the SARS-CoV-2 coronavirus. Also analyzed the legal status of other similar foreign organizations, in particular in Israel (MAFAT), France (DGA) and Australia.*

Keywords: *public-private partnership, Military-Industrial Complex, DARPA, Defence Technologies Agency, organizational structure*

The draft of the Strategy for the development of the Ukrainian military-industrial complex provides that one of the most important goals of the state military-industrial policy is the establishment of a legal entity for the implementation of innovative projects and the development of critical technologies in accordance with the best world practices - the Agency of Defense Technologies. At the same

time, there is no clear understanding of the features for the legal status of this organization, the procedure for the formation of management bodies, financing and the structure of this organization. (Uruskyi 2020)

The main purpose of this article is to study the legal status of foreign innovative scientific and technical organizations in the defense industry and to develop optimal ways in order to solve the relevant problems for Ukraine.

In 2021, Ukraine plans to establish the Defense Technologies Agency (Agency), the prototype of which will be the American DARPA (Defense Advanced Research Projects Agency) - the Office of Advanced Research Projects of the US Defense Department). It is assumed that the Agency will be controlled by both the Ministry for issues of Strategic Industries and the Ministry of Defense of Ukraine. In addition, the National Academy of Sciences of Ukraine represented by the Section for Applied Research will be responsible for the innovative scientific and technical part of the Agency. A part of the property complex and personnel of the Central Scientific Research Institute of Arms and Military Equipment under the Ministry of Defense of Ukraine is also supposed to be allocated for the establishment of the Agency. (NISS 2020).

DARPA (Wikipedia 2021a) was founded in 1958 in response to the launch of the first artificial Earth satellite in the USSR. DARPA was tasked with keeping US military technology advanced. DARPA operates independently of conventional military research institutions and reports directly to the leadership of the Defense Department. DARPA has approximately 240 employees (approximately of which 140 are technicians); the organization's budget is about $ 3 billion. These numbers are approximate, as DARPA focuses on short-term programs (2-4 years), carried out by small, specially selected cooperatives of contractor companies.

The structure of the Agency consists of 7 divisions (Burenok, Ivlev, Korchak 2009):

1) Adaptive Execution Office (AEO) - research in the field of building adaptive platforms and architectures, including universal software platforms, modular hardware, multifunctional information systems and development and design tools;

2) Defense Scientific Office (DSO) - research in the field of fundamental physics, new technologies and devices based on new physical principles, energy, new materials and biotechnology, applied and computational mathematics, medico-biological means of protection, biomedical technologies;

3) Innovations in information technology (I2O) - information monitoring and control systems, high-performance computing technologies, data mining, pattern recognition systems, cognitive machine translation systems;

4) Microsystem Technologies Office (MTO) - technologies of electronics, photonics, micromechanical systems, advanced architecture of integrated microcircuits and algorithms for distributed data storage;

5) Strategic Technologies Office (STO) - communication systems, tools of protecting information networks, instruments of electronic warfare (EW), resistance of systems to cyberattacks, systems for detecting camouflaged targets based on new physical principles, energy conservation and alternative energy sources;

6) Tactical Technologies Office (TTO) - modern high-precision weapons systems, laser weapons, unmanned weapons based on air, space, land and sea platforms, advanced space monitoring and control systems;

7) Biological Technology Office (BTO) - research in the field of engineering biology, including omix technologies, synthetic biology, metabolic engineering, gene therapy (including the artificial human chromosome), and applied aspects of neuroscience.

Most of DARPA's new research programs are aimed at solving the problems of enhancing the interaction of robots and people, as well as information environments and people - for performing joint operations. (Klabukov, Alekhin, Nekhina 2014)

The clearest example of the effectiveness of this approach was the initiative project of Local Motors together with DARPA, created on the basis of a vibrant community of engineers, designers, drivers and mechanics, passionate about the idea of jointly designing the image of the automotive industry of the future. The basis of the software toolkit is the original method of multi-stage selection of ideas and rationalization proposals for the collective formation of the future appearance of vehicles, as well as the implementation of the main stages of the product life cycle in accordance with the concept of "digital production".

Developers from all over the world responded to the first open competition to create a dream vehicle. Local Motors later entered into an agreement with the Manufacturing Technology Association (MTA) to supply the first 3D-printed car. The premiere of this car took place in early September 2014 at the exhibition in Chicago. At the moment, it is known for sure that the original vehicle was created specially for the needs of urban transport. The use of 3D printing in this concept car will also demonstrate the importance of using greener digital manufacturing technologies to create machines that are durable, safe, fast, convenient and economical in accordance with the real needs of people.

In early April 2014, DARPA announced the establishment of a new structural unit - the Department of Biological Technologies. Its task is to put biology at the service of national security. Its priority is to improve the survival rate of seriously injured servicemen. According to the US Army Institute for Surgical Research, blood loss is the leading cause of death on the battlefield. Especially relevant is the development of drugs administered orally in case of severe internal bleeding, which increase blood clotting and make it possible for the victim to be hospi-

talized. The program for the development of advanced prostheses is completely transferred under the control of the new department. It was launched back in 2006 and is called promisingly - “Revolutionizing Prosthetics”. Developments in the field of prosthesis control using a neurointerface - i.e. the efforts of thought have made great strides in recent times. Achievements in the technology of cortical microelectrodes have made the connection between the nervous system and cybernetic parts of the body so strong that complex combinations of movements are available for a robotic prosthesis, which differ little from the mobility of biological limbs. However, neuroscientists are working to get the signal in both directions - so that the prosthesis is not only controlled by the mind, but they send tactile signals back to the nervous system themselves, causing a sensation of genuine physical touch. In order to increase the survival rate of soldiers with the help of rehabilitation methods, research is being conducted in the area that traditionally arouses tremendous interest and many questions - the study of the characteristics of the neural work of the brain. By answering the fundamental questions related to functional maps of the brain, it will be possible to restore memory lost as a result of traumatic brain injury, remove or relieve post-traumatic stress disorder, and normalize behavioral functions. The listed basic research will be used in order to create a portable implant placed in the brain of a military man, which will record the entire volume of memories. In the event of severe brain injury, the implant will restore memories. Of particular interest is the fact that the results of brain studies are planned to be used not only to restore lost abilities, but also to improve the existing, unimpaired, qualities of a serviceman. Hippocampus stimulation will be used to improve cognitive skills so important on the battlefield, such as memory, learning new skills, and decision making.

In 2020-2021, the DARPA Accelerated Molecular Discovery (AMD) program is developing new systematic approaches that accelerate the discovery and optimization of high-performance molecules to realize the capabilities of the Defense Department. This includes simulants and drugs needed to counter emerging threats, coatings, dyes and special fuels needed to improve performance. AMD Systems will provide end-to-end computing and experimental tools to design, detect, validate, and optimize new molecules, interactively learning more efficient and effective molecular detection techniques that improve performance in national security applications (DARPA 2021).

AMD executives are partnering with the Walter Reed Army Research Institute (WRAIR) to apply artificial intelligence (AI) techniques to accelerate drug discovery to combat SARS-CoV-2. Through this program, the National Center for the Advancement of Translational Sciences (NCATS) and WRAIR provide MIT and SRI with expertise in medicinal chemistry and in vitro AI prediction testing to validate and inform models.

Researchers at the Massachusetts Institute of Technology are focusing on developing new artificial intelligence algorithms that specifically address the lack of data inherent in the study of a new virus, and are looking to apply such methods to identify synergistic combination therapies in the future. They recently posted on a blog post about the results of their model trained to predict antiviral activity against COVID-19 and efforts to develop machine learning tools that will help identify molecules with therapeutic effects against disease.

AMD specialists at SRI International are developing artificial intelligence tools that incorporate the expertise of chemists, in addition to the knowledge gained from the data, to discover analogues of existing therapeutic agents with efficiency against SARS-CoV-2. They also recently published data on their efforts to use machine learning models to identify virus inhibitors.

DARPA's Make-It program automates small molecule detection and synthesis to advance the field of synthetic chemistry beyond traditional batch and intuition-based capabilities. Make-It develops artificial intelligence-based approaches to planning and optimizing synthetic routes combined with fully automated synthesis techniques that include algorithms for process automation and control, interconnected fluid modules for continuous synthesis, and in-line characterization and purification. Researchers are also working on methods to rapidly explore the vast parameter space associated with synthesis, which until now has been minimally hand-selected. Make-It seeks to provide the basic technologies needed to transform synthetic chemistry into information-driven science, accelerating the pace of chemical innovation and small molecule production (Shakhtman 2012).

DARPA employees create a suite of flexible manufacturing capabilities for the scalable and sustainable production of critical medicines.

On Demand Pharmaceuticals (ODP) specializes in fine chemicals and active pharmaceutical ingredients (APIs), and their technology is based on small chemical production devices that were developed in the DARPA Battlefield Medicine and Make-It programs. Their efforts are jointly funded by DARPA and HHS under the CARES Act, and FDA Commissioner Dr. Stephen Hahn and DARPA Director Dr. Peter Highnam visited the company on December the third.

SRI International is developing an approach that makes it easy to scale pharmaceutical manufacturing from laboratory to production scale in one step.

Virginia Commonwealth University is also developing tools for the analysis and optimization of chemical manufacturing in the United States to ensure that existing land-based process flows can be quickly redistributed to critical APIs when needed (Jones 2009).

DARPA's activities reflect the fact that while the Agency's mission and philosophy have remained unchanged for decades, the world around DARPA has changed dramatically - and the speed with which these changes have taken place has in-

creased in many ways. These changes include some remarkable and even amazing scientific and technological advances that, if having being used intelligently and purposefully, can not only ensure continued US military superiority and security, but also accelerate social and economic progress. At the same time, the world is undergoing some deeply troubling technical, economic and geopolitical shifts that pose a potential threat to US supremacy and stability. These conflicting trends of unprecedented opportunity and growing threat - and how they can be expected to impact US national security needs ten or more years from now - have profoundly influenced DARPA's latest definition of its strategic priorities for the next few years.

DARPA program portfolios are built from the bottom up: DARPA program managers identify and propose new programs that they believe promise revolutionary change. This is important for several reasons. An effective DARPA program manager is the person closest to critical challenges and possible technological capabilities in their arena, and personal inspiration and commitment to a new idea is the spark needed to ignite a big fire. But ideas also come from the top down, sometimes from the DARPA leadership, and often from the military services themselves, which DARPA is ultimately called to serve.

Today DARPA focuses its strategic investments in four main areas (Popova 2010):

1) Rethinking Complex Military Systems: in order to help accelerate the development and integration of revolutionary military capabilities in a rapidly changing modern landscape, DARPA is working to make weapon systems more modular and easily upgradeable and improved; ensure superiority in the air, at sea, on land, in space and in cyberspace; improve position, navigation and time (PNT) regardless of the global positioning satellite system; and strengthen protection against terrorism;

2) Overcoming the flow of information: DARPA is developing new approaches to obtaining information from massive datasets with powerful tools for working with big data. The agency also develops technologies to ensure the reliability of data and systems through which critical decisions are made, such as automated cyber defense capabilities and methods for establishing fundamentally much more secure systems. In addition, DARPA addresses the growing need for privacy at various levels of need without sacrificing the national security value of having adequate access to network data;

3) Using biology as a technology: in order to leverage the latest advances in neurobiology, immunology, genetics and related fields, DARPA established its Biological Technology Division in 2014, giving new impetus to the Agency's portfolio of innovative biology-based programs. DARPA's work in this area includes programs to accelerate progress in synthetic biology, anticipate the spread of infectious diseases, and master new neurotechnologies;

4) Expanding technological frontiers: DARPA's core business has always been to overcome seemingly insurmountable physical and engineering barriers, and, once demonstrating the resolve of these daunting challenges, to apply the new capabilities made available by these breakthroughs directly for national security needs. Maintaining momentum in this important specialty, DARPA works to reach new opportunities by applying advanced mathematics; invention of new chemicals, processes and materials; and the use of quantum physics.

Defense Science and Technology Australia is an affiliate of the Australian Department of Defense that researches and develops technologies for use in the Australian defense industry.

The organization is the lead agency of the Australian Government responsible for the application of science and technology to safeguard and protect Australia and its national interests. She supports Australia's defense by exploring future technology for defense assets, providing advice on the acquisition of military equipment, the development of new defense capabilities and the expansion of existing systems. Led by the Chief Defense Scientist, the organization has an annual budget of $ 400 million and has over 2,300 employees, mostly scientists, engineers, IT professionals and technicians (Wikipedia 2021d).

Conclusions

Taking into account the above, we consider it expedient and necessary to reform the innovation industry of the domestic MIC by the following actions:

1. **Establishment of the Defense Technologies Agency** as the central executive body of Ukraine, responsible for the implementation of the state innovative military-industrial policy and the organization of scientific research in the defense industry of Ukraine. Controllability - the Ministry for issues of Strategic Industries and the Ministry of Defense of Ukraine, direct subordination - the Cabinet of Ministers of Ukraine. The advantages of this option also lie in the fact that when it is implemented, there are good opportunities for staffing the Agency with highly qualified personnel. The latter can be selected among the employees of structural subdivisions of the Ministry of Defense of Ukraine, the Ministry for issues of Strategic Industry, the General Staff of the Armed Forces of Ukraine, the National Academy of Sciences of Ukraine and scientific research institutions subordinate to them. If necessary, the Agency can include small units, staffed with specialists in certain types of weapons, military and special equipment, inherent exclusively to individual components of the defense forces.

2. One of the priority tasks of the Agency should be considered to carry out a comprehensive audit of the results of research and development works at state, and, by their consent, private enterprises of the defense industry of Ukraine and scientific institutions regarding the creation of innovative models of weapons and military equipment and their implementation in the development and production

of military-technical equipment.

3. The organizational and legal form of the Agency is a joint stock company, the authorized capital of which is formed by the Government of Ukraine represented by the Ministry for issues of Strategic Industry and the Ministry of Defense on parity terms. This will allow attracting not only shareholders-partners, but also shareholders-investors to the implementation of innovative projects in the military-technical sphere using public-private partnership models by means of the principle “use it or lose it” (Sina Bruna 2013), as well as using the Triple Helix Model, that is, more active and wider interaction of state authorities with private structures and scientific institutions.

4. Approximate structure of the Agency:

Department for the development of samples of robotics and automation of processes in the defense industry of Ukraine; department of innovative projects in the field of military weapons and military equipment (small arms, military equipment, UAV design, etc.); department for the construction, repair and equipment of military armored vehicles; department for the production and repair of aircraft; directorate for the production and modernization of missile and space technology and anti-aircraft missile systems; department for Biological, Medical, Information and Digital Technologies; department of International Cooperation.

5. Financing of the Agency's activities: State budget + all sources not prohibited by law. Particular attention should be focused on attracting investment through the implementation of public-private partnership projects, and, accordingly, a wider involvement of private enterprises in the implementation of relevant projects.

6. Management of the Agency: appointed and fired by the decision of the Cabinet of Ministers of Ukraine on the proposal of the Minister of Defense of Ukraine and the Minister for issues of Strategic Industries of Ukraine.

7. The main direction of the Agency's activity is the prevention and elimination of “threats to the future”, taking into account the fact of the Russian Federation's military aggression against Ukraine (following the example of the European Defense Agency).

8. Contractual cooperation with higher educational institutions, in particular with the Kiev Polytechnic Institute of Sikorsky, including with the aim of forming the staff of the Agency and introducing advanced scientific and technical developments in the MIC of Ukraine.

TYPICAL TECHNOLOGICAL PRIORITIES OF THE DEFENSE TECHNOLOGY AGENCY OF UKRAINE FOR THE PERIOD UP TO 2030

1. Human technologies: biological protection against previously unknown pathogens; therapy of neurotrauma of the central nervous system; fundamental mechanisms of slowing human aging; computer-aided design systems for living beings.

2. Robotics technologies: highly efficient vehicles for the delivery of personnel and cargo; autonomous operations of robots (underwater, ground, air); power supply for long-term autonomous actions; navigation in conditions of electronic countermeasures; robotic transport for air and water space, rough terrain and public roads.

3. Network technologies: processing of structured and unstructured data of huge volumes and significant variety to obtain human-readable results; software implementation of the concept of "systems of systems»; gamification of control of operations in the combat space.

4. Technologies for integrating human and robot capabilities for action in the real world: development of robotics to reduce physical stress on humans; automatic means of monitoring and correcting of health; expanding the capabilities of sense organs through the use of electronic sensory systems;

5. Integrated network technologies for transforming the real world through the interaction of humans and robots: management of the configuration of the cohnectome of the human and animal brain; a single combat space with a universal protocol for conducting militant operations; autonomous resource-independent robotics and supporting infrastructure.

References

1. Burenok V., Ivlev A., Korchak Yu. (2009) Analiticheskiy obzor deyatrlnosti Upravleniya perspektivnykh issledovatelskykh proektov MO SSHA (in Russian) // Razvitiye voennykh tekhnologiy XX veka: problem, planyrovaniye, realizatsiya. – Tver, OOO “KUPOL”, 2009. – s. 93. – 640 s.

2. Defence Advanced Research Projects Agency (DARPA) (2021, in English). Available: https://www.darpa.mil/ (Accessed on 26.01.2021).

3. Jones J. (2009) MIT Red Balloon Team Wins DARPA Network Challenge (in English). DARPA 5th of December 2009. Available: https://archive.darpa.mil/networkchallenge/darpanetworkchallengewinner2009.pdf

4. Klabukov I., Alekhin M., Nekhina A. (2014) Issledovatelskaya programma DARPA na 2015 god. (in Russian). Available: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2439081 (Accessed on 24.01.2021).

5. Klabukov I., Kramnyk I., Lebedev V. (2013) Fond perspektyvnykh issledovaniy v systeme oboronnykh innovatsiy. (in Russian) Moskva, Obshchestvennyi sovet predsedatelya Voenno-promyshlennoy kommisiyi pri pravitelstve RF – 106 s.

6. National Institute for Strategic Studies (NISS, 2020). Jak zabezpechyty rozvytok oboronnykh tekhnologiy v Ukrajini (in Ukrainian). Available: http://opk.com.ua/як-забезпечити-розвиток-оборонних-те/ (Accessed on 25.12.2020).

7. Popova E. (2010) Organizatsionnaya structura i mekhanizmy funktsionyrovaniya upravleniya perspektivnykh issledovatelskykh proektov Ministerstva oborony SSHA DARPA // Innovatsii. – 2010. - № 11. – S. 5-10. – ISSN 2071-3010. (in Russian)

8. Shakhtman N. (2012) Exclusive DARPA gets a new boss, and Solyndra is in her past. (in English). Wired 10th July 2012.

9. Sina I., Bruna S. (2013) Development of Public and Private Partnership projects in Latvia. Proceedings of the 2nd International Scientific Conference on Project Management in Baltic countries, Riga. Available: https://www.researchgate.net/publication/256841333_DEVELOPMENT_OF_PUBLIC_AND_PRIVATE_PARTNERSHIP_PROJECTS_IN_LATVIA (accessed on 10.01.2021).

10. Uruskyi O. (2020) Oleg Uruskyi anonsuvav stvorennya v 2021 rotsi Agentsii z oboronnykh tekhnologiy (in Ukrainian). Available: https://armyinform.com.ua/2020/12/oleg-uruskyj-anonsuvav-stvorennya-v-2021-roczi-agencziyi-z-oboronnyh-tehnologij/ (Accessed on 06.01.2021).

11. Wikipedia (2021a). Upravleniye perspektivnykh issledovatelskykh proektov Ministerstva oborony SSHA (in Russian). Available: https://ru.wikipedia.org/wiki/Управление_перспективных_исследовательских_проектов_Министерства_обороны_США (Accessed on 19.01.2021).

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SOME OF ISSUES OF TIME-LIMITS OF THE OF LETTERS ROGATORY ENFORCEMENT ON CRIMINAL CASES FOR MUTUAL LEGAL ASSISTANCE BETWEEN THE STATES

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Abstract. *The article examines the issue of timely execution of letters rogatory in criminal cases in the order of legal assistance in criminal cases based on the requirements of the reasonableness of the terms of the proceedings. The legislation of the Republic of Azerbaijan and international documents on the provision of legal assistance in criminal cases are analyzed. To improve the legislation on the provision of legal assistance in criminal cases, the author proposes the introduction of specific changes.*

Keywords: *mutual legal assistance, letter rogatory, reasinability, guarantee speedy, legal procedure, time-limits*

Introduction

In the context of globalization and integration, the development of communication means, transparency of borders and other technical capabilities enhance the transnational nature of crime and, accordingly, determine the need for legal assistance between states.

The effectiveness of legal aid in criminal cases with foreign elements sometimes depends on the timely and quality execution of letters rogatory. According to paragraph 3 of art. 9 of the Covenant on Civil and Political Rights and art. 5 of the European Convention for the Protection of Human Rights and Fundamental Freedoms, everyone who is arrested or detained has the right to trial within a reasonable time or to release pending trial.

Purpose of the study – to analyze international acts and national legislation of individual states and identify elements that affect the timing of letters rogatory and develop proposals to improve the speed of execution.

Materials and methods- the research analyzes the scientific works of lead-

ing scientists, international acts on human rights, the provision of legal assistance between states, the legislation of the Republic of Azerbaijan and the Russian Federation. Methods such as analysis, synthesis, historical, comparative jurisprudence were used.

Results and discussion. Despite the fact that the Criminal Procedure Code of the Republic of Azerbaijan (hereinafter referred to as the CPC RA) and other legal acts do not contain the concept of "reasonable time", but contains separate provisions related to ensuring the speed of court proceedings. Article 8.0.3 of the CPC also refers to the tasks of criminal proceedings as prompt disclosure of crimes, comprehensive, complete and objective clarification of all the circumstances associated with criminal prosecution.

Letter Orders in the RA are executed in accordance with the CPC and the Criminal Legal Assistance Act, and are executed in the manner prescribed by the RA legislation. Therefore, the CPC's requirement for prompt crime detection also applies to the execution of letters rogatory.

According to art. 62 of the Chisinau Convention, orders are executed within the time period provided for by the legislation of the requested party and, upon agreement of the competent institutions of justice of the parties, can be extended.

Bilateral agreements of the RA on legal assistance and legal relations in civil, family and criminal cases when regulating the procedure for the execution of letters rogatory, provide for the notification of the institution from which the order originates, about the time and place of execution of the order, by the institution of justice to which the order is addressed.

But in practice, time passes before the requested side receives the request and the requesting side receives a response. Some more problems associated with the procedural terms of legal proceedings also affect the timing of the execution of letters rogatory of foreign states.

The CPC provides for procedural deadlines for the execution of individual investigative and judicial actions. The CPC does not use the term "reasonable time", but art. 48 CPC is dedicated to ensuring the promptness of prosecution proceedings and, accordingly, prosecution proceedings must be started and completed within the time frames stipulated by the CPC in such a way that the timely receipt and examination of evidence is ensured; the persons did not wait for an excessively long time to be charged, to consider the case and to restore the violated rights.

Violation of procedural terms, according to art. 10.5 CPC, the execution of procedural actions and the adoption of decisions, entails their recognition as invalid, unenforceable.

One of the ways out of the situation of violation of procedural deadlines is to extend them, the scope of which is determined by law. For example, the term of the preliminary investigation may be extended according to the complexity of the

criminal case by the corresponding higher prosecutor on the basis of a reasoned request from the investigator and the submission of the prosecutor in charge of the procedural direction of the preliminary investigation, etc.

When considering the issue of extending the period of preliminary investigation, a higher-ranking prosecutor must verify the legality and validity of the petitions and representations; evaluate the activities of the investigator and prosecutor.

By the Decree of the President of the RA dated January 19, 2006, № 352, the Supreme and Appellate Courts were recommended to organize the study of the case law of the European Court of Human Rights (hereinafter the ECHR) and take them into account in judicial practice. Therefore, Azerbaijani law enforcement practice should take into account the requirement of the European Convention for the Protection of Human Rights and Fundamental Freedoms (hereinafter the European Convention) and precedents related to the right to a trial within a reasonable time.

Despite the absence in the legislation of a special indication on a reasonable time frame for a trial, there are separate departmental acts regulating the application of a reasonable time frame in court proceedings. The Plenum of the Supreme Court of the RA dated March 30, 2006, № 5, clarified that when administering justice, courts must take into account the right to a fair and public hearing of a case within a reasonable time by an independent and impartial court established by law. The purpose of determining a reasonable time limit is to protect the parties in the civil proceedings, as well as the accused in the criminal proceedings, from undue delay, and to achieve the effectiveness of justice. When calculating these time limits in relation to criminal cases, the "reasonable time" covers both the time frame for the preliminary investigation and the time frame for the trial before sentencing. The "reasonable time" in each case should be determined depending on the nature, complexity of the particular case, the applicant's behavior in connection with the process.

The nature of a particular case is its qualitative indicator and "as you know, the nature of the social danger of a crime is determined by the object, the content of the damage, the form of guilt and such methods of action (inaction) as violence, deception, group, use of official position" [9, p.107].

The practice of the ECHR has determined the criteria for assessing the "reasonable time" for the consideration of the case. These include the complexity of the case; the behavior of the court and the parties to the case - the authority, the behavior of the applicant himself, the significance of the case for the applicant. ECHR in the case of Fedorov and Fedorova v. Russia dated October 13, 2005 indicated that "28. The Court reiterates that the reasonableness of the time frame for the consideration of the case must be assessed in the light of the circumstances of the case on the basis of the criteria established in the jurisprudence of the Eu-

ropean Court, in particular: the complexity of the case and the conduct of the applicant and the relevant state authorities [2].

In the judgment in Kormacheva v. Russia on 29 January 2004 "51. The Court reiterates that the unfoundedness of the lengthy proceedings must be assessed in the light of the circumstances of the case and the criteria established by the court's case-law, in particular, the complexity of the case, the conduct of the applicant and the relevant authorities, and what exactly was the subject of the applicant's dispute [8].

The ECtHR recalled that the "reasonableness" of the length of the proceedings must be assessed in the light of the circumstances of the case and with reference to the following criteria: the complexity of the case, the actions of the applicant and the relevant authorities, and the relevance of the subject matter to the applicant. For example, the judgment of the Grand Chamber of the ECHR in the case "Comingersoll S.A. v. Portugal" states that "19. The reasonableness of the time limit for the consideration of the claim is determined in the light of the circumstances of the case with reference to the criteria set out in the case-law of the European Court, in particular the complexity of the case, the behavior of the applicant and the relevant state authorities, as well as the importance of the dispute for the applicant [4].

When assessing the reasonableness of the duration of the trial, the ECHR proceeds from the criterion of compliance and sufficiency of the motives of the judicial authorities. The existence of compelling reasons to suspect the arrested person of committing a crime is a sine qua non condition for the lawfulness of the detention, but after a while this is no longer enough; the Court must then determine whether the rest of the judicial authorities' motives justify the deprivation of liberty. If these reasons are found to be "appropriate" and "sufficient", the Court will also take into account whether the national authorities exercised "due diligence" during the procedure. Therefore, the decisive factor in assessing the reasonableness of the proceedings is the behavior of the judicial authorities in this case [10].

The legislation of the RA contains requirements for ensuring the speed of criminal prosecution and the relevant departmental acts governing the application of a reasonable time in criminal prosecution, and these provisions also apply to the execution of letters rogatory from foreign states. And in some cases, special departmental acts are adopted, detailing a reasonable time frame for the execution of letters rogatory. For example, the order of the Attorney General of the RA dated 14.02.2007 № 10/13 provides for the execution of letters rogatory within 10 (ten) days. In exceptional cases, in connection with the execution of the request, in cases of the need for numerous and complex actions, this period can be extended by the corresponding Deputy Prosecutor General, taking into account the conclusion of the Department, up to one month.

When extending the term, the criminal procedural legislation of the RA uses the terms "complexity" and "special complexity" of a criminal case. The legislator does not disclose the essence of these concepts. In practice, the ECHR developed criteria for the complexity of the case - the presence of public (public) interest, the presence of serious grounds to suspect the arrested person of committing an offense; an unexpected and unforeseen increase in the volume of the case materials, the number of investigated episodes, the conduct of complex examinations, the summoning and interrogation of a large number of witnesses, and some other circumstances.

The practice proceeds from the fact that it is not possible to give a closed list of criteria for determining the "complexity" and "special complexity" of the case. The criteria depend on the corpus delicti and the circumstances of the criminal case.

The criminal legislation defines the criteria for classifying crimes into crimes that do not pose a great public danger, less serious crimes, serious crimes and especially serious crimes. Sometimes one can agree with the equating of complex criminal cases and serious crimes, for which an extended period of consideration is determined. But, proceeding from the practice and the number and volume of procedural actions in the case of grave crimes and in the case of less grave crimes, etc., we consider this equalization to be incorrect. But, we believe that it would be appropriate, at the level of the Supreme Court, in whose authority, according to Art. The Law "On Courts and Judges" of June 10, 1997 № 310-IG is included "in accordance with Article 131 of the Constitution of the RA, gives explanations to the courts on issues of judicial practice" giving explanations to the courts on the complexity and special complexity of the case.

One of the criteria for assessing the "reasonable time" for the consideration of the case is the behavior of the court and the parties to the case - the authority, the behavior of the applicant himself. We agree with K.V. Volynets is that "...it is necessary to take into account not only the behavior of the applicants (who in criminal proceedings are most often the accused), but also of other persons involved in criminal proceedings, since often the process of considering a case is delayed due to the dishonesty of other participants - victims, witnesses, defenders and even public prosecutors"[1, p.183].

V.M. Polukhin identifies subjective and objective criteria for assessing the reasonableness of the term. Objective criteria for assessing the reasonableness of the term of criminal proceedings include the legal and actual complexity of the criminal case, the sufficiency and effectiveness of the actions of the court; the total duration of the criminal proceedings. Further, he proposes to reveal the essential features of the "legal and factual complexity of a criminal case" [16].

According to Ryabtseva E.V. the principle of the reasonableness of the crimi-

nal process lies in the need for subjects to be within the boundaries excluding the possibility of abuse of subjective rights, and to correlate their actions with the goals of criminal law models of behavior of participants, the rights, freedoms and legitimate interests of others, as well as society and the state [12].

Urban V.V. argued by the fact that the content of the principle of a reasonable time frame for criminal proceedings is made up of two interrelated elements: the requirement to carry out criminal proceedings within a reasonable time, which is implemented both in the legislative setting of time limits in criminal proceedings, and by the law enforcement officer in the course of his procedural activities, and legal proceedings within a reasonable time, the guarantees for the implementation of which is a combination of preventive, compensatory and other remedies [21, p.23].

A reasonable time period includes the period from the moment the criminal prosecution starts until the moment it is terminated or a conviction is issued, taking into account such circumstances as the legal and actual complexity of the criminal case, the behavior of the participants in the criminal proceedings, the sufficiency and effectiveness of the actions of the court, the prosecutor, the head of the investigative body, investigator, head of the inquest unit, body of inquiry, inquirer, carried out for the purpose of timely implementation of criminal prosecution or consideration of a criminal case, and the total duration of criminal proceedings. In the Court's opinion, a "reasonable time" in criminal matters is calculated from the moment when "charges are brought". This can happen before the case is referred to a court, for example, from the date of detention, from the date on which the person in question was officially notified that criminal prosecution would be carried out against him, or from the date of the commencement of the preliminary investigation and, finally, the total duration. trial in the case and non-execution of a judicial act.

Thus, we are also talking about a reasonable period of criminal prosecution, including the stages of initiating a criminal case, carrying out a preliminary investigation, considering a criminal case on appeal, when the court can make a completely new decision against a person, including completely exempting from criminal prosecution.

The function of a prosecutor arises from the need to protect the constitutional rights of a person and citizen, to carry out criminal prosecution and to supervise the legality of decisions taken by the preliminary investigation bodies.

We agree with V.A. Sementsov, A.P. Sheremetyev. in the fact that "The calculation of a reasonable period of criminal proceedings should begin with the detection of signs of a crime and end with the termination of criminal prosecution or entry into force" [18, p. 174].

Art. 48. The CPC ensures the promptness of the criminal prosecution in such

a way that the criminal prosecution must be initiated and completed by an inquiry officer, investigator, prosecutor or court within the time limits provided for by this Code. The law requires that any criminal case from the moment of initiation must be sent to the court along with the indictment within the time frame, or the criminal prosecution must be terminated. Ensuring the speed of proceedings under the Azerbaijani legislation covers the pre-trial process and the trial of the case. The stipulated CPC provision encourages the investigator, investigator and judge to complete the process within the stipulated time frame and guarantees the right of the accused, the victim, to a reasonable time for the proceedings. But, on account of the violation of ensuring the speed of criminal proceedings, article 48.4 of the CPC directly defines only cases of keeping a person under arrest during pre-trial proceedings over a period of time, for which he has the right to receive monetary compensation for moral damage suffered. The issue of compensation is resolved regardless of the decision adopted in the case, in the manner of civil proceedings. From the analysis of article 48 CPC it appears that the law leaves other cases of violation of ensuring the speed of proceedings in the criminal prosecution out of the spotlight.

One of the criteria for non-violation of the CPC's provision on ensuring the speed of criminal proceedings is the indication of article 146.3 of the CPC that the collection of evidence in its entirety should not lead to an extension (delay) of the preliminary investigation or trial.

Ensuring the promptness of criminal proceedings does not apply to the principles or conditions of criminal proceedings provided for in Chapter II of the CPC, and therefore the requirement of article 9.2 of the CPC that violation of the principles or conditions of criminal proceedings in the cases established by this Code may lead to the invalidity of the completed Proceedings on criminal prosecution, to the cancellation of decisions taken in its course, or to the conclusion about the lack of probative value of the collected materials, does not apply to it. There is another requirement of the CPC in article 125.2, according to which it is unacceptable to accept as evidence in a criminal case information, documents and things obtained with the deprivation or restriction of participants in criminal proceedings of their legally guaranteed rights in violation of constitutional human and civil rights and freedoms or other requirements of this Code that should or may affect the validity of this evidence. The law, in connection with the violation of speed, connects the inadmissibility of accepting in the form of evidence in a criminal case information, documents and things obtained in violation of ensuring the speed of production, with the influence and the possibility of influence of these violations on the validity of evidence. If violations related to the speed of criminal proceedings cannot affect the reality, they are allowed. Another problem is the validity of the evidence. The CPC does not define criteria for the validity of evidence. Ac-

cording to art. 145 CPC each piece of evidence should be assessed according to its belonging, feasibility, reliability. And all the evidence collected in the criminal prosecution, in their totality, must be assessed to resolve the prosecution on the basis of their sufficiency. Here, the law also does not require an assessment of reality.

The new philosophical encyclopedia defines reality as an objective reality, as an actually existing being that realizes certain historical possibilities; the concept is also used in the sense of true being, in contrast to appearance. In philosophy of the 16-18 centuries reality is interpreted as a set of material bodies that exist objectively in space and time and are clearly given in perception [13].

Based on the above concept, the validity of evidence can be defined as existing objectively in space and time and visually data in perception. According to art. 125.1 CPC validity acts as a criterion for the admissibility of evidence. Here we are talking about no doubt about the validity of the evidence. According to this article, other criteria for the admissibility of evidence are the absence of doubt about the source of education and the circumstances of obtaining evidence.

Let's return to the violations related to the speed of criminal proceedings, which cannot affect the reality. Based on the above concepts of reality, we mean violations that exist objectively in space and time and visually data in perception.

Azerbaijani legislation does not provide for the right of the accused, the victim and other participants in the criminal process to apply to the prosecutor in charge of the procedural investigation and the chairman of the court and other instances in case of violation of the promptness of the criminal prosecution.

International acts and national laws of some states allow the use of a hearing in the mode of videoconferencing only for receiving interrogations and mainly for obtaining testimony. We believe that for the speed of execution of letters rogatory, the use of videoconference in a face-to-face confrontation between a witness, a victim, a suspect and an accused, both among themselves and in any combination of them, is a promising area of legal assistance between states between all possible and requires its legislative decision at the level national legislations.

Conclusion

Summarizing the results of the research, we come to the conclusion that in order to accelerate the execution of letters rogatory in the order of legal assistance between states in criminal cases, which are mainly regulated by the domestic legislation of the requesting country, a legislative solution is required for the issue of execution of letters rogatory in a short time. Legal aid between the member states of the Council of Europe requires both the application of the criterion of reasonableness in criminal proceedings and to letters rogatory in criminal matters. We believe that in order to apply common concepts, to simplify mutual understanding in the provision of legal assistance between states in the context of the integration of legal systems and legal systems of states, including, it would be advisable to re-

name article 48 of the CPC to "Reasonable time frame for criminal proceedings", which will provide for criteria for a reasonable period of proceedings, based on the precedent law of the European Court of Human Rights, and the right of participants in criminal proceedings to appeal in case of violation of the provision of speed at the pre-trial stage and at the stage of the trial. A reasonable time frame for criminal proceedings is one of the guarantees of the effectiveness of legal proceedings, the violation of which also entails a violation of such a fundamental right as the right to a fair trial. We believe that in order to further improve legal assistance between states in criminal matters, it is necessary to provide in bilateral treaties on legal assistance between states and special provisions related to specific deadlines for the execution of letters rogatory or direct appeal to domestic authorities carrying out letters rogatory from foreign judicial authorities, with the obligatory preservation of the supervision of the domestic central authority or the use of video conferencing during admission and confrontation.

References

1. Volynets K.V. Some problems in the legal regulation of the principle of "reasonable term of criminal proceedings" // Bulletin of the Udmurt University. Economics and Law. 2013. Iss. 1, P.181-187.

2. Law of the Republic of Azerbaijan "On Legal Assistance in Criminal Cases" dated June 29, 2001, № 163-IIQ // http://www.zewo.ru/laws/163-iiq.html (access date 19.07.2014).

3. Law of the Republic of Azerbaijan "On Courts and Judges" dated June 10, 1997 №310-IQ// http://www.zewo.ru/laws/0310-1q.html (access date 19.07.2014).

4. "Comingersoll S.A."against Portugal" (Comingersoll S.A. v. Portugal), complaint N 35382/97, § 19, ECHR 2000-IV)// http://www.lawmix.ru/abrolaw/8311 (access date 19.07.2014).

5. Constitution of the Republic of Azerbaijan / Official site of the President of the Republic of Azerbaijan// http://ru.president.az/azerbaijan/constitution (access date 19.07.2014).

6. Convention for the Protection of Human Rights and Fundamental Freedoms // Official website of the Council of Europe // conventions.coe.int/treaty/rus/treaties/html/005.htm (access date 19.07.2014).

7. Convention on Legal Assistance and Legal Relations in Civil, Family and Criminal Matters. Chisinau, October 7, 2002 // Official site of the CIS Executive Committee // http://www.cis.minsk.by/page.php?id=614 (access date 19.07.2014).

8. Kormacheva v. Russia (Application № 53084/99) //europeancourt.ru/.../ECHR_Kormacheva_v_Russia_29_01_2004.doc (access date 19.07.2014).

9. Kuznetsova N.F. Problems of qualification of crimes: Lectures on the special course "Fundamentals of qualification of crimes" / Sci. ed. and foreword. Academician V.N. Kudryavtsev. - M.: Publishing House "Gorodets", 2007. - 336 P.

10. Letellier v. France Judgment of June 26, 1991 http://www.echr.ru/documents/doc/2461412/2461412.htm (access date 19.07.2014).

11. International Covenant on Civil and Political Rights // Official site of the United Nations// www.un.org/ru/documents/decl_conv/conventions/pactpol.shtm (access date 19.07.2014).

12. Ryabtseva E.V. Implementation of the principle of rationality in the criminal process of Russia. International Association for the Promotion of Justice Criminal Justice: Link of Times "Reports and messages at the conference" Criminal Justice: Link of Times " // http://www.iuaj.net/node/463 (access date 19.07.2014).

13. New philosophical encyclopedia Internet version of the publication: in 4 volumes > / Institute of Philosophy RAS; Nat. soc.-sci. fund; Repr. sci.-ed. council of V.S. Stepin. -M.: Thought, 2000. - V. 1-4. - 2659 P.; 2nd ed., rev. and add. - M.: Thought, 2010.- V. 1-4. - 2816 P.// http://iph.ras.ru/elib/3641.html (access date 19.07.2014).

14. Plenum of the Supreme Court of the Republic of Azerbaijan dated March 30, 2006, № 5 "On the application of the provisions of the European Convention" On the Protection of Human Rights and Fundamental Freedoms "and the case law of the European Court of Human Rights in the administration of justice" (in Azerbaijani) / Official website of the Supreme Court The Republic of Azerbaijan // http://www.supremecourt.gov.az/?mod=2&cat=3016&c=7&lang=az (access date 19.07.2014).

15. Order of the Prosecutor General of the Republic of Azerbaijan dated February 14, 2007 № 10/13 "On the tasks of prosecutorial bodies in connection with the implementation of issues specified in international treaties signed by the Republic of Azerbaijan and strengthening the effectiveness of international cooperation" / Official website of the General Prosecutor's Office of the Republic of Azerbaijan// http://www.genprosecutor.gov.az/?/az/content/79/ (access date 19.07.2014).

16. Polukhin V.M. Realization of a reasonable time in criminal proceedings as a failed problem of strengthening the Russian state property // Journal of Science and Education: Economy and Economy; entrepreneurship; law and administration, 2012, April. http://www.journal-nio.com/index.php?option=com_content&view=article&id=1194&Itemid=105 (access date 19.07.2014).

17. Collection of bilateral international treaties of the Republic of Azerbaijan in the field of legal assistance, 2014 (in Azerbaijani) (Electronic resource)/Official website of the Ministry of Justice of the Republic of Azerbaijan// www.justice.gov.az/images/toplu-2014.pdf (access date 19.07.2014).

18. Sementsov V.A., Sheremetyev A.P. The beginning and end of a reasonable time in criminal proceedings // Society and Law, 2010 № 5 (32), P.172-17.4

19. Criminal Procedural Code of the Republic of Azerbaijan // Official site UNODC//https://www.unodc.org/tldb/pdf/Azerbaijan_Code_of_Criminal_Procedure_in_Russian_Full_text.pdf (access date 19.07.2014).

20. Criminal Procedural Code of the Russian Federation //http://www.consultant.ru/popular/upkrf/11_2.html#p240 (access date 19.07.2014).

21. Urban V.V. Implementation of the principle of a reasonable time frame for criminal proceedings. Abstract of dissertation for the degree of candidate of legal sciences. M., Academy of Management of the Ministry of Internal Affairs of Russia, 2013. 23 P.

22. Fedorov and Fedorova v. Russia (Complaint N 31008/02) [Electronic resource]:// europeancourt.ru/.../ECHR_Fedorov_and_Fedorova_v_Russia_13_10_2... (access date 19.07.2014)

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CRIMINOLOGICAL CHARACTERISTICS OF CRIMINALS IN THE FIELD OF FAMILY AND DOMESTIC RELATIONS

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Abstract. *This article clarifies the criminological characteristics of criminals in the field of family and domestic relations. The study is based on the study of materials from 441 criminal cases initiated on the territory of the Moscow region, a survey of convicts on the basis of these crimes in the period 2018-2020. The study was carried out in two classifications. The first classification is based on the totality of relations that make up the family and domestic sphere, the second classification is based on the study of the types of the offender in accordance with the specifics of the criminal act. The author proves that a differentiated approach is needed for the objectivity of criminological research.*

Keywords: *crimes in the field of family and domestic relations, identity of the offender, motives of family-domestic crimes, family-domestic conflict.*

Introduction

Crimes in the family and domestic sphere occupy a significant place in the total mass of crime. However, in the Criminal Code of the Russian Federation, they are not separated into a separate category. As a rule, crimes in the family and everyday life in the Criminal Code of the Russian Federation are considered in the general structure of crimes in the sections devoted to crimes against the person, as well as against public safety and public order (sections 7 and 9). It is obvious that a wide range of types of criminal acts committed on family and domestic grounds does not allow them to be considered at the legislative level as a separate type. The choice of any form of violence as the predominant way of resolving interpersonal conflict in the family testifies to persistent tendencies of degradation of the institution of the family as the basis of human life, devaluation of values and moral degeneration.

Purpose of the study – to establish the criminological characteristics of criminals in the field of family and domestic relations. The study of the personality of a family and domestic criminal is the basis of a system of preventive measures.

Materials and methods

The article examines as key indicators that allow a comprehensive study of the personality of a family and domestic offender: gender, age, level of education, social status, psychophysiological indicators such as alcoholism or drug addiction, convictions, motive of the crime and the specifics of the conflict that provoked the crime. With regard to crimes in the field of family and domestic relations, the study of the specifics of the personality of a typical criminal can be carried out within the framework of two classifications. The first classification assumes, as the main feature, to consider the totality of relations that make up the family and everyday life. These relationships are classified as follows: family and domestic (relations between relatives), communal and domestic (relations between neighbors), leisure and domestic (relations between friends and acquaintances), production and domestic (relations between colleagues, colleagues). The second classification is based on the study of personality types of the offender in accordance with the specifics of the criminal act. In this study, the second classification is presented by the study of the personalities of criminals who committed intentional attacks on life (Articles 105, 106, 107, 108, 109, 110.1 of the Criminal Code of the Russian Federation), health (Articles 111, 112, 113, 114, 115, 116, 117 , 118, 119, 125 of the Criminal Code of the Russian Federation), sexual inviolability and sexual freedom (Articles 131, 132, 133, 134, 135 of the Criminal Code of the Russian Federation), human property (Articles 158, 159, 161, 162, 163, 164, 165, 166, 167 of the Criminal Code of the Russian Federation).

The study was based on the study of materials from 441 criminal cases initiated in the Moscow region, a survey of those convicted of these crimes in the period 2018-2020.

Results and discussion

Within the framework of the first classification, it was possible to establish that in the array of crimes in the sphere of family and domestic relations, criminal acts in the leisure and domestic sphere dominate (35.4%), then in the family and domestic (29.0%), communal and domestic (24.5%) and production and domestic (11.1%) spheres. The generalized portrait of a person who has committed a crime in the leisure and domestic sphere is as follows: this is a man (in 79.5% of cases) 18-29 years old (55.1%), less often 30-49 years old (21.8%), with a predominant main general level of education (34.6%), in most cases without a permanent source of income (48.7%). A crime, as a rule, is committed in a state of alcoholic (73.1%) or narcotic (25.0%) intoxication. Less than half of the respondents (45.5%) have a criminal record. The most widespread crimes committed by criminals in the leisure and domestic life are crimes against health (64.7%), against sexual inviolability and sexual freedom (17.3%), against life (10.3%). The main motives for crimes are motives of self-affirmation (30.1%), hostility (17.9%) and hostility (16.0%).

The provoking factors are conflict, aggressive behavior of a criminal (36.5%), an immoral lifestyle (34.6%), an acute, sudden conflict (25.0%).

The offender in the family and domestic sphere is a man (61.7%), but the share of women is also high in this group - 38.3%. In general, as noted by A N Varygin, D Yu Yakovlev [7], N A Grishko [3], in the family and domestic sphere, the share of female criminals is much higher than in the general structure of crime in general and violent crime. particular. The age of a family offender is most often 30-49 years (53.9%). The main general education dominates (37.5%). Most often a criminal is either a worker (32.0%) or without a permanent source of income (26.6%). The majority of criminals were in a state of alcoholic (71.1%) or narcotic (23.4%) intoxication at the time of the crime. More than half of the criminals (51.6%) had a criminal record. The most common crimes are crimes against health (75.8%), against property (11.7%), against life (10.9%). The motives for committing crimes against relatives are jealousy (39.1%), a desire to assert themselves (30.5%), and also to preserve relationships (22.7%). The provoking factors of crimes against relatives are long-term conflict (41.4%) and hostile behavior of the aggressor (21.9%).

A communal and domestic offender is a man (82.4%) aged 30-49 (70.4%). According to the indicator "education" for this category of criminals, the dominant level is not distinguished. The same situation is observed in terms of the "social status" indicator, with the exception of students who are not represented in this category (0.9%). Most of the domestic crimes were committed by persons who were not intoxicated with alcohol or drugs (75.9%). Most of the criminals had no criminal record (88.9%). A communal and domestic criminal most often encroaches on the health of citizens (76.9%), property (12.0%), life (11.1%). There were no crimes against sexual inviolability and sexual freedom among communal crimes. The motives of communal and domestic crime are most often hostility (21.3%), hostility (18.5%), revenge (15.7%), hatred (12.0%). A communal and domestic crime in most cases was caused by a long-term conflict (45.4%), aggressive behavior of a criminal (25.9%).

A criminal in the production and domestic sphere is a man (89.8%) aged 30-49 (75.5%), who, as a rule, has a secondary vocational education (73.5%). Persons from this category are in most cases workers (87.8%). Alcohol or drug intoxication, as well as a criminal record, are not typical for industrial and domestic crime. Industrial and domestic crimes are most often crimes against human health (75.5%), his property (14.3%), rarely life (10.2%). The motives of industrial and domestic crimes are hostility (36.7%) and self-interest (30.6%). The conditions for the formation of criminal intent are aggressive behavior (51.0%), long-term conflict (38.8%).

Within the framework of the second classification, in the course of an empiri-

cal study, it was found that, from the criminal-legal point of view, crimes against human health (72.1%), his life (10.7%) and property (10.7%) dominate in the structure of domestic crime. %), as well as sexual inviolability and sexual freedom (6.6%). Among the murderers, men predominate (61.7%), but the proportion of women is the highest (38.3%). This conclusion is consistent with the data obtained as a result of the dissertation research of P A Fedorov & V S Kharlamov [2, p. 120]. The dominant age of the offender is 30-49 years (68.1%). In terms of education, there are no peaks among family killers. Approximately the same picture is observed when using the indicator "social status". About half of the murders were committed by persons under the influence of alcohol (51.1%) or drugs (19.1%). Most of the murderers had no criminal record (74.5%). The most common motives for murders in the family and everyday life are self-affirmation (31.9%), jealousy (25.5%), an attempt to maintain the old relationship (23.4%). The killer is formed as a result of a state of prolonged conflict (51.5%), also provokes the individual to kill the victim, a sudden stressful situation, an acute conflict (36.2%).

A person who has committed a crime against the health of another person is usually a man (79.9%), although the proportion of women in this category is still high (20.1%). The age of a typical criminal is 30-49 years (43.7%) or 18-29 years (39.3%). This category of criminals most often has secondary vocational education (32.7%) or basic general education (31.8%). The share of criminals with incomplete basic general education is also high (23.0%). In terms of social status, criminals in this category are most often workers (29.9%) or without regular income (28.6%). More than half of these crimes were committed by convicts in a state of alcoholic (54.7%) or narcotic (17.0%) intoxication. Previous convictions were recorded for 39.6% of criminals. The motives of criminals-aggressors in the family and everyday life are hostility (18.6%), self-affirmation (17.0%), hostility (16%), revenge (13.8%) and jealousy (13.8%). The determinants of violent crimes in the family and everyday life are aggressive, hostile behavior of the offender (36.5%) and long-term conflicts with the victim (31.8%).

Only men aged 30-49 years old (62.1%) were rapists in the sample. In terms of education, criminals with secondary vocational education (41.4%) or only basic general education (37.9%) predominate. According to the indicator "social status", 3 dominant categories of citizens were identified: without a permanent income (37.9%), workers (27.6%), students (20.7%). Almost half of sexual crimes were committed while intoxicated (48.3%), a fifth - drug intoxication (17.2%). Most of the rapists had no criminal record (89.7%). The motives for rape in the family and everyday life are exclusively motives for self-affirmation (96.6%). In most cases, this crime is the result of the abuser's immoral lifestyle (58.6%).

Criminals who have committed criminal offenses against property are both men (51.1%) and women (48.9%). The age of such a criminal in most cases is 30-

49 years (57.4%), less often - 18-29 years (25.5%). The education of such a criminal is either the level of basic general education (40.4%) or the level of secondary vocational education (38.3%). More than half of all criminals in this category are persons with a variable source of income (57.4%) or workers (23.4%). Most of the criminals were in a sober state at the time of the crime (46.8%), 38.3% were under the influence of alcohol, 14.9% were under the influence of drugs. Most of the criminals had no criminal record at the time of the crime (70.2%). The motives of criminals in this category are exclusively self-interest (96.4%). As a rule, crimes against property in the family and everyday life are the result of the criminal's immoral lifestyle (48.9%).

In the context of the investigated problematics, the specific characteristics of the personality of the family and domestic criminal from the substantive point of view is the motivation of the crime, from the procedural point of view - the nature of the conflict that caused the commission of the crime. The last thesis reflects the specifics of domestic crime in comparison with the determinants of most crimes (K A Myasnikova [5], P A Fedorov, B C Kharlamov [2]).

In its most generalized form, the motives of crimes in the sphere of family and domestic relations are interpreted as the need of the offender to end or change the relationship with the victim by causing him harm. In scientific sources, there are two approaches to determining the specific motives of domestic crimes. The criminal-legal approach appeals to the motives that determine specific types of crimes: selfish, selfish-violent, violent [6].

However, it should be noted that this approach is too straightforward when studying the motives of a limited range of crimes. A more promising psychological approach, according to which the motives of family and domestic crimes are considered hostility, revenge, hatred, hostility, jealousy, self-affirmation, maintaining relationships, self-interest, defensive motives [1, 4]. The specificity of the conflict that provokes an individual to a family and domestic crime is quite fully considered in the work of K A Myasnikova. The author identifies a long-term conflict, conflict behavior of a criminal, an immoral lifestyle of a criminal, an acute conflict resulting from a stressful state of a criminal as the types of family and domestic conflicts [5].

Conclusion

As can be seen from the analysis of the personality of the family and domestic criminal, for the objectivity of criminological research, a differentiated approach is needed to identify significant correlations. In general, the following signs have a statistically significant value. First, despite the fact that men dominate in the array of family and domestic crime (76.2%), the proportion of women, compared with a similar correlation in the context of general crime, is quite high (23.8%). The most frequent age of family and domestic offenders is 30-49 years (49.0%). The study

of the level of education and the specifics of the employment of convicts makes it possible to draw a conclusion about the low social status of the offender. There is a high probability of his alcoholism or drug addiction at least at the time of the crime (69.2%). As a rule, the dominant motives are self-affirmation, hostility, jealousy, hostility. A provoking factor in the commission of a domestic crime is a long-term conflict with the victim, as well as the aggressive, hostile behavior of the offender.

References

1. Dolgovaya A I (2018) The identity of the criminal and its criminological study / edited by the professor. Moscow: Russian Criminological Assoc., 195 p.

2. Fedorov P A, Kharlamov B S (2011) Criminological analysis of crimes in the household sphere at the present stage // Bulletin of the St. Petersburg University of the Ministry of Internal Affairs of Russia, 3 (51), 118-123.

3. Grishko N A (2020) Criminal violence committed by women in the family and household sphere. Moscow: Jurlitinform, 139 p.

4. Ilyashenko A N (2002) Motives of violent crimes committed in the sphere of family relations // Russian investigator, 12, 20-23.

5. Myasnikova K A (2012) Motives of criminal violence in everyday life // Philosophy of law, 2 (51), 128-132.

6. Starkov O V (2005) Crime prevention. Moscow: Yurist, 283 p.

7. Varygin A N, Yakovlev D Yu (2017) Crimes against life committed by women: criminological characteristics, motivation and prevention. Moscow: Jurlitinform, 154 p.

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THE INFLUENCE OF THE DEVELOPMENT OF COORDINATION ON THE SOCIAL ADAPTATION OF CHILDREN WITH HEARING IMPAIRMENTS

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Abstract. *This article deals with the social adaptation of children with hearing impairments. We propose a solution to the problem of social adaptation of hearing-impaired children through the development of their coordination.*

We carried out a pedagogical experiment on the development of coordination abilities in hearing-impaired boys, and analyzed the influence of the development of coordination abilities on social adaptation.

Keywords: *children with hearing impairments; coordination abilities; methodology; physical development; social adaptation.*

Introduction

The self-fulfillment and the development of a child directly depend on the level of his/her socialization. Socialization is defined as a process during which the social norms transmitted by society are assimilated and then retransmitted by a person throughout his or her life.

Socialization also provides an individual with the qualities, behavioral patterns, and values necessary to live in society. This process is two-way: society transfers the rules and norms of interpersonal communication, social behavior in certain social roles, and a person should take an active part in assimilating this information. If one of the parties does not fulfill its function for any reason, the process will be disrupted [2, p. 68].

Hearing loss and deafness are physical problems affecting socialization. Vy-

gotsky called these "social slips" since a physical disability provokes a social disability [9, p. 83].

The main task of teachers working with children with hearing impairments is to do their utmost so that such a child does not feel "defective" or "not like everyone else." Modern society can help treat blindness, deafness, and dementia both with the help of progressive medical technologies and social education [1, p. 47].

In Russia, hearing-impaired and deaf people are defined as a special segment of the population requiring individually organized work and educational conditions, education in special institutions, or within a framework of inclusion. Consequently, the socialization of such children lies in uniting them with society so that they can successfully acquire social norms and values.

Socialization is a set of many conditions, but one of the most important is preparation for an independent life as a full member of society. This is possible with the normalization of relations in the child's family, and pedagogical interaction with teachers. We should not ignore the fact that the development of the cognitive activity and personality of such children generally differs from the development of healthy children. Deaf and impaired-hearing people have psychological peculiarities of perception and response, which need to be taken into account when arranging education, interaction, and social integration [3, p. 10; 6, p. 152].

Sports and physical education affect the formation of the child's personality. Sports and physical exercise are social situations. These help to develop life experience and build a system of social guidelines and attitudes.

Culture can be developed only if a person makes cultural achievements and develops him- or herself as a social being, analyzing and improving the previous culture. If this process is reduced to a spiritual or purely moral component, and all aspects and possibilities of physical culture and sports, physical development, and education are ignored and neglected, the process itself will be impoverished and disrupted.

Hearing impairment is accompanied by the following physical development disorders [7, p. 17]:

– the impairment of physical cognitive processes (speech, attention, thinking, imagination, and memory),

– disfunction of the vestibular system,

– delayed mental and motor development,

– postural disorders and uneven physical development,

– disfunction of internal organs,

– respiratory diseases,

– the impairment of balance, coordination, spatial and temporal orientation, precision in movements, etc.

It has been proven that hearing children are 1–3 years ahead of non-hearing

children in their psychophysical development.

Regular physical education of children with hearing impairments allows them to develop thinking, attention, memory, space mental capacity, improve posture, etc.

These shifts in the development of the child also affect the level of his or her socialization, significantly improving it compared to those who are not engaged in physical activity [5, p. 180].

Hearing impairment is a big obstacle for cognition and the exploration of the environment, and can also lead to intercurrent diseases. Significant differences between normally hearing children and children with hearing impairment are physical inactivity and asthenia. Children's physical development is slower in growth, in the development of the chest circumference, in body weight, and muscle weakness.

Developmental pediatricians have not ignored the motional sphere of deaf and impaired-hearing children. There are numerous studies in this field allowing us combine educational activities and physical education. During clinical studies of deaf and hearing-impaired schoolchildren, certain features of their physical development, health in general, and the state of the vestibular and visual apparatus were identified. The dependence of their state on sports or physical exercise was also noticed [8, p. 6].

Pedagogical observations and biomedical studies have revealed several motional activity disorders in deaf schoolchildren [10, p. 107]:

– low development of vital abilities (strength, speed-strength, endurance, etc.),
– poorly developed spatial orientation,
– poorly maintained dynamic and static balance,
– tentative movements, lack of coordination,
– the slow formation of motor skills,
– deficiencies in fine motor skills and in the spatiotemporal characteristics of movement,
– reflexes and movement initiation and continuation were slow.

All these disorders in the motor sphere of deaf children are interconnected, because they have common causes, for example, insufficiently developed speech functions, the general nature of the hearing defect, the reduced volume of information from the outside world, and the state of the motor analyzer.

Physical exercises selected and designed for the development of the vestibular apparatus improve the stability of the vestibular system to various influences and irritators.

Studies confirm the mutual influence of motor and sound analyzers; with a long absence (or degradation) of auditory information, there is a significant de-

terioration in the perception of space and the coordination of movements. The reason that the lack of auditory information is accompanied by a slowdown in the perception of space is that hearing plays an important role in the processing and analysis of incoming information on movements (duration, speed, etc.) [4, p. 39].

As a deaf or hearing-impaired child grows older, spatial orientation improves because the motor analyzer takes over some of the spatial orientation functions, which helps to compensate for the insufficiently developed vestibular system.

Children with severe hearing impairments have specific coordination disabilities. They are manifested in the reduced ability to feel rhythm and to maintain balance, reduced spatial awareness, a reduced ability to separate the parameters and trajectories of movement, and reduced vestibular stability. These abilities are formed over a long period and with difficultly compared to children without hearing impairments.

Modern society faces problems in the education, training, socialization, and development of children with hearing impairments. These can be alleviated with the application of physical education so that the socialization of such children occurs in the same way as that of their healthy peers. It is in our hands to change “children with limited health capacities” into children with increased needs.

Purpose of the research: to prove the connection between the development of coordination abilities of children with hearing impairments and the improvement of socialization and adaptation.

Research hypothesis: the purposeful development of coordination abilities in children with hearing impairments will have a positive effect on social adaptation.

Research organization and methodology

We carried out a pedagogical experiment to determine the influence of the development of coordination on the socialization of children with hearing impairments. The study involved 44 7–9 y.o. boys with hearing impairments. Two homogeneous groups were formed balanced for the level of their coordination, hearing impairment, and social adaptation. The study was based on a methodology for investigating the degree of socialization of the children’s personality developed by Rozhkov.

The pedagogical experiment lasted for six months. Coordination was tested according to four indicators, using pre- and post-tests. The test results were processed by the mathematical statistics methods.

The experimental methodology of the development of coordination abilities included two-hour gymnastics classes three times a week:

1. Exercises on gymnastic apparatus: floor exercises; pommel horse; rings; parallel bars; crossbar.

2. Exercises to develop flexibility: epee; gymnastic bridge; leg swings to the sides; arm twists with a broom handle.

3. Exercises to maintain balance: maintaining balance on a gymnastic balance beam; “horizontal position on one leg” balance; hand balance.

4. Dynamic exercises while maintaining balance: swings on parallel bars; swings on the horizontal bar and rotations; swings on the rings; leg swings with hand support.

The exercises were selected taking into account the boys’ physical fitness. This includes the selection and use of exercises according to the technical complexity and the degree of load corresponding to the development level of the trainees’ motor abilities, as well as supervision and assistance in performing technically complex exercises on the gymnastics equipment.

Research results

After the experiment, the level of coordination in the experimental group became higher than that of the subjects of the control group. The results in all four tests characterizing coordination abilities in the children of the experimental group improved:

- In the dynamic balance test “walking on a gymnastic beam”, the experimental group improved by 17%; the result of the control group remained at the same level.
- In the test “three forward rolls”, the experimental group improved by 10%; the result of the control group remained at the same level.
- In the accuracy test “goal ball” the experimental group improved by 11.5%; the result of the control group remained at the same level.
- In the accuracy test “3x10 shuttle run” the experimental group improved by 12.5%; the result of the control group remained at the same level.

The results show that the level of coordination abilities in the subjects of the experimental group became higher than in the subjects of the control group for all of the tests.

We then tested the level of social adaptation of hearing-impaired boys before and after the experiment. After the coordination experiment, the level of social adaptation in the experimental group improved as compared to the subjects of the control group. Before the experiment, there was an approximately equal level of social adaptation in both groups (1.9 points in the control group and 2.0 points in the experimental group). These data indicate the low level of the children’s social adaptation. After the coordination experiment, the social adaptation of the control group remained almost at the same level (2.0 points), while in the subjects of the experimental group, the result was 2.8 points. A level higher than two points is interpreted as a normal (but not high) level of social adaptation for children.

Teachers working with the children from both groups also noted that the children of the experimental group became more confident and sociable.

Findings

We found a relationship between the indicators of coordination and socializa-

tion of children with hearing impairments. Due to the development of coordination abilities with gymnastics exercises, social adaptation improved in the experimental group with hearing impairments as compared to the control group.

Conclusion

Physical education and sports have a positive effect on the socialization of children, which is connected with the specifics of communication and the relationships between people during sports and physical exercise. Classes aimed at the development of coordination help to improve the motor sphere of children with hearing impairments and increase their movement precision. The development of coordination also improves the smoothness of movement.

This experimental study indicates a significant influence of the development of coordination on the socialization of children with hearing impairments. Children who showed a higher level of motor coordination had better social relations with their peers and felt more confident. This proves our assumption that the development of coordination abilities has a positive effect on the social adaptation of children with hearing impairments.

References

1. Alkhuri N.M. Professional orientation of students with hearing impairment / N.M. Alkhuri // Science, Education and Culture. - 2018. - # 2 (26). - pp. 47-51.

2. Akhmetzyanova A.I., Modeling the prognostic competence as a resource of socialization of an elementary schoolchild with developmental deficits / A.I. Akhmetzyanova, T.V. Artemieva // Psychology. Psychophysiology. - 2018. - # 1. - pp. 68-74.

3. Beketova E.S. Ways of forming communication skills in children with hearing impairments / E.S. Beketova // Proceedings of the All-Russian Scientific-Practical Conference “Science and Society”. - 2017. - # 4. - pp. 10-13.

4. Burov K.S., A model of socializing students with hearing impairments in the conditions of an educational organization / K.S. Burov, N.I. Burova // Bulletin of South Ural State Pedagogical University. - 2018. - # 6. - pp. 39-52.

5. Voronov N.A. The influence of sports activities on the formation of personality / N.A. Voronov // Epokha nauki (The Epoch of Science). - 2018. - # 15. - pp. 180-182.

6. Gelogaeva Z. Kh., Features of the emotional sphere of children with hearing impairments / Z. Kh. Gelogaeva., A.B Akhmedov // Skif. - 2019. - # 12 - 1 (40). - pp. 152 -156.

7. Kipen M.N., Physical development of children with hearing impairments / M.N. Kipen, A.N. Yakovlev // Bulletin of Tula State University. Physical Culture. Sport. – 2019. - # 10. - pp. 17-22.

8. Mushastaya N.V., The program of socialization of hearing-impaired elementary schoolchildren in the society of healthy peers / N.V. Mushastaya, I.V. Danchenko // Russian Psychological Journal. - 2015. - # 3. - pp. 6-15.

9. Orusbaeva T.A. On the issue of teaching and upbringing children with hearing impairments / T.A. Orusbaeva // Problemy nauki (Problems of Science). - 2016. - # 19 (61). - pp. 83-86.

10. Sutyrina M.P. Outdoor games in the physical education of children with hearing impairments / M.P. Sutyrina // Proceedings of the All-Russian Scientific-Practical Conference "Science and Society". - 2019. - # 10-1. - pp. 107-111.

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INNOVATION ACTIVITY AS A RESOURCE FOR PROFESSIONAL DEVELOPMENT OF AN EDUCATION MANAGER

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Abstract. *The article reveals the meaning and mechanism of innovative practice for the professional development of an education manager. The concepts of "management" and "management" are correlated, the specifics and tools of pedagogical management are determined. The subjects of innovative activity, variants of segmentation of the educational system and strategies are characterized. The directions of innovative activity are indicated: ensuring the quality of human capital, technological modernization of education, development of social sustainability, digital transformation. A check-list is proposed to stimulate innovative search.*

Keywords: *innovative activity, motivational program-targeted management, professional development, segmentation, educational system*

In a situation of uncertainty of the future and competitive processes, the leading countries will be those countries that know how to make a key stake on the person himself and the development of his potential. Education plays a leading role in this. The place of Russia in the world by 2050 is determined by the level of quality of conditions, process and content of education in preschool educational institutions, schools, in organizations of secondary and higher vocational education, in the field of continuing education in 2018-2024. In this regard, IK Shalaev, from the point of view of management theory, anticipated the importance of attention to a person, his ability to correlate the goals of the organization and his own.

The development by I.K.Shalaev of the model of the object and subject of management of an educational institution, the design of the law of the tree of management goals, the definition of measurable parameters of the executing and control programs, the establishment of qualimetric principles for assessing the quality of education and the effectiveness of management of an educational institution contributed to the development of a methodology for attestation of a teacher and head of an educational organization.

The process of integrating target-programmed (rationalistic) and motivational (behavioral) approaches in management practice into the metasystem - motivational

target-oriented management (MTOM) - has actualized attention to the innovative component of management science. The drivers of innovation in education today are: the Internet, digital technologies, competition and rapid development of economic sectors, the challenges of the consumer society, technology startups in education. The progressive development of education under the applied conditions can be ensured by those who are themselves ready to change, initiate or carry out innovative activities. As one of the development priorities of the Russian Federation for the period up to 2024, "ensuring the global competitiveness of Russian education, the entry of the Russian Federation into the top ten countries in the world in terms of the quality of general education" [4] is designated, which further actualizes the problem of resource support for the professional development of an education manager conditions of the knowledge economy.

The managerial competencies of a modern education manager in the MTOM logic represent three areas: management of their own performance, management of team activities, management of thinking. Today, the focus of management theory is on the issues of organizational culture, leadership, corporate governance, readiness to initiate and/or carry out innovative activities, which is the essence of the new management paradigm. The concept of "pedagogical management" is actively used. The peculiarities of pedagogical management include the uniqueness of the subject, products, tools, and the result of labor. The activity of the subject of management is the subject of labor of the education manager. The product of labor is information about the educational process. The tool of labor is represented by word, speech. The result of labor lies in the level of training, education and development of the object of pedagogical management [5].

Comparison of the concepts of "pedagogical management" and "management" became the subject of analysis in the works of V. I. Bondar, K. Ya. Vazina, L. A. Veretennikov, Yu. A. Konarzhevsky, VS Lazarev, M. M. Potashnik, V. P Simonova, T. I. Shamova. The analysis is based on such methodological approaches as:

- functional: determination of the structure and number of functions in school management as a social-pedagogical system (V. I. Bondar, Yu. A. Konarzhevsky, B. C. Lazarev, M. M. Potashnik);

- socio-psychological: determining the role of the personality factor in the management of the pedagogical system (A. I. Naumov, T. I. Shamova);

- cybernetic: defining the role of information, organizational cycles, structure and specifics of the process of making managerial decisions (V.P.Simonov, V.A.Yakunin).

According to V.P. Simonov, pedagogical management is a process, an activity-based, dynamic system that is in constant development. This system is controlled and self-improving under the influence of a manager-teacher [7]. The structure of pedagogical management includes a triad of levels. At the first level, the tasks of managing the activities of the teaching staff are concentrated. At the second level, the teacher's

activities are managed. The third level of pedagogical management is focused on managing the student's activities.

The professional level of management presupposes an awareness of three fundamental management tools. First, the organization, the hierarchy of management, in which the impact on a person is carried out using the functions of motivation, planning, organization and control of activities, distribution of material wealth. Secondly, the culture of management as values, social norms, behavioral features developed and accepted by the society, organization. Thirdly, market relations, which are based on the purchase and sale of products and services, on the balance of the interests of the seller and the buyer. Each of these tools involves addressing key categories: need/desire to change the current situation (motivation) in accordance with the desired result (goal), consistently performing certain actions (program).

The report of the Center for Strategic Research and the NRU "Higher School of Economics" focuses on the quality of human capital, technological modernization of education, social sustainability and digital transformation [3]. An important element of human capital is intellectual capital as the ability to generate and master innovations, the economic projection of creative activity, since it is intellectual capital that determines the quality of transformations in the economy and social life, the solution of new technological problems. Technological modernization will ensure the personalization of education, a different nature of the interaction of participants in educational relations.

Ensuring social sustainability allows us to meet the challenges of a consumer society, when the generation of workaholics has been replaced by a generation that does not always strive to conquer new heights. The need for social sustainability is explained by another challenge of our time: the family and school have ceased to be monopolists in education. The mechanism for the development of social sustainability is the creation and development of an educational system. The components of the educational system are conceptual ideas, goals, activities, subjects of this activity, relations that arise between them in the process of activity and the process of managing this system. From the standpoint of the need for a person with developed critical and systemic thinking, who is capable of constructive interaction, creativity, the need for a person who is flexible and ready for changes, with developed emotional intelligence, who is able to search and manage information, the question arises: what are the formats of educational, work activities will be in demand, which of them will become the leading, most significant, defining development? The understanding of the need for digital transformation is due to a change in the channels for transferring social experience. Online services and instant messengers are added to the traditional methods of verbal transmission of social experience from generation to generation, through print sources, literature, art.

From the point of view of IK Shalaev, the setting of innovative goals in the mis-

sion of an educational organization as internal motivators for self-actualization of subjects of education management is one of the factors of increasing the efficiency of education management [8]. The need for active innovative practice of the education manager is dictated by the transformation of the anthropological basis on which education is built: the image of the person himself. The transformation is caused by the new state of society: from the economy of skills and rules we have come to the economy of knowledge ("economy of services", "creative economy", "knowledge society", "production of innovations"). In the knowledge economy, humans play a major role rather than technology. The knowledge economy is characterized by: a system for the production of knowledge in demand, a knowledge management system. Knowledge and human capital are the main drivers of development. The mechanisms for developing the infrastructure of the knowledge economy are: ensuring the availability of information sources, interaction between producers and consumers of knowledge, organizing the activities of innovation parks, professional associations, exhibition and marketing activities. The sources of innovation processes will be: intuition, experience, directives, consumer opinion, the needs of the teaching staff of the region, country, scientific achievements.

E. Rogers defines innovation as an object, idea or action that is perceived by the consumer as new and offers a classification of the subjects of innovation [1]. The first group includes "innovators" (2.5%) - they are always open to new things, absorbed in innovations, are characterized by some adventurism, and intensively communicate with local groups. The second group is made up of “early implementers” (13.5%), who follow the innovators, but are more integrated into their local association. By exercising influence, they often become opinion leaders. Appreciated as reasonable implementers. The third group is the "preliminary majority" (34%). They need significantly more time to make a decision than the leading groups. The group of the "late majority" (34%) treats innovations with a significant degree of skepticism; nevertheless, they begin to master them sometimes under the pressure of the social environment. The hesitant group (16%) is guided by traditional values. The decision to adopt an innovation is given to them with great difficulty [1].

The education manager's understanding of the importance of innovation is largely determined by the answer to the question: a person for an organization or an organization for a person? If personnel is understood as a cost factor, an educational organization is characterized by: coercive relations, cost minimization, a short planning period, only a quantitative analysis of results, an inflexible and dependent nature of the relationship. In a situation where personnel is classified only as a "resource", the concept of expediency of actions, cost optimization, a longer period of planning activities, a qualitative assessment of performance results, a flexible autonomous nature of relations arises. In the case when the personnel is perceived as a process, the team realizes the expediency of actions, a program for the development of costs is devel-

oped, a long period of planning activities, the effectiveness is represented by quantitative and qualitative characteristics, while the quantity turns into quality. Relationships are characterized by flexibility and mobility, a balance between independence and team commitment.

At different stages of adopting an innovation, there is a logic behind the actions of an education manager. At the stage of denial, the team can be focused on the previous level of activity, since it experiences a lack of information. At the stage of denial, the team should be given some time to adapt, the opportunity to orient itself regarding the future development of the organization. At the stage of resistance, irritation phenomena may arise, which are due to the inevitability of changes. A significant role for the positive dynamics of changes in this situation will be played by "feedback", the ability of managers to listen to colleagues. The research phase demonstrates agreement with the need for change. The team is developing new directions and forms of activity. It is important to support the development of the process, to help determine priorities. At the stage of involvement, creative groups appear, goals are set, and activities are coordinated, therefore, particular importance is given to the joint nature of developing long-term goals, constructive interaction to create updated symbols and rituals.

The quality of innovation activity, the degree of involvement in it or the presence of experience in innovative practices affect the segmentation of the educational system and strategies. With a low threshold of innovative activity, the use of innovative ideas, an educational organization mainly solves the problem of ensuring social security. Of the innovative areas, the digital format of education is mainly used. Social adaptation programs are key. The mass segment is represented by niche strategies that are shared, tested, and implemented by the majority. The trajectory of the organization's development is selected from the already "promoted" ones. There is training in a team, there is a mentoring system. Along with the traditional ones, the author's pedagogical technologies are used. Social networks are used to support the educational process, there is a wide range of partner programs. The leaders of new practices are characterized by the identification of a key success factor, a unique advantage. Individual (asynchronous) educational trajectories are being implemented, there is a practice of a flexible system for assessing educational results and results of professional activity. The teaching staff is characterized by a culture of experiment, flexible architecture of education and a strong partner community.

The student's path to 2030 will be determined by the effectiveness and optimal use of innovative practices, when the teacher, in relation to the majority, can act as a navigator of the educational space. The student can choose a role model ("the hero's path"), in the conditions of which the picture of the world is formed, intellectual development is carried out, social, managerial skills are formed, and states are controlled. Another path of the student is independent choice, correction of the goal, inclusion in teams, in accordance with the tasks of development, social order. Process

quality indicators: involvement and "flow", personal portfolio of competencies, creative portfolio, assessment by participants of educational relations, social partners.

An analysis of existing practice, research on the topic allows us to conclude that a checklist as a qualitative analysis can serve as a tool that can stimulate awareness of the importance of innovation:

- existing trends in economic and social development;
- the effectiveness of the technologies and forms of education used;
- performed roles;
- the formats used in the educational space;
- key events that have already taken place or may take place;
- current and potential regulations;
- directions and quality of interaction with real and promising partners;
- the nature of partnerships;
- threats and opportunities.

The most important sign of a good company is the management of personnel development from the standpoint of a conscious attitude (motivation) to the planned results (goal) and provision of content as a way of productive movement towards the goal (program). Involvement in innovative activity is the optimal resource for working out the components of motivational program-targeted management of professional education manager development.

References

1. Baburin V.L., Zemtsov S.P. Innovative potential of regions of Russia: monograph / V.L. Baburin, S.P. Zemtsov. - M.: "KDU", "University book", 2017. - 358 p.

2. Vitvar OI Modern School Management: A Workshop for the Principal. - M .: National Book Center, IF "September", 2014. - 192 p.

3. Twelve solutions for new education. [Electronic resource]. Access mode: https://www.hse.ru/data/2018/04/06/1164671180/Doklad_obrazovanie_Web.pdf

4. On the national goals and strategic objectives of the development of the Russian Federation for the period up to 2024: the decree of the President of the Russian Federation of May 7, 2018 No. 204. [Electronic resource]. Access mode: http://publication.pravo.gov.ru/Document/View/0001201805070038.

5. Potashnik, Mark Maksimovich Exclusive aspects of school management: a guide for the heads of educational institutions and their deputies / M. M. Potashnik. - Moscow: Pedagogical Society of Russia, 2011. - 320 p.

6. Russia 2025: From Personnel to Talents. [Electronic resource]. Access mode: https://d-russia.ru/wp-content/uploads/2017/11/Skills_Outline_web_tcm26-175469.pdf

7. Simonov Valentin Petrovich Pedagogical management: Know-how in education: textbook. - M., Higher education, Yurayt-Izdat, 2009. - 357 p.

8. Shalaev I.K. Improving the quality of educational service on the basis of motivational program-targeted management: monograph / I.K. Shalaev. - Barnaul: AltGPA Publishing House, 2010. - 203 p.

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KEY POSITIONS OF THE IMPLEMENTATION OF CONTINUITY IN THE STUDY OF NATURAL NUMBERS AND FRACTIONS AT THE INITIAL AND BASIC STAGES OF EDUCATION

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Abstract. *The article examines the topical issue at this stage of the implementation of the principle of continuity at different stages of mathematical education in the study of natural numbers and ordinary fractions. The authors put forward as key positions the scientific approach in the presentation of the indicated issues, the formation of a theoretical type of thinking, an orientation towards the developing principles of teaching mathematics.*

Keywords. *Mathematical education, continuity, scientific character, theoretical thinking, natural numbers.*

The implementation of the idea of continuity at different levels of mathematics education is today an urgent problem, the solution of which is aimed at the research of many teachers, mathematicians, methodologists. The modernization of the school mathematics course meets the modern requirements of the development of science, the introduction of mathematics in the most diverse areas of knowledge. At present, not only in our country, but also in many countries of the world, intensive searches are being carried out for ways to improve school teaching in mathematics, which would bring it closer to the modern level of development of mathematical science. The task of such teaching mathematics is:

– not the transfer of ready-made knowledge, but in the organization of students' activities to master the system of knowledge, methods of analysis and generalization of educational material based on practical experience, knowledge gained during the period of informal learning (from everyday life, communication with adults, programs of additional educational institutions);

– systematic assimilation of knowledge, skills, skills, subject competences for the use of mathematical representations and concepts in the process of presenting information about the features of surrounding objects, the course of development of any phenomenon in quantitative and spatial terms;

– creative use of the acquired knowledge in solving theoretical and practical problems;

– "the formation of the ability for continuous mental activity, the foundations of logical thinking, spatial imagination, mathematical speech and argumentation, the ability to distinguish between justified and unfounded judgments" [1, p. 28].

In accordance with the Model Program in Mathematics that meets the requirements of the new standards, you attach particular importance to mathematics as a subject in the mental development of the subject of study. The purpose of mathematical development is "the formation of the ability for intellectual activity (logical and sign-symbolic thinking), spatial imagination, mathematical speech; the ability to build reasoning, choose argumentation, search for information; understand the meaning of quantities and how to measure them; the development of interest in mathematics, the desire to use mathematical knowledge in everyday life"[6].

The solution of the indicated tasks and goals of teaching mathematics lies in:

– difficulties associated with the specifics of the subject of mathematics, its logical and psychological foundations of design, which requires the cognitive side of education, which is a powerful means of developing younger schoolchildren and a strong, faithful internal support of the present, original, not copied mastery of knowledge, skills, and abilities;

– on the peculiarities of perception, thinking, memory of schoolchildren (not only their acquisition of knowledge, but also the mastery of techniques and methods of obtaining them, requiring mental effort and adequate application);

– on the diversity of the current state of pedagogical science and practice, characterized by the variability of concepts, technologies, methodological and methodological systems and approaches;

– implementation of the idea of continuity at different levels of mathematics education.

How can a teacher understand the merits and demerits of this or that, often compulsory for the leadership of an educational institution, training program, how to learn to consider all issues of the program of mathematical education in interrelation and continuity?

Of course, first of all, we are witnessing a new stage in the development of mathematical education, which is determined by the rejection of a uniform, unitary system of schooling. However, already between elementary and basic school, new contradictions arise more and more often, connected with the problem of

continuity and continuity in teaching mathematics. The essence of these contradictions is as follows. As you know, fundamental scientific research on the problem of the relationship between learning and development was carried out in dignitaries on younger students. This led to the fact that the primary school has a fundamental psychological and pedagogical base for the implementation of the ideas of developing education at the methodological level. However, these ideas have not yet received proper development in the mathematics course of 5-6 classes. Secondary school methodologists see the solution to the problem of continuity between primary and secondary schools in the creation of a unified concept of mathematical education, the main principle of which is the priority of the developmental function, based on the scientific presentation of all formed mathematical concepts from the initial stages of education. However, declaring the priority of the developmental function of teaching, one must not forget that it is in the primary grades that the ability to learn should be formed, on the basis of which all subsequent mathematical education will be built.

Thus, the Concept for the Development of Mathematical Education in the Russian Federation states that "the initial stage of teaching mathematics has two main goals: internal (didactic) - preparing students for continuing education - and external (pragmatic) - the formation of mathematical literacy" [5]. Some authors, highlighting the external goal as a priority, argue that the content of elementary mathematics education should be "relatively closed" [2, p. 31]. In other words, the pragmatic goal - the formation of mathematical literacy - corresponds to the thesis about the sufficiency of primary education for a person's everyday life.

In this concept, teaching in grades 5-6 is also assigned a preparatory role, where it is already a question of the functional literacy of students. The closest to this concept is the statement of M.V. Lomonosov that "mathematics should be studied for that reason, that it puts the mind in order."

Summarizing the experience of teachers, as well as their own experience in mathematical training at different levels of education, we note that in order to characterize the concept of continuity in the framework of mathematical education, training must be considered as a process of the formation of a person's personality through mastering the basics of mathematical knowledge, skills, experience of mathematical activity. To characterize the continuity in teaching, an integrated, systematic approach is needed, which reflects: the logic of constructing the main content and methodological lines of the course, taking into account the relationship and development of the concepts studied by schoolchildren.

We will offer key positions for the implementation of continuity in the study of natural numbers and fractions at the initial and basic stages of training. In modern programs and textbooks, the method of studying natural numbers and fractions is carried out within the framework of the concept presented by N.B. Istomina [4],

the main goal of which is to develop students' thinking in the process of assimilating mathematical content. The fundamental key of this concept is also in the study of natural numbers and fractions in grade 5, as well as rational numbers in grade 6. Thus, the main directions of the methodology for studying natural numbers in primary grades received their further development in the study of natural numbers and fractions in grade 5.

Let us characterize the teacher's activities aimed at the implementation of continuity in the mathematical education of schoolchildren.

An elementary school teacher, realizing that the cognitive development of a junior schoolchild takes place in the joint educational activity of him and his students, should be guided not by the type of thinking already mastered by the child, but by the new emerging type - by conceptual, theoretical thinking, because only in this case, learning will be truly developmental.

The traditional elementary course of mathematics with all its content is aimed at the intellectual development of younger students and has great opportunities for the successful organization of developmental education. Like most other initial courses in mathematics, it is largely based on the use of a number system built on the basis of the set-theoretic approach [3, p. 59]. Therefore, the teacher, in order to focus on the formation of theoretical thinking in junior schoolchildren in the process of teaching the elementary course of mathematics, it is necessary to know well the theoretical foundations of this number system, to see and use the possibilities of their application in the further educational process.

There are two independent approaches to constructing the set of non-negative integers - axiomatic and set-theoretic.

In a high school mathematics course, with the axiomatic construction of a set of non-negative integers, the concept of relations "more", "less" is introduced on the basis of the addition operation, already well studied by this time [2, p. 81]. As you know, in the traditional initial course of mathematics, this relation is considered earlier than addition. Therefore, consider the second approach to constructing a set of non-negative integers.

In the set-theoretic construction of the set of non-negative integers, the concepts "more", "less" are defined on the basis of a comparison of the sets representing the numbers under consideration. If these sets are not of equal cardinality, then the numbers under consideration are not equal, since they define different classes of equipotent finite sets. This requires the introduction of new concepts of comparison on the set of non-negative integers - the concepts of "more", "less" [4, p. 81].

Let us give a brief statement of the quantitative theory of non-negative integers, on the set-theoretical basis of its construction, which is the theoretical basis of the relations "more", "less".

Definition. A correspondence between elements of non-empty sets X and Y is

a subset of the Cartesian product of the sets X and Y.

Definition. Let X and Y be non-empty sets. A bijection from a set X to a set Y is a correspondence f between elements of the sets X and Y, which has the following properties: a) to each element of the set X there corresponds some element of the set Y; b) different elements of the set X correspond to different elements of the set Y; c) each element of the set Y corresponds to some element of the set X; d) different elements of the set Y correspond to different elements of the set X. Designation: f: X ↔ Y.

Definition. Non-empty sets X and Y are called equipotent if there is a bijection from the set X to the set Y. Notation: |X| = |Y|.

Definition. Let X and Y be finite sets. There are as many elements in the set X as in the set Y, if X is equal to Y. The set X has fewer elements than in the set Y (or in the set Y there are more elements than in the set X), if X is equivalent to some sub-set of the set Y, provided that this subset is not equal to the set Y itself.

If on the elements of the set of finite sets M we consider the relation of equal cardinality ~ (tilde): ~ ⊂ *M* x *M* and ~ = {(*x, y*)| |*x*| = |*y*|}, and X, then, being an equivalence, it splits the set M into classes of equally powerful sets. Each class is assigned a name and a symbol to record it. For example, a class containing an empty set is assigned the name "zero" and the character to write it "0"; the class of equally powerful sets containing a set consisting only of the element d - the name "one" and the symbol 1, and so on.

Definition. Let M be a set whose elements are finite sets. On M, the ratio of equal power "set X is equal to set Y" is given.

A non-negative integer is the name of the class of the partition of the set M by the equivalence relation. A natural number is a non-zero non-negative integer.

From the last definition it immediately follows that $N_0 = N \cup \{0\}$ (N – is the designation of the set of natural numbers).

Definition. A representative of a non-negative integer p is a set that is an element of the class *p* of the partition of the set M by the equivalence relation (M/~). Designation: capital letter of the Latin alphabet with subscript *p*.

Definition. A non-negative integer p is called the number of elements of the set X if the set X is a representative of the number p. Designation: *n*(X).

It's obvious, that $n(X) = p \Leftrightarrow X \in p$.

Definition. A non-negative integer *m* is less than a non-negative integer *p* (or a number *p* is greater than *m*) if there is a representative of the number *m*, which is a subset of some representative of the number *p* and is unequal to it. Designation: *m* < *p* or *p* > *m*. $m < p \Leftrightarrow (\exists A_m, A_p)[A_m \subset A_p \wedge A_m \neq A_p]$, $p > m \Leftrightarrow (\exists A_m, A_p)[A_m \subset A_p \wedge A_m \neq A_p]$.

It is obvious from the definition, that $m < p \Leftrightarrow p > m$.

Definition. The set of all natural numbers ordered by the ratio "less" is called

a natural series.

Designation: (N, <). For example, (N, <) = {1, 2, 3, 4, 5, 6, …}.

Definition. Let *p* be an arbitrary natural number. A *p*-segment of a natural number series is a set of all natural numbers, ordered by the relation "less than", each of which is less than or equal to *p.*

Designation: N_p. N_p = {1, 2, 3, 4, …, *p*}.

For example: N_1 = {1}, N_2 = {1, 2}, N_7 = {1, 2, 3, 4, 5, 6, 7}.

Definition. A count (or numbering) of elements of a finite set A is a bijection of a set A onto some *p*-segment of a natural series; in this case, the image of an element is called its number.

Example. Count the elements of a set X = {*a, b, c, d, e*}.

Solution. Consider *f* = {(*a*, 1); (*b*, 2); (*c*, 3); (*d*, 4); (*e*, 5)}.

Since $f : X \leftrightarrow N_5$, then *f* – numbering of elements X by definition.

For convenience, it is customary to write the number with a subscript in the numbering. For example, (*d*, 4) ⇔ d_4 and *f* = {a_1, b_2, c_3, d_4, e_5}.

Note that the content of the elementary course in MEC "School of Russia" is based on the use of mainly a numerical system, in the construction of which a set-theoretic approach is used. Therefore, it is quite understandable that the method of studying the relationship "less", "more" on the set of non-negative integers in the first grade of traditional education uses a set-theoretic interpretation.

In accordance with this interpretation, the basis of the concept of relations "more", "less" on the set of non-negative integers is *the ratio of equal power of finite sets*. Let's remind him. One number is less than the other, if there is a representative of the first number, which is a subset of some representative of the second number, and the representatives of the numbers are unequal sets.

Preparatory work for the formation in students of the concept of the relationship "more", "less" (and at the same time the relationship "equal") on the basis of such an interpretation begins already in the pre-number period, at the very beginning of their study of the initial course of mathematics. This work is carried out on the basis of practical actions with various groups of objects. This approach makes it possible to use the experience previously accumulated by students and from the very beginning to teach in close connection with life and in the implementation of the principle of continuity.

Note that the ability to compare two numbers based on this method, that is, characterizing the comparison results with the words "more", "less", "equal", is one of *the main requirements for the mathematical training of students graduating from the first grade.* Using the example of studying the numbers of the first ten, younger students get acquainted with various ways of comparing numbers, one of which is based on comparing the corresponding groups of subjects. The main task of these lessons is "to teach junior schoolchildren to establish a mutually unam-

biguous correspondence between the objects of two sets". Its solution is closely related to the formation of an idea of quantity among junior schoolchildren. It is not excluded that the majority of students will turn to the counting of subjects, but the focus of children should be various methods of establishing a one-to-one correspondence [7, p. 19].

When organizing work on the formation of the concepts under consideration, subject, graphic and symbolic models are used. Therefore, in the process of this work, teachers' instructions for the most part will have to reflect precisely the stages of the modeling process and rely on the theoretical foundations of these concepts. Obviously, in this case, in order to formulate clear, concise and correct instructions, the teacher needs to know well the relevant theoretical material of the university course in mathematics.

Naturally, the instructions and instructions of the teacher for younger students cannot contain the terms of the university course in mathematics. But the teacher should be able to express their essence correctly in a language accessible to younger schoolchildren. He can do this only if he knows the theoretical basis of the concepts used well enough.

The basis of the concepts "more", "less" is the ratio of equal power of finite sets. And the concept "less" for non-negative integers can be expressed as follows: one number is less than the other, if in the set, the number of elements of which is equal to the first number, there are so many elements in the part of the set, the number of elements of which is equal to another number. For example, for a set A (a set of circles) and a set B (a set of rectangles), shown in Figure 1, it is true that sets A and B are not equal in power and, since from set B one can select a part in which there are the same number of rectangles, how many circles are in set A, then the number 4 (the number of circles) is less than the number 5 (the number of rectangles).

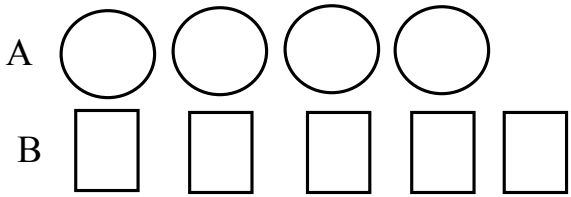

Fig. 1

Thus, the teacher must organize the educational process, the purpose of which is to form in younger schoolchildren the concepts of comparison relations, and hence the concepts "less", "more", so that younger students use a one-to-one corre-

spondence between elements of sets or elements of one set and part of the elements of another set. Let us recall that they were trained to deliberately establish such a correspondence between subjects already in the pre-number period of studying the traditional elementary course in mathematics. Therefore, in the study of the relationship "more", "less" in the center of attention of students should be *various methods of establishing one-to-one correspondence, and not recounting the subjects of each group.* Establishment of a one-to-one correspondence between object aggregates is possible in various ways, the methodology of working with which the teacher must master.

The method of superimposing objects of one set on objects of another: consists in the fact that objects of one set are superimposed on objects of another. This method is used at the very beginning of acquainting students with the use of one-to-one correspondence between object populations to compare their numbers and requires direct action with objects.

But, since one of the goals of learning is to teach younger students to perform many actions, including the action of comparing the number, indirectly, in the mental plane, it is necessary to further use in learning methods that contribute to the advancement towards this goal. These methodists include the following methods.

The way of arranging objects of one set under objects of another set. This method is widely used at the stage of familiarizing younger students with the concepts of "less", "more", "equal" and requires direct action with objects. But since the one-to-one correspondence established with its help *must be recognized as a set of pairs*: an element of one set is an element of another set, then when it is completed, students develop imagination, which, undoubtedly, is an advance towards the specified goal.

For example, figure 2 is considered, the problem is posed: what is more (less) circles or squares?

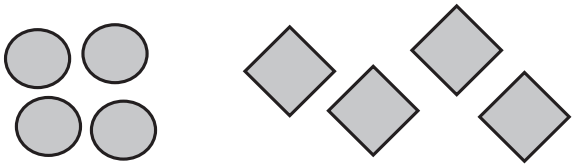

Fig.2

After completing the task based on the method of establishing correspondence between the sets of objects under consideration, figure 3 is obtained:

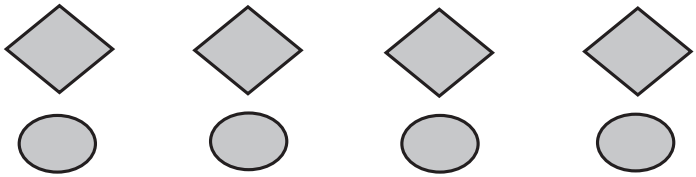

Fig. 3

And it is realized: *there are* **as many** *squares as there are circles.*

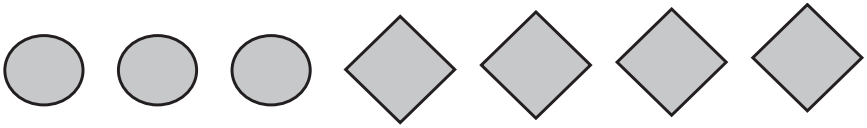

Fig. 4

If the sets shown in Figure 4 are considered, and a correspondence is established between them, then the correspondence model presented in Figure 5 is obtained, which helps students realize that *there are* ***more*** *squares than circles, and there are* ***fewer*** *circles than squares.*

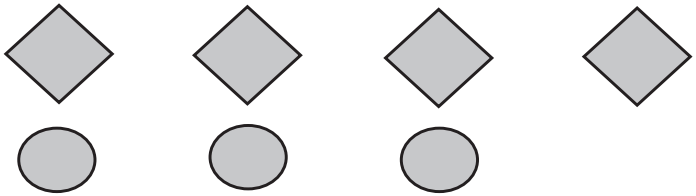

Fig. 5

The next method - **the method of forming pairs**, is the connection of each object of one set with each object of another, without placing the objects one under the other. This way of pairing is already based on the imagination of younger students. For example, Figures 6, 7.

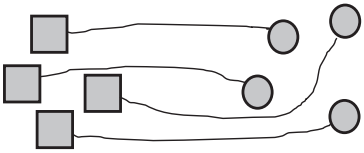

Fig. 6

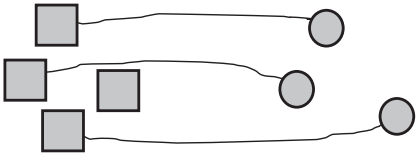

Fig. 7

The task of the teacher, when studying the concepts of the comparison relation, is to force younger students *not to use the recount of objects for the answer, but to concentrate their attention on establishing a one-to-one correspondence between the sets under consideration.*

Psychologists say that, taking into account the patterns of thinking in the learning process, when acquainting a student with any action that he needs to master, he (the student) is first introduced to the performance of actions on the corresponding material objects. And then, distracting from the properties of objects that are unnecessary in this case, they help to move from actions with material objects to action with their substitutes, free from all properties, except for those that are needed in this case. In other words, *go to the stage of materialized action*, which is some kind of graphic system, figurative or symbolic model, *on which, or with the help of which, the student performs the assimilated action.*

In order to carry out such a transition in the initial courses, a variety of tasks presented in the textbook are enough. In addition to the tasks of the textbook, the teacher can propose a system of specially designed tasks that allow you to move from the stage of materialized actions to a graphic or figurative model of establishing relations "less", "more" on the set of objects under consideration.

In building a methodological system for teaching the comparison of natural numbers in high school and further expanding the range of numbers under consideration, a high school teacher needs to build a teaching system so that students have the opportunity to independently acquire new knowledge on the basis of already formed methods of activity. Only in this case, the system of mathematical education will be of a developing nature, and, therefore, meet the requirements of the FSES and be based on the principle of continuity of all stages of mathematical education.

References

1. Abbasov, S.Kh. Ways to ensure continuity in teaching mathematics in primary school and grades 5–6 of secondary school [Text]. – M., 2011. – 126 P.

2. Dorofeev, G.V. Humanities-oriented course – the basis of the academic subject "Mathematics" at school [Text] // Mathematics at school, 2017, № 4. P. 31 – 35.

3. Dorofeev, G.V. On two options for the implementation of the set-theoretic approach to the concept of a natural number [Text] // Elementary school, 2017. – № 1. – P. 58 – 61.

4. Istomin, N.B. Methods of teaching mathematics in primary grades [Text]: textbook for stud. of second. and high. ed. institutions. – M.: Academy, 2009. – 533 P.

5. The concept of the development of mathematical education in the Russian Federation. – Access: http://docs.cntd.ru/document/499067348. – Appeal date: 18.06.2021.

6. An approximate program in mathematics [Electronic resource]. – Access: https://nsportal.ru/shkola/administrirovanie-shkoly/library/2015/02/28/primernaya-programma-po-matematike. – Appeal date: 30.06.2021.

7. Stoilova, L. P. Mathematics [Text]: textbook for stud. of high. ped. ed. institutions. – M.: "Academy", 2011. – 246 P.

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AN ASTRONOMICAL APPROACH TO THE PHILOSOPHICAL STUDY OF THE CHANGE IN MYTHOLOGICAL, RELIGIOUS AND FORMATIONAL CONCEPTS DEPENDING ON CHANGES IN SITUATIONS IN THE STARRY SKY

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Abstract. *This article provides an astronomical analysis of the philosophical points of view of the Russian scientist A.F. Losev, American scientist, Henry M. Shepard, Russian scientist Yu.S. Offense and Greek philosophers about the place and time of the appearance of the orgastic cult of Dionysus of Thebes, the son of Zeus and Semele, characterizing the system of patriarchy against the background of the former social relations of matriarchy. The parallels in the Rig Veda and the Avesta are shown. The author's position on the astronomical reasons for the change in mythological and religious concepts is given.*

Keywords: *Indo-Europeans, Mother of the World, Serpent, Dragon, sun gods, serpent fighters, heroes, thunders, Zeus, Indra, Zagreus, Dionysus*

The creation of this article was based on familiarization with a number of works by Henry M. Shepard, an American scientist from Philadelphia, a graduate of the University of Copenhagen, who for many years has been studying the issue of the causes and place of origin of the cult of Dionysus, its educational functions and immortality. In his articles, H.M. Shepard covers a wide semantic field of research of ancient Greek and modern philosophers.

In the article "Is Dionysus a Greek God? Purcari roots"[20] Henry Shepard notes that on the territory of Greece, even in the pre-Greek period, Achaean inscriptions indicate that the Achaeans knew a god with that name. Greece knew several Dionysos. Non divided them into three: 1) Dionysus, the son of Persephone, and called the first Dionysus or Zagreus, 2) the son of Zeus and Semele (the goddess of the vine) from Theban myths or the later Dionysus, 3) Dionysus-Iacchus, the son of Theban Dionysus and the aura. The first, according to A.F. Losev goes far beyond the borders of Greece [11, p. 145]. Today, there are five hypotheses for the origin of Dionysus and his cult: *Thracian-Phrygian* (Eurip-

ides, Apollodorus, Strabo, Cicero, K. Müller, L. Preller, Fr. Welker, E. Rode, R. Taylor-Perry, L. Fernell and others.), *Aegean* (O. Group, K. Kerenyi, M. Nilsson, B. Otto, Viach. I. Ivanov), *Middle Eastern* (V. Burkert, R. Taylor-Perry, M. Estour, I. Dyakonov, V. Yaylenko), *Egyptian* (Herodotus, Plutarch), *indian* (Quintus Curtius Rufus, Diodorus of Siculus, Hesychius, Hyginus) [20].

Henry Shepard refers to modern research by Yu.S. Obidina "Dionysus serves the mysteries older than himself" [14]. Tracing the evolution of ideas about death and the afterlife in the archaic and classical eras, signs of the transformation of a complex of moral values and a cardinal transformation of a person at the end of the Eneolithic era with: 1) the emergence of Indo-Europeans, 2) the transition from matriarchy to patriarchy, 3) the origin of the cult of personal immortality, are found, the form of which, in contrast to this worldview in the Paleolithic, became the orgaistic cult of immortality with the features of the future Dionysus, which V.I. Ivanov called "Pro-Dionysism", and it happened in the territories of the formation of the Indo-Europeans [20].

In addition to the dedicated H.M. Shepard and Yu.S. Obidina problems, the author of this article considers it necessary to conduct an epistemological and astronomical study of the causes of their occurrence. What could have happened in the territories of the formation of the community of Indo-Europeans at the end of the Eneolithic and what could have so evolutionarily influenced the minds of people of that time, as a result of which there was a departure from the former gods of matriarchy to a new patriarchal orgaistic cult of the immortal Dionysus?

Formation of figurative thinking.

The ability to think appeared in Nomosapiens, a Homo sapiens at the next stage of evolution, which prepared the human brain to create abstract forms of thinking. A person constantly observed nature and the sky above his head and pondered, in much the same way as we are now watching TV, reading books, thinking, looking for answers to our questions on the Internet. And, as an inquisitive thinking creature, Nomo sapiens had a need to understand how and what happens, to draw conclusions - this is an inherent property of an intelligent being. Even if a person was engaged in physical labor, all the same, new information was deposited in his subconscious, waiting for an opportunity to be explained. Paying attention to the sky, a person experienced an "intellectual shock", discovering the celestial centers of rotation: the Pole of the Ecliptic - next to the "head" of the constellation Dragon and the Pole of the World, which sometimes manifested itself as the Pole Star. This is not exactly the shock that K.G. Jung, when he spoke about the emergence of human consciousness as a result of some kind of catastrophe [21, p. 85]. Disasters have happened to animals, but only a person has the ability to be aware of what is happening and to search for ways to abstractly express information about

what is happening. At the next evolutionary stage, the human brain turned out to be ready to discover the properties of abstract thinking.

When ancient people created mythical images, they put in them the structure of real laws and forms of the movement of the sky, only they explained these phenomena not yet in our modern scientific astronomical language, but by images, into the behavior of which the structure of the corresponding concrete celestial phenomenon was embedded. Therefore, ancient archetypes have a clear astronomical structure, recognizable even after millennia. This can be traced to myths and legends that preserve traces of thousands of years of knowledge, even if the source of this knowledge is forgotten. Fairy tales were passed on orally, every evening to children before going to bed. Looking at the night sky, the storyteller showed the habitat in the sky of a certain image. And this oral knowledge is infinite as long as their carriers are alive. Of course, the priests were most concerned with this when the division of labor took place. The priests, on the other hand, created figurative forms of the perceived, as our scientists now clothe the phenomena of nature in laws. Astronomical scientific knowledge took shape much later, but it owes its basis to the knowledge that was tracked down thousands of years earlier by ancient people in the form of precise astronomical structures in the images of gods and heroes.

Tracking the lunar cycles in Eurasia has been carried out for a very long time, as we are told by archaeological finds on mammoth bones or stones, with holes in a certain calendar sequence, for example, at the Achinsk site in Siberia, created 18 thousand years ago [1]. If the cycle of the Moon's revolution was known, it means that the center around which this movement took place along the Ecliptic was known, i.e. Pole of the Ecliptic next to the "head" of the constellation Draco. Since ancient times, the lunar cycle has belonged to the fertile cult of the Mother of the World, which is responsible for the dual real life cycles of birth and death, similar to how the rising and setting of the moon and planets relative to the horizon were observed as they moved along the Ecliptic.

Formation of matriarchy

For the first time a figurine, emphatically feminine, dating back about 230 thousand years ago, was discovered in the Golan Heights near Lake Ram in Israel [15].

Later, on the territory of Eurasia, we meet with the divine cosmic images of the Mother of the World in the form of small plastic on the Russian Plain in Kostenki near Voronezh, 45-30 thousand years ago. One of those buried at the Kostenskov site-14, dated 37 thousand years ago, had a mitochondrial haplogroup U2 (now this haplogroup is distributed mainly in Northern India and the Kama region) and a Y-chromosomal haplogroup C1 [9]. Haplogroup C1 is the oldest haplogroup of

the peoples of Asia, who were the first to leave Africa [4].

Also, Paleolithic Venus on the territory of Eurasia were discovered in Germany about 40 thousand years ago, in Moravia about 31-27 thousand years ago, in Austria about 30-27 thousand years ago; in France about 26-24 thousand years ago, in Belgium about 26 thousand years ago, in the Czech Republic about 25 thousand years ago, in Italy about 25-20 thousand years ago, in Russia at the Siberian site of Malta in Irkutsk Oblast about 26-24 thousand years ago, in Russia in Bryansk Oblast (Khotylevo 2) about 23 thousand years ago, in Slovakia about 23-22 thousand years ago, in Russia at the Siberian site of Bureti about 23-22 thousand years ago, in Switzerland 13-12 thousand years ago , in Chatal Huyuk in Turkey 10-7.5 thousand years ago, in China 8-7 thousand years ago, in the Vinca culture in Serbia 8-7 thousand years ago, in Ukraine in Timkovo 7 thousand years ago, on the island of Malta in The Mediterranean Sea 6.5-5.5 thousand years ago, in Romania 7 thousand years ago, in Ukraine in Tripoli 7-5 thousand years ago, in Hungary 7 thousand years ago, in Romania near the village of Cucuteni 6.5 thousand years ago, in Bulgaria 6-5 thousand years ago, in Egypt about 6.5-5.5 thousand years ago, in Pakistan 5-4 thousand years ago, in Turkmenistan 5 thousand years ago, in Uzbekistan 4.5 thousand years ago, in Japan 4.5 thousand years ago [15].

Observations of the sky centered at the Pole of the Ecliptic in the image of the Mother of the World contributed to the predominance of matriarchy in the ancient system of social relations. The path of the Moon and the planets deviates by a different number of degrees in either direction from the exact position of the Ecliptic line, so the Pole of the Ecliptic was not represented as a point in the sky, but as a certain area near the "head" of the constellation Draco. The name of the constellation has been known in Greek tradition since the 2nd century BC, but only in the Greek tradition?

The image of the Serpent and the Dragon, as one of the central divine symbols, is now widely known in Eurasia, as well as among the Maya Indians in North America, and most likely belongs to the Proto-Indo-European tradition. Images of Snakes and Birds in the form of small plastic were found at an ancient Siberian site, in the Malta burial. A boy from Malta lived, according to calibrated radiocarbon data, about 24 thousand years ago. Research has shown him to be similar to Europeans and American Indians. So, the Y-chromosome haplogroup R-M207 * of the boy MA-1 suggests that his line separated from the trunk of a tree leading, among other things, to modern Europeans, at its very base, and the mitochondrial haplogroup U resembles that of extinct hunters and collectors of the Paleolithic, who inhabited Europe at that time. The nuclear genome of MA-1 is similar to the autosomal genetic signatures of the Afontova Gora-2 sample with Y-chromosomal haplogroup Q1-F903 (17 thousand years ago) from Afontova Gora in Krasnoyarsk. It coincides by 37% with the DNA of South Asians, 34% - with the

DNA of Europeans, 26% - with the DNA of the Indians, 4% - with the DNA of the inhabitants of Oceania. Samples MA-1, AG-2, and AG-3 from the Baikal region had a common origin and were grouped in the Mal'ta Cluster [12]. The first of the ancestors of the American Indians about 25-20 thousand years ago could cross the Bering Bridge to the American continent and then several times the Altai tribes migrated in waves along the Bering Bridge until it collapsed about 12 thousand years ago [7].

Cosmic symbols are tenacious, because they were observed daily by ancient people in the sky. The divine images of the Serpent and the Bird, as Proto-Indo-European symbols among the Altai tribes, were also preserved among the American Indians. They portrayed their sun god Quetzalcoatl as a Bird holding a Serpent in its beak (Fig. 1)

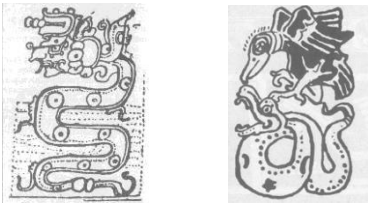


Fig. 1. *Indian symbols of the Snake and Quetzalcoatl [2, p. 96, 97]*

The Chinese also have similar images of the Serpent-Dragon (Fig. 2), whose nation was formed from numerous tribes, including the Altai ones [16].

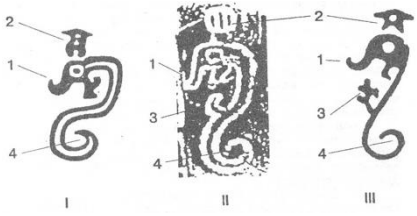


Fig. 2. *Chinese symbols of Dragons [8, p. 24]*

The bends of the Indian Serpents and the Chinese Dragons are directed in the same direction - as they are located in the starry sky in the constellation of the Dragon. Above the "head" of the constellation Draco is the star Vega, alpha of the constellation Lyra, one of the brightest stars in the northern hemisphere of the sky, which was near the Pole of the World 14 thousand years ago. these were images

of the Pole Star Vega, alpha Lyra, next to the "head" of the constellation Draco. The constellation Lyra up to the 17th century was drawn by the Eagle holding Lyra (Fig. 3). Together with the migrating people, these images steadily passed into the cultural traditions of kindred peoples. In particular, one of the images of Zeus was the *Eagle.*

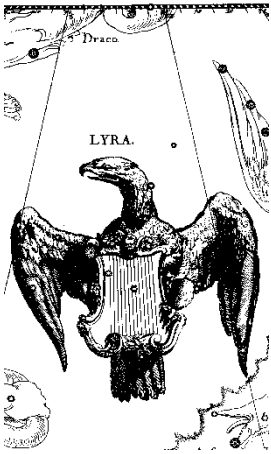


Fig. 3. *Image of the constellation Lyra on the map of Jan Hevelius. [10]*

The emergence of elements of patriarchy

It is known from astronomy that, as a result of the solar-lunar Precession, the Earth's axis of rotation, pointing to the Pole of the World, describes circular motions like the rotation of a whirligig around the Pole of the Ecliptic for 26 thousand years, and, sometimes, falls on the stars, which at such a moment become stationary, the so-called Pole Stars. What does it mean to suddenly see a fixed star against the background of the rest of the rotating, already familiar, sky? A stationary star looks perfect compared to other moving stars. The visible center of rotation of the sky made it possible to refine calendar calculations, combined solar-lunar calendars appeared, radiant-associative thinking developed, geometric signs appeared that characterize the structure of an astronomical phenomenon. In the northern sky, the Pole stars appeared:

50 (24) thousand years ago – with the Polar Star Gamma Cephei,
48 (22) thousand years ago – with the Polar Star Beta Cephei,
46 (20) thousand years ago – with the Polar Star Alpha Cephei,
44 (18) thousand years ago – with the Polar Star Alpha Cygni (Cygnus "tail"),
42 (16) thousand years ago – with the Polar Star Delta Cygni (Cygnus "wing"),
40 (14) thousand years ago – with the Polar Star Vega, Alpha Lyrae,

38 (12) thousand years ago – with the Polar Star Iota Hercules,
35 (9) thousand years ago – with the Polar Star Tau Hercules,
31 (5) thousand years ago – with the Polar Star Alpha Dragon,
26 thousand years ago and in our time – with the Polar Star Alpha Ursa Minor.

We do not assert that in every appearance of the Pole Star at the Pole of the World, the ancient people created exactly geometric signs and calendars, but new, as a rule, solar gods appeared necessarily, because in those days it was believed that the sun revolves around the earth, i.e. around the Pole of the World.

Knowledge accumulated gradually. At first, these were images comparable to well-known natural phenomena, which were realistically depicted in the form of people, animals, birds. Then, when realistic images were no longer enough to explain the structure of the phenomenon, signs appeared that characterize the structure of such a phenomenon: circles, crosses, spirals, holes, etc. At first, many peoples had only legends about chaos, dimensionless and formless universal substance, i.e. the sky has not yet been divided into constellation images, the names of the luminaries and planets have not yet been given. Following this, in many legends, the World Duck appeared, which gave birth to the World (Earth with the Pole of the World). Most likely, the image of the Duck in the Indo-European tradition arose during the standing of the Polar Stars in the constellation Cygnus about 44-42 or 18-16 thousand years ago.

Further, when Vega, alpha Lyrae became the Pole Star about 14 thousand years ago, deities appeared with the symbols of the Eagle, Lyra, Turtle (the lyre was made from the shell of a turtle) - Quetzalcoatl, Zeus, based on the common Proto-Indo-European tradition. In the ancient Greek tradition, the constellation Lyra was depicted as an Eagle holding a lyre. Zeus was a thunderer, most likely related to the Precession of the Pole of the World itself, as the father of many sons, the prototypes of the Pole Stars. It is possible that Kronos, the father of Zeus, also belonged to a more ancient figurative concept of the Precession, since he also had many sons, whom he swallowed, which could be a figurative representation of the fact that the Polar Stars disappeared for a while from the Pole of the World.

Further, there is the myth of the birth of Zagreus, the son of Zeus from Persephone, who was sacrificed annually as a calendar symbol, perhaps the birth of the mythical Zagreus dates back to 12 thousand years ago, when the Pole Star was an iota of Hercules. Zagreus in the Achaean tradition, or the First Dionysus, the son of Zeus, appeared against the background of absolutely undivided thinking at the stage of early matriarchy, but with the idea of dividing the worldview so far only into the donor (Zeus) and the victim (Zagreus) with an emphasized relationship between father and son [11, p. 150]. The undivided worldview took the form of worshiping only the ecliptic gods with an obscure center at the Pole of the Ecliptic next to the "head" of the Dragon. They were realistic, dual gods, with all the ad-

vantages and disadvantages, good and evil at the same time, like the movement of the Moon and planets along the Ecliptic, with their rising and setting above the horizons. The worldview was holistic and not divided. The appearance of an ideally immobile Pole Star in another celestial center, at the Pole of the World, forced us to look for other, ideal, gods. As a result, the worldview was divided into realistic (materialistic) and idealistic gods, who found themselves in eternal combat.

As a child, Zagreus, like his father, threw lightning and peruns, but the titans, representatives of the Pole of the Ecliptic, tore it up and ate it, they did not have time to eat only the heart that Athena saved. The heart of Zagreus was taken to Zeus, probably symbolically in the Precession area, for the conception of new solar gods. It is believed that Zeus swallowed his heart or had his heart sewn into his thigh, which gave the second birth to his son - the second Dionysus through Semele, the goddess of the vine. The second Dionysus was the founder of the cult of winemaking. Winemaking historically arose in the Neolithic era 10-3 thousand years ago, i.e. when the Pole Stars were the tau of Hercules or the alpha Dragon. Hercules was also the son of Zeus, and most likely belonged to the Pole Star tau Hercules 10-9 thousand years ago, when bows and arrows appeared. In his 12th feat, Hercules, in search of the gardens of the Hesperides, came to the north, where Atlas held the Sky, apparently at the Pole of the World. Atlas knew where the apples of the Hesperides were, but did not say, and went for them himself, persuading Hercules to temporarily hold the sky. Why did Atlas not tell Hercules where the gardens of the Hesperides are, but went for apples himself? Because the myth was specially created in order to inform descendants that the tau star of the constellation Hercules 9 thousand years ago for some time became Polar. Of course, the myth was written much later, after the passage of time and the realization of this phenomenon.

Then the second Dionysus could symbolize the Alpha Dragon, the Pole Star of the 3rd millennium BC, as well as Indra among the Hindus, Thoth among the Egyptians, Mercury among the Romans. Then, everywhere in the Northern Hemisphere of the Earth, new solar gods appeared both in Eurasia and in North America, since, despite the lack of contacts between people on these continents, the northern sky was the same for everyone. Local geniuses discovered changes in the sky and gave names to new gods who brought ideas of geometric and mathematical knowledge based on accurate calculations regarding the seen celestial center at the Pole of the World, manifested by the North Star. At the behest of the new time, the old gods of the Pole of the Ecliptic, next to the "head" of the constellation Dragon, the center of the ancient lunar observation system, with its dual characteristics (like the rising and setting of the moon, planets on the Ecliptic), receded into the background, giving way to ideal gods, as it was considered, with the solar characteristics of the Pole of the World. The Rig Veda describes how the new sun god Indra, together

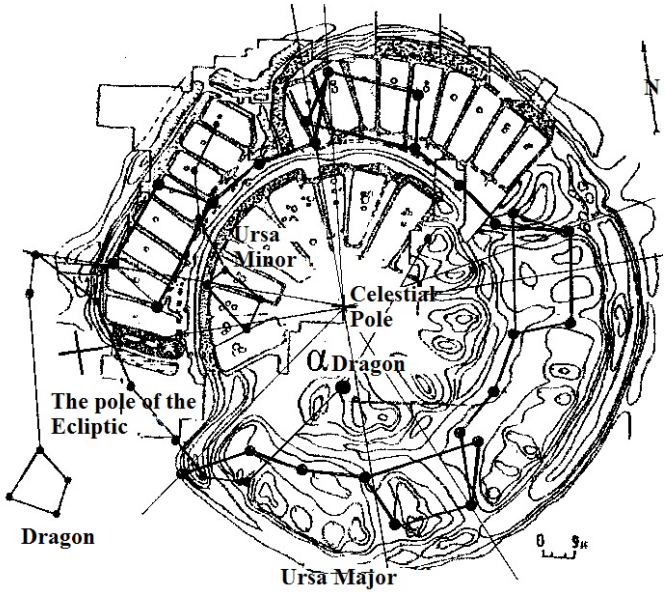
with other sun gods dives, defeated the Serpent Vritra by hitting him with a vajra lower back (the alpha Dragon in the constellation is located below the back, often symbolized by the phallus) and from there new waters flowed, obviously a new grid of astronomical coordinates in the image of a spoked wheel:

"Indra's heroic deeds now I want to proclaim:
Those, the first that the thunderer did.
He killed the serpent, he drilled (channels) for the waters,
He cut the bowels of the mountains… [18, I.32.1].
"Enraged like a bull, he chose soma,
He drank soma squeezed out in three vessels.
Generous grabbed a projectile - vajra.
He killed him, the first-born of serpents ... [ibid, I.32.3].
Legless, armless he fought against Indra.
He hit him on the back with a club.
The ox wanted to become the bull's opponent.
Vritra was lying scattered in different places ... [ibid, I.32.7].
Among the non-stopping, non-calming
The body is hidden by the waterways.
The waters flow through the secret place of Vritra ... [ibid, I.32.10].
Indra is the king of the moving (and) resting,
Hornless and horned, thunderer.
It is he, as a king, who rules the nations.
Like a rim - spokes (wheels), he embraced them all ”[ibid, I.32.15].

Indra is the lord of Svarga, paradise. Probably among the Hindus, Swarga mythologically symbolized the Precession - the place where the Pole Stars, their children, appeared. Also among the Slavs, Svarog was the father of many solar gods and could also symbolize the Precession. Among the Greeks, Zeus was the father of the sons of the serpent fighters and could symbolize the Precession. Among the Egyptians, the god Thoth was the son of the god Ra, and then the god Ra could also symbolize the Precession. Awareness of the phenomenon of the Precession, as the appearance and disappearance of the Pole Stars, probably arose a long time ago and in the language of myths this was expressed by the nature of the birth and death of the gods.

The cult of the second Dionysus in Greece, as well as the cult of Indra among the Hindus, is marked by orgaistic characteristics. Also, like the cult of Osiris in Egypt, the cult of Yaril among the Slavs, the cult of Mercury (Hermes) among the Romans. The appearance of the North Star Alpha Dragon at the border of the IV-III millennium BC coincided with the appearance of the Indo-Europeans in the historical arena, the development of metallurgical production, with the transition from the Neolithic to the Bronze Age. There was a transition from matriarchy to

patriarchy, which was greatly facilitated by the characteristics of the gods, symbolizing the star of the Alpha Dragon. Pillars were installed everywhere, often in the form of a phallus, most likely designed to track the daily and annual time: during the day by the sun's shadow, at night by the rotation of the constellations around the top of the pillar. At the top of the pillar, a wheel with spokes dividing the sky into sectors could be installed, as described in the Rig Veda (see above). The most ancient track from a wheel with spokes was found in Sintashta [5, p. 204, Fig. 107] and it dates back to 2026 BC based on the bones of animals buried nearby [13]. Sintashta and Arkaim, whose settlement plans are made in the form of a wheel, are the South Ural monuments of the Andronovo culture [6, p. 32, Fig. 6.I]. Archaeologists attribute them to the Indo-Iranian community for genetic studies of human remains. The descendants of the Andronovites dispersed to all directions of the world, including to India and Iran, about which the ancient written sources of the Rigveda and the Avesta narrate. The ancient Iranian Avesta says: "... Yima made Var the size of a run (horse) on all four sides ”[3, p. 80]. The horse's run on all four sides represented the rotation of the Ursa Major constellation around the Pole of the World [16, p. 59-61, Fig. 20.21; 19, p. 31] (Fig. 4). The second Dionysus was brought up in Nisa. Henry Shepard places the country of Nisa in Thrace, on the Lower Dniester (Nistra) and sees Indo-European roots in this myth, which originated in the Proto-Anatolian period from the area of the Andronovo culture (South Urals, Siberia) and united the ancestors of the future Nisean Hittites [20].



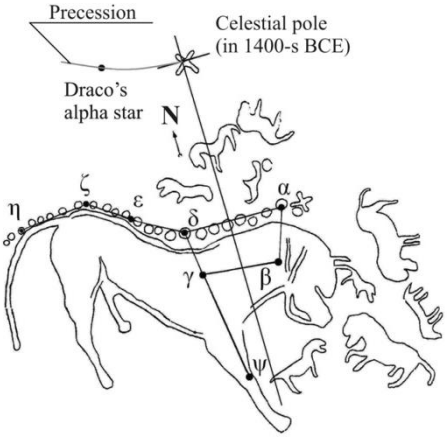


Fig. 4. *The location of the constellation Ursa Major on the plan of Arkaim and on the contour of the horse in Terekty-Aulie [6, p. 32, Fig. 6.I; 16, p. 59-61, Fig. 20.21; 19, p. 31].*

The spoked wheel at first could have been an astronomical instrument, but later it began to be used in light chariots for the fastest crossing of the vast steppe. Also, as an astronomical instrument, according to the principle of "wheel in wheel in wheel", the Mayan Calendar was created in North America, but the wheel did not find use in everyday life, perhaps because the area was dominated by impenetrable jungle. From the III millennium BC refined calendars, schematic signs on ceramics and in rock paintings began to appear, traces of which are found in the places of residence of Indo-Europeans, matriarchy finally began to be replaced by patriarchy. The names of the new solar deities were different, but their characteristics in the Indo-European tradition were similar - they were thunders, snake-fighters - the victors of Serpents and Dragons.

But over time, the Polar Stars left the Pole of the World, showing emptiness in the same place. Perhaps this phenomenon was reflected in the mythological traditions of the periodic birth and death of Zagreus, as well as the oblivion of his name, about which A.F. Losev [11, p. 145-146]. The inferiority of the gods, who ceased to be ideal, appeared, as Yima in the Avesta became sinful in many ways. The names of the former gods became secret, like Yahweh among the Jews, or Zagreus among the ancient Greeks. The myths trace the traditions of the sacrifice of the gods - Kronos swallowed his children, Zeus allowed his son Zagreus to be sacrificed.

A.F. Losev notes "...that the philosophical awareness of the mythology of "being torn apart" in Greece is associated with the Orphic, that is, not earlier than VI

century BC and continued by the Neoplatonists, i.e. ends its evolution together with the end of all ancient philosophy. Only philosophy itself is new here, and not myths and speculations that go back to time immemorial... This philosophical theory of the myth of being torn apart is such a wonderful document of Greek and universal human culture that it is impossible not to dwell on it" [11, p. 149]. K. Jaspers called the VI century BC "Axial time", when science and philosophy were born in ancient Greece. And we will note that this was the time of the middle between the positions of the Pole Stars: the Alpha Dragon in 2800 BC and alpha Ursa Minor in 2100 AD, when the star is closest to the Pole of the World. In times without the polar stars ideally standing in the center of the sky, the ancient Lunar ecliptic religions were restored or new dual religions appeared according to the type of rising and setting of luminaries above the horizon (Taoism, Zoroastrianism), or scientific realistic (materialistic) philosophical concepts were formed.

In the Greek tradition, the gods of Olympus most likely referred to the circumpolar picture of the northern starry sky, where both celestial centers of rotation are located next to any of the Polar Stars on the Precession loop, symbolized by the hero-snake-fighter and the thunderer. The same place is described in the Rig Veda as two World Mountains, Meru (with the sun gods dives at the Pole of the World) and Mandara (with the old gods asuras at the Pole of the Ecliptic). The same place is described as Paradise in the Bible with the Tree of good from evil, guarded by the Serpent (Pole of the Ecliptic) and the Tree of Life (eternal Life), as the ideal point of the Pole of the World, to which the axis of rotation of the Earth points. The same place Iriy is a paradise in Slavic mythology.

Our task is to understand why this or that myth, this or that ancient creation has a certain structure, what epistemological idea was the basis. If there is an astronomical basis in our scientific understanding, then we are dealing with an astronomical structure and can calculate to what time and epoch the investigated area of knowledge may belong.

References

1. Achinsk site. URL: http://my.krskstate.ru/docs/archaeologist_discovery/achinskaya-paleoliticheskaya-stoyanka/ (appeal date: 23.01.2021).

2. Bauer V., Dumots I., Golovin S. Encyclopedia of symbols. – M.: JSC "KRON-press", 1995. - 502 P.

3. Videvdat. 2. [The myth of Yima]. Translation by I.M. Steblin-Kamensky // Avesta in Russian translations. – SPb.: Neva Journal, Summer Garden, 1998. – P. 75-81.

4. Haplogroup C (Y-DNA). URL: https://ru.wikipedia.org/wiki/%D0%93%D0%B0%D0%BF%D0%BB%D0%BE%D0%B3%D1%80%D1%83%D0%BF%D0%BF%D0%B0 (appeal date 5.05.2021)

5. Gening V.V., Zdanovich G.B., Gening V.F. Sintashta: Archaeological monuments of the Aryan tribes Ural-Kazakhst. steppes. – Chelyabinsk: South Ural Publishing house, 1992. – 414 P.

6. Zdanovich, G.B. Arkaim. Aryans in the Urals or a failed civilization // Arkaim: Research. Search. Discoveries. / Sci. ed. G.B. Zdanovich; Comp. N.O. Ivanova. – Chelyabinsk: Stone Belt, 1995. P. 21-42.

7. Indians. URL: https://ru.wikipedia.org/wiki/%D0%98%D0%BD%D0%B4%D0%B5%D0%B9%D1%86%D1%8B (appeal date 23.01.2021).

8. Kaurov, E.N. Constellation of the Dragon: an archaic system of astronomical observations // Dragon and Zodiac. – M.: Astronomical Society. EAAS Paleoastronomy Commission, 1997. P. 5-50.

9. Kostenkovskie sites. URL: https://ru.wikipedia.org/wiki/%D0%9A%D0%BE%D1%81%D1%82%D1%91%D0%BD%D0%BA%D0%BE%D0%B2%D1%81%D0%BA%D0%B8%D0%B5_%D1%81%D1%82%D0%BE%D1%8F%D0%BD%D0%BA%D0%B8 (appeal date 10.04.2021)

10. Lyra. Drawing from the atlas of the Polish astronomer Jan Hevelius (1611–1687). URL: http://lnfm1.sai.msu.ru/~zakh/alm-cat/lyr/lyr_fig.html (appeal date 8.05.2021)

11. Losev, A.F. Ancient mythology in its historical development. – M.: State Educational and Pedagogical Publishing House of the Ministry of Education of the RSFSR (Uchpedgiz), 1957 – 620 P.

12. Malta (site) URL: https://ru.wikipedia.org/wiki/%D0%9C%D0%B0%D0%BB%D1%8C%D1%82%D0%B0_(%D1%81%D1%82%D0%BE%D1%8F%D0%BD%D0%BA%D0%B0) (appeal date 23.01.2021).

13.The most ancient chariot was found in the Urals. URL: https://zen.yandex.ru/media/

yakladoiskatel/na-urale-naidena-samaia-drevniaia-kolesnica-5e00dd7432335400ac0c2d0c

14. Obidina, Yu. S. The concept of the immortality of the soul in the cult of Dionysus [Text]: the interaction of the rational and the irrational / Yu. S. Obidina // Bulletin of the Volgograd State Pedagogical University. Ser. "Socio-economic sciences and art". – 2006. - № 2 (15). - P. 41-46.

15. Paleolithic Venus and the ancient religion of the Mother Goddess. Kostenkovsky Venuses. URL: https://historiosophy.ru/paleoliticheskie-venery-i-drevnyaya-religiya-bogini-materi/ (appeal date 1.05.2021)

16. Polyakova, O.O. Archaeoastronomy in the mirror of evolutionary cognition. – M.: "Company Sputnik +", 2007. – 159 P.

17. Reshetov, A.M., Dzibel G.V. Chinese. URL: https://bigenc.ru/ethnology/text/2070364 (appeal date 1.05.2021)

18. Rig Veda. Mandalas I-IV. / Ed. Elizarenkova. – M.: Science, 1989. – 767 P.

19. Sagyndyk, I. Image of a horse in the petroglyphs of Terekty Aulie // Historical and cultural heritage of North Asia: Coll. sci. op. ed. A.A. Tishkin. – Barnaul, 2001. – P. 29-32.

20. Shepard, H.M. Purcari roots of Dionysus. Is Dionysus a Greek god? URL: https://www.researchgate.net/publication/330565154_Purkarskie_korni_Dionisa (appeal date 23.01.2021)

21. Jung, C.G. The structure of the psyche and the process of individuation. – M.: Publishing house "Science", 1996. – 269 P.

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I. KANT'S TRANSCENDENTAL IDEAS IN UNDERSTANDING THE ESSENCE OF LAW

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Abstract. *The article examines the relevance of the application of the transcendental ideas of the ethics of I. Kant in the modern understanding of the essence of law. When considering the idea of natural law, the question of the ontological status of the norms and prescriptions of natural law is considered, as well as the question of the source of natural law. The axiological aspect of natural law allowed the author to consider law as a value identical to the idea of law, which immanently contains the basic legal values of I. Kant's ethics.*

Keywords: *I. Kant's transcendental ideas, the essence of law, the axiological aspect of natural law, the ethics of law*

Introduction

Currently, the transcendental ideas underlying the ethics of I. Kant are becoming increasingly relevant in connection with the return to the idea of natural law. For more than two centuries (from the Enlightenment to the end of the XX century), the consideration of the essence of law, primarily as a positive right, prevailed for more than two centuries, led to a crisis in legal consciousness, the way out of which many researchers see in the return to the idea of law, to the idea of justice, the content of which is Kant considered, first of all, freedom as a transcendental idea preceding any possible apperception of the subject of cognitive activity. When considering the idea of natural law, the question of the ontological status of the norms and prescriptions of natural law necessarily arises, but, first of all, the question of the source of natural law inevitably arises.

Purpose of the study – to reveal the application of the transcendental ideas of the ethics of I. Kant in the modern understanding of the essence of law.

Research objectives:

- explore the philosophical paradigm of I. Kant in the analysis of state and law in German classical philosophy;

• consider the moral and practical teaching of I. Kant, which regulates the activities of the subject in complex legal education processes;

• to determine the role of the subject in the application of the transcendental ideas of the ethics of I. Kant in the modern understanding of the essence of law.

Philosophical paradigm of I. Kant in the analysis of state and law

In ancient philosophy, nature or a pre-established order, the harmony of nature was recognized as the source of natural law.

In medieval philosophy, the source of natural law was the will of God, and the interpreters of such a will was the Catholic Church in the person of the Pope.

In the era of the Enlightenment, the laws of nature, which can be comprehended by man with the help of reason, are considered as the source of natural rights. This historical period is associated with the emergence of civil society in its modern understanding, which approved and ensured the existence of democratic forms of government in modern times. In addition, the ontological status of natural law was substantiated by the theory of social contract, which assumed the recognition of citizens of their natural rights based on mutual obligations between citizens and the state represented by the ruler.

The definition of rationality as the basis for natural law in the works of J. J. Rousseau, G. Grotius, J. Locke, paved the way for I. Kant to substantiate the transcendental ideas of freedom, law, justice, duty, morality, and law.

The political and legal theory of the German philosopher Immanuel Kant (1724-1804) is the logical conclusion of theoretical research in the field of state and law of the Enlightenment [1]. Having criticized the theory of natural law, I. Kant formulated a new philosophical paradigm in the analysis of state and law, laying the foundation for German classical philosophy. His views were set forth in the works: "Critique of Pure Reason", "Critique of Practical Reason", "Criticism of the Ability of Judgment", "Towards Eternal Peace", "Metaphysics of Morals". The essence of Kant's philosophy consists in denying the possibility of cognition of an objective world independent of the cognizing subject ("things in themselves"). He explains the knowledge of the world as the process of combining our sensations with the so-called pure forms inherent in human cognitive ability, namely, the forms of space and time, categories of reason (which includes causation) and ideas of reason, which give the highest generalization to our knowledge. This knowledge is objective only insofar as it is generally obligatory for the human race. But it cannot pretend to know things in themselves.

The content of his "Metaphysics of Morals" or ethics, where I. Kant draws a clear line between the laws of nature and the laws of freedom, is a moral and practical doctrine that regulates the activity of the practical mind of the subject, in which he opposes the world of phenomena to the world of "things in themselves."

Man, according to the teachings of the thinker, belongs to two worlds. As an

empirical being, he is in the world of phenomena, therefore, is subject to the law of causality and therefore not free. But at the same time, he is a "thing in itself." In this respect, he is free, and his actions are subject to the law of freedom. According to the teachings of Kant, morality does not depend on any external reasons, feelings and authority. The moral law is the command of duty for the sake of duty itself, and since this law does not depend on the above conditions, it is unconditional, and the moral will is autonomous. The command of the moral law is expressed in the so-called categorical imperative. This is an unconditional and obligatory requirement of the will, independent of external influences; he calls such a will "pure."

In his philosophy, the role of human reason, namely, practical reason, is immanently inherent in the subject and manifests itself in the form of freedom of arbitrariness in relation to the object. I. Kant, identifying the laws of freedom, considers their a priori (that is, pre-experienced) character (inherent in the special nature of man) a necessary condition for their existence - reasonable awareness as independence from sensual impulses, as well as "the ability of practical reason to be practical for itself," is expressed in his understanding of the maxim of an act, that is, such an arbitrary act that can be recognized as a universal law.

The indicated laws of freedom of arbitrariness, as the highest law and determining grounds, set the form in which practical reason is considered as the ability to create principles or maxims of arbitrariness in the form of an imperative of prohibition or command.

I. Kant calls such laws of freedom moral, and, depending on the scope of their application, if they concern only external actions, he calls them legal, and if they determine the grounds for actions, then ethical. And thus, those laws, the obligatory nature of which can be cognized by reason without external legislation, I. Kant calls natural laws; positive laws refers to those laws, the binding of which cannot be found without external confirmation in legislation. Positive laws must be preceded by a natural law in order to substantiate and confirm the authority of the legislator [10].

Moral and ethical doctrine of I. Kant, regulating the activities of the subject in complex legal educational processes

The highest meaning of man is the so-called maxim according to I. Kant, he believes that the maxim is the subjective principle of action, which each subject accepts for himself. The objective basis of duty is considered to be a direct indication of practical reason how to act.

Kant called the categorical imperative the law of moral freedom, which he opposed with a hypothetical imperative - a rule for achieving a specific goal. A moral person, the philosopher believed, cannot be guided by hypothetical or conditional rules that depend on external circumstances [1].

Kant proposed several formulations of the categorical imperative (moral law), one of which is given as an example [4, p. 204]:

"... Act so that you always treat humanity both in your own person and in the person of everyone else the same way you treat the goal, and never treat it only as a means."

In Kant's doctrine of law, there is an opposition between the legal and moral behavior of the subject. When a person's behavior is consistent with the legal norm, regardless of the motives of the act, then it can be considered legal, permissible. A person's awareness of his internal duty is the moral law inside, therefore Kant considers law to be a regulator of behavior, for which the subjective side of an act, its motives, is indifferent. Law is characterized by coercion, and it cannot be applied in the field of morality, the laws of which are based on a free inner consciousness of duty. Kant distinguishes between natural and positive law. He divides law into public and private, and the latter is based on natural law.

The real right is defined by him as the result of the initial acquisition, which gives the absolute right to the thing. At the same time, he believes that the object of private law can be not only a thing or action of a person, but also the person himself. So Kant explains the relationship between husband and wife in marriage and the relationship between parents and children, and he requires the complete subordination of women to men.

Kant considers the source of natural law or moral-practical law both our own reason and "Divine will", by which he understands "the idea of a moral being, whose will is law for all."

Thus, in the philosophy of I. Kant, natural law necessarily precedes positive law or written law, and also indicates its broader content as a concept.

The role of the subject in the application of the transcendental ideas of the ethics of I. Kant in the modern understanding of the essence of law

Kant's doctrine of law became the basis for the idealistic trend in legal science - normativism (pure theory of law), which gives the rule of law a character that is absolutely independent of the laws of development of social life.

The essence of state law, according to Kant, is determined not by the happiness of citizens, but by their law. According to Kant, only the rule of law allows individuals to unite and guarantee everyone civil freedom and obliges citizens to observe only universal legal norms: “So, the general legal law says: act outwardly so that the free manifestation of your arbitrariness is compatible with the freedom of everyone, in accordance with by the general law ... "[3].

However, the development of the guiding will of reason by I. Kant in understanding the essence of law, as well as the further fundamental development of the idea of natural law, as well as the idea of freedom, morality, law, undertaken by G.F.V. Hegel did not stop the dominance of legal positivism, which questioned

the truth of natural law and reduced the understanding of the essence of law to written state laws.

Among the reasons behind the predominance of legal positivism when considering the essence of law are the following: an attempt to establish the rule of law instead of the rule of government; the natural-legal idea, according to which everyone must obey the law established in the state, which has roots in antiquity, including in the philosophy of Plato; the attribution of transcendental ideas that make up the content of natural law to "judgments about what should be" in the spirit of D. Hume's agnosticism, which are not verifiable.

The refusal to recognize the ontological status of the idea of natural law revealed the limitations of positive law, which was expressed in its inability to take into account all the diversity of social relations and respond in a timely manner to their changes.

In this regard, along with the normative direction, a sociological and psychological direction appears in the philosophy of law, which, along with the legislative sources of law, takes into account sociological, psychological, cultural, and economic factors. In addition, the principle of equalizing and distributive justice, introduced into the doctrine of natural law by Aristotle, is still used, despite its natural-legal nature and all the efforts of the positivists to "etch" natural-law ideas from the doctrine of positive law.

Kant believes that the question "What is law?", Addressed to the lawyer, is akin to the question "What is truth?", Addressed to the teachers of logic. What follows by right (quid sit iuris), i.e. what the laws say or say in one place or another at one time or another, he can still indicate; but whether the right (recht) is what they demand, and what is the universal criterion on the basis of which one can generally distinguish between legal and non-legal (iustum et iniustum) - this remains a mystery to him, if he does not abandon the indicated empirical principles even for a while and does not look for the source of these judgments in the mind alone (even if the laws mentioned served him as a good guide for this), in order to establish the basis for possible positive legislation. A purely empirical doctrine of law is a head (like a wooden head in Phaedrus's fable), which may be beautiful, but, alas, brainless [5, p. 304].

The role of the subject in complex legal education processes at any historical stage is key (political subjects, civil society actors) or society as a whole [9,10,11].

"A legal norm is always objectified (finds its external expression) in three forms: in the form of a legal relationship, within the framework of which the corresponding rule of behavior is implemented; in the form of the legal consciousness of the participants in this relationship, evaluating it as something normal, should be, and in the form of a legal text, oral or written, that fixes its content"[2,12,13]. This approach corresponds to the legal tradition of the hypertrophied role of the state in legal education.

Conclusion

Law is conceived by Kant as a regulator of people's behavior, for which the subjective side of an act and its motives are indifferent. Law is characterized by coercion, and it cannot be applied in the field of morality, the laws of which are based on a free inner consciousness of duty. Kant distinguishes between natural and positive law. He divides law into public and private, and the latter is based on natural law. Kant's doctrine of law became the basis for an idealistic trend in legal science - normativism (pure theory of law), which gives the rule of law a character absolutely independent of the laws of development of social life.

The refusal to recognize the ontological status of the idea of natural law revealed the limitations of positive law, which was expressed in its inability to take into account all the diversity of social relations and respond in a timely manner to their changes. In the philosophy of I. Kant, natural law necessarily precedes positive law or written law, and also indicates its broader content as a concept.

The emerging crisis of legal consciousness in modern society forces us to reconsider the essence of the understanding of law and return to the doctrine of natural law, albeit in a slightly different way. As one of the reasons for such a crisis, one can single out a kind of disappearance of justice in the individual legal aspect, when it was replaced by ideas of social and corporate solidarity, economic expediency, the principle of maximum utility, and it was declared that in a number of cases social justice is present immanently in any legal system. However, in fact, such a substitution was expressed in the priority of the state interest over the interests of the individual, which leads to a deficit of legal literacy in the social environment, a violation of the value perception of the legal sphere, de-actualization of law as a regulatory principle, deformation of legal consciousness, and a violation of trust in social institutions.

Modern studies prove the axiological aspect of social norms in legal genesis, as a criterion of proper behavior, which allows us to consider law as a value identical to the idea of law, which immanently contains the basic individual legal values - the transcendental ideas of the ethics of I. Kant, which are relevant in understanding the essence of law and are in demand.

References

1. Belyaeva O.M. I. Kant's political and legal views. // Bulletin of Perm University. Legal sciences. - Issue 1 (23), 2014.- P.7-12

2. Varlamova N.V. Russian theory of law in search of a paradigm // Journ. of Russian law, 2009. - № 12. - P. 80.

3. Kant I. Op. In Ger. and Rus. lang. -V. 1.- M., 1994.- P. 95.

4. Kant I. Op.: In 6 V.-V. 4.- Part 2.- M., 1965. - P. 138.

5. Kozlikhin I.Yu. Selected Works. SPb.: Jur. Center Press,2012.-585 P.

6. Kurskova G.Yu. I. Kant's doctrine of state and law // Bulletin of the Moscow University of the MIA of Russia.- №15 (137),2014.- P.132-138.

7. Lipen S.V. History of state legal doctrines: a reader under ex. ed. V.V. Lazarev.- M.: Spark, 2006.- 1071 P.

8. Marchenko M.N., Machin I.F. History of political and legal doctrines. M.: TK "Welby", Publishing house "Prospect", 2007. - 480 P.

9. Murashko L.O. Axiological dimension of the legal education process: history and modernity. - Diss. of appl. dr. jur. sci., 2015.-378 P.

10. Mahoney, J. The challenge of human rights: origin, development, and significance / J. Mahoney. – Malden : Blackwell Publ., 2007 – 215 P.

11. Wellman, C. The moral dimensions of human rights / C. Wellman. – Oxford : Oxford Univ. Press, 2010. – 248 P.

12. World Conference on Constitutional Justice // Venice Commission. URL: http://www.venice.coe.int /WCCJ/WCCJ_E.asp (date of access 05.01.2021).

13. Zupančič, B. Prolegomena to comparative law / B. Zupančič // New millenium constitutionalism: paradigms of reality and challenges. – Yerevan: NJHAR, 2013. – P. 367–385.

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REIMAGING OUR WORLD: FROM FERNAN BRODEL TO WORLD-SYSTEM ANALYSIS AND FROM HISTORICAL GLOBALIZATION TO THE GDELT PROJECT

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Abstract. *Modern Russian social science is in crisis because it is fragmented and highly specialized. Today, knowledge, split into many disciplines not related to each other, generates a flow of poorly integrated information. Such dismemberment is a brake on the process of integrating social science disciplines into a single whole, since all of them, for the most part, explore a common object - the evolution of societies at different periods of world history. World-system approach, big data and the concept of historical global adaptation by actual paradigms capable of combining a set of elements into an integral and general picture of the development of societies of various levels of complexity within the framework of the general movement of historical evolution from primitiveness to modern times.*

Keywords: *macroevolution, crisis of history, globalization, world history, world-system, historical globalization, Wallerstein, long time, national state, regions-economics, GDELT*

Introduction

Social science in Russia is increasingly fragmented. In other words, we know more and more about less. Since the days of F. Braudel and I. Wallerstein, who tried to process the growing volume of new data, the situation has worsened, giving rise to an even greater flow of information on world problems. The proliferation of ridiculously narrow studies in sociology, political science, and history in Russia has led to a situation where the analysis of the evolution of human communities has overshadowed the description of the little things. For global generalizations accumulated by «scientists-ants» an approach is needed that brings together the results of their research. In the current conditions, it can be world-systems analy-

sis, historical globalization and work with big data through the GDELT Project.

In other words, world-systems analysis, although it certainly needs some kind of reformation, is suitable for describing modernity, and historical globalization, perhaps, at least somehow unifies the data on precapitalist civilizations.

Before I. Wallerstein: F. Braudels world

The vague outlines of what in the 1970s I. Wallerstein would call world-systems analysis can already be traced in the studies of F. Braudel in the 1940-1950s of the XX century. History was studied from a positivist standpoint, and the scientist's professional craft consisted in masterly mastering dead languages, reading written sources and working on miniature, usually political topics without intruding on related disciplines. It was a descriptive story-story, whose adherents only meticulously reconstructed a chain of chronological events.

Initially, F. Braudel himself taught in the spirit of positivism, however, a ten-year stay in Algeria allowed him to see his native France «inside out» look at it from the opposite side of the Mediterranean Sea. He suddenly felt, and then became convinced in practice, that the history of his country is only a part of more global world processes. F. Braudel once confessed «I think that these pictures, this Mediterranean, as if seen «from the other side», had a great influence on my historical views» (Brodel, 1982). Fascinated by the Mediterranean, he chose the XVI century analysis of this particular region as the topic of his dissertation.

Returning home in 1932, F. Braudel taught at the Lyceum Condorcet, but two years later he was offered a place at the University of Sao Paulo and he left for Brazil. If Algeria forced him to think in world categories of historical time, then in Brazil F. Braudel faced the coexistence of multi-structure: European culture, «introduced» by the Spaniards and the Portuguese, coexisted here with the local Indian. It was through this motley interdependence of peoples that the historian saw the coexistence of different civilizations and the process of their influence on each other - a problem that eventually took a primary place in his research. «It was Brazil that allowed me to arrive at a concept of history that I would not have had if I had stayed within the Mediterranean» (Brodel, 1982).

Arriving in France, F. Braudel in the summer of 1939 year and began to write a dissertation on the Mediterranean era of Philip II. He did not work for a long time, the war began and he was drafted to the front. A year later, F. Braudel was captured and sent to a camp in Mainz. In captivity, he continued to work and, more importantly, it was at this time that his approach to history was finally formed, where «the fate of mankind is decided on a much deeper level. To choose a long-term scale for observation means to be, as it were, in the place of God the Father and to find refuge there» (Brodel, 1982). Such globalism, the broadest erudition

and contempt for event history, henceforth, will become a key feature of F. Braudel's works.

After his release from captivity, he, having finalized the dissertation, presented it to the members of the Academic Council of the Sorbonne, who eventually awarded him the degrees of Doctor of Humanities. The study of the Mediterranean thus revolutionized the historical science of the time. Fundamentally new ideas of F. Braudel were: 1) the concept of historical duration la longue duree; 2) a call for the integration of the social sciences; 3) introduction of the concept of «world-economy» (economie-monde).

The concept of time, or temporality, is one of the most important components of F. Braudel's approach to history. What is *longue duree*? The fact is that F. Braudel considered the event history to be dust, foam on water, hiding deeper structures. Some of them, for example, geography, climate, geology, changed, in his opinion, slowly, and their restructuring did take centuries. These structures are inactive. In other words, *longue duree* is a time of long duration, when there is a slow transformation of the environment (Brodel, 1958; Blim, Coffi, 2014; Lee, 2018). Along with fading history, F. Braudel distinguished *moyen duree* - conjunctural time, lasting decades and hundreds of years. This includes economic and social change. The last time, according to F. Braudel, is *eventful time* (courte duree). This is the time of a diplomat and a politician, lasting from several years to several days - a kind of moment. F. Braudel, although he gave priority to a long time, forming the geographical and social space of human history, nevertheless, he called for taking into account all three temporal forms when analyzing the past.

F. Braudel's approach destroyed all sorts of frameworks separating the human sciences from each other. Interdisciplinarity helped him combine the achievements of each of the disparate disciplines for a more complete description of world development. This idea, like the concept of longue duree, will later be modified by I. Wallerstein in relation to capitalist *economie-monde*.

In fact, F. Braudel already laid some foundations of the world-systems analysis, which was a negative reaction to the outdated organization of knowledge of the XIX century, whose reflections, to one degree or another, are inherent in the science of the XX century, when history was in charge of the past, and economists (the market) mastered the present, political scientists (state) and sociologists (civil society). Studies outside the Western world have been monopolized by anthropology and orientalism.

Modernization Theory

Until 1945 year, such a paradigm, based on highly specialized and fragmented disciplines, was justified and the researchers did not touch on related problems,

however, due to the change in the post-war geopolitical situation, the growth of the number of universities and the accumulation of scientific information, a different approach was needed. In an increasingly complex and interdependent world, the division of knowledge into industries did not justify itself. So, thanks to new research, a paradigm shift took place, when, in the 1960s, scientists began to revise the mechanistic model of the universe by I. Newton. Its basis is invariance, while the new approach assumed an explanation of the variability of the world, i.e. why some countries are prosperous while others are poor.

In the social sciences of the XX century, modernization theory, dependence theory and Marxism competed for the right to explain the evolution of the world. The idea of modernization became popular in American research in the mid-1960s. Its dominance was attributed to the global leadership of the United States in the post-war world due to technological, political and military expansion. Prosperity and stability have now become the key characteristics of American society, which was set as a reference example for the «underdeveloped» peoples of Asia, Africa and Latin America.

It was believed that their development can be described by analogy with the biological evolution of organisms, i.e. from primitive forms to complex ones. In other words, it was evolutionary theory and functionalism that influenced the provisions of modernism, which was expressed in the use of dichotomous constructions «social differentiation», «social system» and focusing on the adaptation of «primitive» societies to constantly changing environmental conditions.

Interest in the countries of the Third World was largely associated with the growth of nationalism and revolutionary movements that broke out there after decolonization, which led to the desire of previously enslaved societies to participate in geopolitics. As a result, their development began to occupy a significant place in the consciousness of the elites of the USA and the USSR. A side effect of this problem is the accumulation of scientific information about new entrants to the global arena. Fortunately, the American government and private foundations have contributed to the expansion of research in this area.

The theory of modernization, therefore, is an ethnocentric, American, view of the world, representing a multifaceted process of change in all areas of human thought and activity. The unit of analysis here, as a rule, is the nation state, where each component - industrialization, political development, technological progress - leads to the transformation of another.

While collecting information about the former colonial societies, supporters of modernism faced the question «What is a traditional society?» For example, S. Huntington stated «Modernization and tradition are asymmetric concepts. What does not correspond to the present is traditional» (Tipps, 1973). Naturally, he understood the United States as the ideal of modernity. In general, the term «tradi-

tional» was formulated as the opposite of the concept of «modernity», and «traditionalism» ended after the contacts of the backward states with the technological West.

In this respect, the most widespread version of modernization was the concept of the Harvard sociologist T. Parsons. He identified the following types of human evolution: 1) primitive; 2) advanced-primitive; 3) intermediate; 4) modern. The primitive type is characterized by social homogeneity. Religious relations form the basis of interpersonal ties, and members of society have statuses prescribed to them, depending on age and gender. An advanced-primitive organization is divided into the simplest subsystems (political, religious, economic), and success in people's lives depends more on personal qualities. In intermediate systems, writing appears, due to which the process of accumulating information and storing it in human memory begins. Religiousness ceases to form values and ideals. Modern, i.e. European society, which emerged in Ancient Greece, is characterized by: 1) the decisive role of the market economy; 2) the rule of law; 3) social stratification due to the commercial, scientific, cultural success of a person (Parsons, 1991).

Another American scientist, W.W. Rostow, developed a theory of five stages of economic development: 1) traditional society, which include agricultural collectives under the rule of feudal lords; 2) a transitional society, where centralized states and commerce are emerging, national self-awareness is growing; 3) the stage of «shift», characterized by industrialization leading to economic and political transformations; 4) the stage of «maturity» associated with the scientific and technological revolution and urbanization; 5) the stage of «high consumption», whose basis is the transformation of the production of mass goods into the most important sector of the economy (Rostow, 1960).

T. Parsons and W.W. Rostow thus viewed the process of social evolution as exclusively one-line. In addition, the theory of modernization considers the peak of development of the United States and the West with their values, ignoring alternatives in the form of, for example, the modernization of China, the USSR, Korea, Taiwan, achieved not by borrowing the principles of a free market, the rule of law and protection of private property, but «from above» those thanks to the strengthening of dictatorial regimes there.

The next paradigm is the concept of «core / periphery» expressed by R. Prebisch - Executive Secretary of the non-governmental organization ECLA (Economic Commission for Latin America) - and, as a result, borrowed by I. Wallerstein to describe the modern world-economy. R. Prebisch's views on capitalism are reflected in a series of lectures (1945-1949) under the general title «The Crisis of Kensian Political Economy». He believed that Keynes's theory could not explain the cyclical model of the development of world capitalist economies, as a result of which R. Prebisch introduced the concept of the relationship between the

states of the center and the periphery (fourth lecture, 1949), which could indicate the problem of prosperity of some and stagnation of others.

The dynamic theory of the center-periphery assumed the following division of the world economy: the periphery specializes in the supply of raw materials to the center in exchange for the goods it produces. The core has the ability to issue a reserve currency, which forms the basis of monetary circulation in the periphery, which leads to a situation when the imports of peripheral countries are paid for in the currency of the core state. The key idea of the proponents of this approach is that the «undeveloped» states of the periphery are poor because most of their resources flow to the core powers.

In the USSR, comprehension of the development of the Third World countries began, as in the United States, after the war. Two features were present here: 1) N. Khrushchev's speech at the Twentieth Congress of the Communist Party (1956), where the idea of progress was assumed in the spirit of the same modernization theory, with the only difference that his model was the USSR, not America; 2) the concept of the Asian mode of production (AMP) - a structure that existed in the East and is based on power-property.

It was the AMP that caused confusion in the Marxist sequence of modes of production, which brought the one-line process of history from the primitive system to communism. However, if some countries have passed the AMP, and others have not, then Marx's universalism, created for western societies, is false and does not explain the reason for the prosperity of some and the decline of other regions.

World-System Analysis

World-systems analysis has become the next paradigm for the analysis of the world. F. Braudel's approach was limited because focused on the study of capitalism from the XIV to the XVIII centuries, without touching on modernity, which will be analyzed by I. Wallerstein, who tried to break down the barriers between the social sciences and to rectify the situation in which researchers write on ridiculously narrow topics, avoiding the issues of power and social conflicts in world history. However, the main goal of I. Wallerstein was the desire to prove the inconsistency of the theory of modernization, whose alternative was the world-system analysis.

Before moving on to its main provisions, it is important to recall that a significant role in the intellectual development of I. Wallerstein belongs to M. Weber, who explained why the European world economy did not transform into a world empire. The reason lay in the capitalist foundation of the modern world system, fueling the competition between states to attract transnational capital. In other words, each state sought to attract freely circulating capital, and this latter dictated

the conditions on which it agreed to «serve», and capitalism persists until the national state gives way to the world state.

In addition to the legacy of M. Weber, I. Wallerstein relied on the concept of the core-periphery, put forward by the developers of ECLA. He borrowed the idea of the death of capitalism as a system from D. Schumpeter, who insists that capitalism has nurtured the seeds of its own destruction at birth. The sociologist's concept of worlds-systems was an analogy of K. Polanyi's three economic models - interchange, redistribution, market - which corresponded to mini-systems, worlds-empires and worlds-economies of I. Wallerstein. To analyze the cycles of the rise and fall of the world economy, he used the research of K. Bücher, G. Schmoler, I. Kondratyev. The «Annales school» represented by F. Braudel and also Marxism with the ideas of the class struggle played a significant role on I. Wallerstein. As a result of the generalization and revision of the above-mentioned material, I. Wallerstein, in contrast to modernism, which asserted the one-line nature of social evolution, introduces the concept of world-system from now on without considering a single state as a unit of analysis.

What is a world-system? Let's make a reservation - the world in I. Wallerstein's version does not cover the planet, as it seems at first glance, but is an autonomous political and economic zone that combines the principle of globality and consistency. That is why I. Wallerstein wrote this term through a hyphen. His worlds are territories with large and small populations, capital and labor movements.

There are several historical systems: *mini-systems* are characteristic of primitive societies that economically operate on the basis of interchange. *World-empires* are systems for the redistribution of luxury goods over long distances under the control of elites through their military power and political power. Only with the genesis of the European *world-economy* in the long XVI century (1450-1640) did the formation of a market-type capitalist system begin, when the center turned out to be north-western Europe with strong state power, an increase in production specialization and monopolization; Eastern Europe and Spanish America became the periphery; semi-periphery became Mediterranean (Wallerstein, 1974). From 1730 to 1840 India and the Ottoman Empire fall into the capitalist zone (Wallerstein, 1979) since 1750 Africa (Wallerstein, 2000) and Asia (Majid, 2000; Chew, 2014).

Thus, I. Wallerstein's analysis focuses on the networks of interaction of such «worlds» and erases the line of boundaries between them, going over individual states in order to identify the general laws of the evolution of the world system. Hegemony is a key factor in the stability of the world system, where leadership is ensured by the country's dominance in production, finance, minimal use of military force (which, nevertheless, exists), imposing its culture on the world. So, from 1450 to 1650 it belonged to Holland, from 1750 to 1900 – Britain, and since 1945 – the United States.

In fact, the capitalist world-system was not the first in a row, but it turned out to be the only surviving and lasting success of the global economy, which divided the ecumene into a core (Europe, the USA, Japan), a semi-periphery (Russia, the countries of Eastern Europe and south- East Asia), periphery (states of the Third World). Nevertheless, I. Wallerstein predicted the loss of geopolitical influence for America. Systems are finite. They go through cycles of birth, transformation and decline for a longue duree, meaning their extension. Thus, modern capitalism, like any system, will eventually die (Wallerstein, 2000; Mitrovich, 2007; Kuacker, 2014).

Further. I. Wallerstein called economics, political science, and sociology to interdisciplinarity. It, in his opinion, constitutes a single political, economic and socio-cultural space. The scientific barriers, erected by the liberalism of the XIX century that dominated the humanities, turned out to be incapable of synthesis, since the state, market and society were thought of as irrelevant categories of social reality.

I. Wallerstein's approach is not a theory, but a paradigm. The theory is based on empirical confirmation of logical inferences. Theories are volatile because in the light of new data, they undergo transformation, leading either to the refutation of the theory, or to the formation of a new one. This is, first of all, relevant for archaeologists due to the discovery of materials that have not been introduced into scientific circulation, leading to a revision of established assumptions or the creation of a new theory that would otherwise interpret the previous one. On the contrary, a paradigm is a conceptual scheme that pushes to the forefront of science previously unnoticed or completely unconscious aspects of social reality that improve understanding of the relevant phenomena and processes. In addition, the gains achieved are being introduced into a paradigm to find new gaps. When new questions and problems no longer arise within a paradigm, it falls out of use (paradigm shift). In other words, world-systems analysis, in general, is not a theory, but a set of approaches that share key aspects of early versions of the analytical view of the world and, due to their flexibility, bring something relevant to the paradigm.

Historical globalization

By the end of the XX century, the capitalist system became planetary, giving rise globalization, which, in fact, was not something new, but was the fundamental phenomenon of the world system. Globalization should not be understood as a mere phenomenon of modernity, since the exchange of technologies, goods and cultural ideas that form networks of links between civilizations has existed since ancient times. This is a natural process.

Of course, the world has become truly global only today. But the origins of

globalization, I think, are associated with the agrarian revolution and the fate of people who built the world's first cities in the river lowlands of the Ancient East. Thus, A.G. Frank singled out the Afro-Eurasian World-System with a duration of 5000 years, which arose in the zone of the Fertile Crescent in the 4th millennium BC. In his opinion, before the ascent of Europe, the primacy in the World-System was replaced by the civilizations of the Fertile Crescent, then Macedonia, Rome, the Ottoman and Persian empires, China (Frank, 1993).

A.G. Frank identified five most important features of the World-System: 1) the trade of civilizations, which forms a network of interdependent contacts; 2) the accumulation of capital by civilizations; 3) the core-peripheral structure is a key feature of the world system; 4) the world system is characterized by the rivalry between rising and declining hegemons; 5) economically, the World-System develops thanks to long cycles of ascending and descending phases (Frank, 1993; Frank, Thompson, 2005).

Other specialists, K. Chase-Dunn and T. Hall, accepted I. Wallerstein's concept of the capitalist world-economy, but considered it one of the many global systems that existed before the XVIth century (Chase-Dunn, Hall, 1991; Chase-Dunn, 1994). Their typology is as follows:

Systems of consanguinity
A: Stateless, classless societies:
1. Hunters, gatherers, pastoralists
2. Bigmen distributing the surplus product that appeared as a result of the transition from early primitiveness to late In: Chiefdoms.
II. Systems dominated by tribute (cities, states)
A: Primary world systems (Mesopotamia, Egypt, India, China, pre-Columbian America)
B: Primary empires formed as a result of the conquest of autonomous states (Sumer and Akkad, Egypt of the Old Kingdom, Zhou, Teotihuacan, Huari)
C: Multicenter world systems consisting of empires, states and peripheral regions (Middle East, India, China, Mesoamerica, Peru)
D: Systems where trade is known, but tributary dominates (Afro-Asian world-system, including the regions of Rome, China, India)
III. Capitalist world-system
A: European capitalist economy of the 17th century
B: The modern global world system (Chase-Dunn, Hall, 1993).

They also developed the concept of core/periphery, subdivided into: 1) core / periphery differentiation; 2) the hierarchy of the core of the periphery. Within the framework of the first aspect, societies of different levels of complexity interacted

within the boundaries of the same world system, while the second case indicates the existence of political, economic, military domination of some civilizations of the world system over others.

However, the most original design in this respect is T. Barfield's scheme, where the periphery (nomadic empires) systematically used the agrarian center (China), extracting surplus product from there. Remarkable is the fact that in the event of a core crisis, the periphery also fell into decay. In summary, the example of the nomads shows that the core/periphery differentiation and their hierarchy were radically opposed (Barfield, 1989; Kradin, 2016).

Today, in general terms, it is clear that the predecessor of the capitalist world order was probably the Afro-Eurasian world system, which was born in the Middle East. Already in the V– IV centuries BC. here trade in obsidian, metals, leather and textiles is recorded, which reached the Ist millennium BC. Large scale and has absorbed the territory of the Indian Ocean basin from the east coast of Africa to Indonesia, Southeast Asia and China. In this space, the leading role was played by Persian, Arab and Indian merchants who traded in luxury goods, building materials and food.

Another canal that connected medieval Europe with India through the sea trade in spices was opened by the crusaders in the XI–XIII centuries, and in the XIII–XIV centuries. Along with ocean trade, a land corridor was formed that ran through the possessions of the nomadic empires of Eurasia and contributed to the unity of Europe, East and Asia. The most important role in such integration was played by the Mongols - intermediaries in the exchange of goods and technologies in various zones of the world system. Thus, 300 years before the leadership of the West, looking at the world from a height, there is a tendency for "ecumene compounds" or archaic globalization.

One of the key periods for the Afro-Eurasian world system was the XV century, when the Ottoman Empire rose in Western Asia, which blocked the Levantine spice trade by the XVI century and «accelerated» the Europeans' search for a sea route to India. The great geographical discoveries also played a significant role, as a result of which the Afro-Eurasian world system was transformed into a planetary-capitalist one, which gave rise to the phase of modern globalization.

It is also quite possible that the Afro-Eurasian world system was the result of the unification of the three world systems of the Iron Age, which continued in the world from the end of the II to the beginning of the I millennium. What I talking about? After death in 1200 BC. world systems of the Bronze Age period from 1200 BC. at the beginning of the Ist millennium BC. turned out to be a gaping failure of world «perestroika». The old way of life has died, but the contours of the new order have not yet emerged. In the eastern Mediterranean, the rise of semi-peripheral civilizations (Cyprus, phoenician policies) took place for a short time,

which eventually lost their influence, giving way to three systems: western, Indian and eastern, which formed the Afro-Eurasian world system. Thus, the Western world system, which arose between 1000 and 850 BC., covered Egypt, the Levant, Anatolia, Assyria, and the Mediterranean. The center of the Indian world system by the VIIth century became Magadha - the most powerful of the sixteen polities of the Ganges and Gandhara valley, controlling the iron trade in the region. India was connected with western Asia by a land route - through Bactria, northern Iran - and a sea route - through the Persian Gulf. Thanks to «via the Yunnan», China was also included in the interchange network, whose world system, centered in Chu, in the Yangtze river valley, in the VIIt–Vth centuries was connected with Central Asia by the Yunnan - Burma - India road. From about 350 BC the integration of the above three world systems takes place and by the Ist millennium BC. global exchange networks are established between them

Africa and Eurasia were linked to each other at the dawn of human history. Homo Sapiens appeared in Africa 300,000 years ago and has spread throughout the world as a result of migrations caused by climate change. A sharp warming of the climate in the Holocene era allowed the development of land connections between Africa and Eurasia through Arabia and the Sahara, which was then still a flourishing land with lush vegetation, rivers and swamps. However, 5000 years ago, due to the cooling, the Sahara turned into a desert, disrupting the communication routes of Africa and Eurasia. Thanks to the domestication of the horse and the invention of the chariot in Eurasia, a military revolution began 4,500 years ago, which led to the conquest of territories by Central Asian societies from Egypt in the southwest to the Yellow River basin in the east. Horses were also known in Africa, but did not make such a furor as in Eurasia due to the rampant epidemics in the region, which were carried by the tsetse fly. In the Ist millennium BC. ties between regions are reviving again. Largely due to the fact that the camel was domesticated in Eurasia - a desert shuttle that facilitated travel from Eurasia to the Sahara and Arabia, and sea trade along the Red Sea linked Egypt with East Africa and India. Thus, Eurasia, penetrating deeper and deeper into Africa, gradually became its core, and that half-periphery. For clarity, see the image of the main routes of communication between regions.

Of course, the periods of regional integration were replaced by epochs of rupture, mostly due to climate change, but over time, the unity of this world system was restored. In addition, in the Ist millennium Afro-Eurasia was a global world-economy that linked the Mediterranean, East Africa, Arabian Peninsula, South Asia, Southeast Asia, Central Asia, Ceylon and China into a single pre-capitalist space.

Globalization, as indicated above, took many forms long before the XX century. It did not appear *ex nihilo*, but turned out to be a natural consequence, his-

torical logic, of the development of the world from antiquity to modernity. In fact, interest in it came out of the American world history, which sought to discover connections between local civilizations of the past in the long term. Thus, the search for the origins of globalization in the «darkness of the ages» yields certain results that allow one to look at this process differently.

Globalization is a phenomenon that is by no means limited by modernity. Moreover, if we talk about the globalization of modern times, then it will turn out to be the last process of a series of world unions, which have been recorded since the rise of the first megacities of antiquity (Uruk, Babylon, Huari, Cahokia, Delhi, Jericho, Damascus, Byblos, etc.), which required interregional networks and exchanged technologies, ideas, human resources, and goods, destroying the isolation of civilizations. The forms of interaction were different: trade, conquest, migration. Of course, archaic globalization did not yet cover the globe, but it made people strive for regional cooperation. Thus prehistoric North America, Europe, the Aegean Basin, Eurasia and the Ancient East in different historical periods, were zones of pre-capitalist world systems.

It follows from this that the world-systems analysis and the approach of historical globalization are applicable not only to modernity, but also to archaic societies (Edens, Kohl, 1993; Stein, 1999; Algaze, 1997; Kristiansen, 1999; Oka, 2008; Allen, 2012; Ling, 2014; Kardulias, 2016; Willson, 2016). It may be objected that the approach of I. Wallerstein is suitable for describing capitalism, which is limited to a 500-year cycle. In general, it is, but there are many examples of regional integration, demonstrating the complexity of the world system already in the Bronze Age in Southwest Asia, whose economies could easily move from the core to the periphery. This fact allowed the latter to maintain autonomy and eliminate some of the exploitation and lack of knowledge characteristic of the modern world system. In addition, it was the periphery of barbarism that had a significant impact on the development of the main regions.

Understanding the principles of work of the world-system analysis and historical globalization, it is possible, albeit in the most general form, to discern in world history a certain phenomenon of the integration of regions towards ever greater interaction on the several levels: *Local level* of the IV millennium BC, represented by pre-state forms of simple and medium complexity. The beginning of the agraria1n revolution. *Regional level* fell on the period from the second half of the 4th millennium BC. to the first half of the Ist millennium BC. At this stage, the early states and the first empires emerged in the world. Economically, the second stage of the agrarian revolution begins. *Continental connections* (second half of the Ist millennium BC–XV century) between the regions existed from 490 BC. Until 1492 year, mature states were formed here along with empires. The final stage of the agrarian revolution. *Intercontinental or oceanic level* (late XV century -

early XIX), and industrialization begins in production, discovery of new parts of the world through geographical discoveries, colonialism. *Global networks* were established at the beginning of the XIX century and exist until XX century. The genesis of supranational structures (Crozier, Huntington, Watanuki, 1973) and the completion of industrialization. *Planetary level* (started in the last third of the XXI century). At this stage, the strengthening of supranational structures is recorded, erasing state sovereignty, as a result of which the latter begins to search for new ways of political integration. If the states don’t find the way out a further path out of this situation may be the collapse of national states, the collapse of the capitalist system and increased regionalization in the form of a rise of regions-economics.

The GDELT Project (Global data events language and tone)

The modern world requires the ability to work with big data. However, as usual, a significant part of russian specialists prefer to stay within the narrow framework of their topics, which in turn stimulates the uncontrolled growth of micro-studies that are poorly consistent with each other.

An example of working with big data is The GDELT Project led by Kalev Leeataru. From 1801 to 2005 GDELT digitized all available information for seven countries - China, Russia, Japan, Germany, France, USA, UK. The main criterion for assessing was the question of how well the development of these countries corresponded to the corridor of opportunities that was determined by the empirical generalizations of big data? It turned out that the listed countries besides Russia corresponded to the existing corridors of opportunities, and the Russian history «broke out» from it. Conclusion: there is no single, universal approach to the development of complex systems. *The path traversed by the West, in fact, is not universal, but unique*.

Intersen's destiny project. By 2008 year, GDELT had digitized all available research on large countries, and by 2013 year was taken under the wing of the CIA. All publications on the analytical and predictive part of world development have disappeared not only from scientific journals, the Internet, but also the Darknet. All that can be found now, for the most part, old developments, while new ones are applied to practical use. Despite this, even now, GDELT is showing a very successful example of working with big data.

The principle of work of GDELT with large amounts of information is very interesting. The project identifies three units of research: events, situations and transformations. *Events*, single actions of one or several subjects, are the basic units of analysis. Events always take place within a situation, causing it to change. *Situations* are extended during the action, united by the unity of the subjects' actions, the point of application of efforts and the existing conditions. *Transforma-*

tion is the transition from one situation to another. Overall, it is a good language for studying the historical functioning of any system, both pre-capitalist and capitalist.

Such an analysis is good for a general understanding of systems, but it should be borne in mind that for a deeper analysis it is important to remember that in different systems there are patterns that are not in another. For example, power and property are different in different civilizations. Therefore, applying the technique of analyzing large systems, it is necessary to analyze both general and specific issues without diving into any of them. This is a kind of a view from above, taking into account general trends and individual characteristics of particular historical systems.

Conclusion

The familiar world is changing. Not only it image is transformed, but also the basis. From now on, the most important task of the social sciences should be the desire to track the most important trends in global evolution. A kind of analysis of the changes in the world from the dawn of history to the present day. This can be helped by world-systems analysis, historical globalization which, on the basis of big data, for example, GDELT Project, will be able to describe the changing global reality. From now on, the Cartesian dismemberment of the whole into elements does not meet the needs of a modern, global order, since does not cover the entire spectrum of socio-economic, political and technological changes in the world system, focusing on its individual aspects: the market, civil society, policy.

Moreover, two questions are still relevant: «when?» and «where?» globalization started. Probably, its origins are hidden under the shadow of the past capable, I think, to explain the features of the globalization process of our time.

References

1. Algaze G (1999) The Uruk World-System. The Dynamics of Expansion of Early Mesopotamian Civilization. The University of Chicago Press.

2. Allen T (2012) Bronze, Boats and the Kentish Seabord in Prehistory: the Role of Coastal Kent in a Major Trans-Continental Trade Route. Archeologia Cantiana. 132: 1–19.

3. Barfield T (1989) The Perilous Frontier: Nomadic Empires and China. Blackwell.

4. Blim M and Goffi G (2014) The Long and the Short: The Value of Concept of the Long Duree in the Analysis of Contemporary Economic Development and Decline. Economia Marche Journal of Applied Economics. XXXIII(1): 94–113.

5. Braudel F (1958) Histoire et Sciences Sociales: La Longue Duree. Annales. Economies. Societies. Civilizations. 4: 725–756.

6. Brodel F (1989) Svidetel'stvo istorika [Treatment of historian] Moscow: Nauka.

7. Chase-Dunn K and Hall T (1991) Core/Periphery Relations in Precapitalist Worlds. Boulder, CO: Westview.

8. Chase-Dunn K and Hall T (1993) Comparing World Systems: Concepts and Working Hypotheses. Social Forces 71(4): 868–875.

9. Chase-Dunn K and Hall T (1994) The Historical Evolution of World–Systems. Sociological Inquiry. 64(3): 257–280.

10. Chase-Dunn K and Hall T (1994) Forward into the Past: World–Systems before 1500. Sociological Forum. 9(2): 295–306.

11. Chew S (2018) The Southeast Connection in the First Eurasian World-Economy 200 BC–AD 500. Journal of Globalization Studies. 5(1): 82–109.

12. Eedens C and Kohl P (1993) Trade and World-System in Early Bronze Age Western Asia. In: C. Searre, F. Healy (eds.) Trade and Exchange in Prehistoric Europe. Oxbow Books. Oxford: 17– 34.

13. Frank A (1993) Bronze Age World-System Cycles. Current Anthropology. 34(4): 383–429.

14. Frank A (2005) Thompson W. Afro-Eurasian Bronze Age Economic Expansion and Contraction Revisited. Journal of World History. 5(16): 115–172.

15. Kardulias PN (2014) Archeology and Study of Globalization in the Past. Journal of Globalization Studies. 5(1): 110–121.

16. Kradin N (2016) Mongols Empire and the Debate of the Nomadic State Origins. In: B. Cerasetti (ed.) Papers in Honour Maurizio Tossi for his 70th Birthday. International Series: 369–377.

17. Kristiansen K (1999) Europe before History. Cambridge University Press.

18. Kuacker GD (2014) From the Alienation of Neoliberal Globalization to Transmodern Ways of Being: Epistemic Change and the Collapse of the Modern World-System. Journal of Globalization Studies. 5(1): 154–170.

19. Lee R (2018) Lessons of the La Longue Duree: The Legacy of Fernand Braudel. Historia Critica. Lo Micro y Lo Macro: Los Espacios en La Historia. 69: 69–77.

20. Ling J and Uhner C (2014) Unher C. Rock Art and Metal Trade. Adoranten. Scandinavian Society for Prehistoric Art. Tanums Museum Hallristnings Museum Underslos. 2014: 23-43.

21. Manning P (2014) Africa's Place in Globalization: Africa, Eurasia and their Borderlands. Journal of Globalization Studies. 5(1): 2014. 65–81.

22. Mitrovic R.L (2007) Immanuel Wallerstein Contribution to Mondology and the Critical Theory of the Global World System Transition. Philosophy, Sociology and Psychology. 6(1): 100–122.

23. Oka R. and Kharupukha M (2008) The Archeology of Trade Systems. Part 1: Towards a New Trade Synthesis. Journal of Archeological Research. l(16): 339–395.

24. Parsons T (1991) The Social System. Routledge.

25. Rostow WW (1960) The Stages of Economic Growth. A non-Communist Manifesto. Cambridge University Press.

26. Stein GJ (1999) Rethinking World-Systems. Diasporas, Colonies and Diasporas Interaction in Uruk Mesopotamia. Tuscon: University of Arizona Press.

27. Tipps D (1973) Modernization Theory. Comparative Study of Societies. 15(2): 973. 205–213.

28. Wallerstein I (1974) Capitalist World-System and Its Future Demise: A Comparative Analysis. Comparative Study in Society and History. 16(4): 390–415.

29. Wallerstein I (1979) The Ottoman Empire and the Capitalist World-Economy: Some Questions for Research. Review (Fernand Braudel Center). 2(3): 389–398.

30. Wallerstein I (2000) Africa in a Capitalist World. In: Wallerstein, I (ed.) Essential Wallerstein. New York: New Press.

31. Wallerstein I (2000) Globalization or the Age of Transition. A Long Term View of the Trajectory of the World System. International Sociology. 15(2): 251–263.

32. Willson ND (2016) Regional Interaction in World-System Incorporation in during the Classic Period Western Sierra de Los Tuxlas, Mexico. Arizona State University.

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COMPARATIVE ANALYSIS OF INFORMATION PREFERENCES OF YOUNG PEOPLE AND PEOPLE OF MATURE AGE DURING THE COVID-19 PANDEMIC

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Abstract. *This article presents the results of a study of the information preferences of young people and mature people during the Covid-19 pandemic. The choice of informational preferences is seen as an important factor in informational socialization. A brief analysis of personality traits of representatives of the new information generation "Net gen" is carried out.*

Keywords: *digital socialization, generation "Net gen", information preferences.*

Introduction

According to the annual report on the state of the digital environment from Global Digital 2021, in January 2021, 4.66 billion people worldwide use the Internet, which is 7.3% more than last year, and 53.6% of the world's population use social networks. ... We see how the virtual world has been added to the space of the real world, which every year plays an increasing role in the life of every person. All this leads to changes in the conditions of human socialization. On the one hand, expanding its resource, on the other hand, it forces one to be in a constant situation of uncertainty and the search for personal boundaries.

In our country, out of 145.9 million inhabitants, 124 million are active Internet users.

Don Tappscott, studying the impact of the penetration of digital technologies into life, identifies the following norms that have formed among people of the Internet generation [1, p. 73]:

1. Freedom. The Net Gen (as Tappscott calls them) have been given the freedom to choose what to buy, where to work, and who to be through the Internet.

They do not strive to find a job immediately after receiving an education, to which they will give their whole life. They are open and ready to experiment. Young people today tend to avoid traditional office space and tightly regulated work schedules. And many tech giants like Google and Intel are striving to create the most comfortable work environment for the next generation of their employees.

2. Customization. Young people strive to do everything for themselves. When they buy various goods, they change them in order to express themselves in their things. Today you can see a lot of young people with different stickers, stickers, pins and badges.

3. Skepticism. The Net Gen motto is "Trust but Verify." This norm is especially important in the digital space, where there is a lot of false information. Therefore, representatives of this generation, who were familiar with the digital environment from an early age, adapted to it by checking the incoming information.

4. Tolerance. Net Gen representatives strive to be honest, considerate of the world's problems and concerns of others, and to honor their commitments. However, Professor Jean Twenge disagrees with this norm, highlighted by Tappscott, who calls the younger generation "the I generation" and believes that this is the most narcissistic generation in history.

5. Cooperation. With the advent of digital technologies into our lives, it has become easier to communicate, find like-minded people and unite with them in groups to work on a common cause.

6. Speed. Young people today are online almost all the time. At any moment they can receive messages on the phone, and they immediately answer. If they need to find some information, then the search process will not take them long. The ability to quickly navigate a situation young people can transfer to any field of activity.

7. Innovation. Today's world is constantly evolving. New technologies appear every year. The Net Gen representatives, who are most densely integrated into the digital environment, strive to keep up with the progressing world, actively seeking new information. The drive for innovation is also associated with the drive for customization. Young people want to adjust everything for themselves and therefore come up with something new.

All these norms look like positive consequences of living in the digital space, but attention should also be paid to the negative impact of digital technologies.

Modern users who receive information, mainly from digital sources, are characterized by a superficial style of information processing, rapid switching of attention, which in turn can lead to a violation of the formation of important educational skills: logical analysis, critical thinking and reflection [2, p. 50] .

Purpose of the study

One of the main tasks is to study the way a person adapts to a new reality. We

see how much young people differ from people of the older generation, and we are interested in how these changes take place, how the digital socialization of the younger generation takes place.

Digital socialization is mediated by the technosystem. The technosystem includes human interaction with both living (peers) and non-living (electronic devices, programs, applications) its elements. The use of more complex tools (elements of a technosystem) by a person in the process of socialization may require the development of more and more complex cognitive processes, which means a more complex person to interact with the outside world [3, p. 72]. Digital socialization is an important part of traditional socialization and is the process of mastering and appropriating a person's social experience, which was acquired in the context of the virtual and real world. The result of digital socialization is the formation of a digital personality of a person, which today is an integral part of a real personality.

One of the important aspects of digital socialization is the formation of information preferences - that is, the choice of the most suitable and reliable sources for a person to find the necessary information.

The formation of information preferences is significantly influenced by such factors as: reference group, categorization in the process of forming a group identity, leading human activities, territorial position, as well as age, interests and values.

Our earlier study of information preferences [4, p. 90] showed that today the most preferred sources of information for representatives of younger and older age groups is the Internet, and people spend about two hours a day searching for the information they need.

It was also found that young people prefer social networks and information sites, while older people spend more time on news sites.

Informational preferences affect the behavior of people, the construction of their lifestyle. The issue of information preferences turned out to be especially relevant to us in the situation of the COVID-19 pandemic, when there was a lot of information about this disease in various sources, and sometimes the information was rather contradictory.

An empirical study of the information preferences of young people and adults during the Covid-19 pandemic.

Objective of the study: comparative analysis of information preferences of representatives of young and mature age groups during the covid-19 pandemic

Study sample. The study involved 167 people, including 89 at the age from 18 to 25 years old and 78 at the age from 45 to 60 years old.

Materials and methods

The respondents were asked to fill out a questionnaire to identify information preferences during the covid-19 pandemic.

Results and discussion

During the covid-19 pandemic, the new disease was talked about from various sources of information. We were interested in how our respondents learned about the coronavirus. The results are shown in the diagram below.

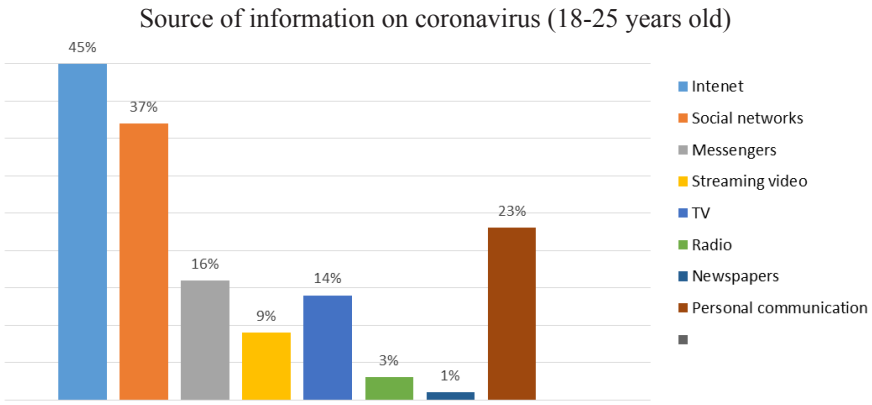

Fig. 1. *Source of information on coronavirus (18-25 years old)*

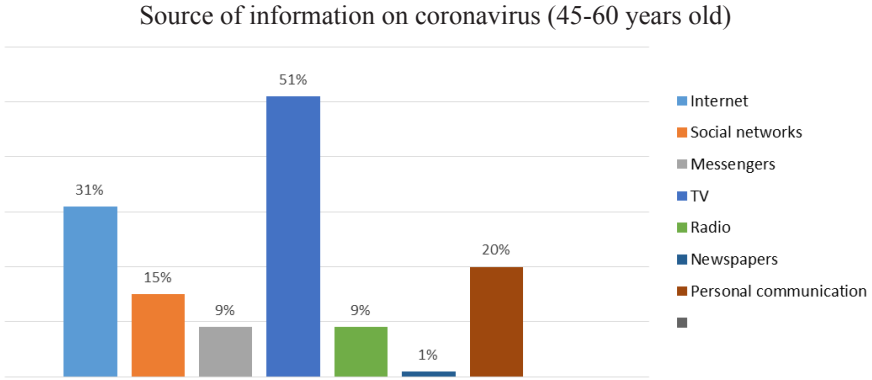

Fig. 2. *Source of information on coronavirus (45-60 years old)*

It can be seen that the main source of information about the coronavirus differs in different age groups. So, young people learned about a new disease, mainly from the Internet and social networks, and adults received this information more through television. In addition, young people have such a source of information as "streaming video", while mature people do not use this source.

It is also worth noting that in both age groups, almost a quarter of the respondents received information about the coronavirus from personal communication.

It was important for us to find out which sources of information the surveyed respondents trust.

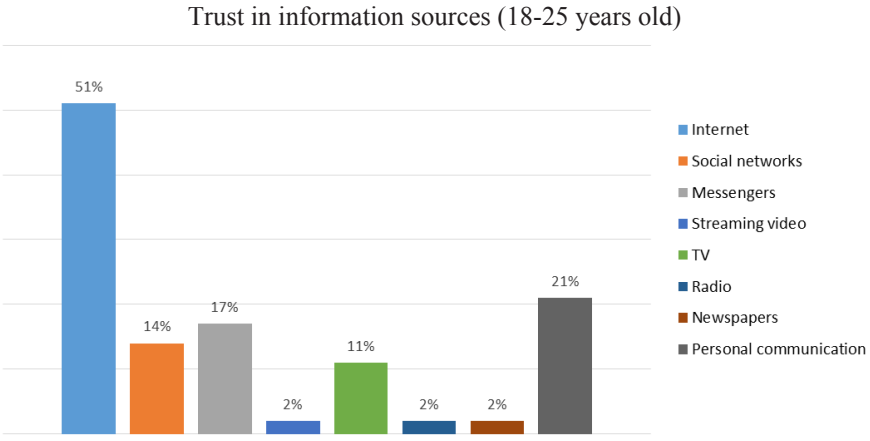

Fig. 3. *Trust in information sources (18-25 years old)*

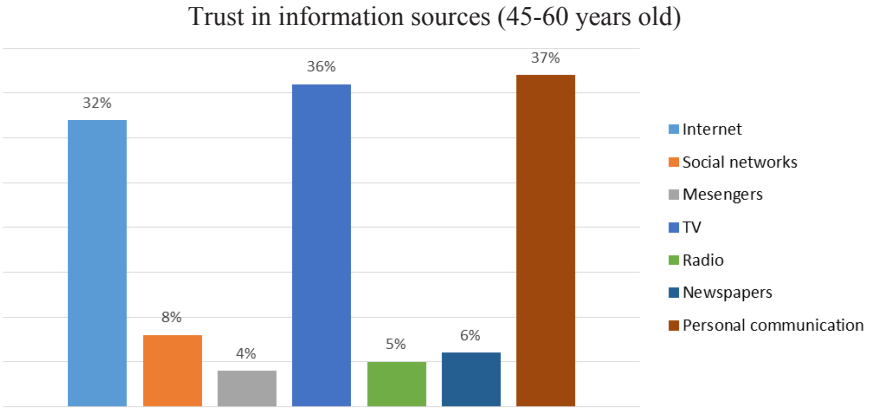

Fig. 4. *Trust in information sources (45-60 years old)*

On this issue, we have obtained quite interesting results that illustrate the discrepancy between different age groups. Thus, young people most of all trust information received from the Internet, and only a quarter of respondents from this age group trust personal communication.

For mature people, there are three main sources of information that are most trusted: the Internet, television and personal communication. Such a higher level of trust in information obtained from personal communication can be justified by the fact that people of mature age either have more competent acquaintances, or by the fact that they are less confident in themselves and in the information that they have found on their own, so it is easier for them to trust other people whom they consider to be more competent in this matter.

All respondents actively monitored the spread of coronavirus in the world and we were interested in what sources they used to search for up-to-date information about the situation with the coronavirus.

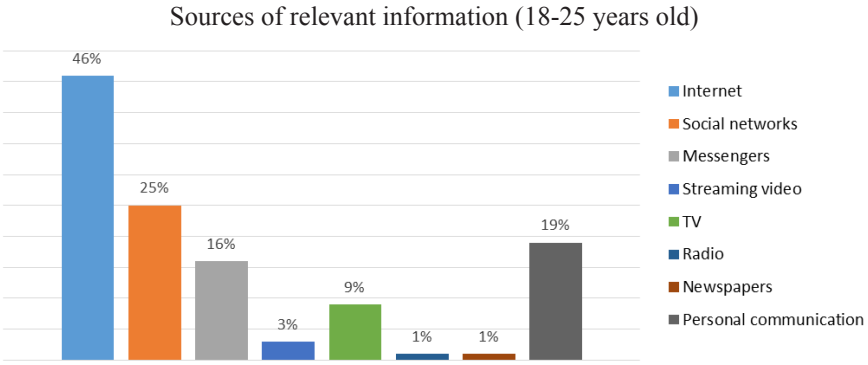

Fig. 5. *Sources of relevant information (18-25 years old)*

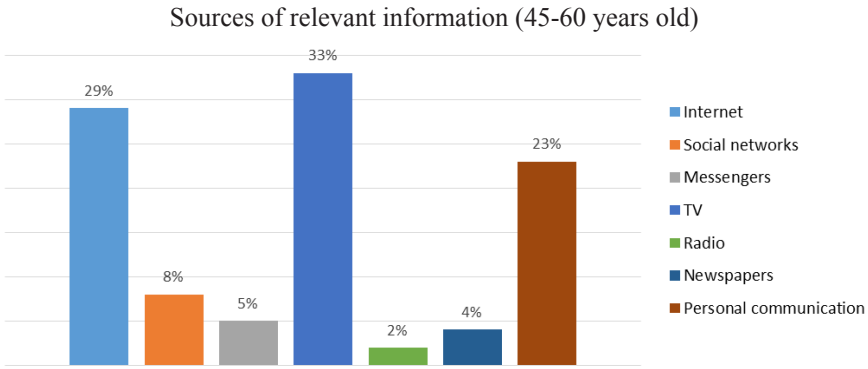

Fig. 6. *Sources of relevant information (45-60 years old)*

The results obtained are similar to those of the previous question. The Internet stands out among young people, followed by social networks and personal communication. For people of mature age, television and the Internet are approximately at the same level and, with a slight lag, personal communication follows.

In the midst of the covid-19 pandemic, there was a lot of different information from different sources. Along with useful and reliable information, a lot of fake news about a new disease, its spread and possible consequences got into the information field. We asked the respondents a question about whether they got to such news or viewed them. In both age groups, the majority of respondents (90% in both groups) answered negatively to this question.

Many famous people spoke about the situation in the world, who shared their opinions and attitudes towards the coronavirus and the precautions that were taken in many countries. In this regard, we were interested in how important the opinions of famous people about the pandemic were for our respondents.

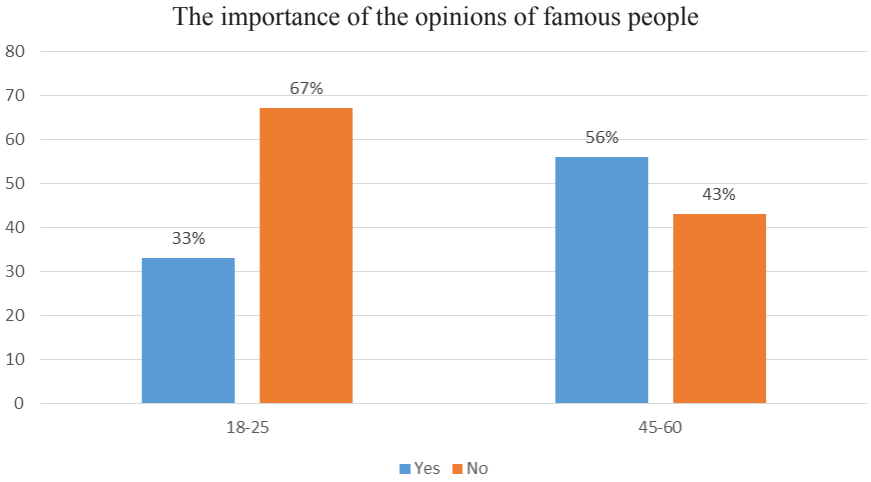

Fig. 7. *The importance of the opinions of famous people*

The results obtained show us that for young people the opinion of famous people is generally not important. It can be assumed that they themselves form an individual opinion about the current situation and independently decide whether to take precautions or not. For the majority of mature people (56%), the opinions of famous people turned out to be an important indicator.

Through our research, we obtained data on the preferred sources of information about the coronavirus and the sources that are most trusted by our respondents. But it was also important for us to find out how the respondents disseminate information about the coronavirus among their friends, relatives and, possibly, among other people through a blog.

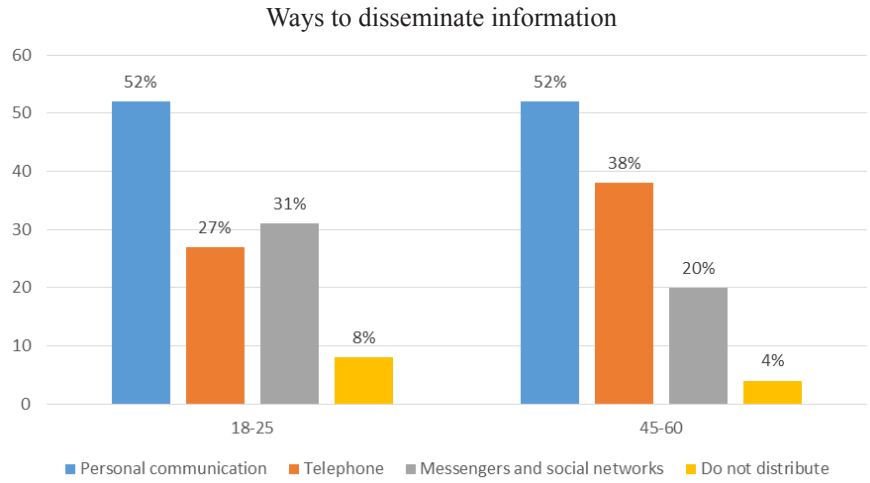

Fig. 8. *Ways to disseminate information*

Representatives of both age groups prefer personal communication as the main way of disseminating information. There is a slight discrepancy in the second most popular way of disseminating information: young people prefer instant messengers and social networks, while mature people prefer live communication by phone.

The choice of information sources, even in critical conditions, is largely due to how the process of digital socialization of people took place.

References

1. Tapscott D., Barry B. Grown up digital: How the net generation is changing your world. - New York: McGraw-Hill, 2009. - T. 73.

2. Ershova, R. V. Digital socialization of personality in the era of global changes / R. V. Ershova // Applied psychology at the service of the developing personality: Collection of scientific articles and materials of the XVI scientific-practical conference with international participation, Kolomna, February 14-15, 2019 ... - Kolomna: State educational institution of higher education of the Moscow region "State social and humanitarian university", 2019. - pp. 49-54.

3. Soldatova G.U. Digital socialization in the cultural-historical paradigm: a changing child in a changing world // Social psychology and society. 2018.Vol. 9.No. 3. P. 71–80. doi: 10.17759 / sps.2018090308

4. Plotnikov A. Yu. Information preferences of young people and people of mature age in the digital space / A. Yu. Plotnikov, O. A. Semizdralova // Scientific Almanac. - 2021. - No. 3-2 (77). - P. 89-95.

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COMPARATIVE ASSESSMENT OF THE RATE OF CHANGE IN THE AMOUNT OF PRECIPITATION IN THE NORTH CAUCASUS REGION FOR 1961-2019 AND 1976-2019

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Abstract. *Global climate change and the impact of these changes on the environment, ecology, economy at the end of the twentieth century, became one of the main problems of human life. Since climatic changes are not synchronous in time and space, regional studies are necessary fragments in building an overall picture of climate change.*

The purpose of this article is to assess changes in the precipitation regime in the North Caucasus region for the periods 1961-2019 and 1976-2019 for different climatic zones.

It was found that in all climatic zones of the North Caucasus region, both an increase and a decrease in seasonal and annual precipitation were observed, mainly these trends are statistically insignificant. In all climatic zones, with the exception of the alpine one, in the period 1976 to 2019, a negative trend in the amount of precipitation was observed, which increased in comparison with the entire observation period.

Keywords: *North Caucasian region, climatic zone, modern period, precipitation amount, trend, rate of change.*

Introduction

Climate is a generalization of weather changes in a given area of space at a given time interval. To characterize the climate, a statistical description is used in terms of averages, extrema, indicators of variability of the corresponding values and the frequency of occurrence of phenomena for a selected period of time. The most important and popular climatic variables used to estimate climate change are air temperature at the surface of the earth and precipitation.

Atmospheric precipitation in the form of rain, snow and hail are common natural phenomena. Abundant atmospheric precipitation increases the likelihood of floods, avalanches, rockfoils, mudflows, landslides, landslides, contributes to the accumulation of a critical amount of water in mountain lakes and unexpected breakthrough of dams, river overflow, destruction of roads, power lines, buildings, destruction of farmland [1].

According to the results of the forecast [2] in the XXI century, the amount of precipitation on the territory of Russia, as a whole, will increase, and the most significant in the winter. The distribution and intensity of future precipitation changes are highly seasonal.

Purpose of the study - to establish the nature of the change in the precipitation regime in different climatic zones of the North Caucasus region for the observation period 1961-2019 and for the period of modern warming 1976-2019.

Materials and methods

According to climatic characteristics, the North Caucasian region can be divided into 4 zones depending on the height above sea level: plain, foothill, mountain and high-mountain.

The flat zone occupies most of the region's territory and stretches from its northern borders to the south, to the Terek River. Plains are territories with a slight elevation difference (up to 200 m), they are low-lying up to 200 m, elevated from 200 to 500 m and higher than 500 m, such plains are called plateaus.

The foothill zone (500-1000 m above sea level) is located to the south and stretches in a small strip from northwest to southeast. The mountainous zone is located at an altitude of over 1000 and alpine at an altitude of over 2000 m above sea level. The physical and geographical characteristics of the meteorological stations in the North Caucasus region are shown in Table 1.

Table 1 - *Physical and geographical characteristics of meteorological stations in the North Caucasus region*

№ n/n	Weather stations	Longitude (°N), Latitude (°E)	Height above the sea level, (m a. s. l.)
Plain stations (< 500 m a. s. l.)			
1	Prokhladnaya (Kabardino-Balkaria)	43.46° N; 44.05° E	198
2	Izobil'nyi (Stavropol region)	45.22° N; 32.42° E	194
3	Makhachkala (Dagestan)	42.59° N; 47.31° E	173
4	Mozdok (Republic of North Ossetia - Alania)	43.44° N; 44.39° E	126

5	Derbent (Dagestan)	42.04° N; 48.17° E	30
6	Izberg (Dagestan)	42.34° N; 47.45° E	21
7	Kizlyar (Dagestan)	43.51° N; 46.43° E	-17
Foothill stations (500–1000 m a. s. l.)			
8	Kislovodsk (Stavropol region)	43.54° N; 42.43° E	819
9	Vladikavkaz (Republic of North Ossetia - Alania)	43.21° N; 44.40° E	680
10	Buinaksk (Dagestan)	42.49° N; 47.07° E	560
11	Stavropol (Stavropol region)	45.03° N; 41.58° E	540
12	Cherkessk (Karachay-Cherkessia)	44.17° N; 42.04° E	526
13	Nalchik (Kabardino-Balkaria)	43.22° N; 43.24° E	500
Mountain stations (1000–2000 m a. s. l.)			
14	Teberda (Karachay-Cherkessia)	43.45° N; 41.73° E	1280
15	Akhty (Dagestan)	41.28° N; 47.44° E	1054
High-mountain station (> 2000 m a. s. l.)			
16	Terskol (Kabardino-Balkaria)	43.15° N; 42.30° E	2144

To study changes in the precipitation regime, averaged values, anomalies and trends for calendar seasons and the year as a whole were used.

The time series were investigated by the methods of mathematical statistics and supplemented by linear trends characterizing the trend of the value under consideration for the periods 1961-2019 and 1976-2019. Average values and norms of annual and seasonal precipitation were calculated for each climatic zone and the region as a whole.

Results and discussion

In different climatic zones of the North Caucasus region, climate change can vary significantly. Figure 1 shows the course of annual precipitation amounts according to data from 16 m/stations in the North Caucasus region. Figure 1 shows that changes in the precipitation regime in different climatic zones are not synchronous. The greatest amount of precipitation is observed in the high-mountainous zone, and the least in the lowland zone.

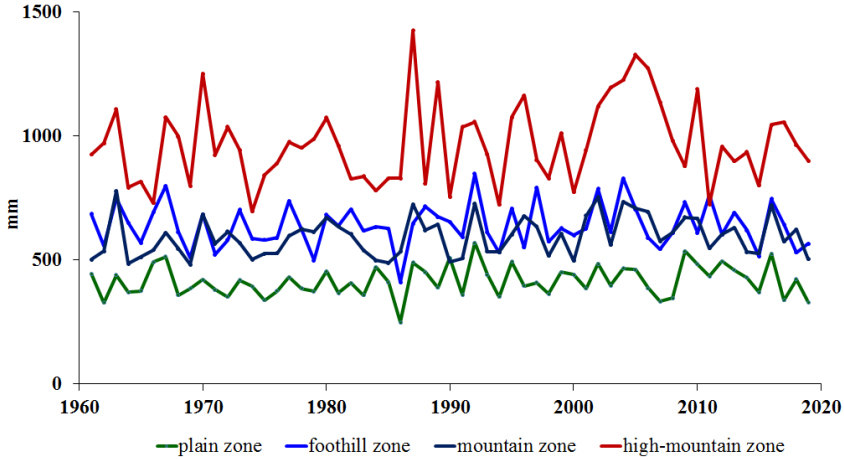

Figure 1 - *The course of annual precipitation totals according to data from 16 m/stations of the North Caucasus region*

To study changes in the precipitation regime, as in previous works [3, 4], we used averaged values and trends for calendar seasons and the year as a whole.

The time series were investigated by the methods of mathematical statistics and supplemented with linear trends characterizing the trend of the value under consideration for the periods 1961-2019 and 1976-2019. Average values and norms of annual and seasonal precipitation were calculated for each climatic zone and the region as a whole.

Throughout the North Caucasus region in the period from 1961 to 2019 there was a statistically insignificant increase in annual precipitation. Table 1 shows the averaged values of precipitation amounts and their climatic norms in different climatic zones and on average for the region for the periods 1961-2019 and 1976-2019.

Table 2 shows that in all climatic zones in the period 1976-2019 the excess of the climatic norm is higher than in the period 1961-2019.

Table 2 - *Climatic norms and annual precipitation for the periods 1961-2019 and 1976-2019 in the North Caucasus region*

Climatic zones	Plain	Foothill	Mountain	High-mountain	Average for the North Caucasus
Climatic norm (1961-1990), mm	405	631	576	936	637

Average annual precipitation, 1961-2019, mm	416	640	594	969	655
ΔP exceeding the climatic norm	11	9	18	33	18
Average annual precipitation, 1976-2019, mm	421	642	605	983	662
ΔP exceeding the climatic norm	16	11	29	47	25

Table 3 shows the summary characteristics of the linear trend (slope b (mm/10 years) and contribution to the total variance *D* (%)). The slope *b* characterizes the rate of change of the meteorological parameter, and the strength of the trend, its significance, describes the value of the contribution to the total variance (*D*,%). Table 3 shows that in all climatic zones, both an increase and a decrease in seasonal and annual precipitation were observed, these trends are mainly statistically insignificant. In the plain zone, from 1976 to 2019, there was a slight decrease in the growth rate of annual precipitation amounts from 5.4 mm/10 years to 5.32 mm/10 years. Winter and spring seasons, the growth rate has increased, the autumn and especially summer season (from -3.2 mm/10 years for the entire period to -4.45 mm/10 years in the modern period) is characterized by a decrease in precipitation. All trends are statistically insignificant, with the exception of a steady increase in winter precipitation. In the foothill zone, the growth rate of annual precipitation amounts in the modern period decreased compared to the entire observation period and amounted to 0.93 mm/10 years, the trend is statistically insignificant. This is due to the strengthening of the negative trend in summer precipitation amounts and a decrease in precipitation in the autumn season. In the mountainous zone, there is also a tendency towards a decrease in annual precipitation amounts to 6.55 mm/10 years. The main contribution to this change is made by the winter season, where the growth rate decreased from 1.34 mm/10 years to 0.042 mm/10 years, summer and autumn seasons, where the growth rate has a negative trend (-2.25 mm/10 years and -0.66 mm/10 years respectively). In the mountainous zone, only the spring season is characterized by an increase in the amount of precipitation (from 5.5 mm/10 years for the entire period to 10.01 mm/10 years in the modern period). At the high-mountain meteorological station Terskol, the growth rate of annual precipitation totals was 15.25 mm/10 years (*D* =1.36%), which is lower than the annual precipitation totals for the entire observation period. In the winter season, there was a negative trend in the change in the amount of precipitation, and in the modern period the growth rate was -3.02 mm/10 years. Spring and sum-

mer seasons are characterized by a slight increase in the growth rate of seasonal precipitation amounts.

Table 3 - *Comparative estimates of the rate of change in the amount of precipitation in different climatic zones of the North Caucasus region for 1961-2019 and 1976-2019*

Season	Year		Winter		Spring		Summer		Autumn	
years	1961-2019	1976-2019	1961-2019	1976-2019	1961-2019	1976-2019	1961-2019	1976-2019	1961-2019	1976-2019
Plain zone										
b	5,4	5,32	2,69	5,21	1,53	2,27	-3,2	-4,45	5,2	3,12
D(%)	2,26	1,12	4,6	**9,62**	1,2	1,64	2,9	3,0	5,8	1,08
Foothill zone										
b	1,1	0,93	8,82	2,47	3,0	7,27	-4,4	-7,95	2,5	-0,34
D(%)	0,05	0,01	0,6	2,87	2,0	6,04	1,4	2,75	1,5	0,01
Mountain zone										
b	10,36	6,55	1,34	0,042	5,5	10,01	0,2	-2,25	4,3	-0,66
D(%)	5,1	1,2	0,3	0,0	5,8	8,9	0,0	0,6	2,4	0,03
High-mountain zone										
b	16,31	15,25	0,3	-3,02	9,1	12,89	-0,4	0,57	8,8	5,7
D(%)	2,9	1,36	0,0	0,25	3,8	3,52	0,0	0,01	2,6	0,66
Average values for the North Caucasus region										
b	8,55	6,96	1,3	1,18	4,4	7,46	-1,9	-3,52	5,2	1,96
D(%)	3,3	1,38	0,4	0,23	4,3	5,57	0,7	1,3	4,4	0,35

b – the value of the slope of the linear trend (mm / 10 years), ***D***(%) – the contribution of the trend to the total variance. Bold indicates trends that are statistically significant at the 5% level.

In general, in the North Caucasus region, we can talk about a decrease in the growth rate, both in annual precipitation amounts and seasonal, with the exception of the spring season, where the growth rate in the modern period has increased to 7.6 mm in 10 years. All trends are statistically insignificant.

Separately, I would like to note the change in the amount of precipitation in the summer season. In all climatic zones, with the exception of the alpine one, in the period 1976 to 2019, a negative trend in the amount of precipitation was observed, which increased in comparison with the entire observation period. Only in the alpine zone, in which there was a negative trend in the change in the amount

of precipitation over the entire observation period, there was an increase in the amount of precipitation in the modern period, although this trend is statistically insignificant.

Since the plain and foothill zone of the North Caucasus region is the most important producer of agricultural products, a decrease in summer precipitation may negatively affect the production of agricultural products.

In contrast to the forecast given in [2], in the region under consideration, there is a tendency towards a decrease in annual and seasonal precipitation amounts in all seasons, except for spring.

Conclusion

During the study of changes in the precipitation regime in the North Caucasus region, both an increase and a decrease in annual and seasonal precipitation were observed.

In the plain zone of the North Caucasian region, an increase in winter and spring precipitation and a decrease in summer and autumn were observed, due to which there was a tendency to a decrease in annual precipitation as well.

In the foothill and mountainous zones in the winter, summer and autumn seasons, as well as in the year as a whole, there was a decrease in seasonal precipitation amounts in the modern period, compared to the baseline, in contrast to the spring season, characterized by their growth.

The alpine zone is the only zone where there is an increase in summer precipitation.

References

1. *http://climatechange.igce.ru*

2. *Kattsov V.M., Kobysheva N.V., Meleshko V.P. et al. Assessment of the macroeconomic consequences of climate change on the territory of the Russian Federation for the period until 2030 and beyond. Proceedings of the GGO them. A.I. Voeikova, St. Petersburg. No. 563. 2011. Pp. 7-59.*

3. *Ashabokov B.A., Tashilova A.A., Kesheva L.A., Taubekova Z.A. Trends in precipitation regime and frequency of extreme values in different climatic zones of southern Russia (1961-2011) Meteorology and hydrology. Number 3. 2017. Pp. 18-28*

4. *Ashabokov B.A., Fedchenko L.M., Tashilova A.A., Kesheva L.A., Teunova N.V. Spatio-temporal climate change in the south of the European territory of Russia, assessment of its consequences, methods and models of agro-industrial complex adaptation. Monograph, Fregat LLC, 2020. 476 p.*

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PRIORITY AREAS FOR IMPROVING STATE POLICY TO SUPPORT SMALL AND MEDIUM-SIZED BUSINESSES IN THE RUSSIAN FEDERATION

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Abstract. *This article examines the application in the Russian Federation of specific mechanisms and instruments to support small and medium-sized businesses, which had a positive impact on the development of the USA economy, but taking into account the specifics of the economic, political and social spheres in Russia.*

Keywords: *small and medium business, government support, support program, economy, entrepreneurs, Russian Federation, USA*

The development of the small and medium-sized enterprises (SME) sector is considered one of the important for socio-economic transformations not only in Russia, but also in other countries, since it is this area that has a tremendous impact on the development of the country as a whole (unemployment, social tensions in the country, introduction of innovations and many other problems are solved mainly with the help of small and medium-sized businesses).

However, despite this, Russian entrepreneurs continue to face many obstacles in various areas (legislation, taxation, obtaining loans, as well as administrative barriers), which complicates the development of small and medium-sized businesses. That is why it is necessary to modernize the existing government support (introduce new government measures that will be aimed at the development of small and medium-sized businesses, as well as determine the impact of existing measures), applying the positive experience of the USA.

State support for small and medium-sized businesses in Russia and the USA boils down to the following areas:

1) Grants. This is a certain amount of money received by a businessman whose organization is under 2 years old. It is issued on the basis of an approved business plan to cover the costs of its implementation.

The maximum amount in the Russian Federation is 300,000 rubles. In this case, it is important to fulfill one condition. The entrepreneur himself contributes 30-50% of the total project amount to the general budget, which is documented. The amount of the initial payment depends on the region of residence and business registration.

In the USA, the size of the grant depends on the organization, state, or other body that forms it as an incentive for a developing business.

2) Subsidy. If you need to grow your business on a large scale, you can apply for this kind of irrevocable help already with a decent period of activity. In this case, for the purchase of fixed assets, an amount is issued that covers from 50% to 90% of their value. The maximum amount of such funds can be 10 million rubles.

Self-Employment Benefit. If you start your journey with the status of an official unemployed, then a verified, confirmed business plan can bring you 58,800 rubles. This amount is calculated based on the amount of the annual unemployment benefit. By the way, if you hire people like you in your business, you can apply for this benefit again.

3) Partial payment. By purchasing equipment or machinery under the contractual obligations of the bank, you can pay off part of the interest on the state program. This is approximately 2.75 - 5.5% of their total. When collecting documents on monthly payments of contributions, upon presentation, an estimated refund is issued.

4) Repayment of 2/3 of the planned exhibition costs. If you grow your business by participating in special events, you can count on support.

5) Agricultural organization. The development of this industry in Russia gives start-up entrepreneurs the right to cover the costs of purchasing grain, livestock, seeds.

In the USA, there is a corresponding policy of financial institutions aimed at lowering interest rates on lending to banks.

Based on the foregoing, we can conclude that support for small and medium-sized businesses in Russia and the USA has basically different approaches, which consist of the fact that in the USA state support is of a complex nature, the nature of "institutions", and in Russia it is individual, according to type of isolated cases.

But despite this, in the USA there are a large number of measures aimed at supporting small and medium-sized businesses that should be applied in Russia. So, for example, due to the federal structure of the USA, on the territory of each specific state, the business support program is carried out in different ways and it is such an experience, taking into account regional characteristics, would be very

significant for the entire business support system in Russia.

There are no known small business loans or grants in Idaho, Nevada, West Virginia, and Wyoming. Only 26 states have (or have had) a statewide small business loan, and only 17 states are implementing a grant-based government business support scheme. While all states have received some federal funding in the form of loans, some have received much more support than others. For example, 25.71 percent of small businesses received a loan in North Dakota, while only 12.19 percent received a loan in Maryland. The highest percentage of small businesses that received loans within the same state was 1.18 percent in Hawaii. The lowest was 0.56 percent in West Virginia. Small businesses in California are offered two government loans. The California Disaster Relief Loan Guarantee Program was $ 50 million and guaranteed up to 95% of the loan for up to 7 years. The California Capital Access Program is run by the California Pollution Finance Agency and is aimed at small businesses that find it difficult to get funding. There are also 30 other loans available in California cities and counties. Companies were also given an extension to filing their first quarter returns (extended through July 31, 2020) and access to sales and use tax incentive plans for small businesses.

Also, it is necessary to implement a program to encourage small businesses that create jobs in unused business areas or areas with low business activity, in the USA this program is called HUBZone business. On the basis of the program, small enterprises located in such zones are provided with preferences when accessing federal orders, which allows them to function and develop, attracting residents and creating jobs for them, which results in the overall development of territories and an increase in the level of well-being of the population.[1]

It must be implemented in poorly urbanized areas and rural settlements, in agricultural regions, as well as in federal districts, where there is a decrease in the growth of the number of small and medium-sized enterprises, such as the North Caucasus Federal District, the Far Eastern Federal District, the Ural Federal District, etc. This program should be combined with a regional business support system. It is this interaction that will be most effective than if these measures are applied separately.

Another program to be implemented in Russia is a program to support small and medium-sized enterprises owned by young people who are citizens of the Russian Federation. This is a large segment of the population that is able to generate new innovative ideas, is ready to implement them, but does not have financial capabilities for this, therefore, the state needs to pay attention and apply a number of measures aimed at supporting them.

[1]Musabirova D.A., Yushchenko N.A. Measures taken to support small business in accordance with the legislation on the contract system of the RF and the USA // Issues of Economics and Law. 2018. №115. P.7-10.

USA has a program 7a "Loan Guarantee Program", which can be applied in Russia. First, assistance is provided by commercial banks and lending institutions acting as an intermediary. Typically, this type of support is provided to new businesses in the market, as they lack the necessary characteristics in order to obtain borrowed funds. This program reduces risks for banks and other credit organizations, since the state assumes long-term obligations and spends significant funds. So, within the framework of the program, up to 85% of the total cost of the loan is guaranteed if it is less than 150 thousand dollars. For larger loans, the guarantee percentage is reduced to 75%, but this significantly affects the decision of banks. As for the warranty periods under this program, they vary significantly, but there are certain limits for fixed capital and for working capital. For working capital, the maximum guarantee period is 10 years, for the fixed capital of companies - 25 years. This is due to the reduced risk for the fixed capital of organizations.

It is important to introduce the practice, which is being carried out in the USA, related to assessing the impact of not only new laws, but also existing ones, which are aimed at supporting small and medium-sized businesses. Since existing laws may contradict new ones, as well as how long it takes to begin to have a negative impact on the development of entrepreneurship in the Russian Federation.

Also, taking into account Russian realities, various state corporations that have close relations with political elites and budget funds could provide important support to small and medium-sized businesses.

In addition, it is worth noting that in Russia there are practically no non-profit funds for supporting entrepreneurship, there are no various investment clubs, within the framework of which they could support small and medium-sized businesses.

Thus, based on the study, we can say that the USA's experience in supporting small and medium-sized businesses should be applied in the Russian Federation, but at the same time it is necessary to take into account the specifics of our country. All of the above measures can improve the state of state support, as well as ensure the development of the Russian economy.

References

1. Federal Law of 24.07.2007 N 209-FZ (as amended on 27.10.2020) "On the development of small and medium-sized businesses in the Russian Federation" // Russian newspaper. 2008. № 12. August 25.

2. Adamenko, A.A. State support as a tool for the development of small business / A.A. Adamenko, T.E. Khorolskaya, D.V. Petrov // Scientific and technical statements of the St. Petersburg State Polytechnic University. Economic sciences. – 2020. – V. 13. – № 3. – P. 57-67.

3. Barseghyan, E.E. State regulation of small business in Russia / E.E. Barseghyan // Labor and social relations. – 2020. – № 1. – P. 18-26.

4. Mirzoyan, R.S. State support of small business / R.S. Mirzoyan // Student Bulletin. – 2020. – № 13-4 (111). – P. 69-72.

5. Musabirova D.A., Yushchenko N.A. Measures taken to support small business in accordance with the legislation on the contract system of the Russian Federation and the USA // Issues of Economics and Law. 2018. №115. P.7-10.

6. Department of Commerce // https://www.commerce.gov.

7. Small Business Innovation Research // https://sbir.nih.gov.

8. Small Business Regulatory Enforcement Fairness Act // https://www.sba.gov/advocacy/small-business-regulatory-enforcement-fairness-act-sbrefa.

9. Small-Business Owners Say Candidates Fail to Address Issues. URL: http://www.gallup.com/poll/191336/small-business-owners-say-candidates-fail-address-issues.aspx.

10. Women-Owned Small Business Federal Contracting program // https://www.sba.gov/federal-contracting/contracting-assistance-programs/women-owned-small-business-federal-contracting-program.

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DYNAMICS OF THE CIRCADIAN RHYTHM OF DIASTOLIC BLOOD PRESSURE IN THE ACUTE PERIOD OF COMBINED SEVERE TRAUMATIC BRAIN INJURY

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Abstract. *During the acute period of CSTBI, the correction of hemodynamics (hypotensive, according to indications of vasopressor therapy) ensured the stability of the indicator within the generally accepted standard values. All injured patients retained a tendency to instability of the vascular vasopressor response, which turned out to be the most significant in group 3 in patients over 61 years of age. The most pronounced daily changes in peripheral vascular tone were found in patients of group 3. The adaptive capabilities of peripheral vessels were comparatively more active in patients of group 1 up to 40 years old from 9 to 17 days of the acute period of CSTBI.*

Keywords: *combined severe traumatic brain injury, circadian rhythm, diastolic blood pressure*

Relevance. The most important goal of intensive care for patients with severe traumatic brain injury (TBI) is "... to maintain an optimal flow of oxygen-rich blood to the brain." Among the measures of intensive therapy, which are of great importance for the prevention of secondary ischemic attacks, there are primarily the provision of external respiration function and the relief of hemodynamic disorders. Systemic BP is a critical factor in compensating for cerebral ischemia in severe TBI. The value of this factor is most pronounced in the first few days after TBI and in the immediate postoperative period. According to the authors, the decrease in cerebral perfusion pressure that occurred during antihypertensive therapy posed a real threat of cerebral ischemia. On this basis, many researchers have given up on lowering BP with TBI treatment. Moreover, recently, sympathomimetics (epinephrine, dopamine, norepinephrine) have been widely used to increase BP. It is believed that they contribute to an increase in cerebral perfusion pressure without significantly affecting ICP [1-5]. Due to the lack of information,

we made an attempt to study and assess the dynamics of the circadian rhythm of diastolic blood pressure (DBP) in the acute period of combined severe traumatic brain injury (CSTBI).

Purpose of the work: to study and assess the adaptive changes in the phase structures of the circadian rhythm of diastolic blood pressure in combined severe traumatic brain injury.

Material and research methods. The indicators of a comprehensive examination of 30 patients with concomitant severe traumatic brain injury (CSTBI) who were admitted to the ICU of the neurosurgical department of RSCEMA in the first hours after an accident - 28, catatrauma of 2 patients were studied. According to the testimony of 29 patients, on admission, invasive mechanical respiratory support (MRP) was started. Monitoring was carried out by complex hourly registration of parameters of body temperature, hemodynamics, respiration. Mechanical respiratory support was started with artificial lung ventilation (ALV) for a short time, followed by transfer 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) of 8 points or less. Patients were considered in three age groups: group 1, 19-40 years old (13), group 2 - 41-60 years old (9), 3 - 61-84 years old (8 patients). Complex intensive therapy consisted in identifying and timely correction of deviations: MRP, after removing from shock anesthetic, anti-inflammatory, antibacterial, infusion therapy, correction of protein and water-electrolyte balance disorders, surgical, to the extent possible, early correction, syndromic, symptomatic therapy.

Results and discussion.

Table 1

Assessment of the severity of the condition by age

Parameters	group 1	group 2	group 3
age in years	29.5±4.3	51.6±4.8	72.3±9.1
CRAMS, points	4.5±0.6	4.4±0.8	4.8±0.6
ISS, points	50.2±5.6	43.3±7.1	46.2±9.1
GS, points	7.3±0.5	7.9±1.3	7.8±1.5

It was found that with the most severe injuries in patients of group 1 (50.2±5.6 points), the severity of the condition and impaired consciousness did not differ significantly from those in groups 2 and 3 (tab. 1).

Table 2

Dynamics of the mesor of the circadian rhythm of diastolic blood pressure

Days	group 1	group 2	group 3
1	75.3±3.1	75.3±7.1	78.0±5.0
2	70.5±1.9	79.5±3.5	75.6±2.5
3	72.0±2.2	77.2±2.4	73.3±2.6
4	77.6±2.3	78.4±3.0	77.5±2.9
5	76.3±1.8	77.0±2.7	79.1±3.5
6	76.7±1.7	76.8±2.0	77.2±2.6
7	76.7±1.7	77.6±2.6	74.3±2.8
8	77.4±2.2	74.9±2.1	73.2±3.9
9	75.1±2.8	74.1±3.0	74.0±2.8
10	78.9±3.0	75.6±2.2	75.8±3.7
11	74.8±2.1	74.6±2.5	73.5±2.7
12	75.0±2.1	73.3±2.1	72.6±3.2
13	72.7±2.8	72.2±2.2	68.5±2.9
14	74.8±2.5	73.0±1.9	76.0±2.7
15	74.6±2.2	73.0±2.4	72.4±3.0
16	73.8±1.9	72.3±2.2	76.4±2.9
17	72.4±3.1	70.1±2.5	75.7±3.9
18	75.3±3.0	79.8±5.2	68.4±3.2
19	72.9±2.4	76.7±4.0	72.6±3.7
20	71.5±2.6	75.5±4.9	74.5±2.9
21	73.0±2.3	72.5±5.0	76.3±5.2
22	74.2±4.2	78.2±4.5	74.5±6.6
23	71.3±2.5	73.9±3.5	70.1±4.4
24	71.2±2.7	75.0±3.5	79.4±6.9
25	72.9±3.6	80.9±5.6	75.8±5.8

As shown in tab. 2, the index of the mesor of the circadian rhythm DBP did not differ from the normative values established in the studied age groups. During the acute period of CSTBI, the correction of hemodynamics (hypotensive, according to indications of vasopressor therapy) ensured the stability of the indicator within the generally accepted standard values.

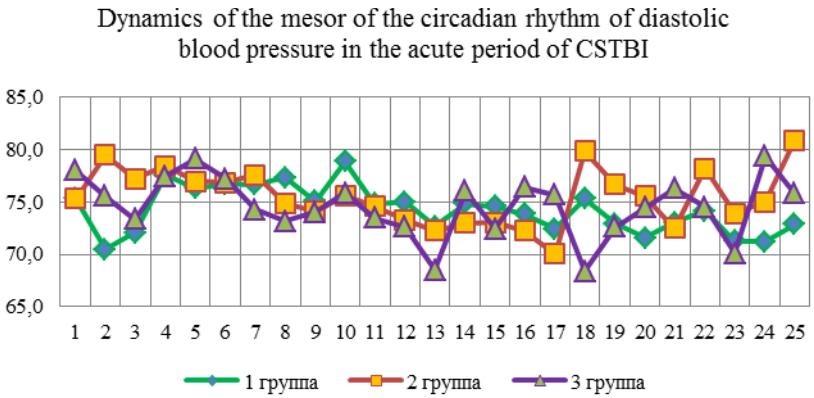

Fig.1

During the acute period of CSTBI, the minimum value of the mesor of the circadian rhythm DBP was detected on day 2, amounting to 70 mmHg, the maximum on day 10 - 79 mmHg. We paid attention to 4-5 day periods of fluctuations. In group 2, the minimum value was noted on the 17th day - 70 mmHg, the maximum on the 25th day - 81 mmHg, fluctuations in the mesor of the circadian rhythm DBP are also represented by 4-5 day periods of fluctuations. In group 3, the minimum DBP level - 68 mmHg was detected on the 13th and 18th days, the maximum on the 5th and 24th days - 79 mmHg, respectively. Fluctuations were represented mainly by 5-day waves. It should be noted that the most significant vasoactive therapy was carried out in patients of group 3 with the introduction of both antihypertensive and vasopressors.

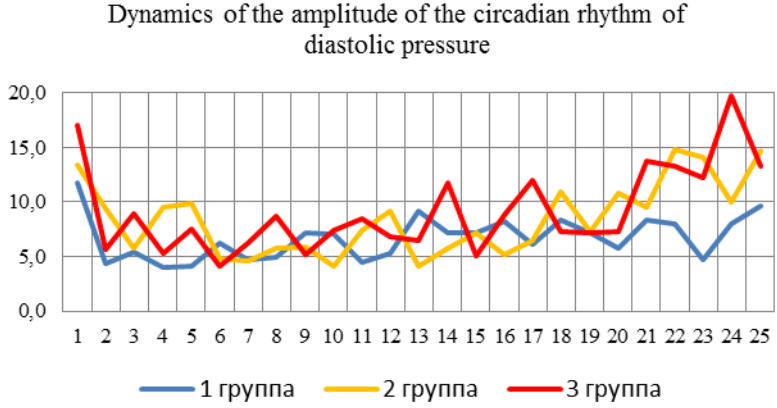

Fig.2

Pronounced deviations from the mesor in the circadian rhythm of DBP were found in all injured patients on day 1. In group 1, the amplitude of daily fluctuations was 12 mmHg, in group 2 - 13 mmHg, and in group 3 - 18 mmHg. Taking into account that the increase in the amplitude of daily fluctuations characterizes the stress response of the indicator, it can be imagined that on the 24th day (20 mmHg), all the injured retained a tendency to instability of the vascular vasopressor response, which turned out to be most significant in group 3 in patients over 61 years old. The severity of daily fluctuations in DBP characterizes the instability of the peripheral vascular tone immediately after injury, the tendency to stabilize the DBP index on days 2-20 with intensive stress-limiting therapy and the progression of instability on the 25th day, despite MRP and vasoactive therapy, correction of volemic parameters, and other parameters of homeostasis. In group 1, waves with a period of fluctuations of 5-4 days prevailed, in group 2 - 4 daily periods, in group 3 - 3-4 day periods (fig. 2).

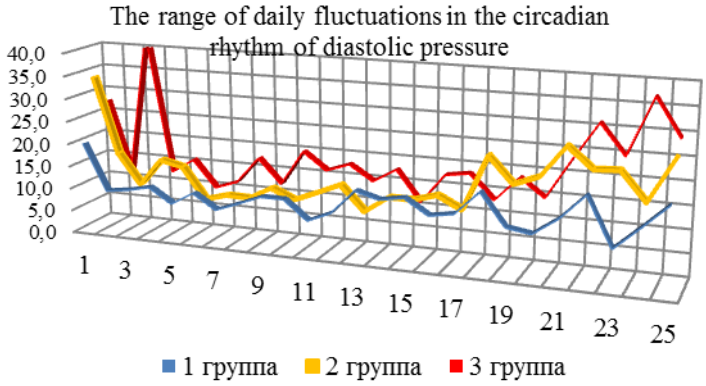

Fig.3

Of all the age groups studied, the most pronounced daily changes in peripheral vascular tone were found in patients of group 3 on day 1 - 26 mmHg, on day 3 - 40 mmHg, 24 - 36 mmHg (fig. 3). The least pronounced DBP fluctuations were noted in the injured group 1 on day 1 17 mmHg, on day 26 - 13 mmHg (fig. 3).

During the first week of the acute period of CSTBI, the mean values of circadian rhythms for the first 8 days in the 1st group characterized the tendency to spasm of peripheral vessels at 5 o'clock (78 mmHg), and the most significant decrease in peripheral vascular tone per day at 9-11 o'clock in the morning (73 mmHg). In group 2, the DBP was 81 mmHg at 8 am, decreased at 12 noon to 75 mmHg. In group 3, the highest DBP values of 78 mmHg were observed at 13 hours, the

minimum at 24 hours was 73 mmHg (fig. 4). The greatest displacements of the acrophases of the circadian rhythm DBP were noted in group 1.

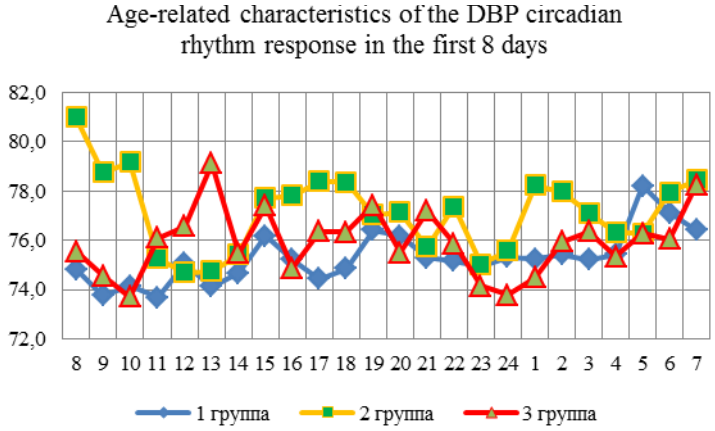

Fig.4

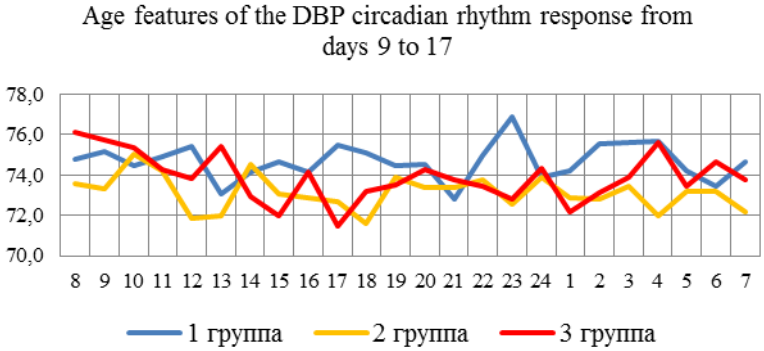

Fig.5

9-17 days of the acute period of CSTBI were characterized by the projection of the acrophase of the circadian rhythm DBP in group 1 at 23 hours (77 mmHg), in group 2 at 10 am (75 mmHg), at 8 am (76 mmHg) in patients of group 3. During the second week of the acute period of CSTBI, the most pronounced displacement of acrophase at night was revealed in group 1 (inversion of the DBP circadian rhythm) (fig. 5). Thus, the most active were the adaptive capabilities of circadian

biorhythms of peripheral vessels in patients of group 1 from 9 to 17 days of the acute period.

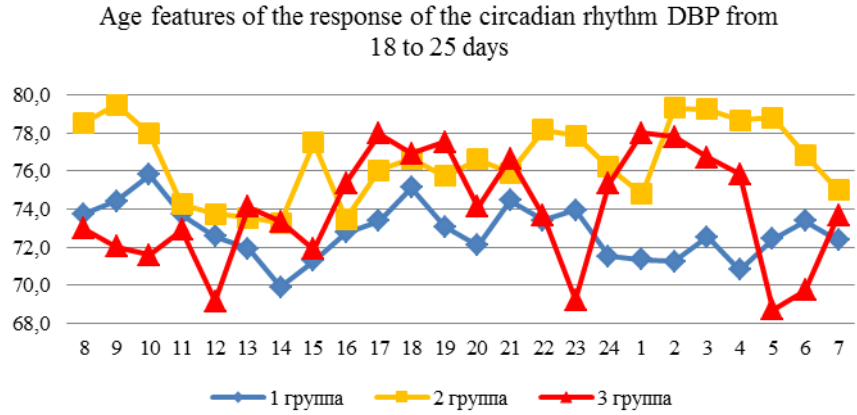

Fig.6

From 18 to 25 days, acrophase DBP appeared at 10 am (76 mmHg), in group 2 at 9 and 2 am (79 mmHg), in group 3 at 18 and 1 am (78 mmHg) (fig. 6). Vasopressor tendency was most pronounced in patients of group 2 and the least significant in group 1. The revealed features indicate the most unfavorable changes in DBP, possibly due to the compensatory direction of the changes.

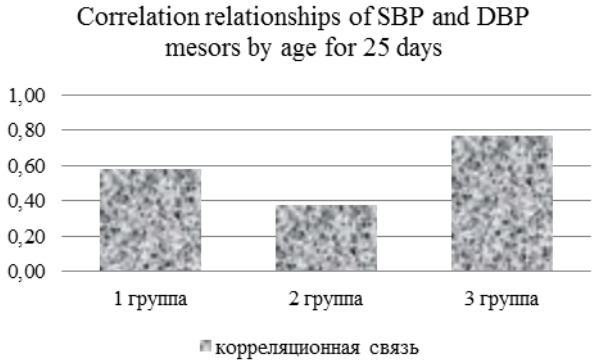

Fig.7

In the acute period of CSTBI, a reliably direct correlation between SBP and DBP was found in patients of group 3 (0.78), in group 1, 0.59, and in group 2, insignificant (0.38). The revealed features are possibly due to the effect of the prevailing vasopressor therapy, the most unfavorable condition, when an increase in cardiac output occurs only with an increase in vascular tone, that is, the effect of "centralization of blood circulation" was observed in group 3 (fig. 7).

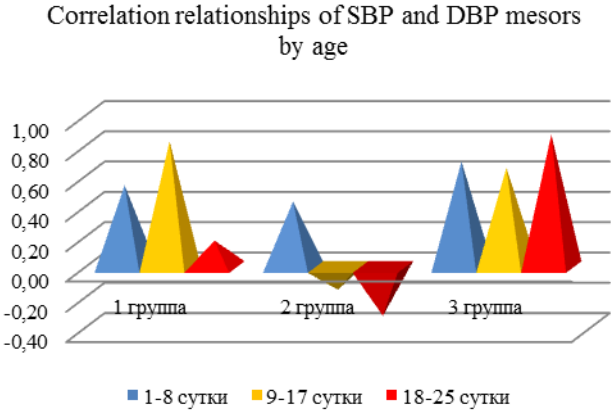

Fig.8

In group 1, the direct correlation between SBP and DBP was moderate in the first week, became significantly significant on days 9-17 and significantly decreased on days 18-25. In group 2, a weak direct correlation in the first week completely disappeared on days 9-17, a negative weak correlation appeared on days 18-25. In patients of group 3, a strong direct relationship between SBP and DBP parameters was observed throughout the acute period (fig. 8).

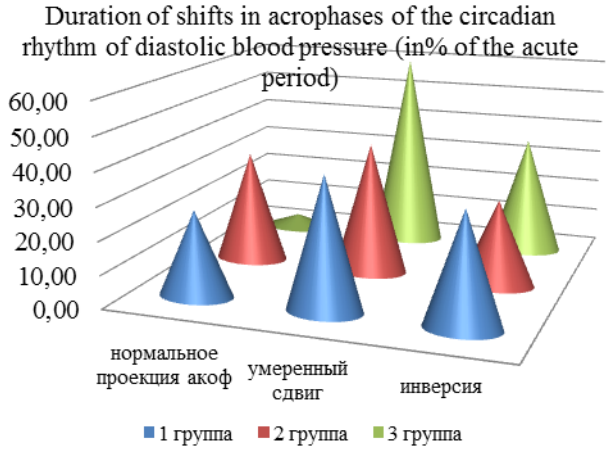

Fig.9

As can be seen from fig. 9, during most of the acute period of CSTBI, a moderate shift in acrophase prevailed, with a shift in the peak within daytime hours. Inversion (the most significant shift at 12 hours) was detected in groups 1, 2, 3 during 34%, 26%, 36% of intensive therapy time, respectively.

Conclusions. In the acute period of CSTBI, hemodynamic correction (hypotensive, as indicated by vasopressor therapy) ensured the stability of the mesor of the circadian rhythm DBP within the generally accepted standard values. All injured patients retained a tendency to instability of the vascular vasopressor response, which turned out to be the most significant in group 3 in patients over 61 years of age. The most pronounced daily changes in peripheral vascular tone were found in patients of group 3. The adaptive capabilities of peripheral vessels were comparatively more active in patients of group 1 up to 40 years old from 9 to 17 days of the acute period of CSTBI.

References

1. *http://www.stm-journal.ru/en/numbers/2010/4/685/pdf*
2. *https://newday-clinic.ru/posledstviya-cherepno-mozgovoj-travmy*
3. *https://www.mediasphera.ru/issues/zhurnal-nevrologii-i-psikhiatrii-im-s-s-korsakova/2018/11/1199772982018111093*
4. *ttps://diseases.medelement.com/disease*
5. *http://symona.ru/shkola-professionala/monitoring-i-terapiya/narusheniya-gemodinamiki-i-dyxaniya-chmt/*

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AESTHETIC RESTORATION OF THE TOOTH WITH WEDGE-DEFECT: CLINICAL CASE

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Abstract. *Localization of a defect in the cervical region of the tooth requires special attention of a specialist due to the high humidity of this area and the risk of bleeding gums. The choice of means and methods of treatment depends on these factors.*

The article describes an alternative method of isolating the gums with teflon tape and filling the defect with a photocurable composite. Compliance with the techniques and stages of working with the material allows us to provide high quality adhesion of the composite to tooth tissues and the optical properties of restoration, characteristic of natural enamel

Performance evaluation has being evaluated using optical systems and digital camera photography.

Keywords: *photocurable, composite, ormocer, wedge-shaped, defect, aesthetic, restoration.*

Introduction

The phrase «Aesthetic dentistry» has won recognition as a generally accepted branch of medicine, as well as a practical solution for specialists and the general public. At the same time, increased demands on the quality of restorations increase the doctor's responsibility for the work performed. The slightest errors and inaccuracies in reproducing the volume and relief or light-color characteristics of the tooth in the constructions cause patient dissatisfaction.

Knowledge of the anatomy and histology of the tooth allows specialists to develop recommendations for the selection of materials and the subsequent modeling of aesthetic restoration [1, 2].

Light curing materials are widely used in therapeutic dentistry due to their positive properties: sufficient mechanical strength, good adhesion to enamel and dentin. The optical parameters of dental materials correspond to the tooth appearance [6, 7]. The preparation of the cavity and filling with composite in the vast majority of cases carried out in accordance with the indications, as well as instructions for use [5]. In this case, the treatment of teeth with non-carious lesions requires increased attention, since the existing features of the location of defects can make it difficult to comply with the prescribed rules for performing manipulations [4, 8].

Therefore, localization in the cervical part contributes to increased humidity of the walls of the formed cavity and a significant risk of bleeding gums. Therefore, an important point when working with hydrophobic photopolymers is the high-quality isolation of the work area from the ingress of biologic fluids (saliva, blood and gingival fluid).

Rubber dam (or dental dam) is the most important tool for isolation. In some cases, in particular, when the patient refuses to use rubber dam (or dental dam), dentists use a teflon tape to isolate sound teeth from aggressive agents getting on them, whose positive properties are low friction coefficient, chemical inertness, insolubility in water and in organic liquids [3]. The material easily formes, can be stretched and adapted to a complex surface. For dental purposes, a 0.2 mm thick tape is most suitable. Due to its resistance to acids, the tape uses to protect adjacent teeth when etching of cavity walls. The described technique can use in cases of treatment of defects of the gingival region of the tooth.

Purpose of the study – in accordance with the foregoing, the aim of this study was to analyze the quality evaluation of isolating the working field and filling wedge-defects with a photocurable composite.

Materials and methods

Material and research methods were consistent with indications for the treatment of wedge-defects (stripping). The preparation carried out with diamond burs of New Technology Instruments of medium and fine grain size. Futurabond U (VOCO) used as an adhesive system. The defect was filled with photocurable composite, which is a universal nanohybrid ORMOCER restorative materials of Amira Fusion range (VOCO) and which is indicated for filling cavities of the I-V class when reconstructing of anterior teeth, shape and color correction to improve aesthetics. Thanks to innovative technology, Ormoker is characterized by low polymerization shrinkage (1.25%) and stress compared to other filling composites. High inertness ensures biocompatibility and color tone stability. Admira is universal in application - it meets high requirements for anterior and posterior teeth; optimally matched color scheme provides compatibility when working with several colors. Fluoride varnish Bifluorid 12 used to cover restored teeth.

Isolation of the working field carried out with Teflon tape, which allowed

minimizing the negative impact of gingival fluid. In addition, the tape protected adjacent teeth from acid gel and adhesive. Starting from the apex of the distal interdental papilla along the marginal gingival border to the apex of the mesial papilla, the tape gently pushes the instrument into the gingival sulcus (Fig. 1).

Fig. 1. *Gingival retraction with teflon tape*

Results and discussion

The results of the study are in a clinical case.

A wedge-defect is localized in the subgingival region of the tooth crown 14 (class V). Dentin pigmentation is noted.

The patient refuses the application of rubber dam. He signed an informed consent to the restoration of the tooth with composite material using Teflon tape as an insulating agent.

Filling of teeth with class V cavities includes the usual stages of working with photopolymers, however, the increased humidity of the cervical region and the possibility of bleeding gums should be taken into account.

Planning the shape and topography requires special attention. It is necessary to assess the severity of root deviation and gingival contour type in accordance with the symmetrical and adjacent teeth. Based on odontoscopy, in this case, it planned to model a rounded gingival dome of the premolar without distal deviation.

The tooth was mechanically cleaned with Klint fluoride-free paste and a brush rotating at low revolutions. The paste was washed off with a stream of water. The choice of shades of the composite was made in accordance with the optimal requirements: the reference colors are compared with the cervical region of the

teeth, standing next to and symmetrically, to complete coincidence. The inscriptions on the standards correspond to the marking of the photopolymer. The dentin corresponds to the color OA2, enamel – A2. Transparent layer – I.

The working field is isolated with Teflon tape, as the patient refuses to impose a rubber dam. For effective use, the tape was carefully laid along the surface to be protected and placed in the interdental spaces. Teflon is autoclaved at 121° C.

The preparation of the cavity was carried out in compliance with the following rules. The gingival wall was formed at an acute angle to the bottom of the cavity. All edges and corners of the cavity are rounded. Enamel processing is carried out with diamond burs of medium and then fine size (Fig. 2). Dentin necrotomy was performed with a round carbide bur.

Fig. 2. *Dissection of defect walls*

Enamel bevel is created towards the equator, for which cylindrical and cone-shaped burs of decreasing grain size are used. The bevel width is equal to the size of the defect. As a result of the preparation, a ledge is formed along the gingival margin, which helps to improve the adhesion of the filling, and in the direction of the equator - a smoothed surface, leveling the «filling-to-tooth» border.

Total acid etching of cavity walls was carried out. The effect of the gel on the enamel is 30 seconds and not more than 15-20 seconds on the dentin of the tooth. The gel was washed off with a stream of water, the surface is dried with an air gun, and the dentin is not overdried.

Gel-etched areas were treated with adhesive using a special brush: the resin is applied to the surface and rubbed in with light movements. Then it was distributed by an air stream, polymerized by the action of an LED lamp. Immediately after curing the adhesive bond, the cavity begins to fill with the composite in accordance with the selected shades.

When filling the gingival region serves as a guideline for modeling the «clinical neck» of restoration. An opaque layer of the OA2 composite was introduced at the bottom of the cavity, making up for the lost dentin. A part of the material was placed in the middle of the area close to the border with the gum, and then gently smoothed. The opaque layer cures within 40 seconds.

An enamel shade of the material forms a rounded periodontal contour and cervical bulge. To do this, a portion of the enamel composite was applied to the central gingival region of the tooth and smoothed from the center to the periphery, carefully rubbing to the borders of this zone.

When modeling the cervical bulge, the burnisher was positioned at an angle of 30° in regards to the vestibular site. The enamel layer was polymerized under the influence of an LED lamp.

As a result, the opaque layer fills the volume of the cavity corresponding to the lost dentin, the main enamel tone covers the entire opaque material. The transparent layer is evenly distributed with a layer of 0.5 mm, moreover, the gingival «filling-tooth» border is overlapped by the composite with some excess (in thickness), which is ground during processing. Polymerization is carried out.

Immediately after inserting filling, it was processed: removal of the surface layer, porous due to its interaction with atmospheric oxygen; shaping and polishing the surface to a shine similar to a tooth.

Preparation of the restoration begins with a fine- diamond burr of cylindrical shape with a pointed end, a thin layer of filling material is removed by moving the burr through the restoration surface in the mesio-distal direction. The subgingival region was emphasized with a thin bur (mosquito bite).

The vestibular surface was polished with disks, rubber heads, a brush and special pastes. Processing, shaping, polishing of the restoration was carried out in a

humid environment in order to avoid heating the fillings and teeth.

The final stage of restoration is the processing of enamel around the filling with Bifluorid-12 varnish containing fluorine. The latter was applied with a brush in a thin layer, dried with an air stream. This measure improves the marginal fit of the filling, increasing the mineralization of enamel. (It was carried out after elimination of Teflon protection).

Examination of the vestibular surface of the tooth and the border with the filling using optical systems (magnifier, digital camera) shows the high quality of the restoration (Fig. 3). Long-term results indicate the effective work of the dentist with the rational isolation of the working field and the optimal choice of filling material.

Fig. 3. *The work has been completed*

Conclusion

Aesthetic restoration of permanent teeth requires not only knowledge of the technique of working with composite materials, but also the proper use of auxiliary means, in particular, for isolating the working field. The use of Teflon tape allows ensuring cleanliness and dryness in the cervical region of the tooth in the treatment of wedge defects. A lightcurable composite having good adhesion to hard tissues, high strength, and optical parameters like enamel provides the ability to mimic the natural appearance of a tooth.

An alternative method of limiting the operative field using Teflon tape, as well as filling the cavity with a modified composite with minimal shrinkage and low polymerization stress, allows expanding the possibilities of restoration of teeth with defects localized in the gum region.

References

1. Kodratyeva V.S. Esthetics of direct composite restoration of front teeth in old and aged patients. Clinical case // New in Dentistry.- 2017.- №1.- P. 56-60.

2. Kostin K. Using of digital tools in single restoration of esthetic important area // Esthetic dentistry.- 2016.- №1-2.- P. 108-111.

3. Lutskaya I.K., Beloivanenko I.O., Lopatin O.A. Alternative methods of the work area protection in dentistry // Journal for Dentists. – 2018. - №3. – P. 5-11

4. Lutskaya I.K. Problem of the method selection in present-day dentistry // Present-day dentistry.- 2017.- №1.- P. 5-11.

5. Dental program 2017-2018 VOCO.- 85p.

6. Yalyshev R.K. Esthetic rehabilitation of the front teeth with the help of nanocomposite material // New in dentistry. – 2018.- №8(236).- P.58-61.

7. Flury P., Schnellbacher. Like a natural tooth // New in Dentistry.- 2017.- №1.- P. 52-55.

8. Frankenberger R. Esthetics of the front teeth with composite restorations / R.Frankenberger // New in dentistry.- 2007.- №3.- P. 1-8.

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CIRCADIAN RHYTHM OF PULSE BLOOD PRESSURE IN THE ACUTE PERIOD OF CONCOMITANT SEVERE TRAUMATIC BRAIN INJURY

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Abstract. *Changes in PBP in the circadian rhythm during the first week in group 1 (19-40 years old) occurred on average at 41.3±2.3 mmHg, in group 2 (41-60 years old) - 51.3±0.9 mmHg, at 3 (61-85 years) - 50.5±1.3 mmHg, acute period of CSTBI. In the second group, in the first and second near-week periods, the average PBP was found at the level of 50.5±1.2 mmHg, 50.6±1 mmHg, from 18 to 25 days of observation PBP was 55.4±1.4 mmHg, which reflected an upward trend in PBP in the third week of observation. The most pronounced range of daily PBP fluctuations was found in group 2. Revealed significant changes in PBP in the evening and night hours, pathological mixing of the acrophase of the circadian rhythm of PBP at night in patients of group 3.*

Keywords: *circadian rhythm, pulse arterial pressure, combined severe traumatic brain injury.*

Relevance. Brain damage occurs not only at the time of injury, but continues over the next hours and days. The affected brain is very sensitive to: hypotension, hypoxia, increased intracranial pressure. Impaired perfusion of the brain leads to an acute deficiency of macroergs, massive release of excitatory amino acids (glutamate "excitotoxicity"), impaired permeability of cell membranes with the penetration of calcium ions into the cell, and the development of lactic acidosis in ischemic tissue. The starting pathophysiological mechanism in acute cerebral insufficiency, as the final link, is the formation of tissue hypoxia caused by mitochondrial dysfunction. These processes are triggered even with short-term episodes of a drop in cerebral perfusion pressure, develop directly from the moment of injury and, in general, fade away by the end of the first day of ischemia. Further damage to the nervous tissue occurs by the mechanism of an increase in oxidative stress and local inflammation (from 2-3 hours after pathological exposure with a

maximum by 12-36 hours) and the progression of apoptosis. Currently, there are 2 areas of urgent measures for acute cerebral insufficiency: restoration of cerebral perfusion and neuroprotective therapy. Prolonged stress-protective therapy (SPT) with ganglion blockers, a- and b-adrenolytics, clonidine and dalargin has a pronounced protective effect on the brain and other functions of the victims. Both early (in the resuscitation phase) and late (in the treatment phase) arterial hypotension are inherently associated with a less favorable outcome. Prevention of hypotension is perhaps more important than medication to maintain blood pressure [1-4].

Pulse blood pressure (PBP) characterizes the dynamic component of the pressor action on target organs, and is also an indirect indicator of increased rigidity of large arterial vessels. Many researchers use PBP as an independent predictor of coronary complications; many have introduced this indicator into the list of standard indicators of daily blood pressure monitoring (DBPM). High PBP is an independent risk factor for coronary atherosclerosis and left ventricular hypertrophy [5]. The lack of data in the literature on the informativeness of the PBP circadian rhythm in assessing the severity of hemodynamic deviations in CSTBI was the reason for studying the indicator in the dynamics of the acute period of CSTBI.

Purpose. To study and evaluate the results of PBP circadian rhythm monitoring in the acute period of combined severe traumatic brain injury.

Material and research methods. The indicators of a comprehensive examination of 30 patients with concomitant severe traumatic brain injury (STBI) who were admitted to the ICU of the RSCEMA neurosurgical department in the first hours after an accident - 28, catatrauma - 2 patients were studied. According to the testimony of 29 patients, on admission, invasive mechanical respiratory support (MRP) was started. Monitoring was carried out by complex hourly registration of parameters of body temperature, hemodynamics, respiration. Mechanical respiratory support was started with artificial lung ventilation (ALV) for a short time, followed by transfer to SIMV. The assessment of the severity of the condition was carried out by scoring methods according to the scales for assessing the severity of combined injuries - the CRAMS scale, the assessment of the severity of injuries on 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 therapy consisted in identifying and timely correction of deviations: MCI, after removing from shock anesthetic, 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.

Table 1.

Circadian rhythm of the mesor of the circadian rhythm of pulse blood pressure in the acute period of combined severe traumatic brain injury (mmHg)

Days	Group 1	Group 2	Group 3
1	50.5±2.7	44.7±4.9	55.8±6.0
2	53.4±1.7	48.6±2.8	51.1±2.7
3	54.8±1.7	49.0±2.7	54.4±1.9
4	56.9±2.3	53.0±3.8	50.3±3.6
5	52.9±2.1	51.8±3.5	54.3±2.4
6	53.6±2.9	52.2±2.8	55.7±2.3
7	55.3±2.8	51.8±2.5	56.2±2.9
8	50.7±2.2	52.8±2.5	55.6±4.6
9	52.0±1.6	52.2±2.3	55.7±4.0
10	52.5±2.1	49.6±2.8	54.1±4.1
11	51.0±2.3	52.3±3.1	55.0±4.1
12	51.7±2.2	50.1±1.8	56.4±3.4
13	53.2±3.9	50.7±2.9	47.6±4.2
14	50.2±2.4	48.1±2.6	50.3±3.4
15	51.0±2.3	49.8±3.1	56.9±5.1
16	50.9±2.9	48.4±2.4	50.0±3.5
17	48.9±2.5	53.9±4.7	55.9±4.1
18	49.0±3.3	52.2±4.1	50.6±2.9
19	45.7±2.4	52.6±3.1	49.9±4.1
20	48.0±2.2	52.7±5.0	49.4±4.3
21	53.2±2.7	61.0±3.6*	50.2±4.6
22	53.9±2.5	55.6±4.3	53.9±7.5
23	51.7±2.5	54.0±4.2	52.8±5.1
24	53.3±2.5	55.1±3.2	55.8±3.7
25	48.9±3.2	60.2±5.9*	54.4±4.9

*-reliably relative to the indicator in 1 day

As shown in Table 1, the mesor of the circadian rhythm of PBP on day 1 did not differ from the generally accepted standard values (30-60 mmHg). During 25 days of the acute period of CSTBI, an increase in the mesor of the circadian rhythm of PBP was revealed only in group 2 by 21 (36%) and 25 days by 34% ($p<0.05$).

Dynamics of the mesor of the circadian rhythm of pulse arterial pressure in CSTBI (mmHg)

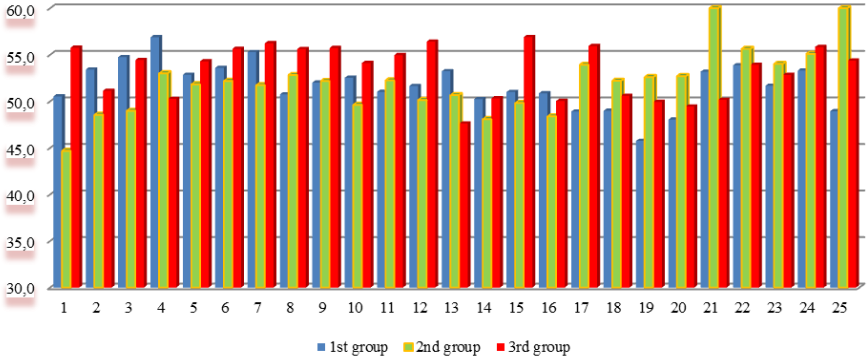

Fig.1

The tendency to an increase in the mesor of the circadian rhythm PBP was also observed in patients of group 3 and, to a lesser extent, group 2 in the first 12 days (fig. 1). While in group 2, there was a more pronounced tendency to increase the mesor of the circadian rhythm of PBP on days 17-25. The revealed hemodynamic feature of group 2 patients characterizes the occurrence of unfavorable changes, possibly requiring a more effective vasodalatory correction. This is confirmed by the tendency to an increase in the DBP mesor of circadian rhythm on days 18-25 of the acute period of CSTBI, presented in the previous article.

Near-weekly mean PBP circadian rhythm in group 1 (mmHg)

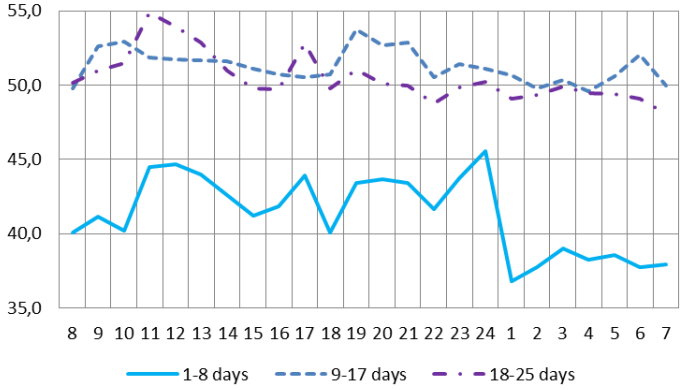

Fig.2

As shown in fig. 2, fluctuations in the PBP index in the circadian rhythm during the first week in group 1 occurred on average at 41.3±2.3 mmHg, in group 2 - 51.3±0.9 mmHg, in group 3 - 50.5±1.3 mmHg, that is, 10 mmHg lower ($p < 0.05$) than in the second week and 9.2 mmHg lower ($p < 0.05$) than in the third week of the acute period of CSTBI. The findings most likely characterize more effective stress-protective therapy during the first 8 days in traumatized patients of group 1.

Circadian rhythms in near-weekly PBP periods in group 2 (mmHg)

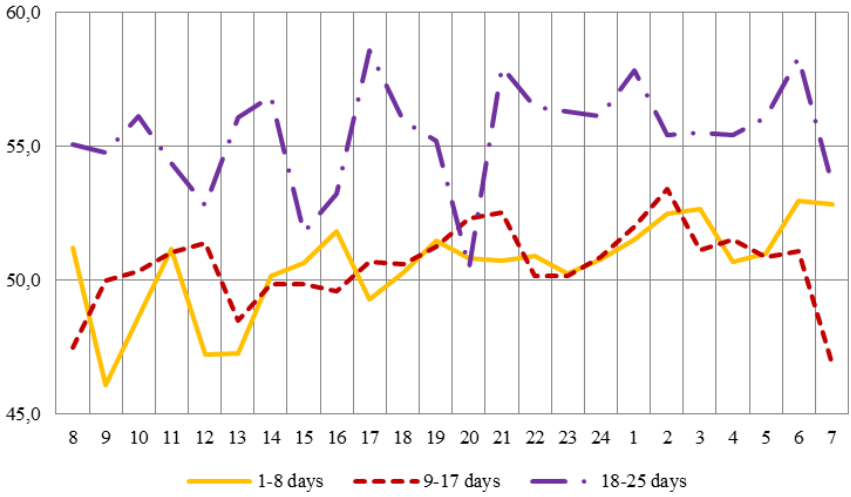

Fig.3

In the second group, in the first and second near-week periods, an average PBP was found at the level of 50.5 ± 1.2 mmHg, 50.6 ± 1 mmHg, from 18 to 25 days of observation PBP was 55.4 ± 1.4 mmHg, which reflected an upward trend in PBP in the third week of observation (fig. 3). The latter can be associated with the limitation of stress-protective therapy in patients of group 2.

Daily fluctuations in average weekly PBP in group 3 (mmHg)

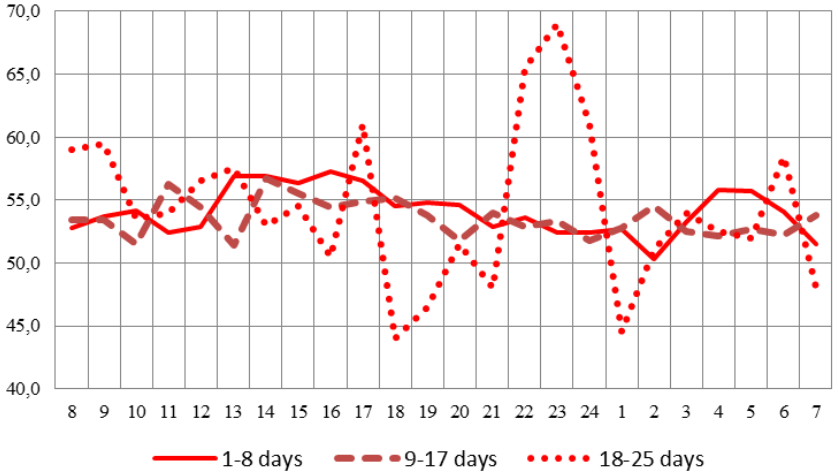

Fig.4

In contrast to the previous first two groups, in persons over 61 years of age throughout the acute period, the average daily indicators in 1, 2.3 weeks did not differ, amounting to 54.1±1.5 in 8 days, from 9 to 17 days – 53.6±1.1, from 18 to 25 days 54.4±4.8 mmHg (fig. 4). Noteworthy are significant changes in PBP in the evening and night hours, which is most likely associated with pituitary-adrenal insufficiency, despite the ongoing hormonal, vasoactive corrective therapy.

Dynamics of the amplitude of daily fluctuations in PBP in the acute period of CSTBI (mmHg)

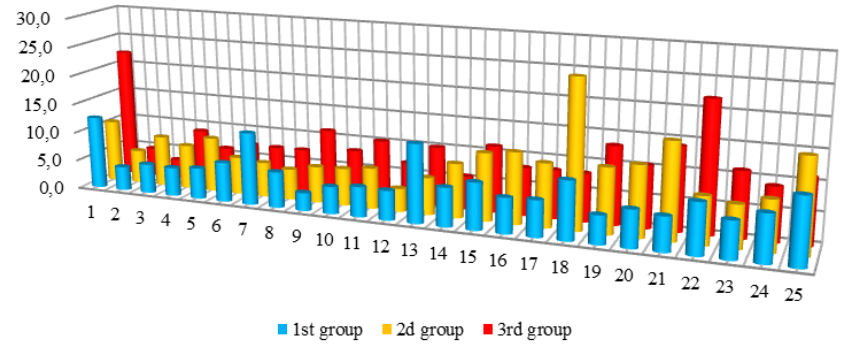

Fig.5

As shown in fig. 5, the least significant changes in the amplitude of circadian rhythm PBP in the dynamics of the acute period were observed in patients of group 1. Changes in the PBP amplitude occurred in waves with periods of fluctuations of 7,6,5,5,4 days. That is, more active stress-protective therapy was accompanied by hemodynamic function (PBP) in the physiological weekly biorhythm. Thus, active stress-protective therapy contributed to the restoration of the physiological biorhythm of PBP in the acute period of CSTBI as early as the first week after injury. A decrease in the about-week oscillation period in the following days to five days is most likely the result of the restriction of stress-protective therapy. More physiological, I think, should be considered an increase in the duration of active stress-protective therapy up to 25 days in the studied contingent of traumatized patients.

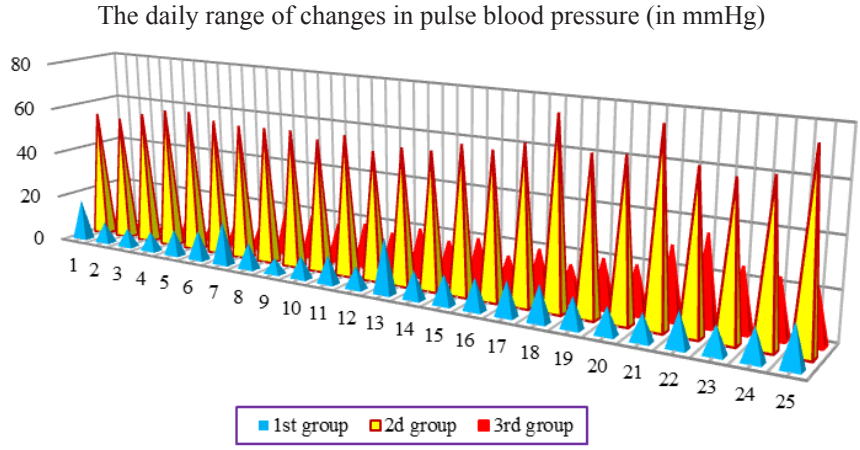

Fig.6

The most pronounced range of daily PBP fluctuations was found in group 2 (fig. 6). Thus, the maximum PBP fluctuations per day were -12.7±2.8 mmHg in group 1, 19.4±4.5 mmHg in group 3, and 61.6±4.7 mmHg in group 2 ($p<0.05$, respectively). The findings confirm the most pronounced hemodynamic instability in patients over 41 years old.

Duration and severity of PBP circadian rhythm acrophase shifts in%.

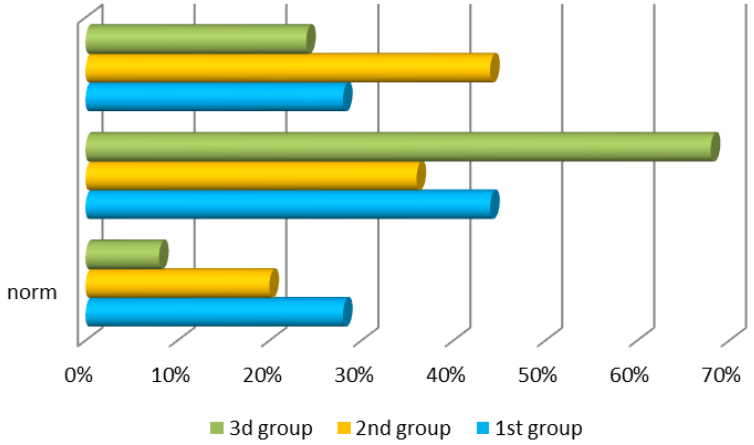

Fig.7

The normal projection of the PBP acrophase peak was 7% in group 3, 18% in group 2, and 27% in group 1. The longest inversion of the PBP circadian rhythm (23%) and the duration of moderate displacements (68% of the time) were found in patients of group 3 (fig. 7).

Correlation Relationships of the PBP mesor with SBP and DBP mesors

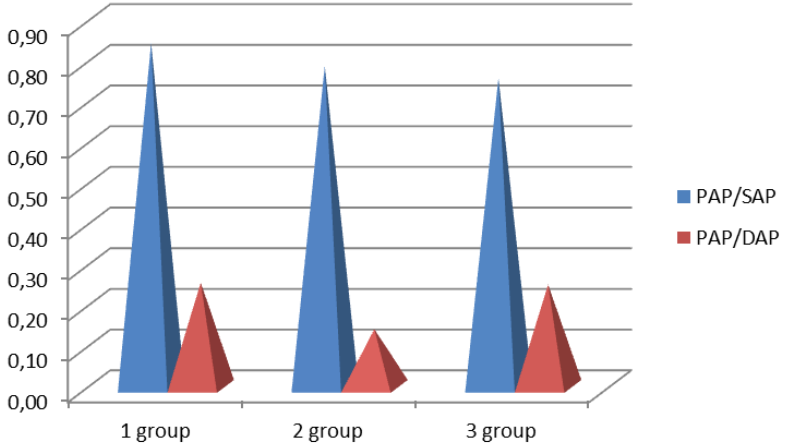

Fig.8

In all age groups, there was a strong direct correlation between changes in SBP and PBP and an insignificant one between DBP and PBP.

Conclusion. Changes in PBP in the circadian rhythm during the first week in group 1 occurred on average at 41.3±2.3 mmHg, in group 2 - 51.3±0.9 mmHg, in group 3 - 50.5±1.3 mmHg, acute period CSTBI. The most pronounced range of daily PBP fluctuations was found in group 2. In the second group, in the first and second near-week periods, the average PBP was found at the level of 50.5±1.2 mmHg, 50.6±1 mmHg, from 18 to 25 days of observation PBP was 55.4±1.4 mmHg, which reflected an upward trend in PBP in the third week of observation. Revealed significant changes in PBP in the evening and night hours, pathological displacement of the acrophase of the circadian rhythm of PBP at night in injured people over 61 years old.

References

1. *http://www.sibmedport.ru/article/10754-intensivnaja-terapija-tjazheloy-cherepno-mozgovoy-travmy/*
2. *https://medelement.com/page/view/p/9*
3. *https://meduniver.com/Medical/Xirurgia/ad_pri_cherepno-mozgovoi_travme.html*
4. *https://www.schiller.ru/profile/articles/smad/146/*
5. *https://cyberleninka.ru/article/n/pulsovoe-davlenie-krovi-rol-v-gemodinamike-i-prikladnye-vozmozhnosti-v-funktsionalnoy-diagnostike/viewer*

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OPHTHALMOLOGICAL MANIFESTATIONS OF A NEW CORONAVIRUS INFECTION

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Abstract. *The relevance of our study lies in the fact that at the moment there is little information in the modern medical literature on the ophthalmological manifestations of the new coronavirus infection. This can be attributed to the short period of time from the appearance of SARS-CoV-2 in the human population, it's still insufficiently understood. Also, during the period in a pandemic, due to quarantine measures, high morbidity, the lack of the possibility of conducting*

in-depth examinations of the ophthalmological profile, difficulties were noted in providing specialized assistance to the population. Retrospective and prospective collection of information on the course of ophthalmic diseases against the background of somatic polymorbidity in persons who have undergone a new coronavirus infection remains relevant, which will allow us to draw reliable conclusions about the effect of SARS-CoV-2 on the organ of vision and its adnexa under the conditions of a specific individual (personalized approach).

Keywords: *new coronavirus infection, ophthalmopathies, polymorbidity*

Introduction

The pandemic of the new coronavirus infection has established a number of problems associated with the difficulty in providing ophthalmic care to the population and the poor knowledge of the effect of SARS-CoV-2 on the eye and its adnexa. According to the results of some studies, the appearance of covid-associated conjunctivitis in both humans and animals has been proven, while the contact route of the virus entering the body is characteristic [4,5,6]. A characteristic feature of SARS-CoV-2 is damage to the vascular endothelium and the development of endotheliosis, in particular of the eyeball and the accessory apparatus of the eye [1]. As a result, blepharitis, phlegmon of the orbit, conjunctivitis, keratitis, lesions of the choroid (uveitis, neuroretinovasculitis), neuritis develop [2,3]. Also, the manifestations of endotheliosis can be considered thrombosis of the own vessels of the eye. The relevance of ophthalmological observation of patients who have undergone a new coronavirus infection remains relevant, since there is still not enough information on the course of eye diseases both during the clinical manifestations of the infection and during the convalescent period [1,2,3]. Therefore, we believe that the data will be interesting and relevant for both ophthalmologists and doctors of other specialties.

Purpose of the study – to establish the features of the somatic status and ophthalmological manifestations of the new coronavirus infection.

Materials and methods. 12 patients were under our supervision, of which men - 10 (83.3%), women - 2 (16.6%) with a new coronavirus infection, who received treatment in the ophthalmology department of an adult hospital SBHCI TO "Oblast Clinical Hospital № 2" February 2020 to May 202. Median age was 51 years (range 18 to 70). The analysis of clinical, laboratory and instrumental data of patients was carried out depending on the period of the disease (incubation, period of precursors, period of main manifestations, period of extinction and period of recovery). The structure of primary ophthalmic manifestations is presented as follows. The onset of ophthalmic diseases (it took from 7 to 14 days before the development of clinical manifestations) was noted in 25% (3/12) of patients. The onset of ophthalmic manifestations coincided with the development of the COV-

ID-19 clinic in 33.3% of patients (4/12). Patients with eye damage after suffering a new coronavirus infection accounted for 41.6% (5/12), of which men - 33.3% (4/12), women - 8.3% (1/12), while the average number days from the diagnosis of COVID-19 to hospitalization in the specialized ophthalmological department was 47.7 days (from 22 to 83 days).

Results and discussion

The structure of ophthalmic nosologies in the analyzed group is presented in table 1.

Table 1

The structure of ophthalmic masks depending on the periods of the course of the new coronavirus infection

Periods of infection / Nosology	Incubation abs(%)	Clinical manifestations abs(%)	Reconvalescence abs(%)
Bilateral optic neuritis	1(8.33%)	-	-
Thrombosis of the CRV branch	1(8.33%)	-	-
Corneal ulcer	1(8.33%)	-	4(33.33%)
Keratouveitis	-	1(8.33%)	-
Iridocyclitis	-	1(8.33%)	-
Orbit phlegmon	-	1(8.33%)	-
Bilateral neuroretino-vasculitis	-	1(8.33%)	-
Bilateral panuveitis	-	-	1(8.33%)

A detailed analysis of the onset of ophthalmopathies in COVID-19 showed that they developed only in men, while bilateral damage to the optic nerve was noted at the age of 34, without the presence of concomitant somatic polymorbidity, 14 days before the clinical manifestations of the infection. Retinal vascular pathology was detected 7 days before infection at the age of 59 years in a man with systemic atherosclerosis, grade II arterial hypertension, risk 3. A corneal ulcer was diagnosed at the age of 60 years in 10 days, against the background of chronic blood pathology (mild congenital anemia). The manifestations of ophthalmopathies in combination with the clinical manifestation of coronavirus infection were accompanied by the development of phlegmon of the orbit in a 40-year-old man with a history of penetrating trauma of the lower eyelid, conjunctiva 3 days before the development of infection and the absence of somatic polymorbidity.

Damage to the retinal tissue and blood vessels was revealed in a young woman, aged 18 years, with the presence of ulcerative colitis, total lesion, severe debut with clinical improvement; chronic gastroduodenitis in remission, chronic mild anemia, reactive thrombocytosis. Pathology of the cornea and choroid of the eyeball was noted in a 34-year-old man without somatic polymorbidity, with a history of a second-degree corneal chemical burn within 7 days of the disease. An isolated lesion of the choroid, anterior section (iridocyclitis) was revealed in a 48-year-old man with a history of reactive arthritis of large joints five years ago. Ophthalmopathies in the convalescent period of infection are represented by one total lesion of the choroid (panuveitis) and four changes in the fibrous membrane (corneal ulcers). The onset of panuveitis of fungal etiology in the patient was noted 81 days after the onset of clinical manifestations of the new coronavirus infection, while diabetes mellitus developed against the background of massive antibiotic therapy carried out in a single hospital.

Somatic polymorbidity was systemic atherosclerosis, grade III arterial hypertension, risk 4, mild chronic anemia. Corneal ulcers were diagnosed in three men and one woman (mean age 62.25 + 4.75 years) with a history of systemic atherosclerosis, stage II - III arterial hypertension, and type II diabetes mellitus was detected in two cases. The disease developed on average 47.25 + 35.1 days after the beginning of the clinic for coronavirus infection. Corneal lesions are characterized by: the depth of the lesion (up to ½ of the corneal stroma), slow regeneration of the process, a long stay in the ophthalmological hospital, on average 20.21 + 5.1 days, and the threat of perforation.

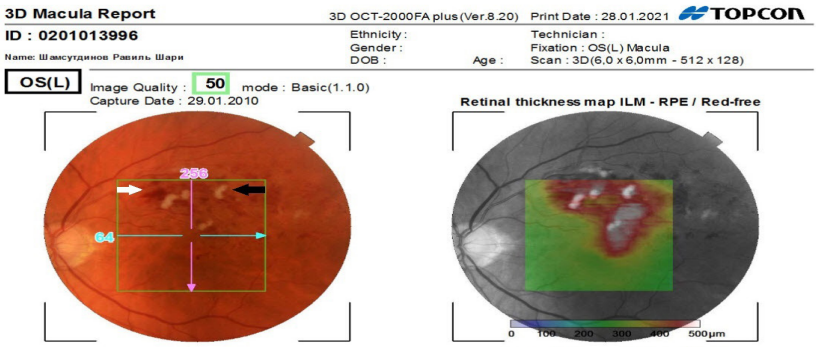
Clinical case. Patient R., 59 years old, on January 27, 2021, was admitted to the adult ophthalmology department SBHCI TO "OCH № 2" with complaints of decreased vision in the left eye that appeared 4 days before the visit. From the anamnesis it is known that the patient suffers from arterial hypertension, constantly takes perindopril, cardiomagnet. He denies other chronic diseases. Local status upon admission: Visus OD = 0.2 s/k +1.75 = 1.0; OS = 0.1 s/k +1.75 = 0.5. OS is calm. TP is normal. The cornea and moisture of the anterior chamber are transparent. The anterior chamber is of medium depth. The pupil is medically dilated, round. The fundus reflex is pink. On the fundus: OND is pale pink, clear boundaries. The arteries are narrowed, the veins are dilated. In the course of the superior temporal branch of the CRV, multiple streak-like hemorrhages, exudate deposition (fig. 1). In the macular region, retinal edema. The periphery was unremarkable. OD is calm.

The patient is consulted by a therapist.

A comprehensive survey was carried out. The general analysis of blood revealed lymphocytosis 40.8%, monocytosis 13.3%. According to the results of the coagulogram, a decrease in APTT to 24 cm was found. Biochemical blood test and

general urine analysis without abnormalities. Electrocardiography - sinus rhythm, 77 beats. in min, incomplete blockade of the right bundle branch block. According to the USDG data of the vessels of the extracranial basin, no hemodynamically significant violations of patency were revealed. Conclusion USDG of vessels of the intracranial basin: a decrease in the velocity indicators of blood flow in the middle cerebral artery (MCA), posterior cerebral artery (PCA) on both sides. Lack of blood flow in both vertebral arteries (VA) at the transcranial level. Computed tomography of the chest: CT scan may correspond to presumably viral pneumonia, CT-1.

As a result of a comprehensive examination, the diagnosis was made: partial thrombosis of the superior temporal branch of the central retinal vein of the left eye. Initial age-related cataract in both eyes. Arterial hypertension stage II, stage 2, risk 3 (high). NPS: Incomplete right bundle branch block. HSN-I. without specifying FC. The following treatment was prescribed: diuretics (mannitol 200 ml intravenously for 2 days, diacarb 250 mg 2 times a day orally for 4 days), parabulbar injections (dexamethasone 4 mg / ml 0.5 ml once a day for 7 days, heparin 750 IU once a day 7 days), instillations of dexamethasone 0.1% 3 times a day and tropicamide 1% 1 time a day were prescribed. The patient also received drugs to control blood pressure (enalapril 5 mg 2 times a day, hydrochlorothiazide 12.5 mg in the morning). The treatment proceeded with positive dynamics.



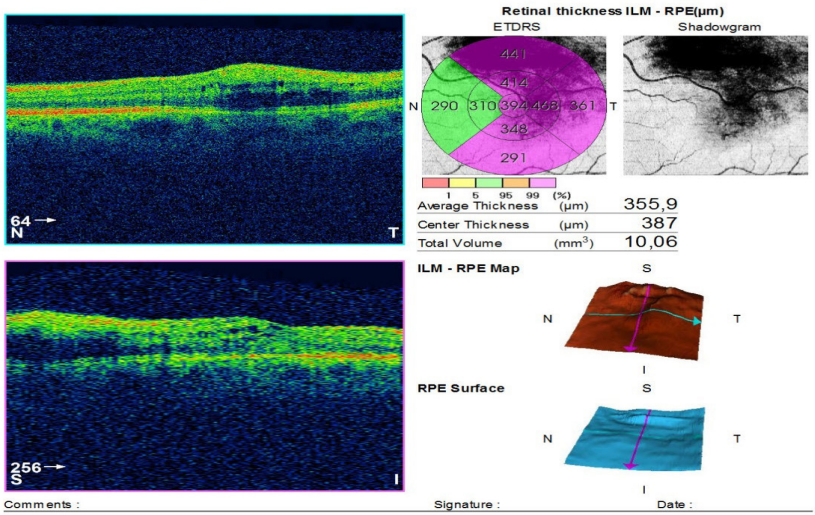


Fig. 1. *Data of optical coherence tomography of the fundus of the left eye of patient R. White arrow denotes streak-like hemorrhages along the superior temporal branch of the CRV. The black arrow indicates the location of the exudate*

02.02.21 the patient began to worry about the increase in body temperature to 37.1C°, deterioration of health, the appearance of a runny nose. A nasal and pharyngeal swab was taken for a new coronavirus infection. The result was positive. For treatment, the patient was transferred to the infectious mono-hospital of the OCH № 1. Local status at checkout: Visus OD = 0.2 s/k +1.75 = 1.0 OS = s/d 0.1 s/k +1.75 = 0.5 – 0.6. OS is calm. TP is normal. The cornea and moisture of the anterior chamber are transparent. The anterior chamber is of medium depth. The pupil is medically dilated, round. In the lumen of the pupil, the lens with initial opacities. The fundus reflex is pink. Fundus: OND is pale pink, clear borders. The arteries are narrowed, the veins are dilated. Along the course of the superior temporal branch of the CRV, multiple streak-like hemorrhages at the stage of resorption, exudate deposits decreased. In the macular area, the retinal edema is less. The periphery was unremarkable. OD is calm. Recommendations of an ophthalmologist for further therapy for thrombosis of the branch of the central retinal vein: dexamethasone 0.1% 4 times a day for 2 weeks, nepafenac 0.1% 3 times a day for 2 weeks, emoxipin 1% 4 times a day for 1 month.

Thus, the presence of arterial hypertension in this patient, insufficient blood flow in both VA at the transcranial level, and a new coronavirus infection in the

incubation stage led to endotheliosis of the vessels of the eyeball, which, in turn, caused partial thrombosis of the superior temporal branch of the central retinal vein of the left eye.

Conclusions

Our study has shown that men are more likely to be affected by eye damage with a new coronavirus infection. The risk of damage to the organ of vision is higher in patients with somatic polymorbility, or trauma to the eyeball, blood pathology, chronic diseases of the gastrointestinal tract, diabetes mellitus. The debut of ophthalmic manifestations in coronavirus infection is represented by optic neuritis, corneal ulcer, and thrombosis of the CRV branch. Damage to the nervous tissue of the eyeball (optic neuritis, retinovasculitis) is typical for young patients and has a bilateral character. It can be the primary manifestation of a new coronavirus infection during the incubation period, or together with the manifestation of clinical manifestations of the disease. Ophthalmic masks of COVID-19 convalescents are characterized by the presence of ulcerative processes of the cornea, located mainly in the optical zone, which makes it possible to judge the development of generalized endotheliosis of the eyeball vessels leading to a malnutrition of the cornea, a decrease in its regenerative capacity, long-term healing and the threat of perforation. Long-term use of antibacterial drugs as an etiotropic therapy for complications of a new coronavirus infection is fraught with the development of bilateral lesions of the choroid of the eyeball of fungal etiology.

References

1. Kalyuzhnaya E.N., Ponomareva M.N., Petrov I.M., Naimushina A.G., Gapon L.I., et al. Ophthalmic changes in patients with covid-19 associated pneumonia // Medical Science and Education Ural. 2020. Volume 21, № 4 (102) P.117-121

2. Ponomareva M.N., Klyashev S.M., Sakharova S.V., Klyasheva Yu.M., Turlybekova D.A., Novikova N.V., Kalyuzhnaya E.N., Markova A.O., Purtova L.L. Features of ophthalmic diseases in COVID-19 infection // Medical Science and Education of the Urals. 2021. Volume 22, № 1 (105) P.132-136

3.Ponomareva M.N., Sakharova S.V., Markova A.O., Turlybekova D.A., Kalyuzhnaya E.N., Karpova D.A., Petrov I.M. Ophthalmic masks of a new coronavirus infection // Medical Science and the formation of the Urals. 2021. Volume 22, №2 (106) P. 106 – 110. DOI: 10.36361/1814-8999-2021-22-2-106-110

4. Liang Liang, Ping Wu. There may be virus in conjunctival secretion of patients with COVID-19. Acta. Ophthalmol. 2020; 98 (3): 223. DOI: 10.1111/aos.14413.

5. Seah I., Agrawal R. Can the Coronavirus Disease 2019 (COVID-19) affect the eyes? A review of coronaviruses and ocular implications in humans and animals //Ocular immunology and inflammation. 2020. Vol. 28 (3). P. 391–395. DOI: 10.1080/09273948.2020.1738501.

6. Wei Deng, Linlin Bao, Hong Gao et al. Rhesus macaques can be effectively infected with SARS-CoV-2 via ocular conjunctival route // BioRxiv. 2020.03.13.990036. [Preprint.] DOI: 10.1101/2020.03.13.990036.

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PSYCHOLOGICAL, SOCIAL AND LEGAL ISSUES IN CLINICAL MEDICINE

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Abstract. *The Internet book, "Force Majeure in Surgery" released with an international book mark - LAP LAMBERT Academic Publishing (Germany), 2018, attracted the interest of even people far from medicine, not because it reflects purely medical issues in the practice of doctors, but also raise, if not strange, other topical issues related to another sphere of human activity and acting in the form of a complex tangle of this causal relationship. The material is systematized and studied for the first time from the standpoint of other humanitarian disciplines (psychosocial and issues of jurisprudence, ethics of deontology). This required a philosophical understanding, an assessment from the point of view of epistemology. This article contains excerpts from the book "Force Majeure in Surgery". The originality of the observations of the above-mentioned book is that, from somewhere, not by chance, completely different phenomena are revealed, which are intertwined in the context of medical issues. But this is not all, the most interesting thing is that with the search for diagnostics, questions of jurisprudence or socio-psychological problems emerge, which are somehow caused by each other. Especially, in their genesis, some act as the main subject of search, while the other creates an accompanying background to the first. Sometimes, in this "bundle" of causation, the doctor himself is captured with*

his desire to treat the patient, although his latent psychosomatic state does not allow him to adequately fulfill his holy mission. Errors are allowed. Sometimes the patient himself is disoriented by the diagnostic line of thought. In the end, on their basis, the question arises where it is necessary to understand from the standpoint of the epistemological discipline of philosophy.

Keywords: *Force majeure in surgery, situational diagnostics, epistemology, diagnostic circumstance in matters of jurisprudence, psycho-sociology in medical practice, ethics, deontology. Errors in surgery, government officials in the patient-doctor relationship.*

Prophylactic appendectomy

In the friendly team of the surgical department of one of the regional hospitals, a celebration has been outlined, which they decided to celebrate in a picturesque corner of the district. Everyone went there, except for the emergency brigade. They naturally remained in the department with great sorrow, which, unfortunately, did not participate in this significant celebration. But they were determined to get there by any means as far as possible, completing their work. And suddenly 2 patients with acute appendicitis come in a row. The surgeon quickly performed both operations and sighed with relief and thought that the time was not far away when he would join the merry gang. I was just about to take off my operating clothes and suddenly a nurse from the preoperative room knocks on the window and shows her index finger, saying that there is another operation and expressively showing that after that – "go Vasya". She made this gesture so expressively, the surgeon was already amused that the old excitement took possession of new forces. "The third appendicitis" is completed with the same speed. Now you can "guln", saying, the surgeon was about to take off his robe. Suddenly the patient on the operating table in a trembling voice says: - "Doctor, will you excise my lipoma on the skin?" The surgeon, in the heat of the upcoming celebration, did not ask - what is the diagnosis? So, this time it was not necessary to "hang out" in full with fun. For the deed done, the answer had to be kept oh - oh - oh. Simple explanation: *The surgeon's emotion completely clouded the doctor's mind. No wonder they say: the surgeon's knife should be controlled by the surgeon's head. Not an obsession with the surgeon: this is a symptom that will entail professional trouble. Consultation of the relevant specialists is required to the surgeon himself.* [1, 2, 4, 6].

"Stepping on a rake" or risk of involuntary

To a familiar dentist, a patient complained of unbearable pain in his teeth. He did not sleep with this problem for two days. The doctor carefully examined, diagnosed and explained to a friend-patient that the tooth, unfortunately, cannot be treated, it is necessary to remove it. Such a verdict was accepted with pleasure, demanded an immediate procedure even "without anesthesia." "This does not hap-

pen in modern medicine," the doctor muttered and took up anesthesia. After he made a conduction block, the patient had an instant picture of an anaphylactic reaction to novocaine. Appropriate therapy was urgently carried out. The patient regained consciousness in 2-3 minutes. The medical staff got scared. Fortunately, the allergic reaction went away literally in 10-15 minutes without consequences. After this alarming procedure, the intensity of the pain in the aching tooth became even greater. The client began to demand the removal of a diseased tooth by any means. The nurse took another anesthetic drug (Lidocaine), from which there were practically no complications, into a syringe and put it on the doctor's table. Now the doctor began to inject the drug more carefully into the right place. And suddenly the same reaction as the previous one. More pronounced this time than the first. The doctor dropped his hands, was in despair. Let’s repeat the same anti-shock measures again, thank God, it didn’t come to a serious complication. The question is what is the matter: it turned out that the doctor confused the syringe and injected the same novocaine in the first syringe. After all, the syringes were the same, and they lay side by side. As the saying goes, "here's a rake." However, the patient's intrusive demand is met by the target on the third risky attempt. The doctor should always be careful, such negligence could cost the patient's life. Situational statement: 1. An attempt to provide medical assistance. 2. A sudden allergic reaction from an anesthetic drug (novocaine) from which the dentist lost his composure 3. There was a second anaphylactic reaction against the background of the first, as a result of an erroneous repetition of the injection of the same novocaine. It turns out that the doctor, in fear, confused the syringe with another anesthetic. The situation was brought about by the doctor's hysteria. Fortunately, the threatening condition has been eliminated. At the patient's insistence, the doctor's risky ordeal continued and achieved the desired success, fortunately. Yes, the doctor is not young, it is highly undesirable to follow the patient's lead, as we have seen. Here we must not forget about the categorical insistence of the patient, even in this critical condition. Comments: *Unfortunately, the ending could have ended in death from anaphylactic shock. This happens, while the quality of the medicine cannot be fully monitored. The doctor was losing his composure. Panic. In this situation, a positive thought is not expected. For information, a very frightening anaphylactic reaction can be cited: Lyell's syndrome of an allergic nature. The chances of this fulminant disease are 30% of those affected. The risk in medical practice, in general, is absolutely nonsense. Is it really possible in our new century to change something in the training of surgeons, changing teaching methods, and with this to improve the quality of Aesculapius? [5].*

Unprofessional interference from high-ranking officials

The girl, 14 years old, was delivered to the surgical department at 23 o'clock. An hour and a half ago, dancing barefoot on the carpet, I felt a stabbing pain in my

foot. On the roentgenogram, between the 1st and 2nd metatarsal bones of the right foot, the shadow of a gramophone needle was found.

The surgical team was busy performing urgent abdominal operations, and the surgeon in charge decided to hospitalize the patient and operate on her in the morning under fluoroscopic control. At 3 am the phone rang. The secretary of the regional committee, who turned out to be a friend of the girl's parents, demanded that the operation be performed immediately. [6].

The surgeon on duty, having completed the next operation, at 5 o'clock in the morning took the patient to the operating table, cut the skin over the supposed localization of the foreign body and did not find the needle. The operation was supposed to continue in the X-ray room. Introducing the patient in the morning to the head of the department, the surgeon on duty turned pale and barely audibly said: "This is not that leg!" The morning shift removed the needle and the girl was safely discharged.

The surgeon was taken to the intensive care unit a day later with myocardial infarction. A criminal case was opened against him, which did not reach the court, since the investigator proved that the medical error was committed due to overwork during the 19th hour of continuous work. The surgeon recovered, but did not return to his profession. *The intervention of the "big boss" ended up with a myocardial infarction of the surgeon with subsequent dismissal.* [3,4].

Unreasonable insult

The chief doctor of the regional hospital, he and the chief surgeon of the region, perfidiously entered a woman, the wife of a high-ranking government official, and expresses her complaint with such indignation. She brought her daughter, a schoolgirl, to the surgeon's appointment with vague complaints of abdominal pain. The daughter was examined by an experienced admission doctor and an ultrasound examination was recommended for an ectopic pregnancy. Then the mother threw a tantrum, insulted the doctor. How can you think of this about a ninth-grader and be caught in such nonsense. The chief physician reassured the woman, examined the girl and suggested an emergency operation, which was performed. *During the revision of the abdominal organs, it was established that the doctor of the admission department was right ...* [6].

On coronavirus

Fresh example. The XXI century did not have time to begin The world is shuddering, and is concerned about the coronavirus-19 pandemic. Yes, history knows what a pandemic of viral-infectious etiology of microorganisms is, which claimed the lives of hundreds of thousands of people. At present, no one knew, the dormant known COVID-19 would take such a turn. People are shocked that there is no effective treatment for this infection. How to survive? Doctors realized that indi-

vidual self-isolation from crowds, avoiding contacts, simply wearing an individual protective mask, as well as observing other non-burdensome protective measures, it is quite possible to protect yourself and your loved ones. All over the world, starting with the heads of state and doctors, every day, if not hourly, the population was informed by the available mass media about the dynamics and statistics of the disease. To our deep regret, simple security measures were not followed, despite the intensified and convincingly visual notification of specialists. Accordingly, the results were very deplorable. As for the criminal silence, I give examples. In one and the other cases, in the family of two officials, of a fairly high rank, they had a party and from where they contracted the disease. The source was the wives of officials who had traveled to countries where the outbreak had just begun. The family members knew about this information, they invited guests in honor of the pilgrimage of the holy places. What a luxury. *Such a stupid tendency exists in our area. As a result, some of the invited guests of the officials became infected. Most importantly, on the initiative of their husbands, officials, they deliberately participated and concealed, making an "anti-popular criminal deal" by making it secret.* But they themselves were treated incognito. Fortunately, the focus was somehow eliminated by the efforts of doctors. Here is the other side of the medal of the elites respected by "us".

The ethical component is one of the central ones in creating a rational model of public service. The regulation of the official behavior of officials at the moral and value level and the cruel control over their observance of high ethical standards is a necessary condition for a real improvement in the quality of public administration as a whole, as a result, an increase in the level of public trust in relation to it, which can be dreamed of by ordinary citizens, unfortunately. ***Obolonsky A.V. Ethics and responsibility. E-mail abolonsky@hse.ru***

In practical medicine, there are mostly kind and good sayings about surgeons. What we have demonstrated are the same errors, but they have their own peculiarities, i.e. here they focus on the humanitarian problem of both the patient himself and his doctor. It is not competent to draw conclusions about the "chairmen" from our own bell tower, for this there is a supervisory body and, unfortunately, it is difficult to prove, but we will hide it with pain in our heart. To do this, I cite separate opinions on this topic, from published works in the media. For example, in one author's article it is noted, “… today, we can confidently say that *80%* of the country's population has deep disrespect for the authorities. Ludicrous laws and restrictions for the entire population of the country have already become the norm and it is very difficult to change this order of things. On the *Top-life TV channel he writes*: For officials, the law is not written: in this regard, everything can do whatever comes to mind! Laws for the people. The only hope is for good officials who are able (from a tightening) to correct or correct "bad laws" into "good" ones.

To prosecute an official for violation of the rights and freedoms of a citizen in medical practice, as recognized by the lawyers themselves, is a complex and difficult issue. Well, this is when there is or is there anything criminally proving the relationship between patients and doctors in the provision of medical care. And when the main argument of motivation is the doctor's resentment, the violation of moral ethical standards is not tolerated, we are usually accustomed to seeing from the side of the doctor, but if it is not strange from the side of the patient's close people, what to do? It's easier for ordinary citizens, you can freely say what you think, if you are still brave. And if you run into the clerk, like in our example, you will remain silent, although cats scratch at heart. Your silent experiences, heart attacks and strokes only lead you to the grave ahead of schedule.

At our discretion, one **conclusion** follows from this: both doctors and officials who work for the good of the people are not young people, experienced responsible ones and they intend to avoid such mistakes in their work, this is unambiguous. From their student days, they know the corresponding strict instructions, rules, even codes, while when a question concerns their own interests, at that moment, these postulates are forgotten, unfortunately. Here its own pragmatism seems to prevail! Individual psychology: self-preservation, self-respect? How to be?

References

1. Arbuznikov A.A. Publication of a medical error as one of the mechanisms for protecting the rights of citizens / A.A. Arbuznikov // Priority scientific directions: from theory and practice.-2013.-№ 5.- P. 129-137.

2. Gnatyuk O.P. Medical errors and professional misconduct. Responsibility of medical workers and preventive measures / O.P. Gnatyuk // Bulletin of Roszdravnadzor. – 2016.- № 2. –P. 16-21.

3. Dvizhnov Yu.V. // Legislative conflicts in medicine. Philosophy of Social Communication. №4 (45) 2018. P. 7-10. 2

4. Ivanova A.A. Medical error qualification / A.A. Ivanova // Actual problems of modern science, technology and education. -2014.-№ 1.- P.246-249.

5. Eroshina T.A. The problem of medical error in the light of the teachings of the knowledge of I. Kant / T.A. Eroshina, E.V. Stolyarov // Personality and the changing world: health, adaptation, development. -2015. - № 2.- P. 1-8.

6. Ludupova E.Yu. Medical errors. Literary review / E.Yu. Ludupova P. 2-3.

7. Toktomushev A.T. Force majeure in surgery. LAP LAMBERT/ Internation Book Market Service Ltd., member of OmniScriptium Publishing Group.2018. P.

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PHARMACOGENETIC STUDIES FOR PERSONALIZED PATIENT THERAPY IN REHABILITATION TREATMENT PROGRAMS AT DIFFERENT STAGES OF REHABILITATION

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Abstract. *The article presents the experience of introducing personalized medicine technologies into the clinical practice of a rehabilitation hospital. An innovative approach to the therapy of patients at various stages of medical rehabilitation using genotyping (to identify hereditarily determined features that determine the pathogenesis of the development of pathology, restorative potential, kinetics of drugs) makes it possible to assess the prognosis of the effectiveness and safety of medical interventions (including when prescribing pharmaceuticals) individually, taking into account the polymorphism of the candidate genes of the examined patient.*

Keywords: *personalized approach; pharmacogenetics; genotyping; rehabilitation treatment, rehabilitation*

Introduction

Personalized medicine based on the determination of human genetic characteristics is a promising trend in the management of a medical process based on

genotyping. This approach is used in modern algorithms for choosing diagnostic, treatment, rehabilitation and preventive programs. Technologies for detecting gene mutations, allelic variants of genes associated with a predisposition to common diseases, metabolic disorders, detoxification, to the characteristics of pharmacokinetics - make it possible to predict genetically determined risks of the implementation of multifactorial diseases in a patient, disruption of adaptation mechanisms when exposed to unfavorable environmental factors. The peculiarities of the patient's genotype enable the doctor to determine the choice of biomarkers for the prevention of the development of pathology and complications, with the choice of adequate treatment to reduce the risk of iatrogenism [1, 2, 3].

Purpose of the study – determination of the polymorphism of allelic variants of candidate genes (protein products of which are involved in the regulation of homeostasis, adaptation, restoration of the body, in the processes of metabolism of xenobiotics) to assess the risk of developing multifactorial pathology and unwanted drug reactions - for adequate therapy and prevention of complications in the patient.

Materials and methods

The object of the study is patients examined at different stages of rehabilitation treatment; methods - analysis of clinical and laboratory data, functional studies; genealogical analysis of family history; genotyping - molecular genetic study of patients' biomaterial using polymerase chain reaction (isolation, amplification - building up of the studied target gene fragments, detection of the results obtained); biomaterial - venous blood. The diagnostic panels used are various sets of single nucleotide gene polymorphisms (products of which are involved in the regulation of blood pressure, endothelial function, thrombus formation and thrombolysis, angiogenesis and revascularization, tissue sensitivity to hypoxia and toxic effects of endogenous and exogenous origin, maintaining homeostasis, metabolic activity, reparative regeneration, direction and strength of the immune response to allo- and autoantigens). Interpretation of identified gene polymorphisms (based on the use of published meta-analyzes on proven associations of genotypes with clinical manifestations, pharmacokinetics [4, 5] with an assessment of the contribution of the studied polymorphic variants of genes to the development of adaptive and pathological processes and responses to non-drug effects, biotransformation of pharmaceuticals in the body patient) with individual recommendations.

Results and discussion

At the Central Clinical Hospital for Rehabilitation of the Federal Medical and Biological Agency of Russia, genetic counseling is carried out in the department

of personalized medicine for patients sent from outpatient appointments and from the hospital. Genotyping of patients is used to assess the rehabilitation potential, the choice of adequate pharmacotherapy, and preparation for surgical treatment [6, 7, 8]. This is a method for identifying individual biological characteristics of a patient (genetically determined molecular mechanisms of metabolic regulation, adaptive reactions, the risk of the formation of multifactorial diseases and comorbid conditions, complications, an unwanted response to anesthesia and medications). Cooperation with licensed laboratories that carry out the necessary molecular genetic studies of the biomaterial of patients allows obtaining genotyping data in order to prepare clinically meaningful interpretation of the results for patients and attending physicians. The choice of profiles for genotyping is carried out by a geneticist according to the history and clinical diagnoses of the patient, family history of multifactorial diseases (especially in cardiovascular pathology with a high risk of heart attacks and strokes: with arterial hypertension, with impaired hemostasis, lipid and carbohydrate metabolism). As part of the personalization of treatment, the pharmacogenetic characteristics of the patient are investigated (for drugs for long-term use - antihypertensive drugs, anticoagulants, antiplatelet agents, statins, non-steroidal anti-inflammatory drugs, etc.) - both for an adequate choice of the drug itself and for choosing its therapeutic dose [9, 10]. Also in demand are studies on the risk of developing cancer, endocrinopathies and osteoporosis, genetic testing for detoxification profiles, pro-inflammatory cytokines, metabolism for weight correction and the formation of individual programs of physical activity and nutrition, the choice and use of correctly dosed nutritional supplements, vitamins and micronutrients that optimize gene activity. The results of genotyping and subsequent genetic counseling, reflected in the conclusion of a geneticist, are important information for the patient and the attending physicians. The final genetic report presents the identified features of the patient's genotype. They can be regarded as individual predictors of insufficiency of adaptive-restorative processes, predisposition to pathology, risk of complications and adverse reactions to treatment. Therefore, in the conclusion of a geneticist, an interpretation of the clinical significance of the results of genotyping is presented, on the basis of which the attending physician can reasonably choose: biomarkers for monitoring the clinical, laboratory and functional state of the patient; the most effective and least toxic drugs, calculate their dosage (based on the metabolic rate); use the information received to prevent complications and improve the effectiveness of rehabilitation treatment.

Conclusion: a personalized approach with the determination of the possibilities of individual rehabilitation in patients of various profiles (neurological, cardiological, orthopedic, therapeutic) allows doctors to carry out comprehensive rehabilitation treatment programs, taking into account the genetic determinism of

pathological and restorative processes. To choose, taking into account the patient's genetic characteristics, the most effective and safe options for drug therapy and non-drug technologies: adequate nutrition; motor mode; physiotherapy exercises; treatment with physical factors (balneotherapy, peloid therapy; low-frequency laser and magnetic therapy, ultratonotherapy, electro- and phonophoresis with various pharmaceuticals, etc.), as well as prescribe individual training programs, kinesitherapy, which reduces the risk of complications and increases the effectiveness of rehabilitation.

References

1. Swen J.J., Huizinga T.W., Gelderblom H. et al. Translating Pharmacogenomics: Challenges on the Road to the Clinic. // PLoS Med. — 2007. — V. 4. — N. 8. DOI: 10.1371 / journal.pmed.0040209

2. Bachtiar M, Ooi BNS, Wang J, Jin Y, Tan TW, Chong SS, Lee CGL. Towards precision medicine: interrogating the human genome to identify drug pathways associated with potentially functional, population-differentiated polymorphisms. Pharmacogenomics J. 2019 Dec; 19 (6): 516-527. DOI: 10.1038/s41397-019-0096-y. Epub 2019 Oct 3.

3. Dokukina T.V., Gilep A.A., Golubeva T.S., Makhrov M.V., Gaidukevich I.V. Improving pharmacogenetic testing for the purpose of personalizing therapy is a doctrine of world health development. // Medical news. – 2017. – №5. – P. 45-49.

4. Sychev D.A. Pharmacogenetic testing: clinical interpretation of results. Recommendations for medical practitioners. Moscow 2011 Available from: URL: http://rek_primen_farmakogen_test_klinich_prakt_10_02_2011_rec.pdf

5. Kazakov R.E., Berdnikova N.G., Sychev D.A. Pharmacogenetics and clinical research: points of contact. // Pharmacogenetics and Pharmacogenomics. – 2016.- №1. – P.18-23.

6. Ponomareva N.Yu., Mitkovsky V.G., Yampolskaya E.N., Kochetkov A.V. The use of innovative approaches to personalized medicine and genotyping in medical rehabilitation. Materials of the Scientific and Practical Conference "Topical Issues of Medical Rehabilitation" in the MC "Reshma". Scientific and practical journal "Resort Medicine" M.: 2016; 2: 119-121.

7. Ponomareva N.Yu. Kochetkov A.V., Mitkovsky V.G., Yampolskaya E.N. Integration of personalized approaches into the practice of restorative medicine: from diagnostics to treatment and rehabilitation. Materials of the III International Congress "Physiotherapy. Physiotherapy. Rehabilitation. Sports medicine", http://www.rehabcongress.ru. 2017; 112.

8. Ponomareva N.Yu., Mitkovsky V.G., Yampolskaya E.N., Kochetkov A.V. Genetic screening and personalized approach in health preservation, preventive and restorative medicine. Materials of the Conference of the XII All-Russian Forum Exhibition and Congress "The health of the nation is the basis of Russia's prosperity" 2018; 36-43.

9. Ponomareva N.Yu., Mitkovsky V.G., Yampolskaya E.N., Lazarev V.V., Kadnikova N.G., Kochetkov A.V. "A clinical case of examination of a patient with iron overload syndrome. Differential molecular genetic diagnostics, choice of treatment" "Pharmacogenetics and pharmacogenomics" 2019; (2) – P.44-46. DOI:10/24411/2588-0527-2019-10065

10. Ponomareva N.Yu., Mitkovsky S.V., Mitkovsky V.G., Yampolskaya E.N., Lazarev V.V., Kadnikova N.G., Kochetkov A.V. Pharmacogenetic testing of a patient for the selection of therapy with non-steroidal anti-inflammatory drugs // Pharmacogenetics and Pharmacogenomics. 2020;(2):38-39. DOI: 10.37489/2588-0527-2020-2-38-39

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BODY MASS INDEX AND PARAMETERS OF DYSLIPIDEMIA, CARBOHYDRATE METABOLISM, LEPTIN AND INSULIN IN THE ETHNIC POPULATION OF KAZAKHS

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Abstract. *Obesity as a multifactorial disease is associated with hyperinsulinemia and insulin resistance, which lead to the development of atherogenic dyslipidemia. The increasing importance in understanding the mechanisms of obesity development is associated with an in-depth study of the functions of leptin produced by adipocytes.*

Keywords: *obesity, Kazakh population, carbohydrate metabolism, leptin, dyslipidemia.*

Introduction

The problem of obesity in the modern world is becoming more and more urgent and begins to pose a social threat to people's lives. This problem is relevant regardless of social and professional affiliation, area of residence, age and gender. According to the WHO, in 2016 1.9 billion of the world's adult population was overweight, 600 million people were obese. It is predicted that 50% of the world's population will suffer from excess weight by 2025. In Kazakhstan, more than half of the population is overweight, and 23.5% of Kazakhstanis are completely obese. The improvement of diagnostic methods to a personalized approach is gaining relevance.

Of particular interest is the analysis of the relationship between body mass index and indicators of insulin, leptin, dyslipidemia. This step is a necessary level of scientific and practical significance in the study of the nature of obesity, which is important for practical health care.

At the same time, the issue of studying obesity taking into account ethnic characteristics has not been sufficiently studied, especially among Asians. The ethnicity of the patient is an important link at the present stage of developing a personalized approach to the treatment and prevention of diseases.

Purpose of the study

Study of the relationship between body mass index (BMI) and indicators of lipid profile, carbohydrate metabolism, leptin, insulin levels in blood serum in the Kazakh population.

Materials and methods

The study was carried out as part of the research work WKSMU named after Marat Ospanov, MRNTI 76.03.39,76.29.37. in accordance with the Declaration of Helsinki of the World Medical Association "Ethical principles of scientific and medical research with human participation" The study was approved by the Local Ethics Committee of the WKSMU named after Marat Ospanov № 17 dated 04.09.2019. The recruitment of patients was carried out by the method of random sampling, taking into account the age and sex composition of the population in public places, on the territory of Aktobe (Western Kazakhstan). Written informed consent was obtained from each participant to conduct the survey. Inclusion criteria: ethnicity - Kazakhs, including grandparents, taking into account three generations; age 18 and over; the patient's ability to participate in the study. Exclusion criteria: a history of endocrine diseases (diabetes mellitus, thyroid and adrenal gland diseases), chronic decompensated diseases of internal organs, pregnancy, lactation. Anthropometric studies included the measurement of height, weight, waist circumference (WC) and hips circumference (HC) of the subject. According to the parameters of height and body weight, the body mass index (BMI) was calculated using the formula: weight (kg)/height in m^2. BMI was assessed according to the WHO classification of overweight and obesity: norm 18.5 - 24.9 kg/m^2; excess weight - 25-29.9 kg/m^2; obesity of the 1st degree - 30-34.9 kg/m^2; obesity of the 2nd degree - 35-39.9 kg/m^2; obesity degree 3 - 40 kg/m^2 or more WC measurements were carried out using a tape measure from a point in the middle between the costal edge and the iliac crest along the mid-axillary line, the results were evaluated in centimeters (cm). Hip circumference (cm) was measured at the widest point around the greater trochanter.

The sample consisted of 159 patients, which was divided into 3 groups according to BMI, which were randomized among themselves by age and gender. Venous blood sampling was performed in the morning on an empty stomach. The

leptin content was determined by enzyme-linked immunosorbent assay in blood serum (ng/ml). Lipid status includes determination of total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides (TG). TC was determined by the enzymatic (CHOD-PAP) method (mmol/l). LDL was calculated using the Friedwald formula (using TC, HDL and TG values) (mmol/l). In determining HDL, a homogeneous enzymatic colorimetric test (mmol/l) was used. When assessing the lipid profile data, we were guided by the NCEP/ATPIII Experts' Recommendations: For hypercholesterolemia, a TC level of ≥ 5.2 mmol/l was taken, a TG level of ≥ 1.7 mmol/l was referred to as hypertriglyceridemia. The atherogenic coefficient (AC) was calculated using the following formula: AC = (TC - HDL): HDL. Fasting glucose and insulin concentrations were determined using a reagent kit. Insulin resistance index (IR HOMA) - was calculated using the formula: IR HOMA = fasting glucose × fasting insulin/22.5.

Statistical data processing. Comparisons of the two groups in terms of numerical indicators were carried out on the basis of the nonparametric Mann-Whitney test. Comparisons of three or more groups on numerical scales were carried out using the nonparametric Kruskal-Wallace method. To describe the quantitative scales, the mean and standard deviation in the form of "M ± S" were used. The statistical significance of different values for binary and nominal indicators was determined using the Pearson Chi-square test in the case of independent samples. Correlation analysis was carried out on the basis of Spearman's nonparametric rank correlation. The level of statistical significance was fixed at the error probability level of 0.05. Statistical data processing was performed using Statistica 10 and SAS JMP 11 software packages.

Results. Table 1 shows the results of statistical analysis comparing the quantitative indicators of the subjects in the three groups according to BMI.

Table 1. *Clinical and laboratory characteristics (mean ± standard deviation)*

Indicator	Body mass index (BMI) classification			P level (df=2)
	Normal body weight	Excessive body weight	Obesity	
Anthropometry				
Age, years	28.5 ± 8.0	44.2 ± 11.0	40.6 ± 12.8	0.0006
Height, cm	164.6 ± 7.7	165.8 ± 7.8	165.8 ± 9.7	0.8699
Weight, kg	56.7 ± 8.9	75.3 ± 7.3	102.1 ± 17.8	<0.0001
Waist, cm	72.3 ± 6.9	88.4 ± 7.6	106.6 ± 11.4	<0.0001
Hip, cm	92.9 ± 3.3	102.1 ± 4.1	119.4 ± 11.9	<0.0001
Waist/hip index	0.8 ± 0.1	0.9 ± 0.1	0.9 ± 0.1	<0.0001
Waist/height index	0.4 ± 0.0	0.5 ± 0.0	0.6 ± 0.1	<0.0001
Body mass index	20.9 ± 1.8	27.3 ± 1.4	37.2 ± 5.6	<0.0001

Lipid profile				
Cholesterol	4.2 ± 0.7	4.8 ± 0.8	4.9 ± 0.9	0.0392
HDL	1.6 ± 0.3	1.3 ± 0.3	1.2 ± 0.3	0.0003
LDL	2.6 ± 0.8	3.4 ± 0.8	3.3 ± 0.8	0.0227
Triglycerides	0.7 ± 0.3	1.1 ± 0.4	2.0 ± 1.4	<0.0001
Atherogenic index	1.8 ± 0.8	2.9 ± 1.0	3.4 ± 1.1	<0.0001
Hormones				
Leptin	10.6 ± 7.5	18.0 ± 20.5	30.5 ± 24.9	0.0010
Insulin	7.8 ± 5.2	14.2 ± 7.8	23.9 ± 17.1	<0.0001

In the lipid profile, all indicators are statistically significantly different between the three compared groups. The most significant differences were found in HDL in persons with BMI for the norm in relation to BMI with obesity (on average, 0.4; P = 0.0003); atherogenic index in obese individuals in relation to the group with normal BMI (on average by 1.6; P <0.0001); triglycerides with BMI of the obese group in relation to the group with BMI for the norm (on average by 1.3; P <0.0001).

The level of hormones (insulin, leptin) was statistically significantly different between the three compared groups. The most significant differences were found for the leptin index in obese patients relative to those with normal body weight (on average, 19.9; P = 0.0010); ninsulin concentration in the obese group in relation to the group with normal body weight (on average by 16.1; P <0.0001).

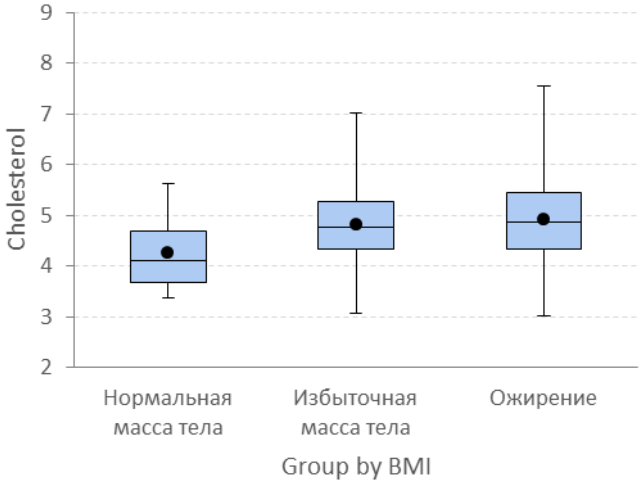

Figure 1. *Statistical scores for each BMI value for cholesterol score*

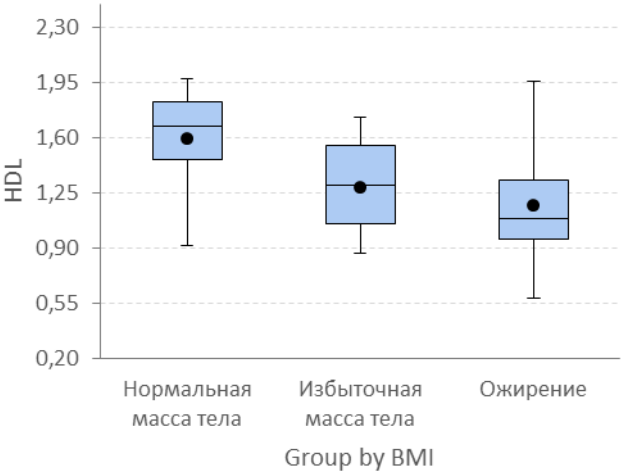

Figure 2. *Statistical indicators for each value of BMI for HDL index*

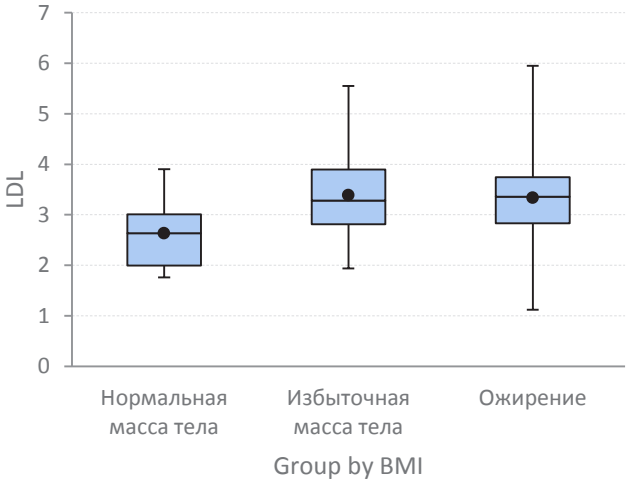

Figure 3. *Statistical indicators for each BMI value for LDL score*

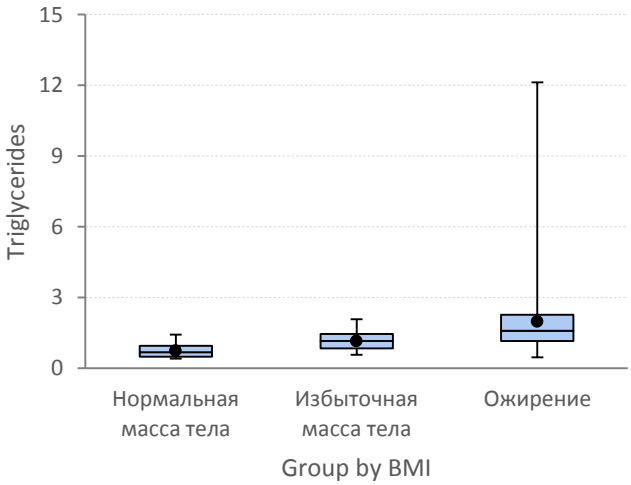

Figure 4. *Statistical indicators for each BMI value for Triglycerides*

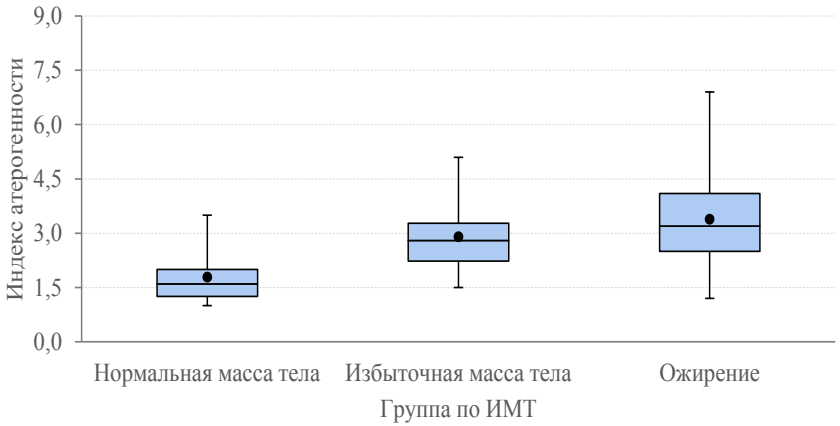

Figure 5. *Statistical indicators for each BMI value for the atherogenic index*

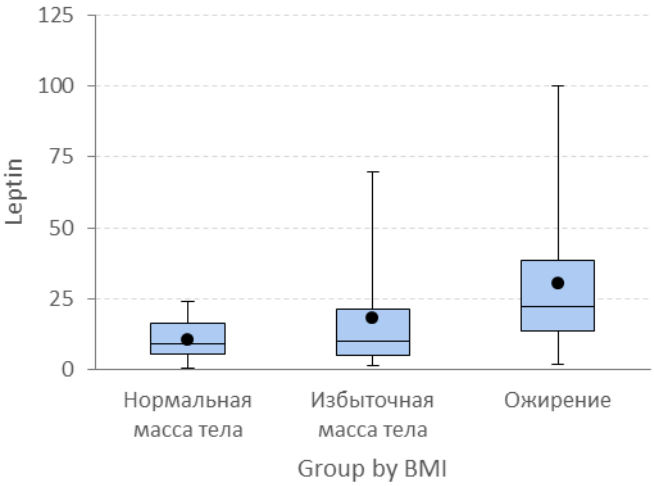

Figure 6. *Statistical indicators of BMI for Leptin*

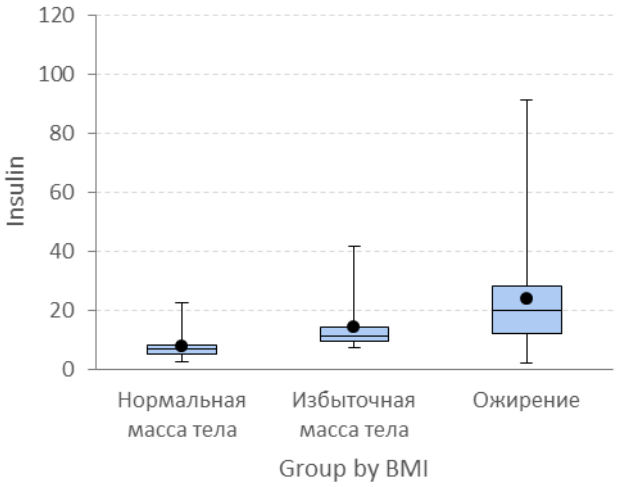

Figure 7. *Statistical indicators of BMI indicators for Insulin*

Table 2. *Mean ± root-mean-square deviations of the carbohydrate spectrum according to BMI*

Indicator	BMI group			P level (df=2)
	Normal body weight	Excessive body weight	Obesity	
Carbohydrate spectrum				
Glucose	5.0 ± 0.7	5.5 ± 1.6	6.4 ± 3.1	0.0011
HOMA index	1.8 ± 1.6	3.5 ± 2.2	6.8 ± 6.2	<0.0001
Glycated hemoglobin	5.5 ± 0.4	6.1 ± 1.3	6.2 ± 1.6	0.0960

Based on table 2, figures 8.9, the most significant differences were found for fasting glycemic parameters in the obese group in relation to the group with normal body weight (on average by 1.4; P = 0.0011); HOMA index in the group with BMI more than 30 kg/m^2 in relation to the group with BMI less than 30 kg/m^2 (on average by 5.0; P <0.0001).

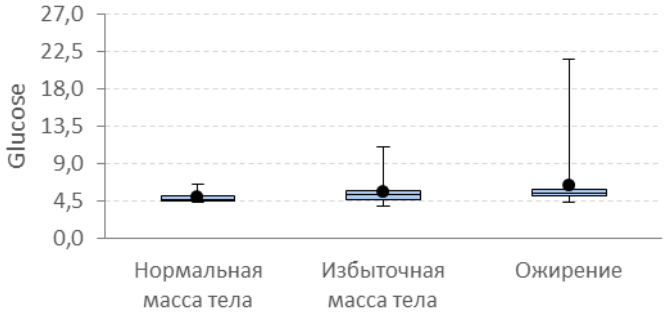

Figure 8. *Statistical indicators of BMI for Glucose*

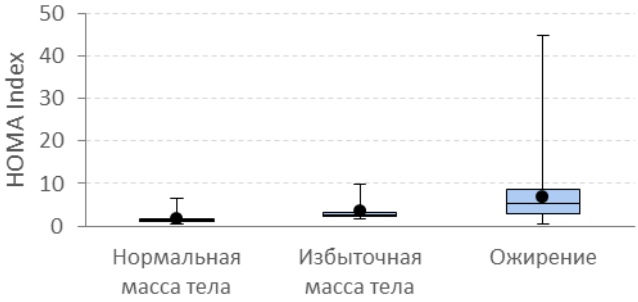

Figure 9. *Statistical indicators of BMI for the HOMA index*

Conclusion

The study investigated the relationship of BMI with parameters of lipid and carbohydrate metabolism, including the hormones insulin and leptin in the Kazakh population. An increase in body mass index is associated with hormonal and metabolic risk factors. Adipose tissue is an endocrine organ that secretes a number of biologically active molecules - adipocytokines, including leptin. The imbalance between adipocytokines arising in obesity can lead to the occurrence of lipid and carbohydrate metabolism disorders, an increase in blood pressure and, consequently, to the formation of metabolic syndrome and its components. Adipose tissue is recognized as a source of pro-inflammatory cytokines, which, along with adipokines, contribute to the development of insulin resistance, the progression of obesity, and, finally, to inflammation of adipose tissue [Kulikov D.I. et al., 2013; Ouchi N. et al., 2011; Hirabara S.M. et al., 2012]. The results of the study show that assessing the relationship between leptin and insulin and understanding the possible mechanisms of action can be used in clinical practice to assess the metabolic status of an obese patient. As a biomarker of obesity, leptin reflects the activity of adipocytes and carries information about risk factors for the consequences of obesity and can be used to improve the efficiency of early diagnosis of obesity-associated diseases. In our prospective study, the identification of the relationship of pathogenetic factors of obesity in the Kazakh population showed that the content of leptin and insulin in serum correlates with BMI, the highest rates were observed with a BMI of more than 30 kg/m^2. Leptin relationships need further study as potential markers for improved clinical outcomes in obesity. The data obtained showed associations of BMI with parameters of carbohydrate and lipid metabolism, along with which the HOMA index as an indicator of insulin resistance are important pathogenetic links of obesity.

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THERMO-SENSITIVITY FACTORS INFLUENCING THE USE OF INFRARED THERMOGRAPHY

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Abstract. *Nowadays, the use of infrared thermography which working principle is by determining the thermal pattern of the skin is increasingly being applied as a diagnostic tool. This technique may influenced by external factor particularly thermo-sensitivity. Review that describes thermo-sensitivity factors for conducting research through infrared thermography approaches is still limited. The aim of this article is to review a classification of the thermo-sensitivity factors that influence the application of infrared thermography in humans. The cooling and warming thermo-sensitivity area of human body is depend on the spot area. Certain body parts have higher sensitivity greater and smaller sensitivity values than the whole-body average. Signals from the skin may be conveyed by thermoreceptors. The mechanism of thermoreceptors activity is related to thermoregulation and action potential. The other factors are the basic characteristics of the subject and are primarily related to age, sex, emotion, circadian rhythm, and medical history. In addition, the final group of potentially temperature sensitivity factors is thermal comfort that described as satisfaction of the mind in an environment. Based on this, there are four factors in thermo-sensitivity that can affect the application of infrared in human: the spot area; physiological factor, biophysical aspects, and thermal comfort.*

Keywords: *Infrared Thermography, Thermo-sensitivity, spot area; physiological factor, biophysical aspects, thermal comfort.*

Introduction

One of method which working principle is by determining the thermal pattern characteristics is Infrared Thermography. Since infrared thermography capability

has been approved to detect many groups of diseases at once, the use of infrared thermography in humans is more intensive in its application as a diagnostic tool. As a non-invasive and low-cost technique, infrared thermography causes no discomfort to the patient. Infrared thermography is completely safe and easy to operate. Even for more frequent use, the security level is very safe. This technique is also possible to use for pregnant women and children [1].

Working with infrared thermography requires accounting for many factors that can influence either the evaluation or the interpretation of the thermal images. One of the weakness of infrared thermography is that it takes into account several factors that can influence either the analysis or interpretation of thermal image [2]. Furthermore, human temperature sensing is not homogenous across the body. Individually differences in how people experience their thermo sensitivity [3]. Attempting to control for such a large number of factors may seem impossible, but simply being acquainted with this factor is an important step in many contexts. Moreover, review that describes thermo-sensitivity factors for conducting research through infrared thermography approaches is still limited. Therefore, the primary objective of this article is to propose a classification of the thermo-sensitivity factors that influence the application of infrared thermography in humans.

Disscussion.

Temperature sensitivity or thermo-sensitivity refers to the ability to detect changes in the temperature of the skin. These changes may involve either increases (warming) or decreases (cooling)-vice versa, relative to the adapted temperature level of the skin. The temperature-sensation system to serve primarily as an early warning system. Temperature sensitivity is important in protecting one's self from intense temperature that may cause damage to the body. Sensitivity to temperature allows a person to adapt to the temperature of her or his environment in order to maintain homeostatic [2]. Based on this, the group of potentially confounding factors in thermo-sensitivity that related to infrared thermography method are: The spot area, Physiological factors, Biophysical factors, and thermal comfort.

1. The spot area

In humans, skin temperature (Tsk) sensing is mediated by free nerve endings of the Aδ- and C-type classes (i.e., thermoreceptors) [4]. Selectively conveying warm and cold afferent inputs via the anterolateral spinothalamic tract to neural centers located in the insular and somatosensory cortices. When the physical stimulus is interpreted by the brain as "hot", the brain sends signals back to the body part in contact to withdraw away from the stimulus. The same response may be observed when the stimulus is perceived as "cold“.

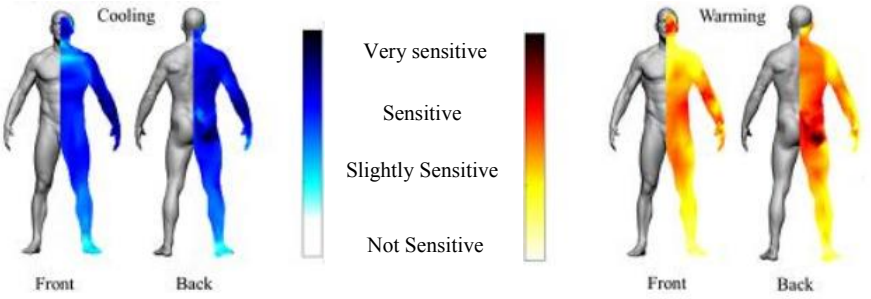

Figure 1. *The Mapping of Cool and Warm Sensitivities across the Human Body [5]*

Figure 1 shows the mapping of cool and warm sensitivities across the human body from both front and back views. In general, the back is more sensitive than the front (darker colors for back than front for both heating and cooling. The cooling and warming coefficients show that the foot, lower leg and upper chest are much less sensitive, while the cheek, neck back, and seat area, are very sensitive to both cooling and warming [5]. There is clearly a large regional variation in thermal sensitivity for different body part.

Table 1 shows that body parts like buttock, face, dorsum of hand, and belly have higher sensitivity coefficients greater than 1 while the foot, lower leg, and chest had smaller sensitivity values than the whole-body average. The coefficients for the neck is quite close to the whole-body average, but the back part of the neck is much more sensitive than its front part. [6]

Table 1. *Sensitivity Coefficient of 15 different body parts*

No	AREA	COOLING	WARMING
1	Face	1.14	1.34
2	Neck back	1.00	1.24
3	Neck front	0.89	0.55
4	Chest	0.94	0.92
5	Belly	1.15	1.38
6	Back	1.17	1.16
7	Upper arm	1.20	1.17
8	Forearm	1.08	1.02
9	Hand palm	1.03	0.96
10	Hand dorsum	1.48	1.22

11	Buttock	1.25	1.92
12	Thigh	1.10	1.16
13	Lower leg	0.87	0.82
14	Sole 5	0.44	0.40
15	Foot dorsum 5	0.64	0.50
16	Sole 7	0.59	0.38
17	Foot dorsum 7	0.63	0.60
18	Overall average	1	1

2. Physiological factor

Density of sensory innervation: thermal perceptions is rely on separate neural pathways involving thin myelinated or unmyelinated axons of the peripheral nervous system. Cold receptor endings lie within 0.15mm of the dermis, whereas warm receptor endings are buried more deeply, at 0.6mm. In addition to being closer to the surface, cold receptors are also three to ten times more numerous than warm receptors across the majority of body regions. Behavioral responses including thermal are depend on signals from peripheral thermosensors to initiate intracellular signaling pathways [7].

Sensory receptors become activated by stimuli in the environment by receiving signals. Signals from the skin may be conveyed by thermoreceptors [8]. These receptors display a constant discharge to their specific temperatures, and when an experience of the opposite temperature occurs, there is a sudden ceasing of receptor discharge. Cold receptors mainly sense temperatures between 25-30°C. Temperatures below this cause release of bursting discharges. In touching dangerously hot objects (greater than 45°C), there can be a brief sensation of cold due to the paradoxical firing of cold receptors. Warm receptors respond to the approximate temperature range of 30-46°C. Higher temperatures may result in the decreased firing of these receptors [9].

As a stimulus constantly excites the receptor consequently influencing the rate of action potentials. An action potential occurs when a neuron sends information down an axon, away from the cell body. The action potential is an explosion of electrical activity that is created by a depolarizing current. This means that some event (a stimulus) causes the resting potential to move toward 0 mV. When the depolarization reaches about -55 mV a neuron will fire an action potential which is known as threshold. If the neuron does not reach this critical threshold level, then no action potential will fire. [10].

Moreover, receptors can adapt to a constant, unchanging stimulus, if there is a change, whether loss of the stimulus or change in intensity, the receptor is able to respond. Researchers found that the human skin has a normal range of adaptation

temperature – from 29-37°C [11]. Different body parts have different temperature sensitivity levels; causing their respective thresholds to vary as well. Temperature threshold is the point at which one can tolerate the hotness or coldness of a stimulus [12].

In fact, the mechanism of thermoreceptors are responsible for helping maintain homeostasis in the body and for allowing the body to best react to internal and external stimulus. One of important type of homeostasis known as thermoregulation. Thermoregulation, by definition, is a mechanism by which human maintain body temperature by tightly controlled self-regulation, no matter the temperature of their surroundings. Without thermoregulation, the human body would not be able to adequately function and inevitably [13].

Thermoregulation has three mechanisms: afferent sensing, central control, and efferent responses. Afferent sensing works through these receptors to determine if the body is experiencing either too hot or too cold of a stimulus. TRPV3 may be more responsible for detecting warm temperatures. In contrast, for colder temperatures, it is believed that TRPM8 ion channels are one of many receptors responsible. These receptors are capable of detecting temperatures from below 16°C to 26°C. The belief is that other undiscovered receptors also have a role in cold detection.[14] Next, the hypothalamus is the central controller of thermoregulation. If the hypothalamus senses external temperatures growing too hot or too cold, it will automatically send signals to the skin. Lastly, efferent responses are carried out primarily by the body’s behavioral reactions to fluctuations in body temperature. Efferent responses also consist of automatic responses by the body to protect itself from extreme changes in temperature, such as sweating, vasodilation, vasoconstriction, and shivering [15][16].

When external environments are exceedingly warm, the heat is produced inside his or her body is typically transported to the blood. The blood then carries the heat through numerous capillaries that are located directly under the skin. Because the blood is near the surface, it can cool the person down. This cooled blood can then be transported back through the body to prevent the body temperature from becoming too high. Sweat is also a means by which the body cools itself down; it is created by glands to carry out evaporation at the topmost skin layer, the epidermis, to release heat. This describes vaporization, one of the four mechanisms used to maintain core body temperature. Radiation is when the heat that is released from the body’s surface is moved into the surrounding air; convection occurs when cooler air surrounds the body’s surface, and conduction comes into play when a person is either triggered by cold water or uses an ice pack in relation to infrared thermography application-their internally generated heat is transferred to the cold water or the ice pack. This is another reason why it is very important to stay hydrated in the heat or during physical activity-not only to maintain adequate

intravascular fluid volume, but also to aid in conduction processes that cool the body down. When cold fluids are ingested, the heat is released into the fluid and excreted out of the body as sweat or urine [17].

3. Biophysical Aspects

The other group of potentially confounding factors in thermo-sensitivity that related to infrared thermography method are biophysical factors. Biophysical aspects are the basic characteristics of the subject and are primarily related to age, sex, emotion, circadian rhythm, and medical history.

Age influences the structures, physiologic, functions of the nervous system, leading to age-related changes in thermal perception [18]. In humans adapted for a long time to various conditions-cold, heat, and physical exercise-directed changes in temperature sensitivity, women having a higher percentage of body fat than men, female sex hormones etc. woman’s body temperature is higher during ovulation and pregnancy, and lower at the start of the menstrual cycle.[19]

Body temperature undergoes significant fluctuation over the course of a diurnal variation. It is usually at its lowest early in the morning and slowly climbs up after a person wakes up, reaching its peak late in the afternoon. This variation corresponds to the level of metabolic activity, which is lowest during sleep and slowly climbs up as the day progresses. Many pharmaceutical drugs, including several classes of antibiotics (cephalosporins, penicillins etc), methyldopa, phenytoin, among others, are known to cause an increase in body temperature. [20]

4. Thermal comfort

The final group of potentially temperature sensitivity factors is related to infrared thermography method is thermal comfort. Comfort can be described as satisfaction of the mind in an environment. In this satisfied environment, physical and mental productivity of human become higher. In general, thermal comfort occurs when body temperature is held within narrow ranges, skin moisture is low, and the physiological effort of regulation is minimized [21].

Body temperature increases in response to stressful situations. Stress hormones such as cortisol and adrenaline mediate this increase in body temperature. This increase in temperature is an adaptive response of the body to deal with perceived threats. Adrenaline, which mediates the body’s “fight or flight” response, stimulates increased heat production in the liver, in addition to driving other adaptive changes. The liver being one of the body’s largest and most metabolically active organs, has a notable impact on body temperature [20].

References

1. Sheiko EA, Kozel YY, Triandafilidi EI, Shikhlyarova AI. Remote infrared thermography as an auxiliary method in the diagnosis and treatment of hemangiomas in children up to a year. International j. applied and fundamental. Researches, 2015; (9-2): 302–4.

2. Fernández-Cuevas I, Bouzas Marins JC, Arnáiz Lastras J, Gómez Carmona PM, Piñonosa Cano S, García-Concepción MÁ, et al. Classification of factors influencing the use of infrared thermography in humans: A review. Infrared Phys Technol. 2015;71: 28–55

3. Filingeri, Davide and Zhang, Hui and Arens, Edward A.. Thermosensory micromapping of warm and cold sensitivity across glabrous and hairy skin of male and female hands and feet. Journal of Applied Physiology 2018 125:3, 723-736

4. Campero M, Baumann TK, Bostock H, Ochoa JL. Human cutaneous C fibres activated by cooling, heating and menthol. J Physiol 587: 5633– 5652, 2009. doi:10.1113/jphysiol.2009.176040.

5. Maohui Luo, Zhe Wang, Hui Zhang, Edward Arens, Davide Filingeri, Ling Jin, Ali Ghahramani, Wenhua Chen, Yingdong He, Binghui Si. High-density thermal sensitivity maps of the human body, Building and Environment. Volume 167,2020.

6. Luo M., Zhang H., Arens E., Wang Z. (2020) Micro-Scale Thermal Sensitivity Mappings of Human Body. In: Wang Z., Zhu Y., Wang F., Wang P., Shen C., Liu J. (eds) Proceedings of the 11th International Symposium on Heating, Ventilation and Air Conditioning (ISHVAC 2019). ISHVAC 2019. Environmental Science and Engineering. Springer, Singapore.

7. Corniani, G and Saal, HP. Tactile innervation densities across the whole body. Journal of NeurophysiologyVol. 124, No. 4

8. Møller A.R. (2011) Anatomy and Physiology of Sensory Systems. In: Intraoperative Neurophysiological Monitoring. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-7436-5_5

9. Delmas P, Hao J, Rodat-Despoix L. Molecular mechanisms of mechanotransduction in mammalian sensory neurons. Nat. Rev. Neurosci. 2011 Mar;12(3):139-53

10. Marzvanyan A, Alhawaj AF. Physiology, Sensory Receptors. 2020 Oct 27. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan.

11. Jänig W. Peripheral thermoreceptors in innocuous temperature detection. Handb Clin Neurol. 2018;156:47-56

12. Green BG, Akirav C. Threshold and rate sensitivity of low-threshold thermal nociception. Eur J Neurosci. 2010;31(9):1637-1645. doi:10.1111/j.1460-9568.2010.07201.x

13. Kurz A. Physiology of thermoregulation. Best Pract Res Clin Anaesthesiol. 2008 Dec;22(4):627-44.

14. Zhang X. Molecular sensors and modulators of thermoreception. Channels (Austin). 2015;9(2):73-81.

15. Boulant JA. Hypothalamic mechanisms in thermoregulation. Fed. Proc. 1981 Dec;40(14):2843-50

16. Zhao ZD, Yang WZ, Gao C, Fu X, Zhang W, Zhou Q, Chen W, Ni X, Lin JK, Yang J, Xu XH, Shen WL. A hypothalamic circuit that controls body temperature. Proc. Natl. Acad. Sci. U.S.A. 2017 Feb 21;114(8):2042-2047.

17. Osilla EV, Marsidi JL, Sharma S. Physiology, Temperature Regulation. 2020 Oct 27. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan

18. Waterhouse J, Weinert D, Nevill A, Atkinson G, Reilly T. Some Factors Influencing the Sensitivity Of Body Temperature To Activity In Neonates, Chronobiology International, 2000. 17:5, 679-692

19. Vierck CJ, Acosta-Rua AJ, Rossi HL, Neubert JK. Sex differences in thermal pain sensitivity and sympathetic reactivity for two strains of rat. J Pain. 2008;9(8):739-749. doi:10.1016/j.jpain.2008.03.008

20. Díaz M, Becker DE. Thermoregulation: physiological and clinical considerations during sedation and general anesthesia. Anesth Prog. 2010;57(1):25-34. doi:10.2344/0003-3006-57.1.25

21. Samsuddin, S.; Durrani, Faisal; Eftekhari, Mahroo; Uno, Y. (2016): Temperature sensitivity analysis of thermal comfort in a UK residential building. Loughborough University. Conference contribution. https://hdl.handle.net/2134/24108

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INFLUENCE OF REPLACING BARE FALLOW WITH A DISUSED LAND ON THE CONTENT OF MACRO- AND MICROELEMENTS IN TYPICAL CHERNOZEM OF KURSK REGION

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Abstract. *20 years after the replacement of permanent steam with a deposit in typical chernozem, the content of the main organogenic elements increased: carbon by 43%, hydrogen by 31%, nitrogen by 25%. At the same time, the recovery of the organic carbon content occurs very slowly, at a rate of about 0.05% per year, which must be taken into account when regulating the humus state of arable soils. The content of the main macronutrients - silicon, aluminum, iron, potassium, sodium, which form the basis of the mineral part of the soil, did not change significantly during this period. At the same time, in the upper part of the profile of the typical fallow chernozem, the content of some mineral elements, actively involved in the biological circulation of substances, increased. This primarily concerns such elements as phosphorus, chromium, lead, sulfur and zinc, to a lesser extent manganese, calcium and magnesium.*

Keywords: *typical chernozem, permanent fallow, fallow, macroelements, microelements.*

Introduction

At the end of the last century, significant areas of agricultural land in Russia were abandoned and turned into a fallow land. This phenomenon was observed in all natural zones, including the chernozem one. The total area of former agricultural lands that have passed into the category of fallow lands in Russia is more than 4.9 million hectares [1]. The overgrowth of former croplands with natural herbaceous vegetation is accompanied by a change in the biogeochemical cycle of substances underlying soil formation. This entails a change in the intensity and direction of elementary soil processes, which is reflected in the properties and regimes of soils. The study of the features of the functioning of soils withdrawn from active agricultural use is of scientific importance associated with the forecast of their development [2, 3]. Also, the study of fallow soils is promising for the development of certain aspects of practical measures to increase the fertility of soils of old arable lands, in particular, improve their humus state.

To date, a certain amount of information has been obtained regarding the peculiarities of changing soil properties during the transformation of arable land into fallow land. In most cases, there is an improvement in the physical properties of fallow soils in comparison with old arable soils, largely due to their better aggregation [4, 5, 6]. In the soils of the fallow, the content of humus increases [2, 3, 5, 6], while the proportion of non-humified organic residues in the composition of organic matter significantly increases [6]. Along with this, relatively dynamic physicochemical characteristics of soils change noticeably in the soils of fallow lands: the reaction of the environment, the sum of exchange bases, the content of water-soluble humus and mobile phosphorus, migratory forms of free carbonates, the activity of a number of enzymes [7-11].

In general, as the researchers note, the transfer of arable soils to a fallow state contributes to the restoration of their main features and properties to the level inherent in virgin zonal soils [3, 8].

The speed and completeness of the restoration of the characteristics and properties of agricultural soils left in the fallow to the indicators characteristic of their natural analogues will, apparently, largely depend on the initial state of the soils withdrawn from agricultural use.

The direction and depth of changes in soil properties under the influence of agricultural use are largely determined by the level of correspondence between the nature of land use and the natural conditions of soil formation.

In areas occupied by crops of continuous sowing, especially perennial grasses, to some extent the natural process of soil formation is imitated. A much stronger anthropogenic impact on the soil is inherent in areas occupied by row crops. The strongest anthropogenic impact on the soil is observed in areas with pure fallow [12], under the influence of which there is a significant change in soil properties

and regimes up to the transformation of the mineralogical composition [13].

The least favorable situation for the restoration of the lost characteristics with the involvement of arable soils in the fallow will be inherent in soils of agricultural landscapes subjected to severe degradation, especially considering the fact that certain types of degradation can be irreversible [14].

The chemical composition is one of the fundamental properties of the soil and is its most important characteristic [15]. It was found that in the chernozem zone there are very significant changes in the chemical composition of soils under the influence of agrogenesis due to the transition of chemical elements from one compound to another [16]. At the same time, certain types of chemical degradation are noted in chernozems that have been subjected to extensive agricultural use for a long time [17].

Therefore, the identification of the features of changes in the chemical properties of typical chernozem, which is the most important representative of soils in the chernozem zone as a result of the transformation of permanent steam into a fallow, is of scientific and practical importance.

Objects and Methods

Samples of typical chernozem were selected on the stationary field experiment of the Petrinsky support point of the Kursk SRI APP, which was laid in 1964. The following variants of the experiment were studied: permanent fallow (54 years). Plot size 296 m^2. In 1998, 2/3 of the area of steam was left for permanent fallow, and 1/3 of the area was set aside for a deposit, whose age at the time of sampling was 20 years. Samples were taken from a layer with a thickness of 0-20 cm. The content of C, H and N was determined on an automatic CHNS analyzer vario Micro cube in individual samples in 3 replicates and the average values were found. The elemental composition was determined in mixed samples by an X-ray fluorescence method using a ReSPEKT substance composition analyzer.

Research results

According to previously obtained data [5], under the influence of fallow deposits in the upper layer of chernozem with a typical thickness of 0-20 cm, the pH value decreased from 6.42 to 6.22 and the content of mobile phosphorus from 177.8 to 97.0 mg/100 g of soil. At the same time, the content of exchangeable calcium increased by 1.9, and hydrolytic acidity by 1.03 meq/100 g of soil, the content of organophosphates increased by 50.9 mg/100 g of soil. The number of waterproof units increased from 7.60 to 60.5%. Aggregation of the soil mass contributed to a decrease in the content of water-peptized sludge from 3.81 to 1.82%.

As a result of overgrowing of the fallow area with natural herbaceous vegetation, the scale of the biological cycle of substances and the amount of plant residues entering the soil changed, which was reflected in the content of organophilic elements (tab. 1).

Table 1

Influence of replacement of permanent steam with a deposit on the content of organophilic elements in typical chernozem of Kursk Region, $M \pm m \cdot t_{05}$, %

Option	C	H	N
Permanent steam	2.43±0.17	0.81±0.13	0.24±0.04
Deposit	3.48±0.22	1.06±0.07	0.30±0.01

Under the influence of deposits in typical chernozem, the content of the main elements of organophiles increased: carbon from 2.43 to 3.48%, hydrogen from 0.81 to 1.06%, nitrogen from 0.24 to 0.30%. Of the organophilic elements, the greatest increase was observed in the content of organic carbon, the amount of which increased 1.4 times, while the amount of hydrogen and nitrogen increased 1.3 times. This is consistent with the increase in the humus content in the soils of the fallow, which has been repeatedly noted by many researchers [3, 4, 6, 9]. At the same time, mineralization processes are actively proceeding in the chernozem of the deposit, which can be judged by the less noticeable increase in the content of hydrogen and nitrogen in comparison with carbon. Hydrogen and nitrogen, predominantly included in the composition of aliphatic compounds of newly formed humic substances, are actively utilized by microorganisms, while carbon, to a greater extent localized in the composition of stable cyclic compounds, accumulates in the soil. This is also evidenced by some narrowing of the H:C and N:C ratios during the transition from steam to reservoir from 0.33 to 0.31 and 0.10 to 0.09, respectively.

Apparently, at first, the enrichment of old arable soils with humus after their transfer to fallow occurs mainly due to stable cyclic compounds forming molecules of humic acids.

Some changes also occurred with the content of the main chemical elements composing the mineral part of chernozem (tab. 2).

Table 2.

The effect of replacing permanent steam with a deposit on the content of the main constitutional elements in the typical chernozem of Kursk Region, %

Option	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	R_2O_3	Na_2O	SiO_2/R_2O_3
Permanent steam	68.36	12.62	4.14	0.76	17.52	0.84	7.81
Deposit	67.03	12.55	4.21	0.77	17.53	0.87	7.67

In the chernozem of permanent steam, silicon oxide predominates, the content of which was 68.36%. In fallow chernozem, its amount tends to decrease and amounted to 67.03%, which may be due to the intensive consumption of silicon by perennial herbaceous vegetation and active involvement in the biological cycle of substances [18].

The content of other chemical elements that make up the basis of the mineral part of chernozem is noticeably lower and is within the following limits: Al_2O_3 – 12.62-12.55%, Fe_2O_3 – 4.14-4.21%, Na_2O – 0.84-0.87 %, TiO_2 – 0.76-0.77, the R_2O_3 value is 17.52-17.53. In general, as a result of the transformation of permanent steam into a deposit, the content of these chemical elements in typical chernozem practically did not change over 20 years, which may indicate the stability of its mineral part. This can be evidenced by the practically unchanged value of the molecular ratio SiO_2/R_2O_3.

The content of some biophilic elements in the chernozem of permanent steam and deposits is shown in table 3.

Table 3. *Influence of the transfer of permanent steam to the deposit on the content of biophilic elements in the typical chernozem of Kursk Region, %*

Option	CaO	MgO	K_2O	P_2O_5	SO_3	$\frac{P_2O_5}{SO_3}$
Permanent steam	1.09	1.30	1.89	0.19	0.28	0.68
Deposit	1.17	1.34	1.83	0.24	0.32	0.75

The transfer of permanent steam to the deposit has an ambiguous effect on the total content of the most important biophilic elements in the chernozem. The content of CaO is in the range of 1.09-1.17%, MgO – 1.30-1.34%, and K_2O – 1.89-1.83. The content of these elements during the period when typical chernozem was in the state of the deposit practically did not change. At the same time, under the influence of the fallow in typical chernozem, the content of SO_3 increased from 0.28 to 0.32%, and P_2O_5 from 0.19 to 0.24%, which, apparently, is due to the accumulation of these elements in the organic matter of the soil. At the same time, the accumulation of P_2O_5 in chernozem proceeds more intensively in comparison with SO_3. This can be judged by the value of the P_2O_5/ SO_3 ratio, which changed from 0.68 in the chernozem of permanent steam to 0.75 in the chernozem of the deposit.

The content of trace elements in the chernozem of permanent steam and deposits is shown in table 4.

Table 4. *Influence of the transfer of permanent steam to the deposit on the content of trace elements in the typical chernozem of Kursk Region, mg/kg*

Option	Mn	Cr	Rb	Zn	Y	Ga	Pb
steam	6115	55	90	58	36	24	15
deposit	6656	123	94	66	36	25	21

Among the microelements in typical chernozem, Mn predominates, the content of which in vapor chernozem was 6115 mg/kg of soil, and in chernozem of fallow lands it increased to 6656 mg/kg of soil. The Cr content changed from 55 mg/kg of soil in the chernozem of permanent fallow to 123 mg/kg of soil in fallow chernozem. A weakly pronounced tendency to an increase in the content in fallow chernozem is found in Rb, Zn and Pb, while the amount of Y and Ga remained unchanged.

Conclusions

1. As a result of the transfer of permanent steam to the fallow, the level of humus content of typical chernozem increased, which can be judged by the increase in the content of organic carbon, hydrogen and nitrogen, the amount of which in the soil of the fallow increased by 1.05, 0.25 and 0.06%, respectively.

2.The change in the biological cycle of substances contributed to the accumulation in the upper part of the profile of chernozem and a number of mineral elements, of whichCr, P_2O_5, Pb, SO_3 and Zn are most actively accumulated, to a lesser extent – Mn, Ca Mg

References

1. State (national) report on the state and use of land in the Russian Federation in 2016 M.: Rosreestr, 2017. 220 P.

2. Kurganova I.N., Lopez de Guerinu V.O. Organic carbon stocks in soils of the Russian Federation: current estimates in relation to land use change. Reports of the Academy of Sciences. 2009. V. 426. № 1. P. 132-134

3. Rusanov A.M., Teslya A.V. Changes in the basic properties of steppe chernozems as a result of their postagrogenic transformation // Bulletin of OSU. 2012. № 6 (142). P. 98-101

4. Titlyanova A.A., Sambuu A.D. Successions in herbal ecosystems. – Novosibirsk: Publishing house of the SB RAS, 2016 – 191 P.

5. Mamontov V.G., Artemyeva Z.S., Lazarev V.I., Rodionova L.P., Krylov V.A., Akhmedzyanova R.R. Comparative characteristics of the properties of virgin, arable and fallow chernozem typical of Kursk Region // Bulletin of the V.V. Dokuchaev. 2020. Iss. 101. P. 182-201.

6. Agroecological state and prospects for the use of lands in Russia, retired from active agricultural turnover / Edited by Acad. G. A. Romanenko. M.: ARSRI "Rosinformagrotech", 2008 —64 P.

7. Matveeva E.Yu. Fallow as a method of restoring the stability of agroecosystems // Agrarian Bulletin of the Urals. 2009. № 4. P. 61-63

8. Filimonova D.A., Miller G.F., Soloviev S.V., Bezborodova A.N. Comparison of soil characteristics of young and middle-aged deposits of erosion-hazardous territories in the south of Western Siberia // International Journal of Applied and Fundamental Research. – 2019. – № 10-1. – P. 23-27

9. O.A. Sorokina O.A., V.V. Tokavchuk V.V. A.N. Rybakova A.N. Postagrogenic transformation of gray forest soils of fallow lands. Krasnoyarsk. 2016. –239 P.

10. Bulysheva A.M., Khokhlova O.S., Bakunovich N.O., Rusakov A.V. Myakshina T.N. Ryumin A.G. Changes in the carbonate state of the Azov chernozems during their transition from arable land to a fallow // Pochvovedenie, 2020. № 8. P. 1025-1038

11. Myasnikova M.A., Kazeev K.Sh., Ermolaeva O.Yu., Chernikova M.P., Kolesnikov S.I., Akimenko Yu.V., Kozun 'Yu.S. Biological properties of uneven-aged postagrogenic chernozems of Rostov Region // Bulletin of the Samara Scientific Center of the Russian Academy of Sciences, volume 18, №2(2), 2016. P. 452-456

12. Van den Bygaart A.J., Bremer, E., B.G. McConkey, B.H. Ellert, H.H. Janzen, D.A. Angers, M.R. Carter, C.F. Drury, C.F., G.P. Lafond and R.H. McKenzie. Impact of sampling depth on differences in soil carbon stocks in long-term Agroecosystem experiments // Soil Science Society America Journal. 2011. 75 (1). P.226-234.

13. Chizhikova N.P., Sapozhnikov P.M., Ivanov D.Yu. Influence of fertilizers and steam on the finely dispersed part of chernozems // Pochvovedenie. 1992. № 12. P. 93-105.

14. Mamontov V.G., Panov N.P. Soil degradation and its classification // Actual problems of soil science, agrochemistry and ecology. M.: MTAA. 2004. P. 52-56

15. Karpachevsky L.O. Ecological soil science. M.: GEOS. 2005. 336 P.

16. Anthropogenic evolution of chernozems // Ed. A.P. Shcherbakova and Vaseneva I.I. Voronezh.: 2000. 412 P.

17. Krupennikov Chernozem. Emergence, perfection, tragedy of degradation, ways of protection and revival. Kishinev.: Pontos. 2008. 288 P.

18. Fokin A.D., Torshin S.P. Plants in the life of soils and terrestrial ecosystems. Riga.: LAP. 2020. 192 P.

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COPOLYMERIZATION OF P-METHYL AND P-OXYMETHYL PHENYLCYCLOPROPYLMETACRYLATES WITH GLYCIDYL METHACRYLATE AND THEIR PROPERTIES

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Abstract. *New p-methyl- and p-oxymethyl- phenylcyclopropyl methacrylates (MePhCMA and OMePhCMA) have been synthesized and studied their radical copolymerization with glycidyl methacrylate (GMA). New cyclopropane and epoxy-containing photosensitive copolymers have been obtained. The relative activity of monomers and the parameters of Q and e have been determined by Alfrey-Price method. The copolymerization constants of the specified compound (MePhCMA and OMePhCMA) (r_1) with glycidyl methacrylate (r_2), calculated by the Fineman-Ross method, are: $r_1 = 0.63$, $r_2 = 0.60$ ($–CH_3$); $r_1 = 0.62$, $r_2 = 0.70$ ($–OCH_3$), respectively; the values of the parameters Q and e: $Q_1 = 1.37$, $e_1 = –0.90$ ($–CH_3$); $Q_1 = 1.35$, $e_1 = –0.94$ ($–OCH_3$), respectively. The composition and structure of this copolymer have been established. Photochemical studies of the synthesized copolymer have been carried out. It was found that structuring proceeds due to the opening of the cyclopropane ring and epoxy groups, as well as the carbonyl group.*

Keywords: *microstructure, monomers, copolymerization, phenylcyclopropyl methacrylates, photosensitivity.*

INTRODUCTION

Rapid increasing of information requires new type of materials to record, storage and reproduce data. The polymers and copolymers containing various reactive groups possess valuable properties and possibility of crosslinking under action of

radiation which allows to prepare various materials used in microelectronics [1-3]. This is one of the main reasons for interesting of the researchers for the preparation of new types of the photosensitive polymers [4-8].

Polymerization of functionally substituted cyclopropyl styrene [9-11] is a well-known way of preparing such materials, and polymers made of cycloprapane compounds with functional groups are subjected to UV radiation cross-linking processes to form negative photoresists with high light sensitivity [12, 13]. Copolymerization of the cyclopropanes containing vinyl groups with other reactive monomers results polymers containing cyclopropane groups located in side part of macrochain is also well known [14, 15].

This work has been devoted to synthesis and investigate the copolymerization of phenylcyclopropyl methacrylates (MePhCMA and OMePhCMA)with glycidylmethacrylate (GMA) and study of lithography properties of the copolymers prepared on their basis with the aim of creation of new photosensitive copolymers. The choice of this monomer has been stipulated with large number and chemical nature of double bonds and presence of cyclopropane ring in combination with carbonyl group in the monomer which has influence on such important photolithographic parameters of resists as photosensitivity, adhesion, film-forming exc [16, 17].

The choice of this compound to copolymerize it with GMA has been stipulated by the presence of light absorbing carbonyl, cyclopropane and epoxide groups or double bond in the molecule. In the copolymerization of the studied GMAp-PhCMA system is an important task is choosing the conditions when the polymerization is proceeded only by participation of vinyl group and the reactive fragments would be remained in the side chain without changes.

EXPERIMENT

The copolymerization of MePhCMA and OMePhCMA with GMA was carried out in benzene solution in the presence of 0.5 % azobisisobutyronitrile (AIBN) (from total mass of monomers) at 70°C. The total concentration of the initial monomers was 1.0 mol/l, and a ratio of the initial monomers was changed as it is given in table 1. The copolymers of various composition have been isolated after 10-20 min by addition excess of MeOH to the reaction mixture. The resulting copolymers were re-precipitated twice from theirs benzene solution with methanol and sulphuric acid and dried in vacuum (15-20 Hg.mm) at 30°C until constant weight. The copolymers formed were white solids which are well soluble in aromatic and chlorinated hydrocarbons. Elemental analysis for $C_{22}H_{28}O_5$: Calculated: C, 70.96 %, H, 7.52% . Found: C, 70.42%, H, 7.83%; for $C_{22}H_{28}O_6$: C, 68.04 %, H, 7.21%. Found: C, 68.27%, H, 7.04%.

The IR-spectra of the copolymers were registered on spectrometer "Agilent-Cary 630 FTIR", NMR-spectra – on spectrometer "BrukerAFR-300 (80 MHz)" in solution of euterated chloroform.

The photosensitivity of co-polymers was determined at various concentrations (4-13% solutions) with making a layer on the glass substrate in a dust-free medium with centrifuging at 2500·min-1. The photoresists were kept for less than 20 min for increasing of adhesion to the substrate before cutting on contour on contour of the procurement preventing the film detachment.

Thickness of the prepared film-resists was measured by microinterferometer „LINNIKA", which was proved to be 0.20-0.25 mkm after drying for 10 and 20 min at room temperature and 30-35°C/10 Hgmm, respectively. The exposure of the procurements was carried out on a device with light point source through photomask with a DPT-220 mercury lamp (current intensity was 2.2 A, distance from source of radiation was 15 cm, mobile shutter rate of exponometer was – 720 $mm \cdot h^{-1}$, exposure time was 5-20 s).

The development was carried out in a jet installation. As a developer dioxane and sopropyl alcohol was used at ratio 1:2 at temperature of 18-25 °C. The photosensitivity is valuated on the basis of the completeness of photochemical polymerization (crosslinking). The photosensitivity – the inverse of the dose of UV-light absorbed means an UV dose necessary for transformation of photoresist to crosslinked (insoluble) state. Where

$$S = \frac{1}{H} = \frac{1}{E \cdot t}$$

H –exposure (or dose of irradiation with UV light), J·cm

E – intensity, $Wt \cdot cm^{-2}$

t – irradiation duration, s

RESULTS AND DISCUSSION

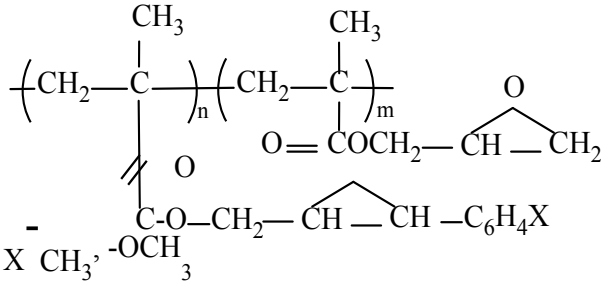
During radical copolymerization of polyfunctional MePhCMA and OMePhCMA with GMA formation of reactive polyfunctional co-polymer showed in Formula 1 could be expected. Comparing of the IR-spectra of the copolymers formed with the spectra of the initial monomer (MePhCMA and OMePhCMA) showed that the deformation and valence vibrations of the vinyl group in the initial monomer at 990 and 1640 cm^{-1} are disappeared.

The absorption bands characteristic for benzene and cyclopropane rings (1410-1460 and 1500-1600 cm^{-1}) and the absorption bands at 1720, 1030 and 1110 cm^{-1}, referring to the carbonyl vibrations of the cyclopropyl ester fragment are remained unaffected. Availability of the characteristic absorption bands of epoxide groups in structure of the copolymers is confirmed by the absorption band at 830, 920 and 1260 cm^{-1}.

The IR-spectrum of MePhCMA and OMePhCMA copolymer with GMA is presented in fig 1.

In the NMR spectrum (fig.2) of copolymer the resonance signals referring to

protons of benzene nucleus (δ = 6.80-6.95 ppm) and cyclopropane ring (δ = 1.50-2.60 ppm) are clearly appeared. The protons of epoxide ring are characterized with signals at 2.10-2.20 ppm(–CH_2–) and at 2.40 ppm (–CH–). As r_1 and r_2 is less than 1, in this system there is a tendency to alternation of links. According to the data of spectroscopy the copolymerization of MePhCMA and OMePhCMA with GMA proceeds only due to opening of double bonds of the vinyl groups with maintenance of the other reactive functional fragments of the both monomers. Thus, on the basis of the analysis of IR and NMR-spectra of the copolymers prepared by copolymerization of MePhCMA and OMePhCMA with GMA, the structure of copolymers is assumed as it is given in formula 1.



Formula 1.

The copolymerization was carried out at various ratios of the initial monomers. It has been revealed that the composition of forming copolymers depends on the composition of the initial monomer mixture. For estimation of polymerization activity of MePhCMA and OMePhCMA there have been calculated the values of relative activity constants of monomers by Fineman-Ross method [18] and the parameters *Q-e* by Alfrey and Praice method. The microstructure parameters of the copolymers were calculated by using the copolymerization constants on formulas [19]. The obtained data are presented in Table 1. The values of the relative activity constants (Table 1) evidence about greater reactivity of MePhCMA and OMePhCMA in comparison with GMA. The conjugation of the ester group causing redistribution of electron density both in the monomer and in the radical formed from it, thus the energy necessary for appearance of transition state is decreased leading to the increase of reactivity of monomer.

The calculated values of parameters Q_1 and e_1 during copolymerization with GMA indicate increased conjugation in monomer (MePhCMA and OMePhCMA) connected with influence of substituent – CH_3, –OCH_3 stipulating relatively high reactivity of monomer and more low reactivity of the radicals. In calculation of factor e_1 it was chosen the negative mark based on the fact that the electron density

of double bond of vinyl group in MePhCMA and OMePhCMA should be less than in GMA, since the influence of substituent of MePhCMA and OMePhCMA leads to redistribute of density of double bond in the vinyl group changing polarity of the radical.

An availability of the synthesized copolymer of the reactive groups of various chemical nature in links of macromolecule arouses interest for investigation of photochemical structuring of this copolymer, i.e. to crosslinking under action of UV-irradiation and such polymers showing as negative type photoresists. These polymers with properties of high light sensitivity, film-forming ability, good solubility before irradiation, resistance to solvents, plasma and etchants after crosslinking and good thermal stability, which are very important for photoresist. Due to availability of strongly absorbing light energy of groups (cyclopropane, glycidyl, >C=O etc.) the synthesized copolymers are photosensitive and under the influence of UV-irradiation are subjected to the photochemical conversions leading to formation of crosslinked structures.

The influence of irradiation on photosensitive polymers has been investigated by measurement in UV-spectrum. The photoreactive fragments have been considered with various concentrations 15-150 mg in thin films. The absorption bands in the UV spectrum of polymers at 296 and 300 nm, respectively, are referred to $\pi \rightarrow \pi$ transitions. The intensities of absorption through various intervals of irradiation were changed in the UV-spectrum of the copolymer with ratio 50.25:49.75 (p-MePhCMA-co-GMA) and 48.72:51.28 (p-OMePhCMA-co-GMA) (fig.3)

During irradiation decrease or disappearance of photoactive fragments could be observed. The irradiation led to fast decrease of the absorption intensity at 296 and 300 nm and to disappearance of the bands almost completely after 5 min irradiation. It has been revealed that an increase of concentration of polymers raises a photocrosslinking rate due to large quantity of photosentive units.

In films of copolymer, a conversion rate of the photosensitive fragments depends on composition of the light-sensitive links in the copolymer chain. The crosslinking rate grows with increase of cyclopropane and epoxy rings in the polymer (fig.4). It could be concluded that after 40-80 sec. irradiation (transformation is 50-70 %), the polymer films become insoluble in organic solvents in which they were dissolved at room temperature to do irradiation experiments. Such behaviour is caused by formation of hard three-dimensional network due to intermolecular photoinduced cycloaddition of hanging units.

The three-dimensional structure during irradiation has a form of a loose net with large cells, which swells strongly during development and is compressed drying of the polymer layer, causing folds and wrinkles. The good results have been prepared in work with films of thickness 0.2-0.3 mkm.

The process of 3D-structure evolution during irradtiation of the prepared cy-

clopropane-ring containing copolymers has been followed by IR spectroscopy as well (fig.1). The intensity of the absorption bands characteristic for cyclopropane ring (1030-1035 cm^{-1}), carbonyl group (1720-1725 cm^{-1}), and epoxide ring (830, 920, 1260 cm^{-1}) were decreased with increasing of irradiation time and were completely disappeared ~ 5 min irradiation due to 3D-structure evolution with opening of double bonds and cyclopropane rings.

The availability of cyclopropane ring, glycidyl, carbonyl groups in macromolecules of the prepared copolymer allowed to create a material with high photosensitivity. These copolymers have high photochemical crosslinking ability to create solid elastic layers with good adhesion to substrates and to prepare polymer films with low microdeficiency.

References

1. K. Mizoguchi, E. Hasegaawa, “Photoactive polymers applied to advanced microelectronic devices,” Polym. Adv. Technol. vol. 7, May-June 1996, pp. 471-477.

2. Reichmanis E, Nalamasu O, Houhihan F.M, Novembre A.E. Radiation chemistry of polymeric materials: novel chemistry and applications for microlithography // Polym. Int.1999.V. 48.N 10. P. 1053-1059. https://doi.org/10.1002/(SICI)1097-0126(199910)48:10<1053::AID-PI268>3.0.CO;2-T

3. Ohe, Y., Ito, H., Watanabe, N., Ichimura, K., A novel dry photopolymer for volume-phase holograms. Journal of Applied Polymer Science, 2000, Vol 77, №10, 2189-2200

4. V. H. Filichkina, “Application of transparent plastic materials in the construction of capitalist countries,” Chem. Industry abroad, pp. 11-27, November 1985.

5. S. W. Fang, H.J. Timpe, A. Gandini, “Photocrosslinkable polymers bearing pendant conjugated heterocyclic chromophores,” Polymer. vol. 43, June 2002, pp. 3505-3510.

6. A. Ya. Vayner, and K. M. Dyumaev, “Negative photoresists on the basis of unsaturated derivatives of polyamidoacids,” Chem. industry, p. 3, July 1989.

7. A. Ya. Vayner, K. M. Dyumayev, I. A. Likhachev, A. D. Shalatonova, Yu. A. Yartsev, “Methacrylate Derivatives of Carboxyl-Containing Polyimides: Synthesis and Photochemical Transformations,” Doklady Physical Chemistry. vol. 396, May 2004, pp. 115-118. . DOI: 10.1023/B:DOPC.0000029167.69210.4c].

8. Hou H., Jiang J., Ding M.Ester-type precursor of polyimide and photosensitivity// Eur. Polym. J. 1999. V.35. N 11. P.1993-2000. https://doi.org/10.1016/S0014-3057(98)00290-0.

9. K. G. Guliyev, G. Z. Ponomareva, A. M. Guliyev, “Photosensitivity of Polymers Based on Epoxy-Substituted Vinylphenylcyclopropanes,” Russian Journal of Appl. Chem. vol. 79, March 2006, pp. 488-491.

10. K. G. Guliyev, G. Z. Ponomareva, A. M. Guliyev, “Synthesis and properties of epoxy-containing poly(cyclopropylstyrenes),” Polymer Science. Vol. 49B, August 2007, pp. 196-199. DOI: 10.1134/S1560090407070068].

11. K. G. Guliyev, G. Z. Ponomareva, and A. M. Guliyev, “Influence of substituents on copolymerization of p(2-substituted)cyclopropyl styrenes with methylmethacrylate,” Processes of Petrochemistry and Oil-refining, pp. 40-43, January 2003.

12. K. Subramanian, A.V. Ramai Reddy, V. Krishnasamy, “Photopolymers: synthesis and characterization of poly(4-cinnamoylphenyl methacrylate),” Macromol. Chem. Rapid Commun. vol. 12, April 1991, pp.211-214

13. A. Rehab, N. Salahuddin, “Photocrosslinked polymers based on pendant extended chalcone as photoreactive moieties,” Polymer. vol. 40, April 1999, pp. 2197-2207.

14. K.G.Guliyev, A.E.Rzayeva, A.M.Guliyev. Synthesis of photosensitive cyclopropa¬ne-containing polymers. Russian Journal of Applied Chemistry, 2019; 92; 9; 1131-1140

15. K. G. Guliyev, G. Z. Ponomareva, S. B. Mamedli, and A. M. Guliyev, “Ultraviolet absorption spectra of 2-substituted-1(n-vinylphenyl)cyclopropanes,” Journal of Structural Chemistry, vol. 50, pp. 693-695, August 2009.

16. K.G. Guliyev, A. A. Garayeva, G. Z. Ponomareva, A. M. Aliyeva, A. M. Guliyev, “Radical Copolymerization of p-(2,2-Dichlorocyclopropyl)styrene with Glycidyl Methacrylate and Properties of the Polymer Obtained,” Russian Journal of Appl. Chem. vol. 88, June 2015, pp.1047-1051.

17. K. G. Guliyev, A. M. Aliyeva, G. Z. Ponomaryova, D. R. Nurullayeva, A. M. Guliyev, “Investigation of Photosensitivity of Copolymer with (P-Vinyl Phenyl) Cyclopropyl Methyl Cinnamate,” American Journal of Applied Chemistry. vol. 3, February 2015, pp. 21-24.

18. E. V. Kuznetsov, S. M. Divgun, , L. A. Budarina; N. I. Avvakumova, V. F. Kurenkov. Practical work on chemistry and physics on polymers. M.: Khimiya, 1977.

19. E. N. Zilberman, “Parameters of microstructure of multi-component copolymers,” High-molecular compounds, vol. B21, pp. 33-36, January 1979.

PICTURE SIGNATURES

Figure 1. *IR-spectrum of a polymer film of p-methylphenylcyclopropylmethacrylate (p-MePhCMA) copolymer with glycidylmetacrylate (GMA) : unirradiated (1) and irradiated during the 10th (2), 15th (3) and 40th (4) seconds.*

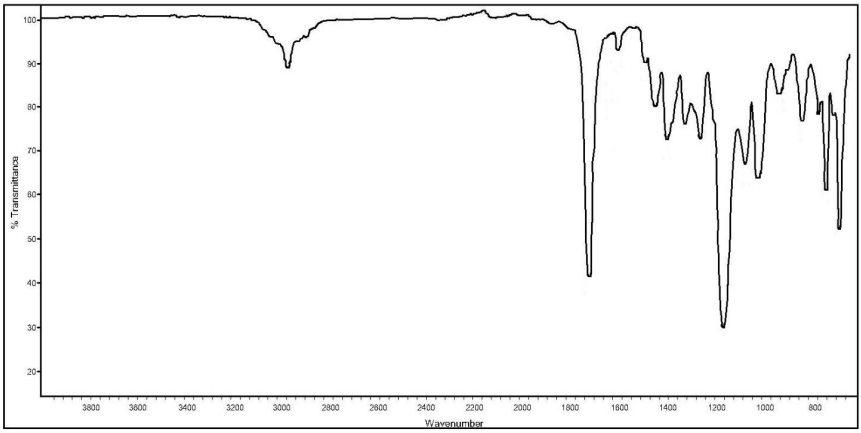
Figure 2. *NMR spectrum of a copolymer of p-methylphenylcyclopropylmethacrylate (p-MePhCMA) with glycidylmetacrylate (GMA) .*

Figure 3. *Change in the UV–spectrum upon irradiation of poly p-methylphenyl–cyclopropylmethacrylate (p-MePhCMA) with glycidylmetacrylate (GMA), (from top to bottom, after the irradiation time t = 0; 50, 100, 150, 300 and 600 s).*

Figure 4. *Disappearance rate associated with cycloprophane and epoxy rings of poly p-phenylcyclopropylmethacrylates with glycidylmetacrylate (GMA) , as thin film: (m1 and m2).*

Tab.1. *Copolimerization of p-CH_3PhCMA (M_1) and p-OCH_3PhCMA(M_1) with GMA (M_2)*

Composition of the initial mixture, mol. %		Composition of copolymers, mol. %		r_1	r_2	Q_1	e_1	$r_1 \cdot r_2$
M_1	M_2	m_1	m_2					
p-CH_3PhCMA-co-GMA								
10	90	14.32	85.68	0.63±0.03	0.60 ±0.02	1.37 ±0.01	-0.90 ±0.02	0.378
25	75	30.07	69.93					
50	50	50.25	49.75					
75	25	70.59	29.41					
90	10	86.21	13.79					
p-OCH_3PhCMA-co-GMA								
10	90	12.29	87.71	0.62 ±0.03	0.70 ±0.02	1.35 ±0.01	-0.94 ±0.02	0.434
25	75	27.54	72.46					
50	50	48.72	50.25					
75	25	69.42	30.58					
90	10	85.92	14.08					


% Transmittance
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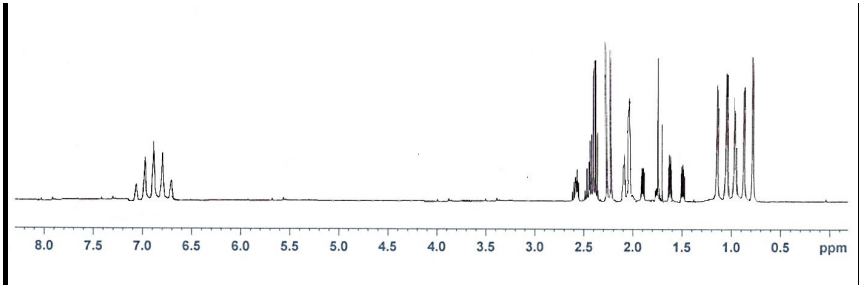
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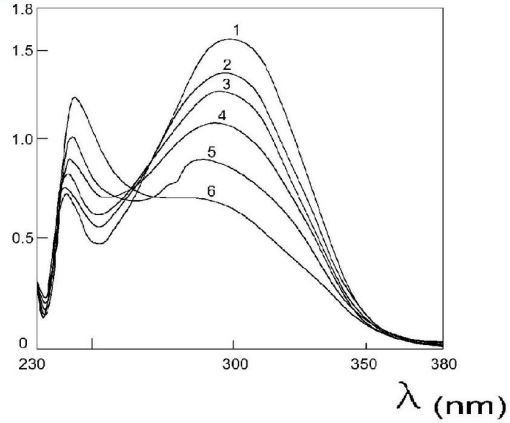
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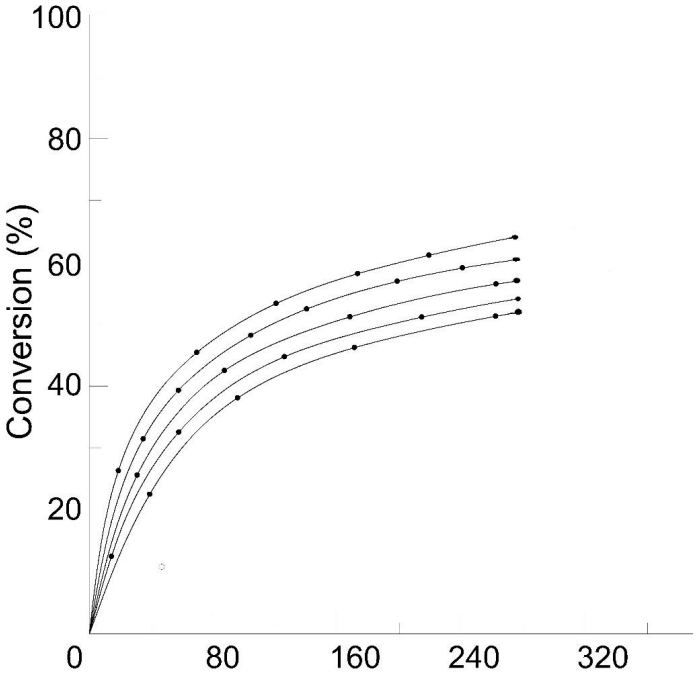
6
λ (nm)


100
80
60
40
20
Conversion (%)
0
80
160
240
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DOI 10.34660/INF.2021.75.36.028

MICROHARDNESS OF HIGH-ENTROPY COATINGS

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Abstract. *The article shows that the hardness of most stainless steels is 2-3 times less than high-entropy coatings, which shows the prospect of their use as parts of various industrial structures. Microhardness of metallic glasses, which have a defect-free base, and do not differ from high-entropy coatings. An equation is obtained in the article, which shows that the destruction of the coating should be determined by the surface energy of the coating. It linearly depends on the hardness of the alloy and the destruction of the coating should decrease with decreasing surface energy without changing the mechanical properties of high-entropy coatings. Its decrease is also associated with the formation of nanostructures and the size dependence of the surface energy.*

Keywords*: microhardness, high-entropy coating, steel, surface energy, destruction of the coating, nanostructure.*

Introduction

In high-entropy alloys, as a result of the effect of intense mixing, the entropy contribution increases, which stabilizes the formation of a solid solution with a simple structure [1-3]. Based on Boltzmann's hypothesis on the relationship between entropy and system complexity, the configurational change in entropy ΔSconf during the formation of a solid solution of n elements with equiatomic content can be calculated using the following formula:

$$\Delta S_{conf} = -R \ln(1/n) = R \ln(n), \quad (1)$$

where R is the universal gas constant, n is the number of mixing elements.

At n = 5, ΔS_{conf} = 1.61R approaches the value of the melting entropy of most intermetallics (about 2R). However, it was later shown that a high entropy of mixing is not a necessary condition for the formation of a single-phase solid solution, but the very term for the name of such an alloy remains in use. We have also investigated high-entropy alloys and coatings obtained by mechanical alloying and magnetron sputtering of targets [4-7].

Purpose of the study – let us experimentally investigate the microhardness of high-entropy coatings and propose a model that will allow us to explain the observed effects within the framework of the energy theory..

Materials and methods

High-entropy (HEA) coatings of the following composition were used as objects of research: TiNiZrCuCr, CrFeNiTiZrCu, TiFeCuAlSn, AlCrNiTiZrCu, PbCrNiTiZrCu, CrNiTiZrAlCu, made by mechanical alloying [8]. Moreover, after annealing in a vacuum chamber, the samples became nanostructured. In fig. 1a shows, as an example, the samples under study, in Fig. 1b their SEM image, and in Fig. 1c diagram of the formation of nanostructured coatings [9].

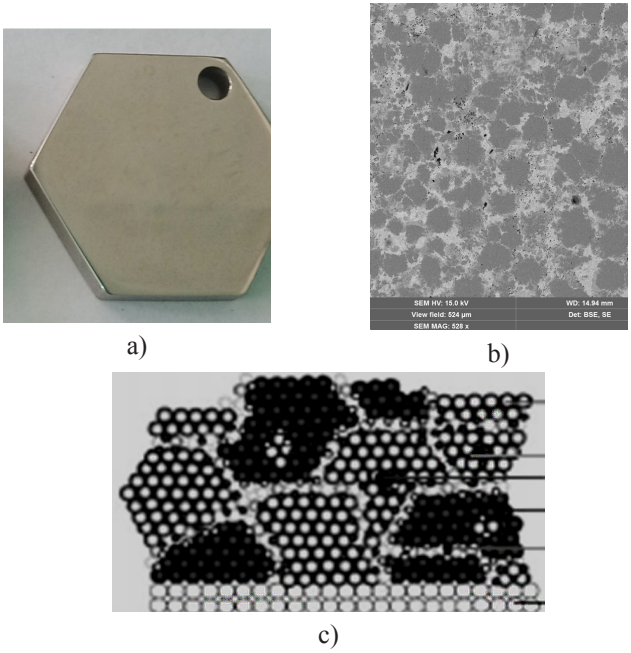
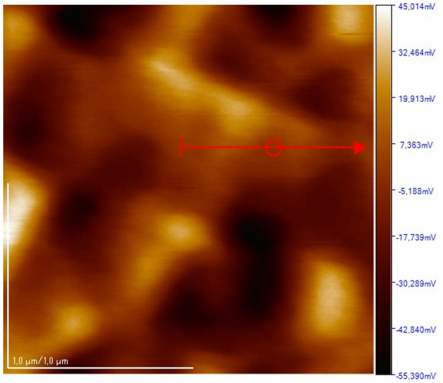
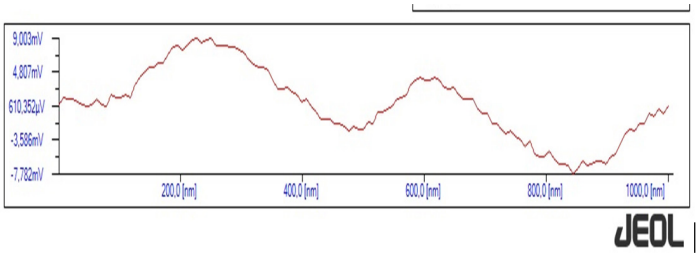


Figure 1 - *Sputtered samples (a), REM samples (b), formation nanostructured coatings [9].*

The roughness of the coating as an example, measured on a JSPM-5400 atomic force microscope (AFM) manufactured by JEOL, is also negligible (Figure 2) [10].



a)



b)

Figure 1 - *Sputtered samples (a), REM samples (b), formation nanostructured coatings [9].*

The roughness of the coating as an example, measured on a JSPM-5400 atomic force microscope (AFM) manufactured by JEOL, is also negligible (Figure 2) [10].

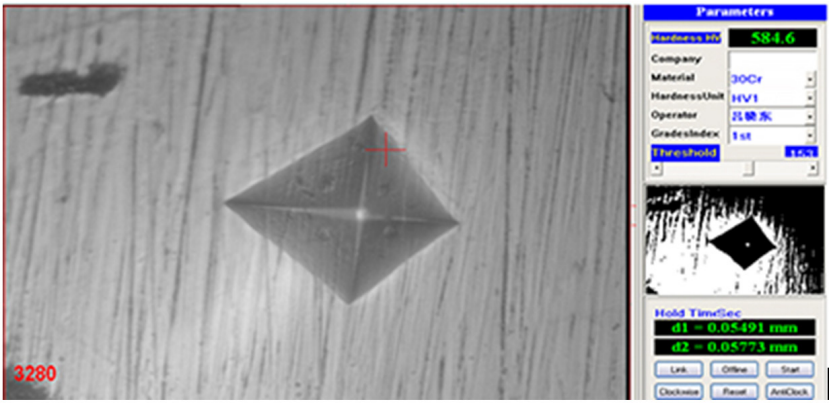


Figure 3 - *Microhardness tester HVC-1000A*

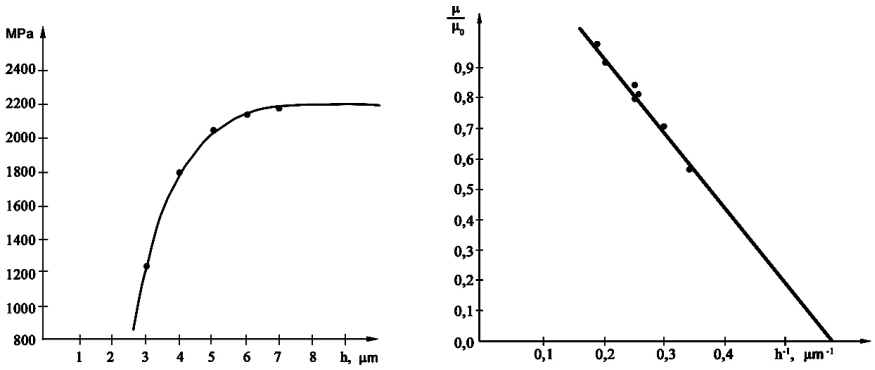
To determine the specific surface energy (surface tension) σ, we used the method described by us in [11]. The first method provides for the measurement of surface tension by determining the dependence of the microhardness on the thickness of the deposited coating. The dependence of the microhardness of the deposited coating on its thickness is described by the formula:

$$\mu = \mu_0 \cdot (1 - d/h), \tag{2}$$

where μ is the microhardness of the deposited coating; μ_0 - "thick" sample; h is the thickness of the deposited coating. The parameter d is related to the surface tension σ by the formula:

$$d = 2\sigma\upsilon / RT, \tag{3}$$

where σ is the surface tension of a massive sample; υ is the volume of one mole; R is the gas constant; T is the temperature.



a) *b)*

Figure 4 - *Dependence of microhardness on the thickness (a) and inverse thickness (b) of the CrFeNiTiZrCu coating on steel 20X13 [11]*

As an example, consider the determination of the surface tension of the CrFeNiTiZrCu coating on steel 20X13. The results are shown in Figure 4. In the coordinates $\mu/\mu_0 \sim 1/h$, the experimental curve is straightened in accordance with formula (2), giving the value h = 1.3 μm. For the CrFeNiTiZrCu coating on 20X13 steel, the surface tension obtained is $\sigma = 1.409$ J/m^2. This value confirms the wear resistance of the CrFeNiTiZrCu coating on steel 20X13.

Results and discussion

Using the above methods, a table of experimental values can be given.

Table 1 shows that pentaatomic alloys have high hardness, surface energy ranges from 1 to 1.2 J/m^2. Hexaatomic alloys have slightly less hardness. Let us compare the hardness of stainless steels [12] with the hardness of high-entropy coatings from Table 1.

Table 1 - *Experimental properties of high-entropy coatings (HEA) and metallic glasses (MS) [13]*

HEA	μ, HV	σ, J/m^2	MS	μ, HV
CrTiNiZrCu	890	1.149	$Fe_{78}Mo_2B_{20}$	1015
TiFeCuAlSn	700	1.192	$Fe_{40}Ni_{40}P_{14}B_6$	640
CrFeNiTiZrCu	740	1.409	$Fe_{78}P_{13}C_7$	760
AlCrNiTiZrCu	585	1.644	$Fe_{78}Si_{10}B_{12}$	890
PbCrNiTiZrCu	560	1.387	$Ni_{75}Si_8B_{17}$	860
CrNiTiZrAlCu	530	1.152	$Co_{75}Si_{15}B_{10}$	910

Table 2 - *Hardness of stainless steels [12]*

Steel	μ, HV	Steel	μ, HV
12X13	121-187	08X17T	372
40X13	143-229	10X17H13M2T	200
08X18H10	170	12X18H10T	179

The hardness of most stainless steels is 2-3 times less than high-entropy coatings, which shows the prospect of their use as parts of various industrial structures. For comparison, Table 1 shows the microhardness of metallic glasses, which have a defect-free base and do not differ much from high-entropy coatings [13]. What is the reason for this difference?

We will consider the question of the response of a subsystem of n electrons in high-entropy alloys to an external action during friction from the standpoint of nonequilibrium statistical thermodynamics. The electrons in the alloy will be considered as a system of non-interacting particles immersed in a thermostat. The thermostat is a metal alloy minus n "free" electrons. Quantum transitions during friction, caused by the interaction of a system of electrons with a thermostat, will be dissipative (with probability P), in contrast to the interaction during friction (with probability F). Dissipative processes lead to the fact that the secondary field (system response) is always less than the primary one, which causes the formation of heat during friction.

We will assume that the electron subsystem exchanges only energy with the thermostat during friction. Then the corresponding ensemble of particles will be canonical. In this case, the expression for the statistical entropy is:

$$S = -k\sum_i f_i \ln f_i, \tag{2}$$

where f_i is the distribution function; k is Boltzmann's constant.

Differentiating (2) in time and transforming, we get:

$$\frac{dS}{dt} = \frac{k}{2}\sum_{i,j}\left(\mathrm{lhf_i} - \ln f_j\right)\left(P_{ij}f_i - P_{ji}f_j\right), \tag{3}$$

where P_{ij} is the probability of transition from the initial i (with energy E_i) to the state j excited by friction (with energy E_j). For dissipative processes, the principle of detailed balance has the form:

$$\frac{g_i P_{ij}}{g_j P_{ji}} = e^{\frac{E_j - E_i}{kT}}, \tag{4}$$

where g_i, g_j are statistical weights for the levels E_i and E_j. Then (4) takes the form:

$$\frac{dS}{dt} = \frac{k}{2} P_{ij} \left(\ln f_i - \ln f_j\right) \left(f_i - \frac{g_i}{g_j} f_j e^{-\frac{E_i - E_j}{kT}} \right), \quad (5)$$

Canonical distribution function:

$$f_{ij} = \frac{1}{Z} e^{-E_{ij}/kT}$$

where the statistical sum:

$$Z = e^{-G/kT}$$

where G is the Gibbs potential (free energy) of the thermostat + electron system.

We assume that the non-configurational part of the Gibbs potential linearly depends on the concentration of n electrons:

$$e^{-G/kT} = \sum_N h(n), \quad (6)$$

where $h(n)= \omega(n)\cdot e^{-G/kT}$; ω(n) - statistical weight.

After cumbersome but simple calculations, it is easy to show that the function h(n) is a Gaussian distribution about a value with low variance, i.e.:

$$h(n) = h(\bar{n}) e^{-\Delta\bar{n}^2/n} \quad (7)$$

Substituting (7) into (6), we have:

$$e^{-G/kT} = h(\bar{n}) \sum_{\Delta n} e^{-\Delta\bar{n}^2/\bar{n}} \quad (8)$$

To estimate the sum in (8), we replace it by the integral:

$$\sum_{\Delta n} e^{-\Delta\bar{n}^2/\bar{n}} = \int_{-\infty}^{+\infty} e^{-x^2/\bar{n}} dx = \sqrt{\pi x} \quad (9)$$

Then (8) takes the form:

$$e^{-G/kT} = h(\bar{n})(\pi\bar{n})^{1/2}. \quad (10)$$

Taking the logarithm of (10), we get:

$$G/kT = -\ln \omega(\bar{n}) + \frac{G(\bar{n})}{kT} + \frac{1}{2} \ln(\pi\bar{n}) \quad (11)$$

where $G(\bar{n})$ is the part of the total Gibbs potential associated with the electron concentration. From the estimate of the first logarithmic term it follows:

$$\ln \omega(\bar{n}) = n \ln\left(1 + \frac{\bar{n}}{n}\right) + \bar{n} \ln \frac{n + \bar{n}}{n} \quad (12)$$

Approximating the logarithm in the first term on the right-hand side of (12) by the first term of its expansion in a series, and expressing the second term in terms of the Gibbs potential of the thermostat G^f, we obtain:

$$\ln \omega(\bar{n}) = \bar{n} + \bar{n}G^f / kT \tag{13}$$

Substituting (13) into (11) and neglecting the $1/2 \ln(\pi\bar{n})$ term in comparison with $\bar{n}$, we obtain:

$$G = G(\bar{n}) - \bar{n}G^f - \bar{n}kT. \tag{14}$$

As above, assuming that the thermodynamic potential $G(\bar{n})$ depends on the equilibrium number of electrons G^f in a linear manner, i.e:

$$G = G^0 + \bar{n}G^f, \tag{15}$$

where G^0 is the thermodynamic potential of the thermostat, we find:

$$G = G^0 - \bar{n}kT. \tag{16}$$

With the help of (16), the expression for Z is transformed to the form:

$$Z = e^{-G^0/kT} e^{\bar{n}}. \tag{17}$$

Substituting (17) into (5), we find:

$$\frac{dS}{dt} = \frac{k}{2} \sum_{i,j} P_{ij} e^{G^0/kT} e^{-\bar{n}} e^{-E_i/kT} \left(\frac{E_j - E_i}{kT} \right) \left(1 - \frac{g_i}{g_j} e^{2\frac{E_i - E_j}{kT}} \right). \tag{18}$$

Neglecting small terms and replacing the sum by an integral in (18) (which is true for the continuous spectrum of electron energies in the alloy), we obtain:

$$P = \frac{2\Delta S}{k\Delta t} \exp\left\{ -\frac{E_m - G^0/\bar{n}}{kT} \right\}, \tag{19}$$

where ΔS is the change in entropy in the dissipative process; E_m is the average value of the energy of the ground state of electrons during friction; Δt is the time of movement during friction.

The response function of the thermostat + electrons system is:

$$\Omega = \frac{F}{F+P} = \frac{1/\tau}{1/\tau + 2\Delta S / k\Delta t \exp\left\{ -(E_m - G^0/\bar{n})/kT \right\}}, \tag{20}$$

where F is the probability of a quantum transition inducing a secondary field of electrons, and $F = 1/\tau$ is the "radiative" lifetime of the electron system in an excited state during friction.

From (20), we obtained the following formula for the destruction efficiency $\Omega = \eta$ of a metal coating:

$$\eta = \frac{k^2 \Delta t}{2\Delta S \cdot \tau} \cdot T \cdot \frac{E_m}{G^0} \cdot \bar{n} = const \cdot T \cdot \frac{\sigma \cdot S}{\tau \cdot G^0} \cdot \bar{n}, \quad (21)$$

Equation (21) describes the destruction of the coating η proportional to k - the Boltzmann constant, the change in entropy ΔS and the time of motion during friction Δt, the work of friction forces $E_m = A = \sigma S$, the concentration of electrons n near the Fermi level, surface energy σ, contact area S and vice versa is proportional to the relaxation time τ and the Gibbs energy G^0 of the thermostat.

For high-entropy coatings $G^0 = H\text{-}TS + PV \rightarrow S \sim 2R$ and the destruction of the coating should decrease. The surface energy σ linearly depends on the hardness of the alloy: $\sigma = \alpha \mu$, $\alpha = const$, and the destruction of the coating should decrease with a decrease in the surface energy.

Its decrease is also associated with the formation of nanostructures and the dependence of the surface energy σ according to A.I. Rusanov. [15]: $\sigma = K\, r \rightarrow 0$ at $r \rightarrow 0$ (see Figure 1c).

Conclusion

The method of mechanical alloying for obtaining high-entropy coatings is much cheaper than the method of metallurgy, which produces cast high-entropy ingots. The hardness of high-entropy coatings is 2-3 times higher than the hardness of stainless steels, but it turns out to be similar to the hardness of metal glasses, which are also quite difficult to obtain.

We have shown experimentally and theoretically that the destruction of high-entropy coatings is mainly determined by the surface energy, which is proportional to the hardness of the coating. The surface energy for the coating decreases due to its nanostructural state, without significantly changing its physical properties. The destruction of high-entropy coatings is also reduced due to an increase in the entropy of the coating.

Thanks

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References

1. Yeh J.-W., Chen S.-K., Lin S.-J., Gan J.-Y., Chin Ts.-Sh., Shun T.-Ts., Tsau Ch.-H., Chang Sh.-Y. Nanostructured High-Entropy Alloys with Multiple Principle Elements: Novel Alloy Design Concepts and Outcomes // Advanced Engineering Materials, 2004, Vol. 6, №8. - P. 299-303.

2. Yeh J.W., Chen Y.L., Lin S.J. High-entropy alloys – a new era of exploitation // Materials Science Forum, 2007, Vol. 560. – P. 1-9.

3. Wang Y.P., Li B.Sh., Heng Zh.F. Solid Solution or Intermetallics in a High-Entropy Alloy // Advanced Engineering Materials, 2009, Vol. 11, № 8. – P. 641-644.

4. Yurov V.M., Eremin E.N., Guchenko S.A. Wear resistance and tribological properties of high entropy coatings CrNiTiZrCu // Eurasian Physical Technical Journal, 2020, Vol.17, No.1 (33). – P. 13-18.

5. Yurov V.M., Guchenko S.A., Makhanov K.M. Structural properties of the high-entropy TiNiZrCuCr coating // Modern science-intensive technology, 2020, No. 4. - P. 78-83.

6. Yurov V.M., Shelpyakov B.N., Guchenko S.A., Tvardovsky A.N. Application of high-entropy coatings on turbine blades // Trends in the development of science and education, 2020, No. 59, Part 1.- P. 49-54.

7. Yurov V.M., Goncharenko V.I., Oleshko V.S. Anisotropy of surface energy and thickness of the surface layer of magnetic nanostructures // Nano- and microsystem technology, 2021, V. 23, No. 2. - P. 59-62.

8. Yurov V.M., Guchenko S.A., Tvardovsky A.N. Two targets for magnetron deposition of high-entropy coatings // Trends in the development of science and education, 2020, no. 60(1). - P. 28-34.

9. Pogrebnyak A.D., Bagdasaryan A.A. Pink A.V., Dyadyura K.A. Multicomponent nanocomposite coatings with adaptive behavior in surface engineering // Uspekhi fizicheskikh nauk, 2017, Vol. 187, no. 6. - P. 629-652.

10. Yurov V.M., Guchenko S.A., Makhanov K.M. Atomic force microscopy of high-entropy coatings // International Journal of Applied and Fundamental Research, 2020, no. 4. - P. 62-67.

11. Yurov V.M., Laurinas V.Ch., Guchenko S.A., Zavatskaya O.N. Surface tension of hardening coatings // Hardening technologies and coatings, 2014, No. 1. - P. 33-36.

12. Povolotskiy D.Ya., Gudim Yu.A. Stainless steel production. - Chelyabinsk: SUSU Publishing House, 1998. - 236 p.

13. Cheng Y.Q., Ma E. Atomic-level structure and structure–property relationship in metallic glasses // Progress in Materials Science, 2011Vol. 56. – P. 379–473.

14. Yurov V.M., Guchenko S.A., Zavatskaya O.N. Structure and surface tension of composite coatings // Bulletin of KSU. Physics, 2012, No. 1 (65). - P. 45-53.

15. Rusanov A.I. Phase equilibria and surface phenomena. - Publishing house "Chemistry", Leningrad branch, 1967. - 388 p.

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INVESTIGATION OF MAGNETIC PHASE SEPARATION IN STRONTIUM-SUBSTITUTED GADOLINIUM FERROMANGANITE BY MÖSSBAUER SPECTROSCOPY AND EPR

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Abstract. *Multiferroics of rare-earth manganites $RMnO_3$ attract a lot of attention due to the significant correlation of electrical and magnetic parameters. The replacement of rare-earth ions in $RMnO_3$ with atoms of a different radius and / or valence leads to the appearance of new effects, such as colossal magnetoresistance and various thermomagnetic effects. These phenomena are usually associated with magnetic separation in the subsystem of magnetic moments - the formation of microregions of ferromagnetic ordering in an antiferro- or paramagnetic matrix. When studying this phenomenon, it is promising to use the methods of Mössbauer spectroscopy and electron paramagnetic resonance (EPR), which make it possible to register the presence of magnetic impurities in small amounts.*

Strontium-substituted gadolinium ferromanganite $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ was prepared by ceramic technology. Its magnetic microstructure was investigated by the method of Mössbauer spectroscopy at temperatures of 100-300 K and EPR at temperatures of 100-340 K.

The data of Mössbauer and EPR measurements indicate the magnetic phase separation in the system of magnetic moments in strontium-substituted gadolinium ferromanganite.

Keywords: *ferromanganites, Mössbauer spectroscopy, EPR, magnetic phase separation.*

Introduction

$RMnO_3$ compounds are characterized by two types of crystal structures: hexagonal (ilmenite type) and orthorhombic (perovskite-like), depending on the ionic radius of rare earth elements R^{3+} [1]. In this case, the orthorhombic structure with the space group P_{bnm} is characteristic of "light" lanthanides ($R = La – Eu$). These materials, when hole doped with divalent cations with a large ionic radius ((Ca^{2+}, Sr^{2+}, Pb^{2+}) have colossal magnetoresistance (CMR), and some of them are ferroelectrics, and the ferroelectric properties are induced by magnetic ordering ($R = Dy – Gd$) [2]. Another family of compounds with a smaller ionic radius (from *Ho* to *Lu*) form a stable hexagonal structure with the space group $P6_3cm$ at room and lower temperatures and also exhibit CMR and multiferroic properties [3]. The coexistence of ferroelectric order and magnetic ordering in $RMnO_3$ with a hexagonal or orthorhombic structure gives a complex physical picture of interactions between charge, orbital, lattice, and spin degrees of freedom. The magnetically non-single-phase state in solid solutions $R_{1-y}A_yMnO_3$, where R — are-earth cation, A — divalent cation, arises due to the frustration of magnetic moments caused by the competition of ferromagnetic and antiferromagnetic interactions, close to each other in magnitude. The maximum value of magnetoresistance (negative and `bipolar '[4]) is usually observed at temperatures close to the Néel temperature. Consequently, ferromagnetic clusters can exist in both antiferromagnetic and paramagnetic matrices. Such a magnetic phase separation was found in lanthanum and neodymium ferromanganites [5]. The aim of this work was to study the magnetic microstructure in strontium-substituted gadolinium ferromanganite by the methods of Mössbauer and EPR spectroscopy.

Experimental methods

Strontium-substituted gadolinium ferromanganite $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ was prepared by ceramic technology from a mixture of oxides of gadolinium, manganese, iron, and strontium carbonate. To increase the signal-to-noise ratio in Mössbauer measurements, iron oxide was enriched in the Mössbauer isotope ^{57}Fe (≈ 30%). X-ray structural analysis was performed on an MD-10 mini-diffractometer, and it was found that the sample is single-phase and has orthorhombic crystal symmetry (space group *Pnma*).

The magnetic microstructure was investigated by EPR and Mössbauer spectroscopy. Mössbauer measurements were carried out on a standard WissEL spectrometer (Germany) in a CFICEV flow cryostat (ICE Oxford, UK). Mössbauer spectra were processed using the SpectrRelax program [6]. EPR spectra were obtained on an *EMXplus* EPR spectrometer in the X-band (9.46 GHz). The tempera-

ture dependences of the g-factor, resonance field, width and intensity of the EPR line were found at temperatures of 100-340 K.

Results and discussion

In the course of the experiment, the Mössbauer spectra of strontium-substituted gadolinium ferromanganite $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ were obtained at different temperatures (T = 100-300 K) (figure 1). All spectra contain one quadrupole doublet, the isomeric shift of which corresponds to Fe^{3+} (tab. 1), as well as the superposition of two Zeeman sextets, which may indicate the stratification of the magnetic subsystem of the sample, similar to that observed earlier for ferromanganites of other lanthanides [7, 8].

With increasing temperature, the relative area of the doublet does not change (within the processing accuracy). The isomeric shift of the doublet in both sextets decreases with increasing sample temperature, remaining within the limits characteristic of the Fe3+ ion [7, 8]. The decrease in the isomeric shift of these components is due to the second order Doppler effect. Fig. 2 shows the temperature dependence of the isomeric shift of the doublet. The solid line shows the curve approximating the experimental data in the approximation of the Debye model, with a characteristic temperature, θ_D = 378±30 K. The effective field H_{eff} of both sextets also decreases with increasing temperature, and for the second sextet it is approximately twice as fast as for the first one (Tab 1). The relative area of the "magnetic" structures behaves differently with increasing temperature: it grows in the first sextet and decreases in the second. It can be assumed that a magnetic phase separation is observed in the studied $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ sample, which leads to the appearance in the spectra of two sextets corresponding to the magnetically ordered phase. Stoichiometric gadolinium manganite $GdMnO_3$ is an A-type antiferromagnet with a low (44K) Neel temperature [9]. Antiferromagnetic ordering is realized in $GdMnO_3$ due to the indirect exchange interaction in the Mn^{3+} sublattice. The replacement of some of the Gd^{3+} ions with Sr^{2+} ions leads to the appearance in the 3*d*-sublattice, along with Mn^{3+} cations, of Mn^{4+}cations, which enter into kinetic feromagnetic exchange with trivalent manganese ions. As a result, regions of ferromagnetic ordering appear in the antiferromagnetic or paramagnetic matrix [5]. A ^{57}Fe Mössbauer probe falling into this region exhibits a magnetic hyperfine structure in the spectra.

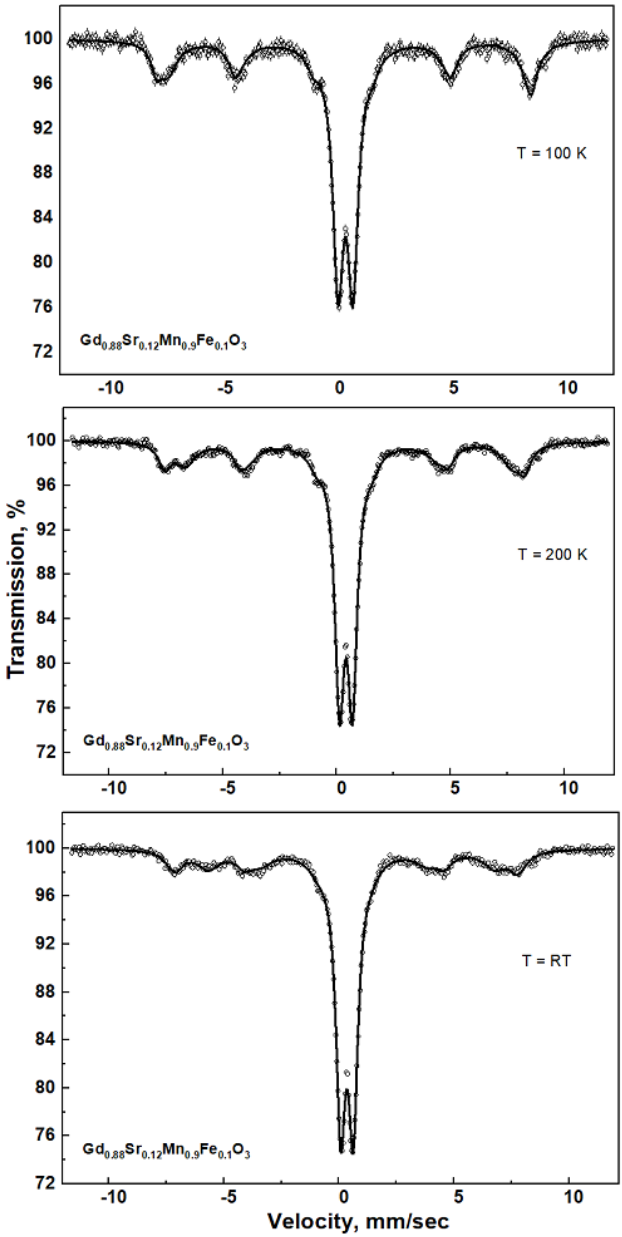

Figure 1. *Mössbauer spectra $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ at T = 100-300 K*

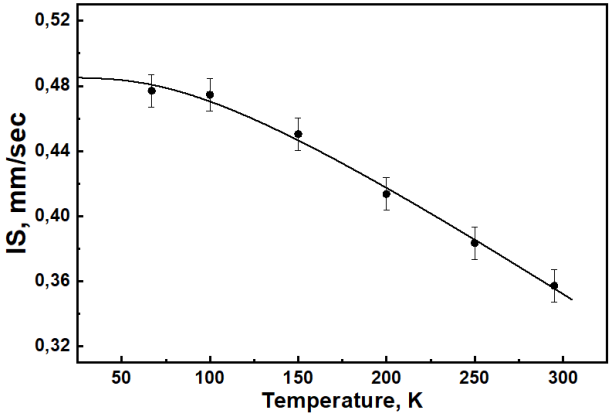

Figure 2. *Temperature dependence of the isomeric shift of the doublet*

Table 1. *Mössbauer parameters for strontium-substituted gadolinium ferromanganite $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ at different temperatures*

T, K		IS, mm/s	QS, mm/s	Relative area, %	H_{eff}, kE
100 K	Doublet	0.48 (0,01)*	0.66 (0,01)	62 (1)	
	Sextet 1	0.39	0.12	11	512 (2)
	Sextet 2	0.48	0.16	27	489
200 K	Doublet	0.41	0.57	62	
	Sextet 1	0.35	-0.01	14	490
	Sextet 2	0.41	0.26	24	447
300 K	Doublet	0.36	0.54	63	
	Sextet 1	0.28	0.10	18	463
	Sextet 2	0.37	0.34	19	386

* - the parameter determination error is indicated in brackets.

EPR spectra were studied for the $Gd_{0,82}Sr_{0,18}Mn_{0,9}Fe_{0,1}O_3$ sample at temperatures of 100-340 K (fig. 3). In the entire temperature range, the EPR spectrum line shapes were described by f. 1 [10].

$$P = \left[\frac{\Delta B + \alpha(B - B_0)}{4(B - B_0)^2 + \Delta B^2} + \frac{\Delta B - \alpha(B + B_0)}{4(B + B_0)^2 + \Delta B^2}\right] \quad (1)$$

where P - the power of absorbed microwave radiation, B – the magnetic field, B_0 – the resonant field, ΔB – the absorption line width, α - the asymmetry parameter.

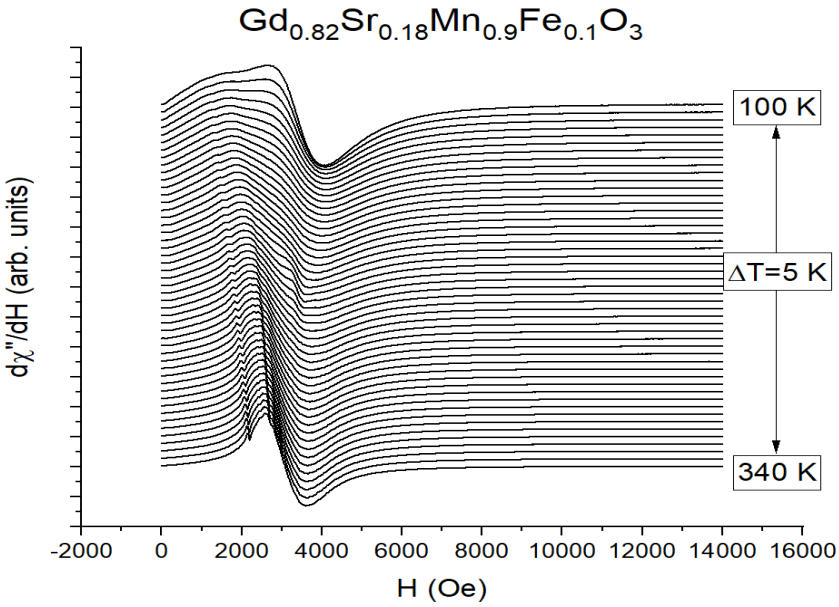

Figure 3. *Spectrum view of EPR $Gd_{0.82}Sr_{0.18}Mn_{0.9}Fe_{0.1}O_3$ at T = 100-340 K*

From the analysis of the EPR spectra of the ceramic sample $Gd_{0,82}Sr_{0,18}Mn_{0,9}Fe_{0,1}O_3$, the temperature dependences of the absorption line width, resonance field, g-factor, and integrated intensity of the EPR line were obtained, which are shown in fig. 5, 6, 7, 8, respectively. The EPR spectra in $Gd_{0,82}Sr_{0,18}Mn_{0,9}Fe_{0,1}O_3$ ceramics were described using three lines L_1, L_2 and L_3 (fig. 4), which coincides with the result obtained in Mössbauer spectroscopy (doublet and 2 sextets).

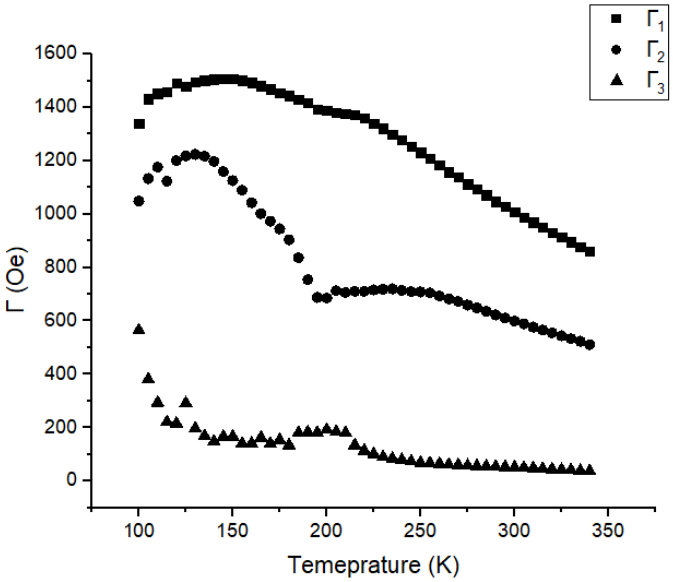

Figure 4. *Temperature dependence of the absorption line width at T = 100-350 K*

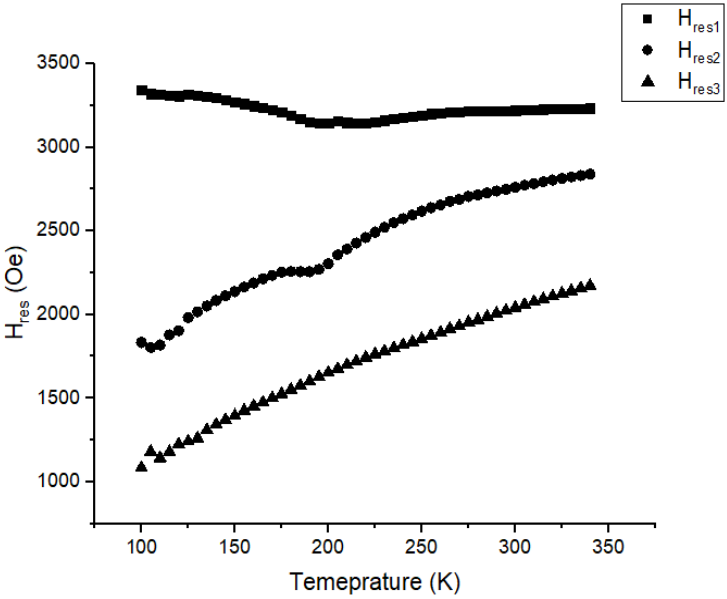

Figure 5. *Temperature dependence of the resonance field at T = 100-350 K*

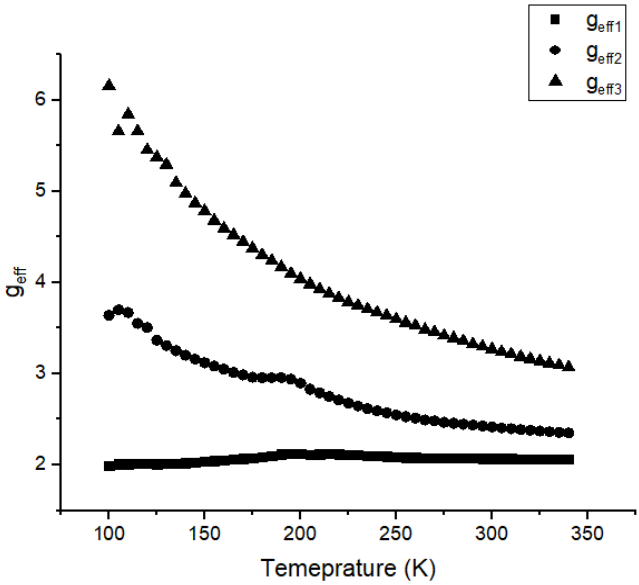

Figure 6. *Temperature dependence of the g-factor at T = 100-350 K*

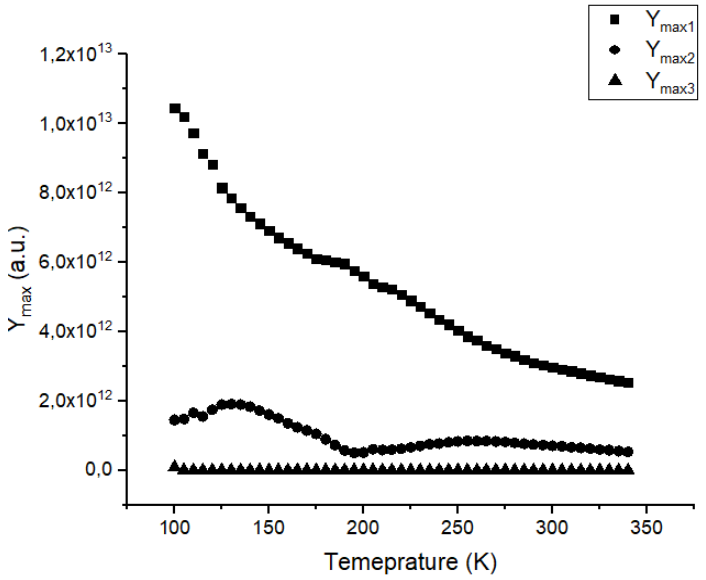

Figure 7. *Temperature dependence of the integrated intensity atT = 100-350 K*

The effective g-factor for the first line ($g_{eff} \approx 2$) is practically independent of temperature, for the second line it varies from 3.64 at $T = 100$ K to 2.35 at 340 K, and for the third, from 6.16 (100 K) to 3.07 (340 K). The spins of iron and manganese ions in gadolinium ferromanganites are related by isotropic exchange interaction, which narrows the EPR line in the paramagnetic phase. It is also known that g_{Mn} and $g_{Fe} \approx 2$. From this, it can be concluded that L_1 with an effective *g*-factor of ≈ 2 in the EPR spectrum under study is associated with manganese and iron ions in the paramagnetic state. However, we believe that L_2 *and* L_3, belong to ferromagnetic clusters that are observed in a paramagnetic matrix at temperatures exceeding the Néel temperature. The integral intensity and linewidth of the second line signal have a maximum at 130 K, corresponding to the blocking temperature T_{B1} [11]. As the temperature increases, the line width of the ferromagnetic signal (L_2) decreases approximately 2.4 times from 1224 Oe at 130 K to 511 Oe at 340 K, and for the other (L_3) – from 564 Oe at 100 K to 37 Oe at 340 K. The linewidth of the paramagnetic signal (L_1) of the matrix increases from 1339 Oe to 1500 Oe in the range of 100-120 K and practically does not change at temperatures from 120 to 160 K, and with an increase in temperature to 340 K it decreases by about 1.7 times (to 861 E). A similar behavior of the magnetic subsystem was observed in ceramics $Eu_{0.65}Sr_{0.35}Mn_{1-x}Fe_xO_3$ [8].

Conclusions

As a result of the study of the magnetic microstructure of strontium-substituted gadolinium ferromanganite $Gd_{0,82}Sr_{0,18}Mn_{0,9}Fe_{0,1}O_3$ мby the method of Mössbauer spectroscopy, one quadrupole doublet was detected, the isomeric shift of which corresponds to Fe^{3+}, ions, and the superposition of two Zeeman sextets, which speaks of a superposition of two Zeeman subsystems of the magnetism. The EPR spectrum of $Gd_{0,82}Sr_{0,18}Mn_{0,9}Fe_{0,1}O_3$ can be described by three lines, which correlates with the results of nuclear gamma resonance. Two lines refer to ferromagnetic clusters, which are observed in a paramagnetic matrix at temperatures above the Néel temperature, and the third is associated with manganese and iron ions in the paramagnetic state.

References

1. Shannon, R.D. Revised effective ionic radii and systematic studies of interatomic distances in halides and chalcogenides / R.D. Shannon // Acta Cryst A. – 1976. – V.32. – P.751-767.

2. Rao, C.N.R. Colossal magnetoresistance. Charge ordering and related properties of manganese oxides / C.N.R. Rao, B. Raveau // Singapore: World Scientific, 1998. – 356 p.

3. Wang, Y.T. Understanding multiferroic hexagonal manganites by static and ultrafast optical spectroscopy / Y.T. Wang, C.W. Luo, T. Kobayashi // Adv. Condens. Matter Phys. – 2013. – V.2013. – P. 1-13.

4. Harmatullin, A.R. Electrical properties of strontium-substituted thulium and ytterbium ferrimanganites / A.R. Harmatullin, I.F. Gilmutdinov, V.V. Parfenov, I.I. Nigmatullina // News of higher educational institutions. Volga region. Physics and mathematics. – 2018. – № 3(47). – P. 79-86.

5. Nagaev, E.L. Lanthanum manganites and other magnetic conductors with giant magnetoresistance / E.L. Nagaev // Advances in physical sciences. – 1996. – V. 166. – № 8. – P. 833-857.

6. Matsnev, M. E. SpectrRelax: An application for Mössbauer spectra modeling and fitting / M. E. Matsnev, V.S. Rusakov // AIP Conf. Proc. – 2012. – V.1489. – P. 178-185.

7. Nigmatullina, I.I. Study of Sr-doped ytterbium ferromanganites by EPR and Mössbauer spectroscopy / I.I. Nigmatullina, V.V. Parfenov, R.M. Eremina, T.P. Gavrilova, I. V. Yatsyk // FTT. – 2018. – V.60. – №5. – P. 933-939.

8. Eremina, R.M. Investigation of magnetic phase separation in $Eu_{0.65}Sr_{0.35}Mn_{1-x}Fe_xO_3$ ceramics by EPR and Mössbauer spectroscopy / R.M. Eremina, I.I. Nigmatullina, V.V. Parfenov, Sh.Z. Ibragimov, A.V. Pyataev, R.A. Nazipov // Solid State Physics. – 2010. – V.52. – №.11. – P.2245-2249.

9. Wang, X.L. Magnetic and optical properties of multiferroic $GdMnO_3$ nanoparticles / X.L. Wang, D. Li, T.Y. Cui, P. Kharel, W. Liu, Z.D. Zhang // Journal of Applied Physics. - 2010. – V.107. – N. 09B510. – P. 1-3.

10. Joshi, J.P. On the analysis of broad Dysonian electron paramagnetic resonance spectra / J. P. Joshi, S.V. Bhat // Journal of Magnetic Resonance. – 2004. – V.168. – P. 284-287.

11. Gubin, S.P. Magnetic nanoparticles: methods of preparation, structure and properties / S.P. Gubin, G.Yu. Yurkov, Yu.A. Koksharov, G.B. Khomutov // Advances in chemistry. – 2005. – V.74. – №.6. – P. 539-574.

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DEVELOPMENT OF A STATISTICAL FORECASTING METHOD USING THE EXAMPLE OF HIT PARADES

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Abstract. *The article describes a forecasting method that allows you to determine the position of an object in the rating. The method is based on the theory of mathematical statistics without the use of artificial intelligence (neural networks). The proposed method is illustrated by a representative sample of Russian charts collected by the author from 1999-2020.*

Keywords: *data array, rating units, compression ratio.*

Introduction

All existing forecasting methods are usually divided into intuitive and formalized [1, 2]. Formalized methods are divided into domain models and time series models. In the modern world, neural networks related to time series models are increasingly used for forecasting [3]. But neural networks have a number of disadvantages: arbitrary assignment of weight coefficients, the absence of a theory for choosing a network architecture, the requirement to obtain an adequate result of a large amount of data, close to the general population of the phenomenon. Therefore, despite attempts at widespread use and aggressive advertising, neural networks are not an uncontested forecasting method [4, 5]. The article describes the forecasting method proposed by the author and is illustrated with examples based on the statistics of hit parades.

Purpose of the study - to develop a forecasting method that allows to determine the position of an object in the rating based on a statistical sample of hit parades.

Materials and methods

Statistical data of Russian hit parades from 1999 to 2020 collected by the author were used as a representative sample required for the statistical model (research material). The theory of mathematical statistics is a research method.

Results and discussion

Let's take the following designations: "song" is a set of places that a song has

visited during its time in the hit parade. From the point of view of mathematics, this is a set (array) of positive integers ranging from 1 to *m*, where *m* is the number of places in the hit parade. A song being in the hit parade can change its positions within the specified range. An example of representing a song in the form of an array in general form $[m_1\ m_2\ m_i]$, where m_i – are the places visited by the song while in the hit parade, with $1 \leq m_i \leq m$. A number of parameters can be obtained from the recording of a song as an array of places it has visited. External parameters of the song: *n* - the number of weeks spent by the song in the hit parade. In terms of mathematics - the number of numbers in the array, peak (*p*) is the highest place the song has climbed to (the smallest number from the array). When recording the external result, the number of weeks spent by the song in the hit parade is indicated in brackets, as well as the peak of the song and the number of weeks spent by the song at the peak, thus *np(n)* - weeks in the hit parade, peak (the number of weeks at the peak).

Song rating.

A song's rating (*S*) is a function of the number of weeks a song has been on the charts and where the song has held: $S = f(n, m_n)$.

The rating is calculated using the main formula of the hit parade.

The main formula of the hit parade.

Let's assume that 1 point is given for one week spent by a song in the last place of the charts, and *m* points are given for a week spent in the first place. The dependence of the rating on the place $S_n = S_n(m_n)$ – is linear, its graph will be a straight line passing through points (1;*m*) and (*m*;1) (see fig. 1).

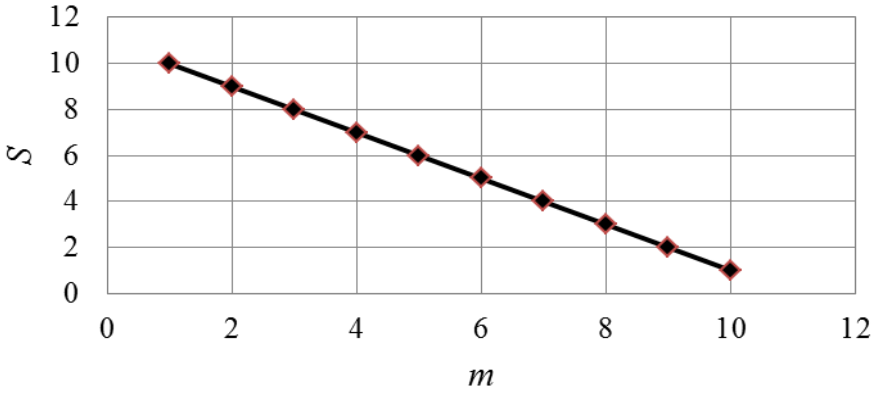

Fig. 1. *Dependence of the rating on the place in the hit parade*

The equation of the straight line in coordinates (*m;S*) will have the form

$$S_n(m_n) = km_n + b$$

Angular coefficient *k*

$$k = \frac{\Delta S_n}{\Delta m_n} = \frac{m-1}{1-m} = -1$$

Define **b** from the boundary conditions:

$$S_n = 1 \text{ at } m_n = m \; 1 = -m + b \rightarrow b = m + 1$$

The dependence of the rating on the place will look like

$$S_n(m_n) = m + 1 - m_n$$

A song's rating is the sum of the ratings for the places the song has visited, i.e.

$$S = \sum S_n = m + 1 - m_1 + m + 1 - m_2 + \cdots$$

$$+ m + 1 - m_n = (m+1) \cdot n - \sum m_n$$

Then the main formula of the hit parade is

$$S = (m+1) \cdot n - \sum m_n$$

$$\sum m_n - \text{sum of places the song has visited}$$

The restriction imposed on the main formula of the hit parade: the position number m_n - is a positive integer, the number of weeks *n* - is also a positive integer. Accordingly, the song's *S* rating is also a positive integer.

Rating units.

1 point is the main and minimum unit of measurement. It is the rating of the song that held the last place in the hit parade for one week. In other words, 1 point = 1 week × 1 place. The song rating, calculated using the basic formula, is measured in points and is numerically equal to the area under the graph of the song's rankings, built in the form of a bar chart in coordinates (*n;m*).

1 week of leadership (WL) - the rating of a song that stayed in the charts for one week in first place. 1 WL= *m* points.

The procedure for transferring the rating from points to leadership weeks.

1. The rating of the song in points is divided by the number of places in the hit parade *m*.

2. Round off the resulting value to the nearest lower whole value, the resulting value will be the number of weeks of leadership without taking into account the "remainder" in points.

3. Multiply the result obtained by the number of places in the hit parade *m*.

4. Subtract the resulting value from the result of the song in points - you will get the "remainder" of the result in points.

5. Write down the answer in the form of WL + points.

The rating of a song, expressed in weeks of leadership, allows you to determine the minimum number of weeks in which it can be recruited. If the rating of a song is equal to any number of WL without a "remainder" in points, this number is the minimum number of weeks required to gain this rating. If the rating is equal to any number of WL+ any number ("remainder") of points, the minimum number of weeks is equal to the number of WL+1.

1 set (H) - the rating of the song that stayed in the hit parade for *m weeks* and visited each place once. It is the largest rating unit.

The rating of such a song is numerically equal to the sum of integers from 1 to m, and can be calculated using the arithmetic progression formula.

$$\mathrm{H} = \frac{1+m}{2} \cdot m, \text{points}$$

Relationship between rating units.

1 point<1 WL<1*H*, 1 WL=*m*,points; $1\mathrm{H} = \frac{1+m}{2} \cdot m, \text{points} = \bar{m}m$,points;

1*H*=m̄WL

The complete result of the song.

$n\ p(n)\ S -$ weeks in the hit parade,peak (number of weeks at peak),song rating. Example: song $[5\ 4\ 2\ 1\ 1\ 2\ 2\ 6\ 8\ 10]$, $m = 13$. The outer result of the song is 10 1 (2). The complete result of the song is 10 1 (2) 99. The rating of the song, according to the main formula of the hit parade

$$S = (m+1)n - \sum m_n = (13+1) \cdot 10 -$$

$$-(5+4+2+1+1+2+2+6+8+10) = 140 - 41 = 99 \text{ points.}$$

An example of calculating the rating of a song in different values: $S = 358$ points; $m = 13$; 1 WL = 13 points; $H = \frac{1+m}{2} \cdot m = \frac{1+13}{2} \cdot 13 = 91$ points; in leadership weeks $S = \frac{358}{13} = 27{,}53 \rightarrow 27$ WL; $27 \cdot 13 = 351$ points $\rightarrow 358 - 351 =$ $= 7$ points; $S = 358$ points $= 27\mathrm{WL} + 7$points; in sets $S = \frac{358}{91} = 3{,}93 \rightarrow 3\mathrm{H}$; $3 \cdot 91 = 273 \rightarrow \ 358 - 273 = 85$ points $= \frac{85}{13}$ WL $= 6$ WL $+ 7$ points

$S = 358$ points $= 3\mathrm{H} + 6$ WL $+ 7$ points.

The indirect parameters of the song, discussed below, can be obtained from the full result: Average score $(\bar{S})$ – rating divided by the number of weeks spent by

the song in the hit parade

$$\bar{S} = \frac{S}{n} = \frac{(m+1)n - \sum m_n}{n} = m + 1 - \frac{\sum m_n}{n} = m + 1 - \bar{m}.$$

Average place $(\bar{m})$ - is the sum of all places on which the song held, referred to the number of weeks spent by the song in the hit parade:

$$\bar{m} = \frac{\sum m_n}{n} = m + 1 - \bar{S}.$$

The average score and the average place of a song can take, in contrast to the rating and place, fractional values, i.e. when calculating the specified parameters, the restriction imposed on the main formula of the hit parade does not apply. At the same time, the average place and the average score, as well as the rating of the song, are positive values.

Compression ratio (*k*) - the ratio of the number of weeks spent by a song in the hit parade to the minimum number of weeks for which a rating of a given song can be gained:

$$k = \frac{n}{n_{min}}.$$

How the compression ratio is calculated.

1. Divide the song's rating by the number of hits in the m.

2. Round the resulting value up to the nearest whole value. The result is the minimum number of weeks for which you can get this rating. In other words, to determine the minimum number of weeks, it is necessary to calculate the song's rating in leadership weeks (see above).

3. Divide the number of weeks the song spent in the hit parade by the value obtained in ex. 2. The resulting value is the compression ratio.

Compression Ratio Properties: The compression ratio is dimensionless by definition. In any hit parade, the minimum value of the compression ratio is equal to one, and the maximum value is equal to the number of places in the hit parade. That is, $1 \leq k \leq m$. In this case, the compression ratio can take fractional values.

Proof. *The first critical case* - the song stayed in the charts for n weeks in first place. The rating of such a song is $S = (m + 1 - 1) \cdot n = mn$ points. The minimum number of weeks for which you can get the *mn* points rating is:

$$n_{min} = \frac{S}{m} = \frac{mn}{m} = n;$$

$$k = \frac{n}{n_{min}} = \frac{n}{n} = 1.$$

The second critical case - the song lasted n weeks at the last place of the charts. The rating of such a song $S = (m + 1 - m) \cdot n = n$ points. The song stayed on the charts for $n = n$ weeks. The minimum number of weeks for which you can

score n points is $n_{min} = \frac{S}{m} = \frac{n}{m}$. Compression ratio $k = \frac{n}{n_{min}} = \frac{n \cdot m}{n} = m$.

The graph (fig. 2) shows the change in the compression ratio for a song that lasted n weeks at the last place of the charts for the case *m*=13. As can be seen from the graph, the compression ratio after a certain period *T*, measured in weeks, reaches its maximum value *m*. The number of the week at which the value of the compression ratio reaches its maximum can be determined by the formula $n_m = m + TZ$, where $Z \geq 0 - \text{any integer}$.

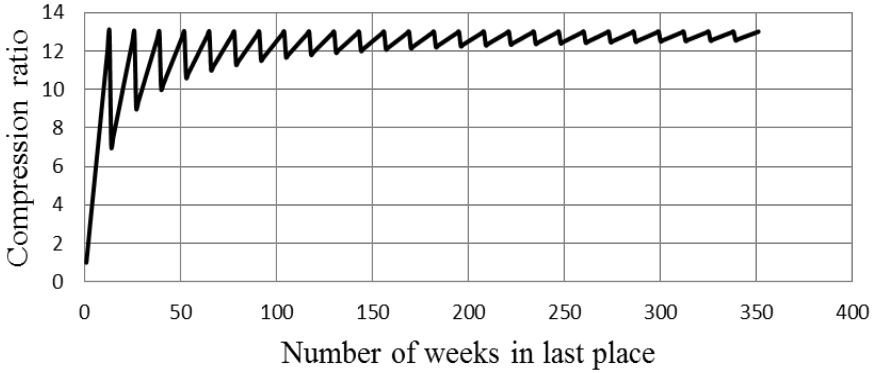

Fig. 2. *Changing the compression ratio for a song that lasted n weeks at the last place of the charts (m=13)*

The "lower" value of the compression ratio changes with the "conditional" period $T = m$. The number of the week in which the compression ratio falls to the "lower" value is determined by the formula $n_n = 1 + mZ = 1 + TZ$. The "lower" value of the compression ratio corresponding to the week defined above is determined by the formula:

$$k_n = \frac{1 + mZ}{Z + 1} = \frac{1 + TZ}{Z + 1} = \frac{n_n}{Z + 1}.$$

At the initial moment, when $Z = 0$ and $n_n = 1$, the "lower" value of the compression ratio is minimal and equal to one

$$k_n = \frac{n_n}{Z + 1} = \frac{1}{0 + 1} = 1.$$

With an increase in the number of periods *Z*, the "lower" value of the compression ratio will also increase, each time, with each new period, approaching the maximum value of *m*:

$$\lim_{Z\to\infty}\frac{1+mZ}{Z+1}=\lim_{Z\to\infty}\frac{\frac{1}{Z}+m}{1+\frac{1}{Z}}=\frac{0+m}{1+0}=m,$$

which once again confirms that the maximum possible compression ratio is numerically equal to the number of places in the hit parade. If a song has been on the hit parade for $n = mZ$ weeks, which corresponds to the compression ratio period, and its average score is expressed as an integer, the compression ratio can be determined using the formula below. In this case, the compression ratio will be maximum possible for a song that lasted any number of weeks n in one place m_n of the hit parade:

$$k = k_{max} = \frac{m}{\overline{S}} = \frac{m^2}{S}$$

The compression ratio of the set is in the range of $1 \le k \le 2$. In this case, a set means a song that has visited all the places of the hit parade once. The external result of such a song is m 1(1). The rating of the set is numerically equal to the sum of integers from 1 to m. According to the formula of arithmetic progression

$$H = \frac{1+m}{2}\cdot m$$

The minimum number of weeks for which you can get this rating is

$$n_{min} = \frac{H}{m} = \frac{1+m}{2\cdot m}\cdot m = \frac{1+m}{2}$$

Dial compression ratio

$$k = \frac{n}{n_{min}} = m : \frac{1+m}{2} = \frac{2m}{1+m}$$

Since the number of hits in the hit parade lies within $1 \le m < \infty$, it is necessary to consider two critical cases.

First critical case $m \to 1$ $\lim_{m\to 1}\frac{2m}{1+m} = \frac{2\cdot 1}{1+1} = 1$

Second critical case $m \to \infty$ $\lim_{m\to\infty}\frac{2m}{1+m} = \lim_{m\to\infty}\frac{2}{\frac{1}{m}+1} = \frac{2}{0+1} = 2$

Thus, for any values of the number of places in the hit parade m, the compression ratio of the set lies within: $1 \le k \le 2$

Below (fig. 3) is a graph of the dependence of the compression ratio of a set on the number of places in the hit parade.

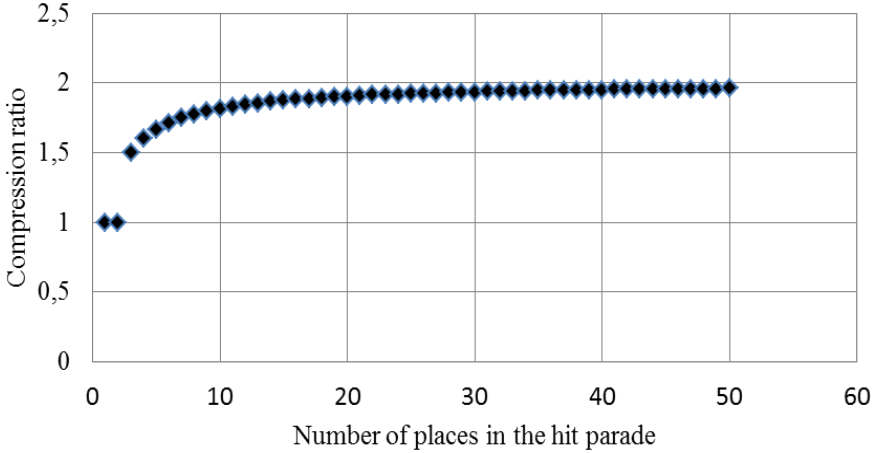

Fig. 3. *The compression ratio of the set from the number of places in the hit parade.*

Example. The song "On my Moon" by the "Dead Dolphins" group stayed in the chart of the "Chartova Dozen" $n = 13\ weeks$ and scored $S = 117\ points$. Average song score $\bar{S} = \frac{S}{n} = \frac{117}{13} == 9\ \text{points}$. The average song score is expressed as an integer, i.e. the rating of the song is equivalent to 13 weeks of being only in the fifth place of the charts, because $\bar{m} = m + 1 - \bar{S} = 13 + 1 - 9 = 5$. The number of weeks spent by a song in the hit parade corresponds to the compression ratio period $n = T = mZ = 13 \cdot 1 = 13\ \text{weeks}.$ Consequently, the compression ratio of this song is the maximum possible for a song that lasted n weeks at one place in the hit parade, in this case - the fifth. $k = k_{max} = \frac{m}{\bar{S}} = \frac{13}{9} = 1{,}444.$

Group parameters.

Group - a collection of songs. Peak of the group (P_A) – the highest place to which the songs of the group rose in the hit parade. The ceiling - the maximum score scored by the band's song. The ceiling is determined by the song and is measured in points. Annual ceiling (C_a)– the maximum score scored by a song of a group within a year, and selected from all the years in which the group was presented in the hit parade. Factual ceiling (C_F) - the maximum score scored by the group's song in the entire history of the group's stay in the hit parade. Correlation between ceilings: $C_f \geq C_a$. Ceiling difference - the difference between the actual and annual ceiling of the group: $\Delta C = C_f - C_a\ ;\ \Delta C \geq 0$. Ceiling groups can

be classified as follows: groups with zero difference in ceilings; groups with non-zero difference in ceilings. In turn, groups with a non-zero difference in ceilings can be divided into: single-ceiling groups - groups in which the annual and actual ceilings are determined by one song $(\text{the number of ceilings } N_C = 1)$, two-ceiling groups - groups for which the annual and actual ceilings are determined by different songs $(\text{number of ceilings } N_C = 2)$. Groups with zero difference in ceilings are single-ceiling.

“Peak-to-ceiling” ratio.

This ratio is represented in the form of the base *R* in the degree of difference between the peak of the song, which determines the group's ceiling in the hit parade, and the peak of the group. That is R^{Δ}, where

$$\Delta = P_C - P_A.$$

If the peak of the group is equal to the peak of the song that defines the ceiling of the group, the difference between the peaks is zero, and this ratio is called "one-to-one", since any number to the zero degree is one. If a $\Delta \neq 0$, this ratio is “ambiguous”. In this case, the value of the quantity $\Delta - \text{degree of ambiguity.}$ The “peak-to-ceiling” ratio can also be - annual - in relation to the group's annual ceiling, actual - in relation to the actual group ceiling, within the considered year or other period.

Example. Group "Naive". The band's annual and actual ceilings are defined by the song "Memories of Past Love". The song held the charts in 2007 and 2008 and scored 358 points: 245 points in 2007 and 113 points in 2008. The band's annual ceiling $C_A =$ 245 points. Actual group ceiling $C_F = 358 \text{ points}$. Difference of ceilings $\Delta C = C_f - C_A = 113 \text{ points}$. The group is single-ceiling ($N_C = 1$), as the annual and actual ceilings are determined by one song.

Example. Spleen group. The group's annual ceiling in the "Chartova Dozen" is determined by the song "My Heart", which scored 263 points and completely stayed in the hit parade within 2001. The actual ceiling of the group is determined by the song "Mayak", which was in the charts in 2007-2008 and scored 270 points, of which 215 points in 2007 and 55 points in 2008. $C_a = 263 \text{ points}; C_f = 270 \text{ points}$; the difference between the ceilings is $\Delta C = C_f - -C_A = 270 - 263 = 7 \text{ points}$. The group is two-ceiling $(N_C = 2)$, since the annual and actual ceilings are determined by different songs.

Annual rating parameters.

As a rule, the rating is calculated for the year.

1. The number of songs hitting the hit parade per year.

2. Average score of the year - the sum of the ratings of all the songs that hit the hit parade for the year, referred to the number of songs that hit the hit parade

for the year.

3. Overall score - a place in the hit parade, which corresponds to the average score.

4. Number of groups.

5. If the hit parade contains groups from different countries - the number of countries. In this case, the percentage of groups from different countries can be calculated.

Items 2-5 can also be defined for the TOP (for example, TOP-13, TOP-20, TOP-10) of the hit parade.

The condition for the correct filling of the rating

If the table is filled in correctly, the sum of ratings (in points) of all songs that have been in the hit parade for a certain period is equal to the product of the set *H* for this hit parade by the number of *Z* programs released during the given period. When calculating the number of programs released during the period under review, the final program, which summarizes the results of this period, should not be taken into account.

$$\sum_{i=1}^{n} S_i = H \cdot Z$$

If the sum of the ratings is not equal to the given product, the rating is filled in incorrectly. The error can be found by the formula

$$\theta = H \cdot Z - \sum_{i=1}^{n} S_i$$

From this error, you can find the place of the hit parade in which one is admitted, provided that the rating is checked after each new program entered into the archive and the errors are eliminated if they are found. Also, the place containing the error can be found using the formula below if the error does not exceed the number of places in the hit parade:

$$m_0 = m + 1 - \theta$$

Example. For the "Chartova Dozen" hit parade (*m*=13) the set is *H*=91 points (it was determined earlier). In the event that 51 hits of the hit parade were released during the year, with the correct filling of the table, the sum of the ratings of the songs that have visited during the year should be equal to

$$\sum_{i=1}^{n} S_i = H \cdot Z = 91 \cdot 51 = 4641 \text{ points.}$$

Comparison of results for different years.

Comparison can be made for any parameters - the number of songs, programs, average score, average TOP score. When comparing TOPs for different years, you can determine the record scores for different places at the end of the year. Record is the highest score for any place at the end of the year. Records are of two types: a fundamental record means that at the end of any other year the song would have taken a higher place than at the end of the year in which this song set a record, a non-fundamental record means that at the end of any other year the song would also have taken place as at the end of the year in which she set a record. The actual top of the hit parade is the rating of the song that took first place in the consolidated rating in the entire history. The annual top of the hit parade is the maximum rating of a song within a year, or a record score for first place at the end of the year.

Example. The annual ceiling of the "Chartova Dozen" is determined by the song "Nobody" by the "Kukryniksy" group and amounts to 328 points. The actual ceiling is determined by the song "Dance of the Evil Genius" by the "King and the Fool" group and is 405 points. $\Delta C = C_F - C_A = 405 - 328 = 77$ points . The hit parade has two ceilings, because the annual and actual ceilings are defined by two different songs.

Conclusions

On the basis of the classical theory of mathematical statistics, using the example of the statistics of Russian hit parades collected by the author, a method for comparing and predicting the position of an object in the rating is shown.

References

1. Armstrong J.S. Forecasting for Marketing // Quantitative Methods in Marketing. London: International Thompson Business Press, 1999. P. 92 – 119.

2. Jingfei Yang M. Sc. Power System Short-term Load Forecasting: Thesis for Ph.d degree. Germany, Darmstadt, Elektrotechnik und Informationstechnik der Technischen Universitat, 2006. 139 p.

3. Chervyakov N.I., Tikhonov E.E., Tikhonov E.E. Application of neural networks for forecasting problems and problems of identification of forecasting models on neural networks /Neurocomputers: development, application. 2003. № 10-11. P. 25-31.

4. Lebedyantsev V.V., Ozerova M.I. The influence of the architecture of the neural network and the initial data on the operation of the neural network for classification problems // In the collection: Information technologies in science and production. Materials of the VII All-Russian Youth Scientific and Technical Conference. Editorial Board: A.G. Yanishevskaya (ex.ed.) [et al.].2020. P. 145-152.

5. P.P. Bozhenko, R.U. Stativko Brief description of neural networks. Implementation of an expandable neural network//Bulletin of Youth Science of Russia. 2019. №5. P. 1.

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PROSPECTS FOR THE USE OF ALCOHOL FUELS AT THE PRESENT STAGE

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Abstract. *To solve the problems of environmental pollution from road transport, it is proposed to use bioethanol fuel. It significantly reduces both toxic compounds in exhaust gases and carbon dioxide emissions CO_2, which is a greenhouse gas. The advantages and problems associated with the use of alcohol fuels are considered.*

Keywords: *Bioethanol, alcohol fuel, motor vehicles, EURO standards.*

Today, the problem of atmospheric air pollution by harmful components of exhaust gases from cars is becoming more and more acute. It is typical for large megalopolises that the main share of pollution is accounted for by road transport. If in the mid-90s of the 20th century, 50% of pollution accounted for industrial enterprises and 50% for road transport, today the share of pollution from road transport already exceeds 80%. At the same time, the number of cars in the world has increased from 400 million units in the 90s to 1 billion 400 million today.

Much is being done today to reduce pollution. So back in the 90s, the EURO standards were adopted, which established the requirements for emissions up to the present time. Certain compositional requirements were adopted for fuel, in particular, sulfur almost completely disappeared from the fuel, the aromatics content was limited to 30%, and benzene to 1%. The injector is firmly incorporated

into the design of the car, paired with a catalytic converter, which made it possible to reach the level of EURO-3 and higher in emissions, but the measures taken are not enough. So, if you look at the EURO numbers, you can see that, in particular, for gasoline cars, the CO content decreased by 2.72 times. From 2.72 g/km for EURO-1 to 1 g/km for EURO-6. At the same time, since 1992, when the EURO-1 standards were adopted, until today, the number of cars has increased by 3.5 times. Despite the toughness of the EURO norms, they are really, at best, only able to freeze emissions at the level of the 90s.

Obviously, in these conditions, the requirements for emissions should be tightened, but the manufacturers of automotive equipment today have already reached the limit beyond which it is impossible to reduce toxicity by traditional means. Therefore, the next step on the part of legislators may be limiting the content of carbon dioxide CO_2. This compound is not toxic, but it belongs to greenhouse gases that destroy the azone layer of the planet and lead to climate change. Today, CO_2 emissions are already limited for individual countries that have entered the Kyoto Protocol. In these conditions, limiting carbon dioxide in car emissions seems to be very real.

The end products of combustion of any heat engine are CO_2 and H_2O, and the better the combustion process is organized, the more of these compounds will be. Any conventional fuel (gasoline, diesel, compressed and liquefied gas) will invariably emit CO_2 and H_2O.

According to the authors, the solution may be to use bioethanol as a fuel. It is believed that when burned in an engine, bioethanol releases about the same amount of CO_2 as was absorbed by the plants from which alcohol was produced during their growth. Thus, the CO_2 balance will be zero.

The idea of using ethanol as a fuel or fuel component dates back to the 19th century. As a result, the use of alcohol began almost before the use of gasoline. It is believed that the idea of using alcohol as a motor fuel was first announced in Paris in 1902, when 70 ethyl alcohol-fueled engines were introduced. Since then, this idea has been regularly discussed. In practice, this was realized in 1906, when the addition of alcohol to gasoline became the basis for the operation of public transport in Paris. Many were immediately attracted by the cheapness of the novelty and its reduced fire hazard. Later, ethanol began to be used in Germany for conventional cars [1]. Since 1908, the Ford-T car has been produced for about 20 years - the first mass-produced car in history, while it could run on gasoline, ethanol and a mixture of both types of fuel. Henry Ford considered the use of ethanol a promising direction for American farmers, since the raw materials for alcohol were mainly agricultural products and waste products [2].

Ethanol-containing fuels can be divided into 3 groups according to the concentration of ethyl alcohol: standard gasoline containing up to 5-15% (E5-E15),

medium ethanol fuels - from 20 to 40% (E20, E30, E40) and high ethanol fuels for special vehicles - from 50 to 100% alcohol (E85, E100, ED95).

The first option, when the alcohol concentration is up to 15%, is interesting in that it does not require any changes in the design and engine adjustments. Moreover, the Technical Regulations of the Russian Federation for Gasoline [3] and the Technical Regulations of the Customs Union [4], which are, as it were, receivers of GOST R 51866 - 2002, also provide for the addition of ethanol up to 5%. It is believed that the higher the ethanol concentration, the higher the octane number of the fuel and the lower the toxicity of the exhaust gases. The next step in increasing the concentration of ethanol in our country was benzene according to GOST R 52201 [5]. It provides for a 10% alcohol content. From a formal point of view, this is no longer gasoline, but it can be used as a motor fuel without any design changes or adjustments. In the US, they went further and started using 15% ethanol. This fuel is recommended for those cars, the production of which was started after 2001 [6]. Today, 15% ethanol is the limit for alcohol that does not require redesign and engine adjustments.

The third option is of greatest interest from the point of view of realizing the potential advantages of alcohol - these are high-ethanol fuels with an alcohol content of 50 to 100% (E85, E100, ED95). The most important competitive advantage of ethanol over fossil fuels is its renewability and availability of raw materials. Bioethanol at this stage can be produced from any plant material. The world leaders in the production of bioethanol are the USA and Brazil. In the United States, bioethanol is produced from corn, and in Brazil from sugar cane. Bioethanol has a positive energy balance, which, depending on the type of raw material, can vary from 1.24 to 8. That is, when ethanol is burned, several times more energy is released than is expended in its production. In this sense, it is an order of magnitude superior to gasoline or diesel fuel. Huge sums are spent on exploration, production, transportation, oil refining, so the fuel balance of petroleum fuels is less than one [1,7]. This feature predetermines the relatively low cost of alcohol in comparison with petroleum fuels.

An important advantage of alcohol fuel is its high octane number, which reaches 129.5 according to the research method and 101.3 according to the motor method, respectively [8]. It is clear that these characteristics will be realized as fully as possible when using 100% alcohol, as it actually happens in Brazil, where E100 alcohol fuel is widely used. In more northern latitudes, the use of E100 fuel becomes problematic, since alcohol evaporates worse than motor gasoline, then already at a temperature of +10°C, problems with starting the engine may arise. This problem is solved by adding gasoline or low-boiling hydrocarbon fractions to alcohol, as a result, such a "starting fraction" ensures engine start at low temperatures. The most famous alcoholic composition is E85 alcohol fuel (in Russia

it is labeled as Ed75-Ed85 according to GOST R 54290-2010) [9]. This alcohol fuel is subdivided into summer and winter. Summer contains 74% ethanol and 17 - 26% hydrocarbons and aliphatic ethers as a "starting fraction". Winter contains 70% ethanol and 17 - 30% hydrocarbons and simple aliphatic ethers as a "starting fraction".

Poor volatility is not the only drawback of alcohol fuels. So alcohol has a calorific value of 30.6 MJ/kg versus 43.6 MJ/kg for gasoline, which means, other things being equal, the engine on alcohol fuel will develop less power with higher fuel consumption. This problem can be solved by stronger compression of the mixture, since alcohol has a much higher octane number than gasoline, it is able to withstand greater compression without detonation. The compression ratio when using alcohol can be 19 units [1] versus 10 for gasoline. If the antiknock potential of alcohol is fully realized, then the fuel consumption will be lower and the power will be higher than with gasoline, which leads to a higher efficiency when the engine is running on alcohol. It is possible to increase the compression by increasing the ignition timing, but this is unlikely to allow you to get the maximum output from the engine. It must be borne in mind that alcohol is corrosive to metals, especially in the presence of water, as well as corrosive to rubber and plastic. It is hardly possible to solve all these issues by changing the adjustments and alterations of universal cars, therefore, for high-ethanol fuels, only specialized vehicles with universal fuel consumption (FFV – flexiblefuelvehicle) are used. Such cars can run on both regular gasoline and alcohol, as well as any mixture of alcohol and gasoline. The main design features of such cars are as follows [10]:

1. The on-board computer regulates the fuel-air ratio in a wider range depending on the bioethanol content in the fuel. This is most important for FFV vehicles, since complete combustion for gasoline is achieved with an air-fuel ratio of 14.7:1 (stoichiometric mixture), and for alcohol this ratio is 9:1.

2. The on-board computer adjusts the ignition timing over a wider range, depending on the actual octane number of the alcohol composition. The effective pressure in the engine cylinders directly depends on this, which means the output power and fuel consumption.

3. Metallic and non-metallic materials in contact with fuel are highly resistant to bioethanol.

4. Increased fuel tank to maintain range.

5. The fuel pump and injection system have increased capacity to provide more bioethanol fuel, which has a lower heating value than gasoline.

6. The electrical connections of the fuel system are electrically isolated because bioethanol fuel has a higher electrical conductivity than gasoline.

Thus, the technical problems associated with the peculiarities of the use of bioethanol fuel in the design of FFV vehicles are completely solved. Of course,

this is associated with additional costs, however, obviously, they are so small that for most car brands the manufacturer sets the price at the level of base models [10].

To date, a number of technological problems associated with the use of bioethanol fuels remain unresolved. And the main problem lies in the "starting fraction" of alcohol fuel. Traditionally, commercial gasoline was used for these purposes, then they tried to use narrow hydrocarbon fractions, including pentane, isopentane, butane, isobutane and propane [11], to reduce the cost of the composition it was proposed to use low-quality gasolines and gasoline fractions, including by-products of oil refining and even waste. For example, the low-octane fraction of direct distillation of oil or gas condensate [12], the gasoline fraction of the hydrocracking process [13], coking gasoline [14] and the like.

These and other hydrocarbon fractions have one common drawback - low phase stability, that is, under operating and storage conditions, there is a possibility of separation of the hydrocarbon part and alcohol. The presence of water in the fuel and a drop in temperature dramatically increase the likelihood of delamination. To avoid it, there are increased requirements for the strength of alcohol, as a rule, the moisture content in alcohol should not exceed 2%, that is, the ethanol content must be at least 98%. This degree of dehydration of alcohol requires additional costs in its production. Certain difficulties arise when refueling cars, since moisture is often present in refueling containers.

According to the authors, it is possible to increase the phase stability of alcohol fuel if, instead of hydrocarbons, some low-boiling ethers are used as a "starting fraction".

References

1. Tsygankov D. V. Alcohol fuel as the fuel of the future / D. V. Tsygankov, D. S. Konovalov // Collection of materials of the XI All-Russian, scientific-practical conference of young scientists with international participation "Young Russia", April 16-19. 2019, Kemerovo [Electronic resource] / FSBEI HE "T. F. Gorbachev Kuzbass. state tech. un-ty"; editorial board: S. G. Kostyuk (editor-in-chief) [et al]. – Kemerovo, 2019.

2. Konovalov D.S.Alcohol against oil / D.S.Konovalov, D.V. Tsygankov // Innovations in information technologies, mechanical engineering and transport: a collection of materials of the III International Scientific and Practical Conference (October 14 - 17, 2019), Kemerovo [Electronic resource]/ FSBEI HE "T. F. Gorbachev Kuzbass. state tech. un-ty"; editorial board: D. M. Dubinkin (editor-in-chief) [et.al]. – Kemerovo, 2019 – P. 290 – 293.

3. Technical Regulations "On Requirements for Automobile and Aviation Gasoline, Diesel and Marine Fuel, Jet Fuel and Heating Oil", approved by the Government of the Russian Federation of February 27, 2008 N 118 (Collected Legislation of the Russian Federation, 2008, N 9, art. 854).

4. Technical Regulations of the Customs Union "On Requirements for Automobile and Aviation Gasoline, Diesel and Marine Fuel, Jet Fuel and Fuel Oil (as amended on December 2,2015)", approved by the Decision of the Customs Union Commission dated October 18, 2011 №826.

5. GOST R 52201-2004 "Motor ethanol fuel for automobile engines with positive ignition. Benzanols. General technical requirements".

6. Ershov M. A. Chemical requirements for bioethanol fuels E30 and E85 and prospects for their application / M. A. Ershov, E. V. Trifonova, I. F. Khabibullin, V. E. Emelyanov // Chemistry and technology of fuels and oils. – 2015. - №5, P.8-12.

7. Konovalov D.S. Alcohol as a promising fuel / D.S.Konovalov, D.V. Tsygankov // Synthesis of science and society in solving global problems of our time: Collection of articles following the results of the All-Russian scientific and practical conference (Perm, April 30, 2019) – Sterlitamak: AMI, 2019. - P. 116-119.

8. Oil refining industry of the USA and the former USSR / V. M. Kapustin, S. G. Kukes, R. G. Bertolusin. – M.: Chemistry, 1995. – 304 P.

9. GOST R 54290-2010 "Fuel ethanol (Ed75-Ed85) for automobile engines with positive ignition. Technical conditions".

10. Ershov M.A. Experience and prospects of using bioethanol fuels / M. A. Ershov, E. V. Trifonova, I. F. Khabibullin, V. E. Emelyanov // Oil refining and petrochemistry. – 2014. - №12, P.33-37.

11. Oerlikon Maschf, Method of regulating electrical power plants to a constant power factor. Great Britain patent GB 243326 - 1926-07-22

12. Alternative automotive fuel. Pat. 2549179 RF. IPC S10L1/18/ M.A. Ershov, T.A. Klimova, S.P. Evdokushin, Open Joint Stock Company All-Russian Research Institute for Oil Refining, JSC "VNII NP" Appl. 30.01.2014. Publ. 20.04.2015, Bull. № 11

13. Alternative automotive fuel and the method for its production. Pat. 260554 RF. IPC S10L1/182/ M.A. Ershov, E.V. Grigorieva, I.F. Khabibullin, V.E. Emelyanov. Joint Stock Company "All-Russian Research Institute for Oil Refining" (JSC "VNII NP") Appl. 25.12.2015. Publ. 10.01.2017, Bull. № 1

14. Ershov M.A.Test results of E30 bioethanol fuel on a full-size injection engine in comparison with standard gasolines / M. A. Ershov, I. F. Khabibullin, E. V. Grigorieva, V. E. Lazarev, E. A. Lazarev // Chemistry and technology of fuels and oils. – 2017. - №3, P.3-10.

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ASSESSMENT OF THE QUALITY OF AGRICULTURAL LAND IN KAZAKHSTAN

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Abstract. *In the article the issues of research and assessment of the qualitative condition of agricultural lands, taking into account the peculiarities of their use in the Turkestan region are considered. The increase in the production of agricultural products primarily depends on how rationally and skillfully the land is used; also, the complete and correct use of the land has the most important conditions for increasing the production of grain, milk, meat and other products. Research and production work should be aimed at solving these problems. Therefore, to begin with, it is very important to analyze the condition of agricultural land resources and outline ways to improve their use, taking into account the qualitative condition.*

Keywords: *land resources, agricultural land, land valuation, quality condition of land, cadastral value of agricultural land, base rate, reactive income.*

Introduction

The problem of rational use of lands extorts a wide range of activities. One of

the priority research and applied areas is the effective use of the potential of land resources. At the same time, the general goal is to maximize the yield of each plot of land, increase productivity, taking into account the bioclimatic potential of soils, while observing the environmental safety of production.

Assessment of the qualitative condition of lands, taking into account the peculiarities of their use in the Turkestan region, depends on their qualitative condition and economic factors [1].

Therefore, in such a study, it is important to analyze the structure of the agricultural land fund and the processes of economic evaluation.

Turkestan region possesses significant land reserves, which are extremely important in solving agricultural years, since the natural conditions allow it.

Among the regions of the Republic of Kazakhstan, the Turkestan region takes 13th place in terms of the total area, and the administrative-territorial structure of the region includes 13 districts and 3 cities of regional subordination: Baydibek district, Zhetisay district, Kazygurt district, Keles district, Maktaaral district, Ordabasy district, Otyrar district, Sayram district, Saryagash district, Suzak district, Tolebi district, Tyulkubas district, Shardara district, c. a. Arys, c. a. Kentau, c. a. Turkestan. [2].

Results of the study of the land fund of the Turkestan region is 11609.5 thousand hectares.

The entire land fund is located in natural areas characterized by warm climate. In the southern part, agriculture is possible under conditions of regular irrigation, and in the northern regions, rainfed agriculture is possible, which require comprehensive measures to preserve moisture in the soil, and semi-desert is used as arid low-productivity pastures for animal husbandry.

The distribution of the land fund by category for 2020 is shown in Table 14, Figure 1.

Table 1 - *Distribution of the land fund by land category for 2020*

No.	Land categories	Area, ha	%
1	Agricultural land	4114,3	25,0
2	Lands of settlements	785,6	14,0
3	Lands for industry, transport, communications, defense and other agricultural purposes	99,7	0,4
4	Lands of specially protected natural areas	430,9	11,0
5	Forest lands	3010,3	18,0
6	Water fund lands	133,4	7,0
7	Reserve lands	3035,3	21,0
	Total	11609,5	100

As can be seen from the data in the table, the total structure of the region's land fund is 4114.3 thousand ha, land of settlements - 785.6 thousand ha, industrial, transport and communications, defense and other non-agricultural lands - 99.7 thousand ha, lands of specially protected natural areas - 430.9 thousand ha, forest lands - 3,010.3 thousand ha, water fund lands - 133.4 thousand ha, reserve lands - 3,035, 3 thousand ha.

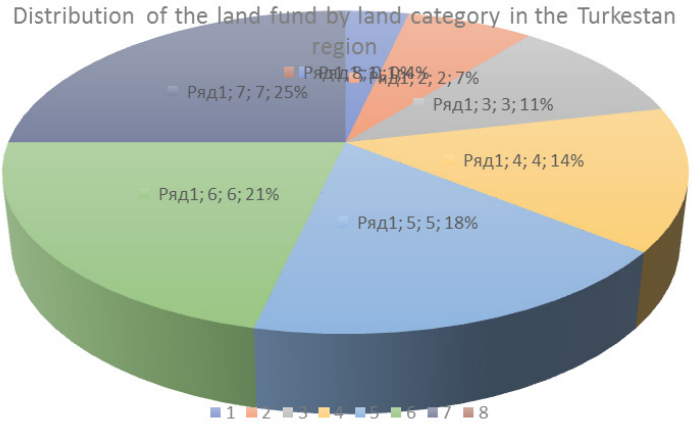

Figure 1. *Distribution of the land fund by land category*

The area of land of the special land fund (reserve land) is 3091.0 thousand ha, including laylands - 22.0 thousand ha, perennial plantations - 0.1 thousand ha, hayfields - 14.6 thousand ha, pastures - 2710.5 thousand ha.

Table 2 - *Dynamics of the area of agricultural land in the Turkestan region for 1991-2018 (million ha)*

Region	1991	2005	2017	2018	Changes, (+ , -)	
					from 2018 to 1991	from 2018 to 2017
Turkestan region	11,5	4,4	4,1	4,1	-7,4	-
Total	11,5	4,4	4,1	4,1	-7,4	-

During the period of reforming agricultural enterprises in 1991-2005, the area of agricultural land in the region decreased by 7.1 thousand ha, but subsequently the area of land in this category decreased annually and its overall decrease, from 2005 to 2018, amounted to 0.3 thousand ha [2].

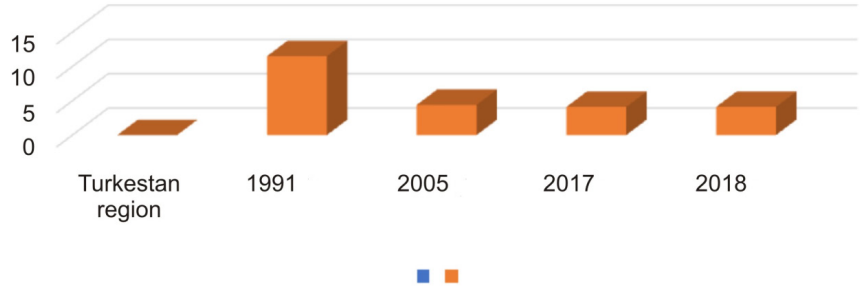

Figure 2. *Dynamics of the area of agricultural land in the Turkestan region*

Agricultural land in the districts of the region is characterized by a variety of soil and vegetation cover. The uniform part is characterized by a distinct latitudinal zoning, and in mountainous areas - vertical zoning, which in turn is characterized by soil vegetation cover within individual zones and altitudinal belts. The composition of agricultural land by type of land can be seen in Table 3 and Figure 2.

Table 3 - *Composition of agricultural land by type of land in the context of the Turkestan region as of November 1, 2020 (thousand ha)*

Region	Total area	Total agricultural lands	Arable land	Perennial plantations	Laylands	Hayfields	Pastures	Gardens and service allotments
Turkestan region	11609,5	4114,3	863,4	28,4	101,2	69,5	2 932,4	-
Total	11609,5	4114,3	863,4	28,4	101,2	69,5	2 932,4	-

The total area of land in the Turkestan region is 11609.5 thousand ha, agricultural land is 4114.3 thousand ha, including: arable land - 863.4 thousand ha (*20.9%*) (*incl. irrigated - 462.60 thousand ha*), pastures - 2932.4 thousand ha (*71.2%*), hayfields - 69.5 thousand ha, other lands 129.6 (*3.14%*) (*many plantations, laylands and other lands*).

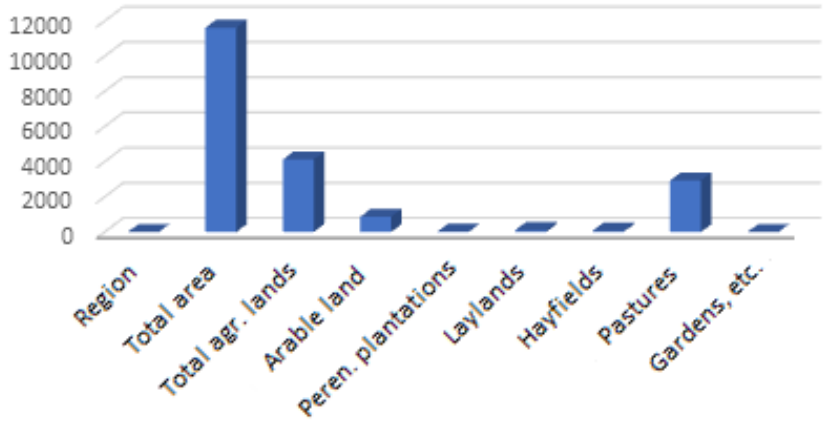

Figure 3. *Composition of agricultural land by type of land*

When performing work on the economic assessment of land, base rates are used. Basic payment rates are necessary to prevent price imbalances for individual land plots when they are sold for private ownership or provided for land use by the condition, as well as to optimize taxation and rent.

In order to form a unified approach to the assessment of land plots on the territory of the Turkestan region and to ensure the comparability of its results, the basic standard for the cost of one hectare of agricultural land, approved by the Government of the Republic of Kazakhstan, is used as the initial indicator for determining the cadastral value of a land plot [3].

The base rate of payment is determined by the income rental method using the following basic estimates:

- cost of gross production per hectare (estimated productivity);
- production costs per hectare (production costs);
- estimated rental income per hectare.

Taking into account the integral values of the calculated correction factors, the basic standards of agricultural land determined at the first stage are differentiated, and the final cadastral (estimated) value of agricultural land is established.

The economic assessment of lands of administrative districts and cities of regional significance is carried out by types of land in the context of the main types and subtypes of soils. On the territory of the Turkestan region, two zones of soils are distinguished: brown and gray-brown.

When conducting the economic assessment of lands, the data of land balances, materials of soil surveys, soil appraisal, and land inventory were also used [4,5].

Correction factors to the basic rates of payment for agricultural land plots are established by paragraphs 2, 3, 4 of Article 11 of the Land Code and are applied depending on:

- quality condition;
- water cut (water supply);
- distance from the service center.

If there are several factors that increase or decrease the cadastral (estimated) value of agricultural land, the coefficients are multiplied. The total amount of the increase or decrease in the cadastral (estimated) value should not exceed fifty percent of the base rates of payment.

Correction factors are calculated with an accuracy of two decimal places.

Correction factors to the base rates of payment for arable land are applied depending on the quality of the condition and distance from the service centers.

The qualitative condition of arable land in the Turkestan region is characterized by two indicators: reclamative condition and a slope of the surface.

The correction factor for the slope of the arable land is taken as a unit, since the value of its slope, in general, does not exceed 3 degrees.

The reclamative condition of the types and subtypes of soils is taken in accordance with their distribution by reclamation groups according to the method adopted by the example [II] are given in Table 4.

Table 4 - *Distribution of agricultural land by reclamation groups as of November 1, 2020*

Reclamation groups	Area, thousand ha	Share, in %
Total agricultural land	4114,3	100
Of them:		
Uncomplicated by negative signs	541,1	17,1
including degraded and stony ones	138,6	
that are completely suitable for	84,0	10,5
agriculture	32,5	21,7
Saline	7,5	9,8
Solonetzic	6,9	9,3
Washed	2,9	30,3
Deflated	-	-
Exposed jointly to water and wind		
erosion	2,2	1,1
Waterlogged	0,7	0,1
Wetlanded	0,3	0,1
Others		

Uncomplicated by negative signs, it occupies -4114.3 thousand ha or 17.1% of all agricultural land. In arable land, this group is -863.4 thousand ha, or -48.4% of its area. A significant area of land (863.4 thousand ha) without negative signs affecting soil fertility cannot be used in agriculture due to insufficient atmospheric moisture, lack of water for irrigation and due to relief conditions. Of this group, there are 4114.3 thousand ha of undoubtedly suitable land for agriculture, of which 863.4 thousand ha or 98.9% are in arable land.

Lands of reclamation group 1. “Uncomplicated by negative signs” are established as lands with good reclamative condition and the application of a correction factor - 1.2 to them.

Table 5 - *Cadastral value of arable land in the Turkestan region*

Reclamation groups	Type, subtype of the soil (sierozem, light sierozem)		Correction factors			Cadastral (estimated) value, thousand tenge
	area, thousand ha	base rate, thousand tenge/ ha	reclamative condition, K1	distance from service centers, K2	total (integral) coefficient K=K1*K2	
1	2	3	4	5	6	7
I. Uncomplicated by negative signs	24,8	87,8	1,2	1,31	1,5	3266160
II. Stony weak, medium and strong	2,6 -	87,8 -	0,9 -	1,31 -	1,18 -	269370,4 -
III. Saline weak, medium and strong	2,9 0,9	87,8 87,8	0,9 0,6	1,31 1,31	1,18 0,79	300451,6 62425,8
IV. Solonetzic weak, medium and strong	0,2 -	87,8 -	0,9 -	1,31 -	1,18 -	20720,8 -
VIII. Waterlogged	0,4	87,8	0,6	1,31	0,79	27744,8
Total	31,8	526,8	5,1	7,86	6,62	3946873,4

Lands of reclamation groups II. “Stony”, III. “Saline”, IV. “Solonetzic”, V. “Washed”, VI. “Deflated”, IX. “Wetlanded” with a weak degree of negative signs are established as lands with a satisfactory reclamation condition, with a correction factor of 0.9. With the presence of these groups of negative signs in an average and strong degree*, they are defined as lands of unsatisfactory reclamation condition, with a correction factor of -0.6.

Lands of reclamation groups VII. "Exposed jointly to water and wind erosion", VIII. "Waterlogged", X. "Others" are accepted as lands of unsatisfactory reclamation condition, with a correction factor of 0.6.

The correction factor for the slope of the arable land is taken as a unit, since the value of its slope, in general, does not exceed 3 degrees.

For the distance of plots of arable land from service centers, depending on the quality of the roads, correction factors are applied in accordance with the subparagraph of the Land Code of the Republic of Kazakhstan [1, 8].

Service centers are considered to be the most closely located cities, towns, regional or district centers, which are the zone of gravitation to them of economic centers, where the main network of institutions and organizations of social, medical, cultural, household and other services for the population, sales markets and processing of agricultural products, bases logistics.

Rural settlements, which are the main place of residence of the population, where infrastructure facilities, points of primary processing of agricultural products, warehouses and other facilities are located, are taken as economic centers [5, 6].

Provided that the plots of arable land in the Turkestan region are evenly distributed throughout the territory of the administrative region, the weighted average correction factor for distance, taking into account the quality of the roads, is determined as the sum of the correction factors from each economic center to the service center divided by their number.

Table 6 - *The cadastral value of the reserve land of the Turkestan region*

Reclamation groups	Type, subtype of the soil (sierozem, light sierozem)		Correction factors			Cadastral (estimated) value, thousand tenge
	area, thousand ha	base rate, thousand tenge/ha	reclamative condition, К1	distance from service centers, К2	total (integral) coefficient К=К1*К2	
1	2	3	4	5	6	7
I. Uncomplicated by negative signs	3	87,8	1,2	1,31	1,5	395100
II. Stony weak, medium and strong	0,3 0,2	87,8 87,8	0,9 0,6	1,31 1,31	1,18 0,77	31081,2 13521,2
III. Saline weak, medium and strong	0,7 0,6	87,8 87,8	0,9 0,6	1,31 1,31	1,18 0,79	72522,8 41617,2
IV. Solonetzic weak, medium and strong	0,2 0,1	87,8 87,8	0,8 0,5	1,31 1,31	1,17 0,67	21081,2 3521,2

V. Washed weak, medium and strong	0,5 0,4	77,8 77,8	0,7 0,4	1,31 1,31	1,16 0,59	52522,8 21617,2
VI. Deflated weak, medium and strong	0,2	87,9	0,7	1,31	0,80	7936,2
VII. Exposed jointly to water and wind erosion	2	67,8	1,0	1,31	1,3	295100
VIII. Waterlogged	0,1	87,8	0,6	1,31	0,79	6936,4
IX. Wetlanded weak, medium and strong	0,5	77,8	0,7	1,31	1,17	21080,2
X. Others	0,1	87,8	0,8	1,31	1,16	42522,6
Total	8,9	1179,3	10,4	18,34	14,23	1026160,2

Reserve lands of the Turkestan region - according to land law, all lands not provided for ownership, possession, use and lease. They also include land, the right of ownership, possession and use of which has been terminated (in accordance with land legislation). The cadastral value of the reserve land in the Turkestan region is 1026160.2 thousand tenge.

Table 7 - *Cadastral value of other land in the Turkestan region*

Indicators	**Units of measurement**	**Type, subtype of the soil (sierozem, light sierozem)**	**Total**
1	2	3	4
1. Base rate of payment for pasture	thousand tenge/ha	4,4	4,4
2.General (integral) correction factor in the assessment of pastures	units	1,31	1,31
3.Base rate of payment for pastures, taking into account the correction factor	thousand tenge/ha	5,76	5,76
4. Base rate of payment for other land (50% of paragraph 3)	thousand tenge/ha	2,88	2,88
5. Area of other land	thousand tenge/ha	33,8	33,8
6. Cadastral (estimated) value of other land	thousand tenge/ha	97411,6	97411,6

The cadastral value of other land in the Turkestan region is 97411.6 thousand tenge.

In connection with the attraction in the Turkestan region to economic centers of various sizes of arable land, correction factors for distance are calculated taking into account their shares. If there is no arable land in the sphere of influence of some economic centers, only those economic centers to which it belongs are taken into account [2, 7].

If the economic centers in the Turkestan region are connected to the service centers by roads of various quality, the correction factor is calculated as a weighted average, taking into account the type of road surface. Roads are divided into hard, stony and ground covers.

The soil cover of the territory of the Turkestan region, which determines the quality of lands, is characterized, on the one hand, by a distinct latitudinal zoning in the distribution of soil types and subtypes, on the other hand, by a change in soils from west to east due to an increase in climate aridity in this direction.

The soils of the territory of the Turkestan region are grouped into the following zonal types and subtypes:

1. Gray-brown soils of the desert zone;
2. Sierozem northern and southern desert-steppe zone;
3. Piedmont chestnut soils of the desert-steppe zone;
4. Mountain alpine and subalpine soils;
5. Mountain chestnut soils (mountain brown).

In the mountainous systems of the south, mountainous subalpine soils and mountain chestnut soils have formed. In addition to plain and mountainous zonal soils, intra-zonal soils are widespread on the territory of the South Kazakhstan region: salt marshes, solonetzes.

An important feature of the soil cover is heterogeneity, high complexity associated with the aridity of the climate, relief and soil-forming rocks, which is manifested everywhere throughout the region.

The heterogeneity of the soil cover significantly reduces the productivity of agricultural land [1, 9].

The high-quality condition of soils in large areas in the region is complicated by the presence of signs that negatively affect their fertility. To take into account the quality of agricultural land, reclamation groups were adopted that combine soils with a general orientation and nature of reclamation measures:

- uncomplicated by negative signs;
- saline;
- solonetzic;
- washed;
- deflated;

- exposed jointly to water and wind erosion;
- wetlanded;
- others.

Conclusion. According to the results of the economic valuation of the quality condition of agricultural land in the Turkestan region, the total area of agricultural land is 4114.3 thousand ha, including: arable land - 863.4 thousand ha (13.8%) (including irrigated - 462.60 thousand ha), pastures - 2932.40 thousand ha (84.4%), hayfields - 69.5 thousand ha, others - 129.6 thousand ha (1.7%) (many plantations, laylands and other lands), cadastral value is 5168817.480 thousand tenge. Irrigated arable land is 462.60 thousand ha with a cost of 9456000 thousand tenge, vegetable gardens are 0.1 thousand ha with a cost of 4728.000 thousand tenge, pastures occupy 2932.40, their value is 4980737 thousand tenge. Other lands amount to 129.6 thousand ha with a cost of 173896.200 thousand tenge.

The area of reserve lands is 3035.3 thousand ha, the cost is 895904.320 thousand tenge. Other lands amount to 129.6 thousand ha, with a value of 421864.000 thousand tenge.

Total (the sum of the I category and the VII category of land) in the Turkestan region thousand ha, with a cost of 6064721.800 thousand tenge, arable land irrigated ha, their cost is 9456.00 thousand tenge, vegetable gardens are 0.1 thousand hectares with a cost 4728.000, other land is 129.6 thousand ha with a cost of 173896.200 thousand tenge.

Comprehensive indicators for the economic valuation of the region's land are used to ensure the regulation of land relations, as a starting level for the cost of land on the market, when establishing the amount of land tax and rent.

References

1. B. Ospanov, Z. Dusenbekov. Land resources and land reform in the Republic of Kazakhstan. Astana, 2011 - p.352.

2. Consolidated analytical report of RK. 2019-2020.

3. Materials of reports of the Kazakh Research Institute of Economics of AIC and RUTI, -Almaty, 2014.

4. Molzhigitova.D.K. The ways of increasing the efficiency of land resources considering regional features, Actual Problems of Economics. №6 (156) 2014, 311-315.

5. Federal Law Russian Federation of 18.06.2001 No. 78-FZ «O land management».

6. Jonson W.C. Controlled soil cracking as a possible means of moisture conservation on wetlands of the Southwestern Great Plains. // W.C. Jonson / Agronomy Journal, 2011. № 54. -P. 323-325.

7. Orlov D. Soil humus status, ecological and geochemical principles of its formation. Trans. // D. Orlov / 13 Congr. Int. Soc. Soil Sei. - Hamburg, 13-20 Aug., 2011. Vol. 2.-P. 413-414.

8. Reuter G. Zwanzig Jahre Rostocker Dauerversuche zur Humusbildung im Boden. // G.Reuter / Mitteilung: Humus bilanzierung und Entwicklung der Humusqualität. /"Arch. Acker und Pflanzenbau und Bodenkunde - 2012, - № 5. - P. 273-281.

9. Ridly A.O. Soil organic matter and crop yields as influenced by the frequency of summer following. // A.O. Ridly, R.A. Hedlin / Canad. J. of Soil Sei., 2012, vol.48, №3. - P.315-322.

10. G. Aitkozhayeva, K. Tireyov, T. Pentayev. Land Policy and land Marvet Aktivity in Kazakhstan. ASERS Publishing Journal of Environmental Management and Tourism /JSSN 2068-7729 Journal DOY Volume X JSSUE3 (35) Summer 2019, D.590-597

11. Gendelman, M.A., Krynbayev, Zh.K. Scientific bases of land management and cadastre. Astana, Faliont, 2004 – p.172.

NOTES

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