

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ імені В.Н. КАРАЗІНА  
ФАКУЛЬТЕТ ІНОЗЕМНИХ МОВ  
КАФЕДРА АНГЛІЙСЬКОЇ МОВИ



«ACADEMIC AND SCIENTIFIC CHALLENGES OF DIVERSE FIELDS OF KNOWLEDGE IN  
THE 21<sup>ST</sup> CENTURY. CLIL IN ACTION»  
«АКАДЕМІЧНІ ТА НАУКОВІ ВИКЛИКИ РІЗНОМАНІТНИХ ГАЛУЗЕЙ ЗНАНЬ У 21-МУ  
СТОЛІТТІ. ПРИНЦИПИ CLIL В ДІЇ»

МАТЕРІАЛИ  
Х ВСЕУКРАЇНСЬКОЇ НАУКОВОЇ КОНФЕРЕНЦІЇ З МІЖНАРОДНОЮ УЧАСТЮ  
12 березня 2021 року



УДК 001 (082) "20"

Рекомендовано до друку рішенням вченої ради факультету іноземних мов Харківського національного університету імені В.Н. Каразіна (протокол № 1 від 22 січня 2021 р.)

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До збірника увійшли доповіді, присвячені актуальним проблемам різноманітних галузей знань у 21-му столітті.

Для наукових працівників, студентів та аспірантів усіх спеціальностей.

ISBN 978-966-285-367

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університет імені В.Н.  
Каразіна, 2021

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**SECTION I**  
**HUMANITIES**

УДК 339.9:005.336.4

**UKRAINE`S POSITION IN INTERNATIONAL LABOR MIGRATION**

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**Анотація. Абраменко А. С. Позиція України на міжнародному ринку праці.**

В статті показано існуючу ситуацію в сфері трудових міграцій в Україні, її вплив на економіку та стабільний розвиток. В дослідженні представлені вплив глобалізації на міграцію та проаналізовано можливість зникнення шляхів нелегального працевлаштування за кордоном. Розглянуто напрямки вирішення проблеми та можливість впливу на ситуацію з боку уряду.

**Ключові слова:** трудова міграція, відтік мізків, міжнародна міграція, позиція України, світові рейтинги, міграційний ефект

**Abstract. Abramenko A.S. Ukraine`s position in international labor migration.**

The article shows current situation in labor migration of Ukraine, its impact on the economy and stable development. There are the influence of globalization in migration, the possibility of the disappearance of illegal employment ways abroad in this research. Ways of solving the problem from the governmental side is discussed.

**Keywords:** labor migration, “brain drain”, international migration, Ukraine’s position, world’s ratings, migration effect.

**General formulation of research and its topicality.** Migration effects can be both positive and negative for the workers and for human development in general. The actual value of this subject is due to the fact that Ukraine is the country of origin, arrival and transit of labor migrants. There is a combination of threats for national development and opportunities of providing conditions for people’s welfare improvement.

**The object** of the study is the Ukrainian labor migration. **The subject** of this research is the position of Ukraine on the international labor migration market. **The purpose** of this article is to analyze the current reasons of the external labor

migration and to highlight the opportunities of preventing “the brain drain”.

**Discussion and Results.** According to the Net migration rate Ukraine ranks 46<sup>th</sup> place among the countries in 2020. Net migration rate compares the difference between the number of people who leave and enter the country during the year per 1000 people of the average annual population. Referring to the rate we have 2.3 migrants on 1000 people. There is an increase in migration, but it is hard to say how positive this situation is [11].

The dynamics of labor migration from Ukraine shows us that in 2012 the number of migrant workers was 1.2 million people, the vectors of the countries chosen by migrants aims at Russia, Poland, Italy, the Czech Republic and Spain. Comparing to previous years, in 2017 the number of migrant workers increased to 1.3 million people who settled in Poland, Russia, Italy, the Czech Republic and the United States. There is a slightly different situation in the movement of Ukrainian migrants with the countries bordering it.

We can see a sharp increase in the numbers from 2012 to 2017 in Poland (up to 10 million people), Hungary (up to 3 million people), Romania and Slovakia (on 1.5 million people). The departure of Ukrainian citizens to Russia decreased in 2013: the number was the largest and reached more than 6 million people. In the following period of 2014-2016, due to hostilities in the east of Ukraine, the number decreased to 4 million people and only in 2017 began to grow again to 5 million people. It should be noted that 60% of them are migrant workers [7].

Surveys by the State Statistics Service of Ukraine show that the main destination countries for Ukrainian labor migrants have changed since the 2014 armed conflict. According to a previous survey, conducted in 2012, Russia was the most popular destination, attracting 43% of Ukrainians working abroad. As can be seen from Figure 1.1, Poland became the most popular destination for Ukrainian labor migrants (39%) in 2017. The rapid increase in the number of migrants to Poland can be explained by the dynamic growth of the Polish economy and the high number of job vacancies, as well as visa liberalization (since 2017) and legislative changes that promote the employment of Ukrainians. Despite tense relations between Ukraine

and Russia, the latter country still attracted 26% of Ukrainian labor migrants in 2017. Italy and the Czech Republic continue to be the third and fourth most popular destinations. 67% of Ukrainian labor migrants worked in EU member states in 2017, compared to 54% in 2012. The right of Ukrainians to work depends on the national rules of their host countries, also within the European Union, which partly explains the choice of destination by migrants [7].

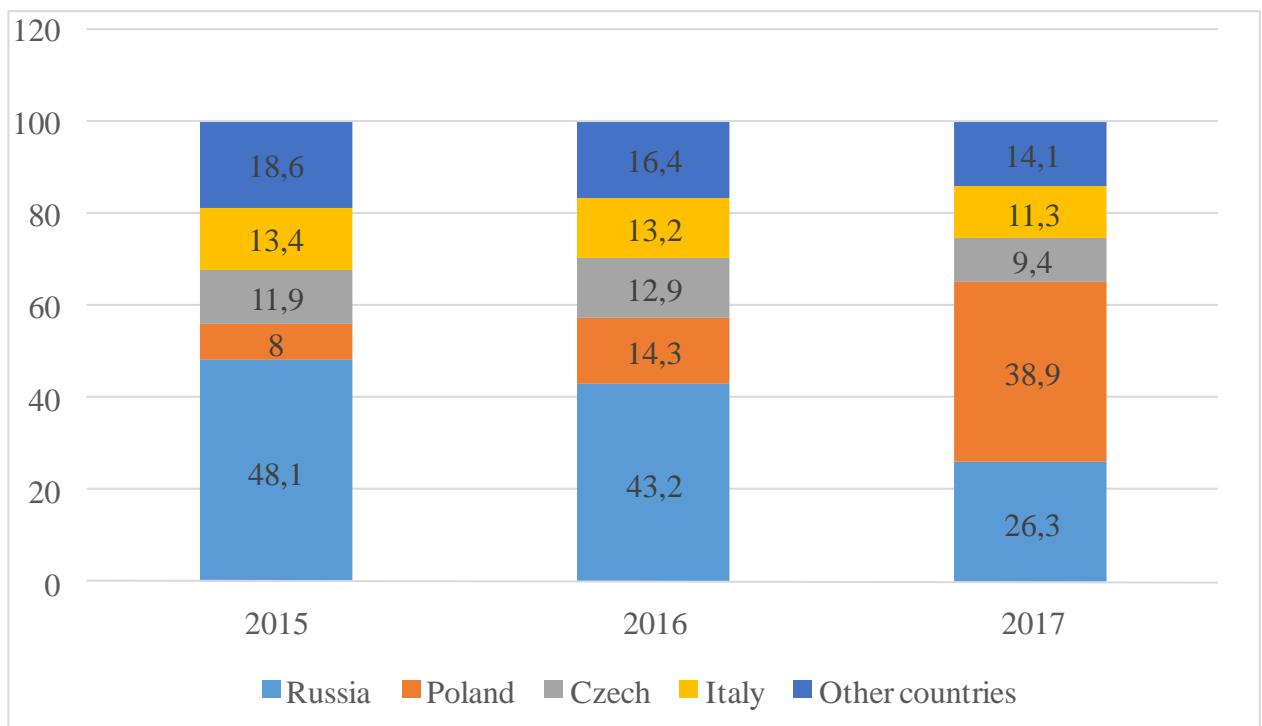


Fig. 1. Structure of emigration from Ukraine by destination countries in 2015-2017 years (in %). Source: Made by the author, using materials: [1;2].

Changes in the geographical location of Ukrainian migrants are reflected in changes in private remittances. In 2015-2017 total remittances from Poland increased by 138.5%, from other EU countries - by 23.8%, from the USA and Canada - by 33.3%, while remittances from Russia decreased by 27.8%. These transformations are caused by external rather than internal factors. Ukraine has long known as country with cheap labor and low wages. This feature has been presented to foreign investors as the main comparative advantage of the country for many years, so this paradigm has had a fairly constant impact on stimulating labor migration. Meanwhile, the

demand for Ukrainian labor has changed, as have the conditions of foreign employment [7].

Ukraine currently occupies not the best places in the international rankings, such as The Global Peace Index, Index of Economic Freedom, Index of Happiness, Doing Business / Ease of doing business, The Global Competitiveness Index, etc., as can be seen from Fig. 2.

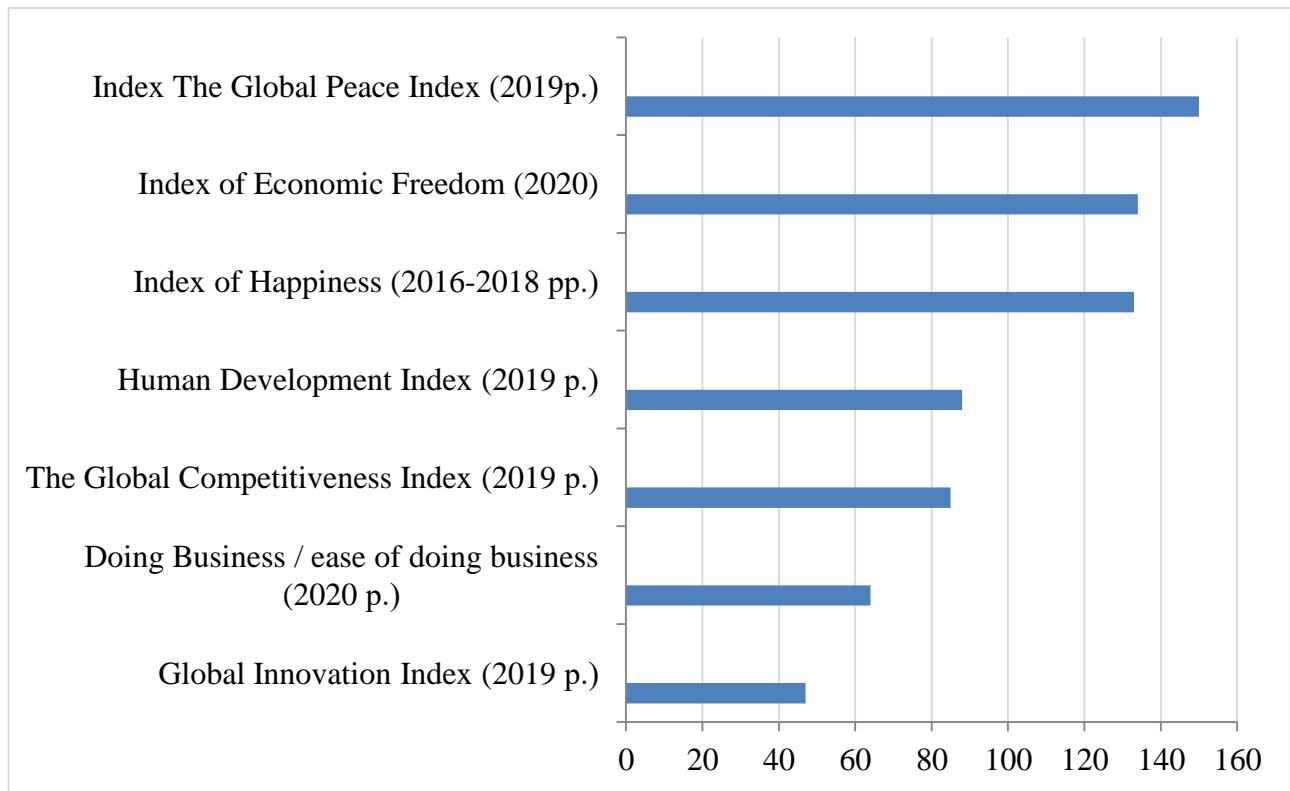


Fig. 2. Ukraine in international indices in 2016-2020

Source: Made by the author, using materials: [3;4;5;6;8;9;10].

Ukraine is a country with an incredibly low price of human labor: the data, presented in Fig. 3, shows the level of the average monthly minimum wage (basic social standard) – in contrast to the countries-recipients of Ukrainian migrants: Poland (611 euros), Portugal (741 euros), Spain (1050 euros), Great Britain (1599 euros), Germany (1584 euros) - lags behind at times (in 2020 it is 161 euros).

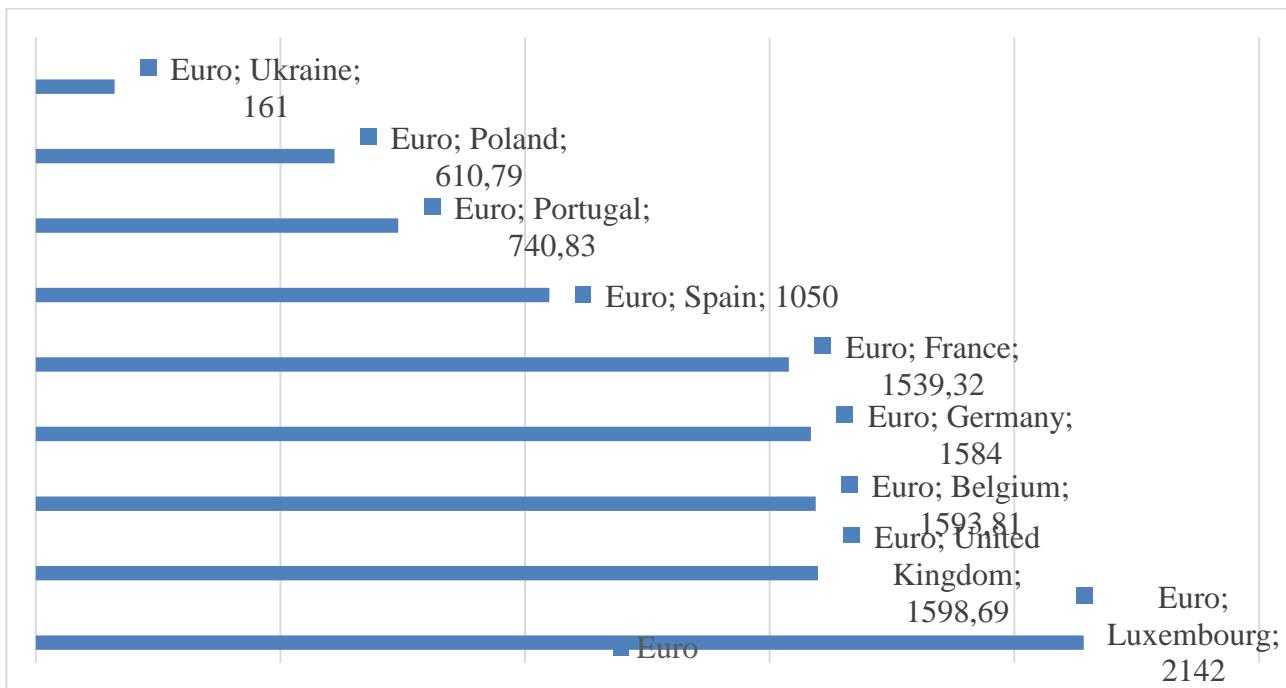


Fig. 3. The minimum wage in the EU and Ukraine in 2020

Source: Made by the author, using materials: [2].

That is why we can highlight two main reasons of Ukrainians` emigration:

### 1) Low wages

The main reason for the outflow of population is low wages in Ukraine. The official minimum wage in Ukraine is only 4,723 hryvnias. This makes neighboring countries, such as Poland, more attractive option for employing Ukrainians.

### 2) Unpredictability

The second important issue is the unpredictable economic and political situation in Ukraine.

Creating better conditions for the employee applies to both the employer and the government. But apart from raising wages, improving conditions in the country is just what the government can do. For example, better infrastructure, education and pensions are general parts of the whole reconstruction process.

International labor migration is one of the important forms of international economic relations. It can be resolved with the joint efforts of the entire international community.

The peculiarity of labor migration of the economically active population of Ukraine in modern conditions is their orientation on European countries, due to geopolitical changes, openness of the domestic economy and the introduction of visa-free control of European integration. This requires much strong cooperation with the European Union to improve the conditions for legalization of Ukrainian labor migrants, intensify cooperation in the field of border control, management of legal migration, promotion of reverse migration, protection of the migrant workers` rights.

Government actions in this particular field should be aimed primarily at:

- creation of conditions for reduction of departure for earnings abroad;
- protection of the rights of citizens working abroad;
- providing more favorable opportunities for their employment in foreign countries;
- encouraging the return of migrants to Ukraine by making maximum use of the results of labor migration in the interests of national development.

Such a policy should be based on the use of a broad public dialogue, which can only ensure public support; be based on accurate and reliable migration statistics and research; be implemented on the basis of clearly regulated activities of government structures, local authorities, social partners, non-governmental organizations.

This statement is true today for the economy of Ukraine, because the realization of human and intellectual potential has to lead to an increase in the number of newly created jobs by companies of the "new" economy. At the same time, highly developed countries, actively demonstrating scientific and technological progress, create the problem of dismissing unnecessary labor. However, they create opportunities for the development of the IT industry and its professionals who can support international migration movement and attract more leading world experts to Ukraine.

## **References**

1. Міграційний рух населення України / Укрстат. [Електронний ресурс]. – Режим доступу: [http://www.ukrstat.gov.ua/operativ/operativ2016/ds/mr/mr\\_u /mr0316\\_u.html](http://www.ukrstat.gov.ua/operativ/operativ2016/ds/mr/mr_u /mr0316_u.html)
2. Офіційний сайт Євростату [Електронний ресурс]. – Режим доступу: [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=earn\\_mw\\_cur&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=earn_mw_cur&lang=en)
3. Doing

Business: Country Ranking. 2020. The World Bank. [Electronic resource]. – Way of access: <http://www.doingbusiness.org/data/exploreeconomies/Ukraine>. 4. Human Development Indices and Indicators: 2019 Statistical update. 2019. [Electronic resource]. – Way of access: [http://hdr.undp.org/sites/default/files/hdr\\_2019\\_ru.pdf](http://hdr.undp.org/sites/default/files/hdr_2019_ru.pdf). 5. Index of Economic Freedom. 2020. The Heritage Foundation. [Electronic resource]. – Way of access: <https://www.heritage.org/index/ranking>. 6. Index of Happiness. The World Happiness Report 2019. [Electronic resource]. – Way of access: <https://worldhappiness.report/ed/2019/changing-world-happiness/>. 7. Migration Policy Institute tabulation of data from the World Bank Prospects Group. Annual Remittance Data (April 2019 update). Available here: [www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data](http://www.worldbank.org/en/topic/migrationremittancesdiasporaissues/brief/migration-remittances-data). 8. The Global Competitiveness Report (2019). The World Economic Forum. [Electronic resource]. – Way of access: [http://www3.weforum.org/docs/WEF\\_TheGlobalCompetitivenessReport2019.pdf](http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf). 9. The Global Innovation Index: Country Ranking. 2019. [Electronic resource]. – Way of access: <https://www.globalinnovationindex.org/gii-2019-report>. 10. The Global Peace Index 2018. The Institute for Economics & Peace (IEP) [Electronic resource]. – Way of access: <http://visionofhumanity.org/app/uploads/2018/06/Global-Peace-Index-2018-2.pdf>. 11. The World Factbook - CIA / Всемирная книга фактов ЦРУ США – [Електронний ресурс]. - Режим доступу: <https://www.cia.gov/library/publications/the-world-factbook/>

УДК 902.01

## **ASSEMBLY OF THE WORLD COUNCIL OF CHURCHES IN UPSAL AND THE RUSSIAN ORTHODOX CHURCH**

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**Анотація. Андреєв Т. ІО. Асамблея Всесвітньої ради церков в Упсалі та Російська православна церква.**

Стаття присвячена аналізу основних питань, розглянутих протягом засідання Асамблеї Всесвітньої ради церков, що відбулася в Упсалі у 1968 році. Висвітлено погляд на проблему крізь призму участі Російської православної церкви в екуменічному русі. Розкрито проблему місця РПЦ у міжнародній культурній політиці СРСР. Акцентується увага на значенні ролі особистості митрополита Никодима (Ротова) у розвитку Російської

православної церкви у контексті екуменічного руху.

Робиться висновок про те, що незважаючи на існуючи протиріччя Асамблея в шведському місті Упсала стала останнім прикладом злагодженої взаємодії радянської влади, РПЦ і ВРЦ. На Асамблії було прийнято низку рішень які з одного боку підтвердили консервативний вектор розвитку РПЦ як релігійної структури, та окреслили прагнення прогресивних кроків у якості актора міжнародних відносин. Ця подія стала однією з ключових віх на шляху розвитку молодіжного спектра в екуменічному русі на території Радянського союзу. Проте ВРЦ вкотре показала себе у якості ефективного плацдарму для реалізації взаємних амбіцій епохи холодної війни.

**Ключові слова:** ВРЦ, екуменізм, православ'я, РПЦ, СРСР, християнство.

**Abstract. Andreyev T. Yu. Assembly of the world council of churches in Upsal and the Russian orthodox church.**

The article is devoted to the analysis of the main issues considered during the meeting of the Assembly of the World Council of Churches, which took place in Uppsala in 1968. The view of the problem through the prism of the participation of the Russian Orthodox Church in the ecumenical movement is highlighted. The problem of the ROC's place in the international cultural policy of the USSR is revealed. Emphasis is placed on the importance of the role of the personality of Metropolitan Nikodim (Rotov) in the development of the Russian Orthodox Church in the context of the ecumenical movement.

It is concluded that despite the existing contradictions, the Assembly in the Swedish city of Uppsala was the last example of coordinated cooperation between the Soviet government, the ROC and the WCC. The Assembly adopted a number of decisions, which on the one hand, confirmed the conservative vector of development of the ROC as a religious structure, and outlined the desire for progressive steps as an actor in international relations. This event was one of the key milestones in the development of the youth spectrum in the ecumenical movement in the Soviet Union. The WCC has once again proved to be an effective springboard for the realization of the mutual ambitions of the Cold War era.

**Keywords:** Christianity, ecumenism, orthodoxy. ROC, USSR, WCC.

**General formulation of research and its topicality.** For more than two thousand years of history, Christianity has experienced a lot – there were divisions, unions, periods of prosperity and persecution. One of the relatively recent phenomena in world Christianity, which has caused very mixed reactions from various denominations, not leaving any of them indifferent, which explicates the topicality of

the present work, is the ecumenical movement. Its main postulates were formed during a series of conferences convened on the initiative of Protestant churches: Geneva (1920), Lausanne (1927) and Stockholm (1945). In the context of the idea of universal Christian unity, the World Council of Churches (hereinafter WCC), founded in 1948, plays a key role [1].

In the late 1950s, there was a change in the vector of church policy in the USSR. As a result in 1961 at the General Assembly in New Delhi, the Russian Orthodox Church (hereinafter ROC) officially became a member of the World Council of Churches [2].

**Setting of the problem and the aim of the article.** In the context of the strategy of interaction of the Russian Orthodox Church with the World Council of Churches, each side pursued its own goals. The Moscow Patriarchate, even during its decline, was an influential actor in the Orthodox world, in this regard, the WCC was interested in membership in the ROC, which in turn helped expand the organization's influence on other Orthodox churches around the world, thus making a significant step towards "Christian unity". The USSR viewed the ROC's participation in the WCC as an effective channel for broadcasting its own foreign policy ambitions. For the Russian Orthodox Church itself, participation in the WCC is one of the possible ways to promote the problems of "religious freedom" in the USSR in order to solve them.

The Uppsala Assembly is of interest to researchers as an example of consensus between the positions of the WCC, ROC and the USSR. The author of the study aimed to explore the main provisions of the Assembly of the WCC in Uppsala in 1968, to consider their features and significance for the development of the ecumenical movement.

**Discussion and Results.** The Fourth General Assembly of the World Council of Churches was held in the Swedish city of Uppsala from July 4 to 19, 1968. Representatives of various Christian churches around the world, theologians and public figures, attended it [3, 99].

The delegation of the Russian Orthodox Church included Vasily (Krivoshein),

Filaret (Denisenko), Vladimir (Kotlyarov), Juvenal (Poyarkov), Anthony (Bloom), Vladimir (Sabodan), Melchizedek (Lebedev) and others. In total, the delegation of representatives of the Soviet Union consisted of 35 people.

During the assembly, the head of the delegation, Metropolitan Nikodim (Rotov), delivered a report on the topic: "Orthodox Churches and the Ecumenical Movement". He did not support the idea of syncretism of Christianity with the ideology of Marxism (such a practice was popular among Catholics and Protestants of socialist countries), theology of the "death of God", "Christian atheism" and so on. In his speech to the Assembly, he noted that the dialogue between Marxism and Christianity is nothing but mutual deception. It should be noted that the Soviet authorities did not condemn this position of the bishop [5].

During the work of the Assembly, the USSR authorities lobbied for their own interests aimed at preventing criticism of the topical problems of the socialist countries and of communist ideology in general. The Soviet government used the WRC as a platform to realize its ambitions in the context of the Cold War, primarily by raising issues aimed at undermining the positions of the United States. Thus, during the Assembly, at the initiative of a delegation from the ROC, a special resolution was adopted condemning the introduction of US troops to Vietnam. [3, 170-171]. Discussions on the situation in the Middle East focused on the issue of the Israeli-Arab conflict, but the relevant resolution was never adopted.

Christian organizations from the Soviet Union, such as the Russian Orthodox Church, the All-Union Council of Evangelical Baptists, and the Armenian Church, increased their representation on the Central Committee of the Council from five to nine. For the first time, a representative from the country of the "socialist camp" – Serbian Patriarch Herman – was elected one of the six presidents of the Council.

According to the decision of the Assembly, the number of members of the Central Committee of the WCC was increased to 120 people; priority was given to representatives of the so-called "third world". In the context of the concept of a "bipolar world", representation in the Central Committee and commissions was as follows: 84% belonged to the countries of the "capitalist" camp, and 16% –

"socialist". From the ROC, the Central Committee of the WCC included Metropolitans Nikodim (Rotov), Anthony (Bloom), Volodymyr (Sabodan), Juvenaliy (Poyarkov), Professors Vasily Sarychev and Oleksiy Buevsky.

It should be noted that during the discussions at the commission level, representatives of the ROC were divided into two groups: one aimed at discussing "ecumenical issues" (within the commission "Faith and Church Order"), the other - on political issues, in this sense the emphasis was made for backstage conversations.

The Assembly could not ignore the issue of cooperation between the Orthodox Church and the Vatican, one of the goals of actualizing this problem was the desire to strengthen the integration of the Catholic Church in the structure of the WCC [6].

For the first time, church youth were involved in the work of the Assembly in Uppsala: members of theological institutions from the USSR, one of whom was the current head of the Moscow Patriarchate Kirill (Gundyaev) [7]. This event was one of the key milestones in the development of the youth spectrum in the ecumenical movement in the Soviet Union.

One of the main achievements of the General Assembly of the WCC in 1968 was the condemnation of the concept of "Christian-centrism" in the system of interreligious cooperation. In the interpretation of the concept of "ecumenism" made adjustments, it began to understand not only the Christian world but also humanity as a whole. Humanistic principles were proclaimed the main postulates of the organization, and countering the global problems of mankind – one of the general strategies of action. Thus, the assembly in Uppsala condemned racism began to create a program to combat this problem [3, p. 192, 269].

Issues related to the levelling of dogmatic differences between different Christian denominations on the way to the goal of "universal Christian unity" were also discussed. Among such forms, "intercommunion" (communion) was proposed. However, the ROC delegation objected, noting that the sacrament in this format can be performed only with "unity in the understanding of the confession of faith" [8].

On July 30, 1968, at a meeting of the Holy Synod of the Russian Orthodox Church, Metropolitan Nikodim (Rotov) delivered a report on the work and results of

the Fourth Assembly of the World Council of Churches. As a result, the Soviet leadership was satisfied with the results of the Assembly. After all, thanks to the activities of representatives of the ROC, it was possible not only to condemn the aggressive foreign policy of the United States, but also to oppose in every possible way the election of representatives of countries "unfavorable to the USSR" to key positions.

**Conclusions.** The Assembly in the Swedish city of Uppsala was the last example of coordinated cooperation between the Soviet government, the ROC and the WCC. The destruction of the idyll was influenced, among other things, by the events in Czechoslovakia, which went down in history as the Prague Spring, which culminated in the introduction of the Warsaw Pact troops in August 1968. The Assembly adopted a number of decisions that determined further trends in the development of the ecumenical movement, identified vectors for the development of both the WCC and the USSR's foreign cultural policy, and the Russian Orthodox Church proved to be an influential actor in international relations.

## References

1. Report of The First Assembly of the World Council of Churches. Held at Amsterdam, August 22nd to September 4th. URL: <https://archive.org/details/wcca5/page/n5/mode/2up> (date of the application: 08.12.2020).
2. The New Delhi Report. The Third Assembly of the World Council of Churches. URL: <https://archive.org/details/wcca11> (date of the application: 08.12.2020).
3. The Uppsala Report 1968. Official report of the Fourth Assembly of the World Council of Churches. Uppsala, July 4th-20th 1968. P. 519.
4. Unity of mankind. Speeches from the 4th Assembly of the WCC, Uppsala 1968, ed. Albert H. van den Heuvel. G.: WCC. 1969; ЦиВ. 1998. № 4 (7). C. 39-54.
5. Metr. Nikodim (Rotov). Slovo za bogosluženiem na plenarnom sobranii uchastnikov IV General'noj Assamblei VSC [Worship Service final say at the plenary meeting of the participants of the IV General Assembly, 5 July 1968]. *Zhurnal Moskovskoj Patriarhii*, № 9, 55-57 (in Russian).
6. Kleman, O. Roma Amor. Besedy s patriarchom Afinagorom [Conversations with the patriarch Afinagor] (1993). Brussels: Prisme Editions.
7. *Zhurnal Moskovskoj Patriarhii (Moscow Patriarchy Journal)* (2016). № 12, 60-73 (in Russian).
8. Metr. Antonij Surozhskij (1968). O bogosluženii i stile hristianskoj zhizni (mysli uchastnika IV Assamblei Vsemirnogo Soveta Cerkvej) [About worshipping and the style of Christian life (ideas of a participant of the IV Assembly of the World Council of Churches)]. *Zhurnal Moskovskoj Patriarhii*, № 9, 67-72.

## **GENDER MAINSTREAMING – SWEDISH SUCCESS STORY FOR EUROPEAN POLICY-MAKERS AND UKRAINE**

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**Анотація. Биканова Д. О. Гендерний мейнстримінг – шведський успішний досвід  
для європейських директивних органів та України.**

Дана робота присвячена аналізу успіху, що його мав гендерний мейнстримінг у Швеції та чи доречно, чи можливо застосувати його в Україні, в її сучасних обставинах, враховуючи її відповідні інтереси і потреби. Автор розпочинає свій розсуд з визначення гендерного мейнстримінгу як такого, посилаючись на офіційні публікації органів ЄС, після чого переходить до стислого викладу історії впровадження даної стратегії у Швеції. Далі надається огляд більш практичних даних, такі як конкретні інструменти та методи, застосовані шведським урядом, а також статистичні підтвердження їх ефективності. Звідти дискусія переходить до України, і автор представляє аргументи на користь наслідування шведського прикладу.

**Ключові слова:** гендерний мейнстримінг, гендерна представленість, політика з урахуванням гендерної проблематики, гендерна статистика, гендерне бюджетування

**Abstract. Bykanova D.O. Gender mainstreaming – Swedish success story for European policy-makers and Ukraine.**

This work is dedicated to analyzing the success of gender mainstreaming in Sweden and whether it should and could be replicated in Ukraine, given its current circumstances, interests and needs. The author begins by defining gender mainstreaming as is, referencing official EU publications and proceeds to briefly map out the history of how gender mainstreaming was first introduced in Sweden. Further, more practical data is overviewed – specific tools and methods implemented by the Swedish government, as well as statistical evidence of their efficiency are discussed. From there the discussion shifts toward Ukraine, arguments for following the Swedish example are presented.

**Key words:** gender mainstreaming, gender representation, gender-responsive content, gender statistics, gender-budgeting

**General formulation of research and its topicality.** Gender mainstreaming has been a subject of international academic research since the early 2000s, one of the most characteristic features of such research being its diversity. Among the fields of knowledge, the point of view of which gender mainstreaming has been studied from are, first and foremost, gender studies (transcending biology, sociology, economics et al.), management theory, climate studies, European studies; the most prominent works being *Gender mainstreaming in theory and practice* by M. Daly, *Diversity management and gender mainstreaming as technologies of government* by E. Prügl, *Gender mainstreaming and climate change* by M. Alston, *Mainstreaming gender in the European Union* by M. A. Pollack and E. Hafner-Burton etc. However, one aspect of gender mainstreaming research that seems yet to be explored by scholars is case-studying, which is precisely what the present article seeks to contribute.

The present research should be considered **relevant** due to a number of factors, namely the national strategy of European integration adopted by Ukraine, as well as its progressive stance regarding gender equality and women' rights, in line with its regional and universal international legal commitments.

**Setting of the problem and the aim of the article.** The present paper is an attempt to resolve the **research problem** of how positive outcomes of gender mainstreaming in Sweden affect Ukrainian policy.

**The object matter** of the present study is international legal relations in the area of the Ukrainian legal system adaptation to *acquis communautaire*, and **the subject matter** – Swedish gender mainstreaming policy.

The **objective** of this research is to gain extensive knowledge of the connection between the measurably positive effects of gender mainstreaming in Sweden, as well as evidence to that end, and EU-Ukraine integration processes. In order to accomplish the set objective, we suggest completing the following **tasks**:

To study topical international legal acts in search of a comprehensive definition of gender mainstreaming;

To conduct a comprehensive analysis of gender mainstreaming in Sweden, including its historical, theoretical and practical aspects, so as to determine its basic

characteristics;

To give an overview of various objective data aiming to measure the general efficiency of gender policy in Sweden in order to showcase the positive effects of gender mainstreaming for Sweden's performance;

To offer recommendations as to the potential steps Ukrainian policy-makers could take to implement Swedish experience in gender mainstreaming with consideration of Ukrainian national interests and strategic goals.

The **materials** that have facilitated the present research primarily consist of relevant acts of community and domestic law, along with works of specialists representing various fields of knowledge, including European Union law, international human rights law, statistics and economics.

**Discussion and Results.** We deem appropriate to begin by defining key terms and concepts. The European Commission describes gender mainstreaming in the following way: “Gender mainstreaming is the integration of the gender perspective into every stage of policy processes – design, implementation, monitoring and evaluation – with a view to promoting equality between women and men. It means assessing how policies impact on the life and position of both women and men – and taking responsibility to re-address them if necessary” [1]. In its essence, gender mainstreaming (GM) is a distinctively dual concept. This can be seen clearly, for instance, in the European Institute for Gender Equality publications; moreover, this point is purposely emphasized by the EIGE and other EU institutions: “[Gender mainstreaming] requires both integrating a gender perspective to the content of the different policies, and addressing the issue of representation of women and men in the given policy area. Both dimensions – gender representation and gender responsive content – need to be taken into consideration in all phases of the policy-making process” [2].

In order to understand the country-specific focus of the present study, a brief overview of the introduction and implementation of GM in Sweden shall be given. Speaking of Sweden as one of the most evident success stories when it comes to proper implementation of policies aimed at achieving gender equality, and the effects

it has on a particular society or social group; – the use of gender mainstreaming as a strategy to reach the goals declared for Swedish gender equality policy notably dates back to 1994 [3], while globally, GM became recognized in 1995 at the UN's Fourth World Conference on Women in Beijing [4].

The right to gender equality had already been recognised in Swedish law at that point (e.g. The Constitution of Sweden Art. 2), but following the gender mainstreaming decision, it became integrated into the regular and daily work in all policy areas. Gender equality was identified as an overarching perspective and all ministers were instructed to promote it in their respective policy areas.

Gender mainstreaming in Sweden takes place at many different levels: national, government agencies, county councils (Swed. *landsting*), municipalities (Swed. *kommuner*) etc., despite the lack of a legal obligation in this respect. There is a de facto binding government decision regarding gender mainstreaming, impact assessment and gender budgeting [5] and the government in power decides the extent to which gender mainstreaming and gender budgeting will be implemented [6].

Overall, Sweden uses a variety of methods and tools to mainstream gender. These include gender budgeting (gender-sensitive budgeting), training and awareness-raising, gender statistics et al [7].

In terms of evidence to support the statement above suggesting the efficiency with which these tools and methods have been used by the Swedish government, there are several problematic aspects. Firstly, GM already being a section of a general gender equality policy, nonetheless, its nature dictates for it to cover a significantly broad spectrum of public policy; which makes it challenging to make an assessment based on any one given metric. Secondly, any attempt to assess the efficiency of a government policy ultimately studies a collective human experience as a compilation of individual experiences; and therefore it is arguable to which extent something as subjective can be objectively examined and systemized, if at all.

Considering that in the present paper the Swedish takes on GM constituting a good practice is treated as a given rather than a thesis to be argued, it is hence acceptable to use a complex but inevitably generalized metric; such as the Gender

Equality Index, a tool to measure the progress of gender equality in the EU, developed by EIGE. With 83.6 out of 100 points, Sweden ranked first in the EU on the Gender Equality Index in 2019. Between 2005 and 2017, Sweden's score increased by 4.8 points (+ 1 point since 2015) and it is 16.2 points above the EU's score [8]. Despite slower progress towards gender equality than other EU Member States, Sweden has maintained its rank since 2005, consistently claiming the title of one of the most gender-equal societies.

All in all, the relevant statistical data combined with GM being the main strategy of the Swedish government in terms of gender equality policy, lead us to conclude that the Swedish approach can and should be studied by other EU and non-EU countries, and implemented whenever and wherever it corresponds to particular national needs of said countries.

How do these conclusions apply to Ukrainian reality? Having set out on a path to Euro- integration, Ukraine inherently is subject to influence from prevalent EU policies and good practices, aside from the more visible processes of incorporating *acquis communautaire* into the Ukrainian legal system, adaptation to European systems of standardization etc. Along with Ukraine's international human rights commitments and a definitive gender equality agenda set in its Constitution (Art. 24), it only makes sense to implement the gender mainstreaming strategy using the Swedish precedent as a blueprint for reasons of effort optimization.

Currently, Ukraine is at the beginning stage of introducing GM, which involves the adoption of acts which put the relevant strategy and objectives in place, as well as programmes, frameworks and other documents of a declarative nature [9] [10] [11]. These steps are necessary, though not substantial, and having traced the first acts of this sort back to 2015 we would like to state that the beginning stage measures have been long taken and is time to move on to actual policy-making, or policy-reviewing.

**Conclusions.** To conclude, it firstly should be stated that GM in Sweden has objectively shown positive results in terms of improving gender equality, one of the most significant of them being its intersectionality. Secondly, Ukraine cannot be immune to these good practices, both functionally and substantially, due to its own

national interests and the fact that its governance is already partly subject to common EU policies. Lastly, having established that introduction of GM in Ukraine is destined to happen, it would be a loss of opportunity to showcase good governance not to extract and implement lessons from the Swedish success story.

## References

1. Gender Equality. *European Commission* : website. URL: [http://ec.europa.eu/justice/gender-equality/tools/index\\_en.htm](http://ec.europa.eu/justice/gender-equality/tools/index_en.htm) (last accessed: 21.12.2020).
2. What is Gender Mainstreaming. *European Institute for Gender Equality* : website. URL: <https://eige.europa.eu/gender-mainstreaming/what-is-gender-mainstreaming> (last accessed: 21.12.2020).
3. Gender Mainstreaming. *Swedish Gender Equality Agency* : website. URL: <https://www.jamstalldhetsmyndigheten.se/en/gender-mainstreaming/gender-mainstreaming> (last accessed: 21.12.2020).
4. UN System Coordination: Gender Mainstreaming. *UN Women* : website. URL: <https://www.unwomen.org/en/how-we-work/un-system-coordination/gender-mainstreaming> (last accessed: 21.12.2020).
5. Gender Equality in Public Services. *Ministry of Health and Social Affairs* : website. URL: [https://www.government.se/49b730/contentassets/3d89b0f447\\_ec43a4b3179c4a22c370e8/gender-equality-in-public-services-sou-200715](https://www.government.se/49b730/contentassets/3d89b0f447_ec43a4b3179c4a22c370e8/gender-equality-in-public-services-sou-200715) (last accessed: 21.12.2020).
6. Gender-responsive budgeting. *Government Offices* : website. URL: <http://www.government.se/articles/2015/11/gender-responsive-budgeting/> (last accessed: 21.12.2020).
7. Gender Mainstreaming: Country Specific Information: Sweden. *European Institute for Gender Equality* : website. URL: <https://eige.europa.eu/gender-mainstreaming/countries/sweden> (last accessed: 21.12.2020).
8. Gender Equality Index. *European Institute for Gender Equality* : website. URL: <https://eige.europa.eu/gender-equality-index/2019/SE> (last accessed: 21.12.2020).
9. Ministerstvo Sotsialnoi Polityky Ukrayny. Nakaz № 86. (07.02.2020). URL: <https://www.msp.gov.ua/documents/5674.html> (last accessed: 21.12.2020).
10. Ministerstvo Sotsialnoi Polityky Ukrayny. Nakaz № 87. (07.02.2020). URL: <https://www.msp.gov.ua/documents/5638.html> (last accessed: 21.12.2020).
11. Ukaz Prezydenta Ukrayny № 501/2015. (25.08.2015). URL: <http://zakon5.rada.gov.ua/laws/show/501/2015> (last accessed: 21.12.2020)

УДК 355.48.014(100)»1939/1945»

## VICTORY OF WESTERN ALLIES OVER THIRD REICH

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**Анотація. Чегринець С.В. Перемога західних союзників над Третім Рейхом.**

Дослідження ролі різних країн у перемозі над Третім Рейхом у Другій світовій війні є актуальним до сих пір. Сьогодні у різних країнах світу йдуть активні суперечки про значення Західних союзників у Другій світовій війні проти Німеччини. Стаття аналізує внесок Західних Союзників (США, Британської імперії, Франції) у перемозі над Нацисткою Німеччиною. Дослідження зусиль, зроблених Західними країнами для перемоги у Другій світовій війні, показали що вони були значними. У даній статті розглянута економічна, військова, технологічна та стратегічна боротьба США, Британської імперії та Франції проти Третього Рейху. Події 1939-1945 рр. продемонстрували той факт, що США та Британська імперія набагато переважали за економічними показниками Німеччину та ефективноскористалися цією перевагою. При розгляді подій Другої світової війни стає зрозумілим, що Західні союзники вдало скооперували свої армії для розгрому німецьких збройних сил, підірвали здатність Німеччини вести війну, а Західний фронт був одним з найважливіших у Другій світовій. Як показує історія, використання наукового потенціалу і створення нової зброї для перемоги ніколи не буває зайвим, і союзники протягом війни активно вдало розробляли нову зброю і готовалися застосувати її проти Німеччини. У статті проаналізовано значення цих подій у Другій світовій війні у Європі. У статті встановлено, що ігнорування або применшення ролі США, Британської імперії та Франції у перемозі над Третім Рейхом Гітлера у Другій світовій війні є неприпустимим.

**Ключові слова:** економічний потенціал, Західний фронт, Західні союзники, Нормандська операція, Третій Рейх.

**Abstract. Chehrynets S.V. Victory of western allies over Third Reich.**

The study of the role of different countries in the victory over the Third Reich in World War II is still relevant today. Today there are active debates around the world about the importance of the Western Allies in World War II against Germany. The article analyzes the contribution of the Western Allies (USA, British Empire, France) in the victory over Nazi Germany. Studies of the efforts made by Western countries to win World War II have shown that they have been significant. This article examines the economic, military, technological and strategic struggle of the United States, the British Empire and France against the Third Reich. The events of 1939-1945 demonstrated the fact that the United States and the British Empire far outnumbered Germany in economic terms and effectively took advantage of this. Considering the events of World War II, it is clear that the Western Allies successfully cooperated with their armies to defeat the German armed

forces, undermined Germany's ability to wage war, and the Western Front was one of the most important in World War II. As history shows, the use of scientific potential and the creation of new weapons for victory are never superfluous, and the Allies during the war actively successfully developed new weapons and prepared to use them against Germany. The article analyzes the significance of these events in the Second World War in Europe. The article finds that ignoring or downplaying the role of the United States, the British Empire, and France in defeating Hitler's Third Reich in World War II is unacceptable.

**Key words:** economic potential, Normandy operation, Third Reich, Western Allies, Western front.

**General formulation of research and its topicality:** World War II was the bloodiest war in human history. It was started by Adolf Hitler's totalitarian Nazi Germany. The very ideology of Nazism during the Nuremberg Trials of 1946 was condemned for horrific crimes and the outbreak of war and is still perceived as "absolute evil." Accordingly, after the war, various countries of the Anti-Hitler coalition tried to exaggerate their contribution to the victory over Germany as an "absolute evil" and downplay the contribution of other countries. As a result, various scientific works were created that reduced the role of the Western Allies in defeating the Third Reich. It is often said that it was the Soviet Union that defeated Germany and the Western Allies were sided. Today, such allegations are common even in Western countries. Accordingly, the need for an objective study of the Western Allies' contribution to the victory over the Third Reich is still relevant today.

Among the most famous works is the book "Day D" by the American historian Stephen Ambrose. In this book the author described the events of Operation Normandy and analyzed the distribution of forces in Europe during World War II. Western historiography mainly recounts the events of World War II. Another important book is «The Battle of the Atlantic and the Mediterranean 1939-1945» by Soviet researcher Vladimir Belli in 1967. In this book the author considers about the sea war of the Western Allies against Germany, and points out that only the USSR was the main enemy of the Third Reich. Soviet historiography has always argued that the opening of the Western Front only in 1944 was almost a crime of the Western

Allies and their betrayal of the USSR. The United States and the British Empire were presented selfish. Modern Russian historiography is not so categorical. The well-known Russian historian Oleg Rzheshevsky tried to consider this contribution of the Western Allies as objectively as possible and considered the cooperation of the USA, the USSR and the British Empire.

**Setting of problem and the aim of the article:** **Object-matter:** the victory of the Western Allies over the Third Reich. **Subject-matter:** the role and contribution of the Western Allies to the victory over the Third Reich. **Purpose:** to analyze the victory of the Western Allies over the Third Reich.

**Tasks:**

1. To explore the role of the Western Front in World War II;
2. To identify the importance of Normandy operation;
3. To point out the Western Allies 'military tactics and use their advantages over the Third Reich.

Materials: historiography's of Stephen Ambrose, Mark Harrison and printed editions Dwight Eisenhower, Winston Churchill. **Actuality:** comprehensive reflection of the economic, military, tactical and technological contribution of the Western Allies to the victory over Germany. **The theoretical and practical significance** of the article lies in the fact that it departed from the measurement of the contribution to victory in "numbers" and considered the economy, military strategy and tactics used by the Western Allies. **Prospects of the analysis:** it will be important to compare this contribution with the contribution of the USSR in the victory over Germany, but using not "numbers", but military strategy, economy and technology development.

**Experiential outcomes:** As the history of World War II has shown, the economic contribution of the Western Allies to the victory over Germany was significant. This world war was a total war. One cannot but agree that in a total war the possibility of winning strongly depends on how much the country's industry can produce military products. The economic and industrial potential of the United States and the British Empire was dominated by the German. The Western Allies had all the

conditions to produce military equipment quickly and in large numbers. The advantage of this was that it made it possible to compensate for the losses in the war quickly. As the analysis sources of the Second World War shows, in a protracted conflict, in a war of attrition, the key is the ability of the economy to survive this war.

Every historian agrees that in World War II, the Western Allies not only fully provided for their own military needs, but also helped all of Germany's enemies. This is also known as a land lease. A separate topic here is the supply of aid to the USSR. The help of the Western Allies of the USSR was great. The Soviet Union received a military equipment, food, medical equipment, medicine and strategic raw materials. Of course, it cannot be said that the USSR fought only at the expense of the Land League, but it is also impossible to reduce the value of this aid [3].

At the same time, a guerrilla movement emerged in German-occupied Europe, which received help from the Western Allies. The most famous of them were the partisans of Yugoslavia, France, Italy, Greece and others. In the armies of the Western Allies, in addition to the Americans, British and French, fought units consisting of Norwegians, Danes, Dutch, Belgians, Poles and others. These military formations also received weapons from the United States and the British Empire.

The study of sources indicates that the activities of the Western Allied armies against Nazi Germany were of great importance. As a rule, those who believe that the contribution of the United States, the British Empire, and France to the victory was insignificant, claim that the opening of the Western Front in 1944 was too late, as if it had no effect on the war, and that the Western Allies had hardly fought before with Germany. In fact, in 1940-1945, the Third Reich actually fought on four fronts. In addition to the Eastern Front, in 1940-1943 Germany was forced to wage hostilities in North Africa, and in 1943-1945 in Italy. At the same time, Germany was forced to keep troops in Normandy and Scandinavia to prevent the invasion of the Western Allies. The fourth front for Germany was, in fact, the constant bombing of its territory by US and British air forces. Of these four German fronts, three are against British, American, and French troops. As historical experience shows, for any country, the war on several fronts is extremely difficult. So we can conclude that the

Western Allies did not allow the Third Reich to transfer all troops to the Eastern Front, against the Soviet Union [1, p 12-24].

At the same time, as Stephen Ambrose noted, in 1943 Hitler considered Bolshevism his enemy, but perceived Western countries as an even greater threat. Hitler was very afraid of the Anglo-American landing on the European continent. In the East, the loss of even a large area of German-occupied space does not pose a mortal threat to Germany's viability. A successful Anglo-American landing would pose a threat to Germany's industrial heart, the Rhine-Ruhr region, which is critical to Germany's military might. The south-east of England was closer to the Ruhr than Berlin. Hitler announced that a decisive battle should take place on the coast of France. Therefore, it was decided to strengthen the defense in the western direction. Hitler believed that if in 1944 he could repel the landing invasion, it would be crucial. First, the Western Allies will need a few more months to carry out the next operation. Second, this failure demoralizes the British and Americans. Third, it will deprive Roosevelt of a chance of re-election and oppress Churchill. After that, Hitler will be able to send 45 divisions from the Western Front against the USSR. Last hope of Hitler was to repel the Anglo-American landing operation [1, p 12-24]. The Normandy operation of 1944 marked the beginning of the liberation of continental Europe and the attack on Germany from the West. It was the largest landing operation of World War II. Its important feature is the large scale and large number of landed troops. Contrary to the misconception that the Western Allies betrayed the USSR and opened the front "when they wanted", this historical fact should be taken into account, this operation was agreed with the USSR during the Tehran Conference in 1943.

Researchers of World War II will agree with the fact that it was the Western Allies who destroyed almost the entire German fleet. Germany was forced to build a large number of submarines to fight the Allied fleet, spending huge resources on it. There is no consensus among historians as to if it were not for the war with the Western Allies, how much military equipment Germany could have created to fight the USSR. No less important is the naval blockade of the Third Reich by the Ally's

Navy. Germany was very dependent on imports of raw materials. A separate story is the bombing of Germany. Anglo-American aircraft carried out a mass bombing of Germany. Years of constant and intense military raids caused terrible damage to the infrastructure of the Third Reich, which in 1944-1945 was almost completely destroyed. Also, part of the German industry was affected, which made it difficult to produce military equipment in Germany. The bombing of Romanian oil fields led to the fact that in mid-1944 the German army had virtually no fuel [5].

The resource of any war clears that without a successfully cooperated military strategy is difficult to win. The Western Allies have shown the world how to work together to win. Western Allies did not like the communist USSR very much, but for the sake of victory they pushed ideological hostility into the background. Speaking of the Allies' successful strategic planning, Dwight Eisenhower said that before opening the Western Front in France, the Western Allies first decided to concentrate forces against the Germans in North Africa, and only then move to Europe. If the Germans had captured the Suez Canal, they would have cut off Great Britain from India and Australia [5]. From this experience of World War II, it is clear that the Western Front was no less important than the Eastern Front, the German bombing and naval blockade undermined the economy of the Third Reich, and during this war the Allies demonstrated effective cooperation for victory.

Few military historians would disagree with the phrase "all means are good in war". During World War II, the Western Allies developed new weapons and cooperated in development. There is one feature by which the Western Allies were ahead of the whole world at that time, and that is the development of nuclear weapons. The United States relied heavily on the development of a nuclear projectile. While Germany paid little attention to its own development of nuclear technology. Although the first nuclear bomb was tested by the United States after the surrender of Germany, it was this weapon that marked the beginning of a new era in military history. Stephen Ambrose argued that if Hitler had been able to repel the Western Allied invasion of Normandy in 1944, then in 1945 Germany would have begun a nuclear bombing. It cannot be denied that the country that would be the first to

develop nuclear weapons would win World War II [1, p 12-24], [4, 357-370].

**Conclusions:** It can be conceded that the Western Allies made a significant contribution to the victory over Germany in World War II. The economy of the United States and the British Empire, which dominated the German, was able to meet its own needs, quickly compensate for losses, and help the USSR, guerrillas, and allied military formations. Virtually the entire German fleet was destroyed by the Western Allies. The Anglo-American bombing severely damaged Germany's ability to fight. The naval blockade has created a shortage of resources in Germany. The Western Front was one of the most important in World War II. The Western Allies have perfectly taught the world a lesson in cooperation for victory. The creation of nuclear weapons by the Allies has forever changed the nature of military conflicts.

## References

1. Ambrose S. E. (1994). D-Day June 6, 1944: The Climactic Battle of World War. — New York: Simon and Schuster.
2. Eisenhower D. (1948). Crusade in Europe. — New York: Doubleday.
3. Mark Harrison, (1998). The Economics of World War II: Six Great Powers in International Comparison, Cambridge University Press.
4. Черчилль У. С. (1998). Вторая мировая война. Москва. Том. 6: TEPPA – Книжный клуб.

УДК 339.138

## TRENDS IN THE DEVELOPMENT OF IDEA MARKETING IN THE WORLD AND UKRAINE

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**Анотація. Чумаков В.П. Тенденції розвитку маркетингу ідей у світі та в сучасній Україні.**

Маркетинг є цінним видом діяльності у сучасному суспільстві. Маркетинг являє собою не лише рекламу, а ще рекламні послуги з продажу. У широкому сенсі маркетингу, він заснований на розумінні, наприклад, середнього бізнес-лідера на ринку по відношенню до його конкурентів. Ще однією важливою ціллю маркетингу є те, щоб підприємство розглядало перспективні частини ринку. Як правило, маркетинг ідей знаходиться в тісному зв'язку з соціально зацікавленими людьми.

**Ключові слова:** маркетинг, благодійність, соціальні проекти, ідеї.

**Abstract. Chumakov V.P. Trends in the development of idea marketing in the world and Ukraine.**

Marketing is a valuable activity in modern society. Marketing is not only advertising, but also advertising sales services. In the broad sense of marketing, it is based on the understanding of, for example, the average business leader in the market in relation to its competitors. Another important goal of marketing is for the company to consider promising market shares. As a rule, the marketing of ideas is closely connected with socially interested people.

**Keywords:** marketing, charity, social projects, ideas.

**General formulation of research and its topicality.**

The relevance of the research topic is associated with the active pace of development of Internet technologies and marketing of ideas, which caused strong changes in the system of social entrepreneurship.

Social marketing is a very voluminous sphere of influence on society. Marketing ideas, as a rule, carries important tasks for society: increasing the level of social responsibility, protecting the environment, taking care of one's own health, and much more [1].

The relevance of the topic has acquired enormous proportions and in the article you can find the marketing ideas of the companies of the giants.

Idea marketing, or social marketing is the process of developing, implementing and monitoring the implementation of targeted programs aimed at the perception of the target group of a public idea, movement or practice.

To achieve the maximum appropriate response of this group in the process of social marketing the necessary measures such as market sharing, consumer analysis, thought development, communication, techniques to facilitate assimilation, incentives to use techniques in the theory of exchange are needed. Idea marketing can pursue a variety of goals [3].

As a rule, the marketing of ideas is closely related to the promotion of socially important ideas to the masses, such as environmental protection, combating bad habits (smoking, drug addiction, alcohol use, etc.)

Public marketing goes beyond advertising with appeals to the public, as it coordinates the efforts of advertising and all other components of the marketing mix. The figure of public marketing formulates the purposes of social changes, analyzes consumer relations and factors of competitive counteraction, develops and tests variants of the plan.

The meaning of social marketing is a significant expansion of the scope of marketing activities. Its subject is not only the market but also socio-political activities [2].

The object-matter is marketing campaigns of world-renowned giant companies such as Starbucks, Uber and others.

The subject-matter is the functional, subject-specific and communicative-strategic aspects of these marketing campaigns.

**The aim of this article** is to study the specifics of using marketing to increase the level of social responsibility.

**The tasks** of this paper are to reveal the historical and technological aspects of the formation of marketing ideas and marketing in general; to form a theoretical understanding of the functions of marketing ideas; to identify thematic features of marketing campaigns.

The theoretical significance of the research results in the article lies in the fact that they contribute to the development of marketing ideas for small and medium-sized businesses using the example of giant companies. The practical significance of the study lies in the possibility of using its results in the practice of building marketing campaigns in Ukraine using the example of world-famous large companies.

The research perspectives are based on the idea that social marketing contributes to an increase in the level of civic responsibility among the population [2].

**Discussion and Results.** In the USA, 42% of buyers are willing to overpay for the products of companies that invest in social projects and the environment. Increased attention to social responsibility is a new trend in marketing. In this article

you will also learn about how social marketing world-famous companies such as Uber, Starbucks, Jetblue operating and what it ultimately brought them [4].

*Consider the company UberGIVING.*

In September 2016, in the midst of the European migration crisis, Uber became involved in charity. From the profits they earn on their application, they have allocated several million dollars for financial assistance. For example, Uber supplies blankets and clothing for UK children (mostly refugee families) through local charity partners.

For 80 hours of the special promotion, Uber has collected 2,800 private donations from its subscribers, which fit in 10 transport containers! To promote UberGIVING, the company used bloggers, email marketing and social networks.

Highlights:

- Uber allows passengers to do something important for themselves.
- The company creates pleasant memories of the act of kindness shared with the brand and encourages participants to talk about it.
- The company covered 46 European cities without media participation.

*Starbucks.*

Starbucks notifies you via email about seasonal specialties, menu updates, special offers. One of the stunning examples of brand marketing is in this letter: "British Starbucks works with the Neighborly platform: it donates 5 cents to sell each drink to local charities. As a result, they receive 500-1,000 pounds. Success is especially noticeable during the holidays, when the menu, interior decorations, etc. are updated with seasonal changes. " [4]

This is a simple and effective example of social marketing. Starbucks has also launched a major \$ 29 million charity campaign to educate young people, provide access to clean drinking water in Africa and support the tea and coffee communities.

*As for the company JetBlue.*

Since 2011, the low-budget American airline JetBlue, together with Random House and the non-profit organization FirstBook, has launched a campaign "Read in the clouds." These are books for children from poor areas. At present, the amount of

donations is more than \$ 1.75 million. Many free books are received by children through school vending machines. JetBlue also runs a volunteer program for staff. Community Connection allows crew members to donate one round-trip ticket to a charity in 25 hours.

Idea marketing or social marketing is the case when you achieve great results in a short time. Literally a few days and the audience's opinion about the brand can be very "warming". Learn from these examples, do good and benefit.

**Conclusions.** Marketing affects people lives greatly every day. It is a process in which goods and services that provide a certain standard of living are developed and became available to people.

Marketing includes many different activities, such as marketing research, product development, distribution, pricing, advertising and personal selling. Marketing combines several activities aimed at identifying, serving, meeting consumer needs to address the goals of the organization.

Idea marketing is a great opportunity for entrepreneurs and for common people. This work has considered marketing ideas from only one side, but there are a whole bunch of varieties. Startups are very popular now, especially among students, and it is also the embodiment of marketing ideas. Marketing ideas can bring in a good income, as we discussed above. But it can also be useless.

Marketing is a type of human activity aimed at meeting needs through exchange. The basic concepts of marketing are needs, requirements, inquiries, goods, agreements, exchange and market.

## References

1. Entsiklopediya po ekonomike [encyclopedia of economics]. Available at: <https://economy-ru.info/index/>.
2. Moroz L.A., Chuhray N.I. (2000). *Marketing*. [Marketing]. Lviv:National university “Lvivska politechnika”. Available at: <https://clck.ru/SirgL> .
3. Kosenko O.P. (2018). *Marketyngova diyalnist pidpryyemstv*. [Marketing activities of enterprises]. Kharkiv:National Technical University – «Kharkiv Polytechnic Institute». Available at: <https://cutt.ly/2jxfeWf> .
4. Reshetilova T.B. , Dovgan S.M. (2015). *Marketingovi doslidzhennya*. [Marketing researchers]. Available at: [http://www.dut.edu.ua/uploads/l\\_1232\\_18873350.pdf](http://www.dut.edu.ua/uploads/l_1232_18873350.pdf)

## CONSTRUCTING A SOCIALITY THROUGH THE INNOVATION TECHNOLOGIES: MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

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**Анотація. Даниленко А.М. Конструювання соціальної реальності за допомогою нових технологій: машинне навчання та штучний інтелект.**

Головною метою роботи є визначення методології дослідження механізмів конструювання соціального у взаємодії «людина-програмне забезпечення». Таким чином, у першій частині статті розглядаються класичні соціологічні теорії конструювання соціального (Бергер та Лукман, Г. Гарфінкель, Дж.Г. Мід) та визначаються первинні емпіричні об'єкти для подальшого дослідження. Друга частина статті присвячена системному аналізу зовнішньої середи програмного забезпечення у питанні механізмів конструювання соціальної реальності за допомогою новітніх підходів кінця ХХ – початку ХХІ століття. Були включені в аналіз концепція об'єктно-централізованої соціальноті Карін Кнорр-Цетінної та акторно-мережевої теорії Джона Ло. Основними висновками є визначення того, що проблема роботи повинна аналізуватись у фреймі соціології знання/соціології інформаційного суспільства, що відкриває нам уявлення про те, чому експерти — це домінуючий образ сучасного суспільства та як конструюється цей образ за допомогою технологій машинного навчання та штучного інтелекту в умовах нескінченних інформаційних потоків.

**Ключові слова:** акторно-мережева теорія, взаємодія «людина-програмне забезпечення», влада експертів, конструювання соціального, машинне навчання, об'єктно-централізована соціальність.

**Abstract. Danylenko A.M. Constructing a sociality through the innovation technologies: machine learning and artificial intelligence.**

As the title implies the article describes the most suitable methodology in investigating mechanisms of constructing a sociality in case of interaction «person - software». The paper also deals with the classical sociological theories of social construction (Berger and Lukman, G. Garfinkel, J. G. Mead). Primary empirical objects are identified for the further research. Much attention is given to the newest sociological approaches of the late XX - early XXI centuries applying to the problem of constructing the social reality through the software algorithms. The research analyzes the concepts of object-centred sociality founded by Karin Knorr-Cetina.

Recommendations are made to investigate constructing a sociality through the innovation technologies in the framework of sociology of information society. Attention is drawn to the role of experts in modern society and how it is constructed through Machine Learning and Artificial Intelligence technologies.

**Key words:** actor-network theory, construction of sociality, expert authority, interaction «person-software», Machine Learning, object-centered sociality.

**General formulation of research and its topicality.** On the same track with the development of society we can observe how technology is being implemented in human life: at home, at work, at school, in supermarkets, at administrative services centers, people are increasingly interacting with new technologies (IT). One of the most significant and most developed technologies is Machine Learning (ML) and Artificial Intelligence (AI) which helps people automate everyday life and spend less time on certain life operations. ML and AI are sensible when the person who models the software has enough information (data expressed in quantitative and qualitative changes). How does data collection work? Usually, a person who interacts with a machine leaves so-called "digital footprints". What are digital footprints? According to Seth Stevens-Davidowitz, one of the Data Science experts, this is data about search queries in such systems as Google (verbal expressions, frequency of queries, the number of such queries, etc.) [8, p. 10], data on people's satisfaction with the interface, program/website content, which can sometimes be accompanied by visual data (emotionality, micro expression). Digital footprints can also include posts, comments, likes/dislikes in social media, belonging to specific social group, people's connections in the network space. Further, this information is aggregated in data warehouses, analyzed by analysts and transmitted to computer engineers for further development of behavioral patterns of system users. And the final stage, the most interesting in this line of work, is the use of data about human behavior (through digital footprints, which may not be noticed by the subject himself) for further design and influence on this behavior.

**Setting of the problem and the aim of the article.** The problem is the lack of sociological research (and as a result of methodological approaches) on the

construction of the social in the interaction between people and computer systems. The main goal is to identify methodological approaches that are the most effective for further identification of social construction models using new technologies (Machine Learning, Artificial Intelligence). The tasks are setted in such way:

1. To examine the notion of "constructing the sociality" through classical sociological theories (Berger and Lukman, etnomethodology by Garfinkel, symbolic interactionism by Mind) in the context of the claimed theme;
2. To examine the notion of "constructing the sociality" through the range of sociological theories of the late 20th and early 21st centuries, in the context of the problem posed;
3. To draw conclusions on the efficiency of methodological approaches in the investigating of the problem.

The global question of this paper is what are the mechanisms and algorithms of constructing the sociality through the interaction of people with computer systems (software)? And the additional questions are formulated in such way: what are the symbols/rituals/myths of the human-human and human-software interaction? What types of data can help us to identify strategies and algorithms for constructing the sociality through the interaction of people with computer systems (software)?

In order to give a scientific, sociological "life" to these questions, we must consider the classical and neoclassical approaches to the construction of the sociality in general.

**Discussion and Results.** Before we start the conceptualization, let us first demonstrate what concepts exist in our system. We will illustrate this with the help of such tool as a mind map, and then we will describe each of these elements and their connection in succession.

The construction of the sociality takes place through interaction/communication between social interaction actors (fig.1).

Can a machine be a full social actor if it has a machine code that runs a series of algorithms of interaction with the user?

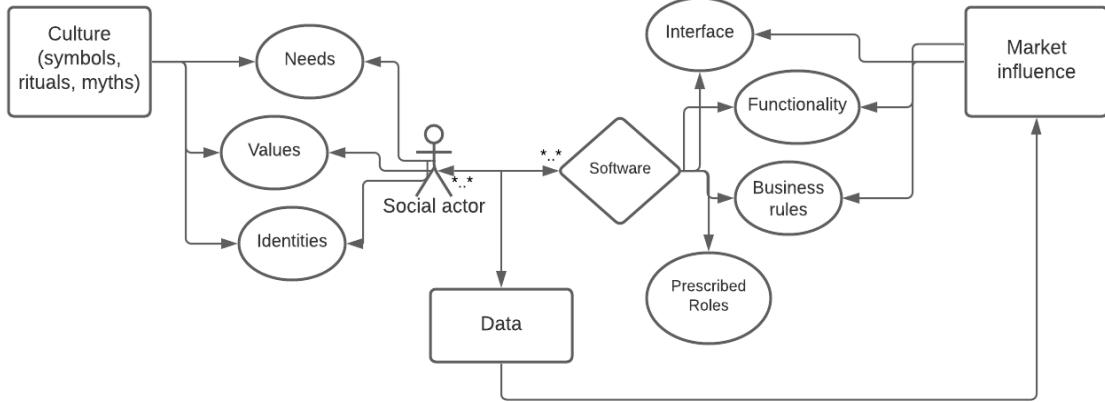


Fig. 1. Scheme of the main work objects and their interconnection (without a conceptualization)

And this interaction is constantly being trained by collecting the necessary data about the user's behavior and processing it with the help of machine-learning and piece-by-piece intell-tecnology. If we assume that a machine with such algorithm interacts only with one user, then such a machine becomes a mirror reflection of actor "X's" needs. But what if the machine interacts with thousands of such actors? It analyzes and adapts to conditions in such a way as to maximize business profits or implement the popularization of the idea (if it is not a commercial project). Based on this thought, the software, analyzing the purchase of data, creates its own order, its own user flow, which leads to the training of this user.

Let us look at the ideas of Berger and Lukman concerning the construction of social reality. The ideas of these theorists can be classified as a macrosociological, institutional approach in sociology. The main component in the work of Berger and Lukman is language. Language, as that which makes up knowledge in the social world. Language is not only about words, but also about symbols (symbolic meanings that are expressed in language), rituals (the language of body movements or the language of social action), myths, which are also composed of language units. Berger and Lukman take the idea of L. Wittgenstein as the basis, which has the following sense: the limits of our perception of the world are determined by the very language that we speak and negotiate with. What is the language in the interaction

between people and software? First of all, verbal information that helps the user to understand the functions provided by the system. This can be for example the phrase "Login" or "Logout", "Sing in" on the first page of the website. But these are only the names of the buttons of the interface. The interface itself also has a certain design, which also takes part in the struggle for domination in the space of symbolic struggle. Not everything that the user sees has an impact on him. There are also non-functional features of the system, which sometimes unknowingly influence our perception. This includes the speed of loading the web page, the content, the look of the news page, and most importantly, the rules for updating and submitting content, which are laid down in the ML and AI system. Moreover, all these components are the basis for the synergistic effect of the rules, which are followed by the user when interacting with the system.

One of the fundamental sociologists of symbolic interactionism is George Herbert Mead. He acts in the framework of behaviorism and as a result considers social reality and its construction through the activation of the "stimulus-response" lancet. But Mead concentrates our attention more on the structure of a single social actor in order to explain how the whole functions. Moving from a purely theoretical context to a problematic situation where a system user interacts with this system, he cannot put himself at the place of this software, because, as noted above, this type of interaction has a different rule, not a healthy moon, but magical performance of certain functions, which cover the needs of the user. Hypothetically, it can be noted that the user can think that the system is built for an "ideal user" and adapt according to the rules set by the machine. With such ignorance, the corridor will be more likely to perceive the given rules as healthy, because the interaction "human-software" is successful for the corridor - his basic need/request is successfully satisfied.

The value of ethnomethodology lies in the detailed study of language practices in the everyday interaction of social actors, which are based on the background expectations of these actors of interaction. Also, the analysis includes such parameters as context [6, p. 379-424]. Under what conditions and social situations do practices acquire the character of a healthy relationship, and under what conditions

can these practices themselves cause a violation of background expectations?

One of the new sociological theories, as was mentioned above, is the transition to a speech-centered approach, i.e. the view of speech as complete objects of social reality creation and social relations. To be more understandable, object-centered sociality is found in the concept of knowledge society. And knowledge is regarded as the main resource of existential security in modern society. The author's concept is the so-called "information society complex". The volume of information in many spheres of human life grows at a certain rate (it should be noted that there is a myth that knowledge is growing in geometric progression, but this law does not work universally). At the time when people learn "here and now," a new view of these or other things is created in the world, which replaces the knowledge that people know now. The key parameter of an expert's status is not the volume of information that he/she possesses, but the ability to structure the information space by selecting what the expert considers to be the most important knowledge. Nowadays it seems to be a closed circle. But logically we come to the idea that the expert's image is socially constructed.

The central point of the actor-centered approach is relativism of the object/actor that exists. Relativism takes place in two spaces (it should be noted that they are not mutually exclusive):

- 1.Ecclesiastical space
- 2.Merge space, which is what sets the context of the integrity [7, p. 134-149].

The emphasis is placed on the homeomorphism of objects/actors of social relations, which requires equality of opportunities in the social space.

More attention should be paid to how expert knowledge is structured, who is the center (benchmark) of this knowledge, how is the scaling method used to increase "expertise" in a certain field? For example, it is possible to use the home culture as a mechanism of "belittling" the people of a certain actor or, on the contrary, using the specification mechanism for "localization" of knowledge, thus attributing more value to it than to other knowledge products.

In the construction of the sociality through the new technologies the main focus

is the placement of software (epistemological objects) in a certain sphere in two types of spaces: euclidean and dimensional-symbolic. This can be implemented by means of ranking software (identifying how they are ranked) and decomposition of all software elements that were listed in the first section as empirical indicators of the future research.

**Conclusions.** Thus, in the first section, we examined the classical sociological theories of constructing the social (Berger and Lukman, G. Garfinkel, J.G. Mead) and determined the primary empirical objects for further research:

1. Context definition (the context is taken as the business domain of the website or add-on);
2. Analysis of the rating of websites/documents that belong to a particular business domain and a particular culture (e.g., Ukrainian).
3. Analysis of software interface elements.
4. Roles that are available on the site.
5. Functionality available to the user.
6. Functional composition: what is in the "header" of the resource, what is in the "body", what is at the bottom of the resource/supplement.
7. Design elements.
8. Symbols and descriptions of them, rituals and myths supported by the web resource.

The second section was devoted to the system analysis of the external middle of the program support for the mechanisms of constructing social reality with the help of new approaches of the end of the twentieth century and the beginning of the twenty-first century. The analysis included the concept of object-centered sociality of Knorr-Tsetinna and the actor-mechanism theory of John Law. The main conclusions are that the problem of work should be analyzed in the frame of knowledge sociology/sociology of information society, This opens our understanding of why experts are the dominant image of modern society and how this image is constructed in the conditions of incomplete information flows. How the "complex of information society" is used and the concept of existential security in modernity. Why has the euclidean space ceased to be central in the analysis of social relations and how does it topologically correlate with the measure-symbolic space? To sum up the methodological summary - placing the objects of research in these two spaces to implement the decomposition principle suggested by M. Heidegger for the

"unification" of methods/mechanisms of constructing the social.

## References

1. Giddens, A. (1979) *Central problems in Social Theory: Action, Structure and Contradiction in Social Analysis*. London: Macmillan.
2. Berger, P., and Lukman, T. (1995). *Socyal`noe konstruyrovanye real`nosti: Traktat po socyologyy znannya [The Social Construction of Reality. A Treatise on sociology of Knowledge]*. Moskow: Academia-Centr; Medyum.
3. Bourdieu, P. (2005). *Socyologyya socalnogo prostranstva [sociology of social space]*. St. Petersburg: Aletejya Publ.
4. Law J. (2004) *After Method: Mess in Social Science Research*. New York: Routledge.
5. Knorr-Cetina, K. (1997) Sociality with Objects. Social Relations in Postsocial Knowledge Societies. *Theory, Culture and Society*, 14-4. 1–30.
6. Merton, R.K. (1995) The Thomas Theorem and The Matthew Effect. *Social Forces*, 74 (2). 379–424.
7. Sayes, E. (2014). Actor–Network Theory and methodology: Just what does it mean to say that nonhuman shave agency? *Social Studies of Science*, 44 (1), 134–149.
8. Stephens-Davidowitz, S. (2020). *Vse lgut: Poyskovyky, Big Data i Internet znayut o vas vse [Everybody Lies: Big Data, New Data, and What the Internet Can Tell Us About Who We Really Are]*. St. Petersburg: Bombora Publ.

УДК 159.9.072.432

## THE CORRELATION BETWEEN SELF-TRANSCENDENCE AND FEAR OF DEATH IN ADOLESCENCE

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**Анотація. Долгих Р.С. Зв'язок самотрансценденції та страху смерті особистості у період молодості.**

У статті наведено результати дослідження зв'язку самотрансценденції та страху смерті у період молодості. Отримані дані свідчать про негативний зв'язок між самотрансценденцією та страхом смерті особистості. Ці результати дозволяють визначити самотрансценденцію як ресурс для вирішення психокорекційних завдань з молодими людьми у яких страх смерті є загостреним.

**Ключові слова:** молодість, ресурс, самотрансценденція, сенс, страх смерті.

**Abstract. Dolhykh R.S. The correlation between self-transcendence and fear of death in adolescence.**

The article presents the results of the research of the correlation between self-transcendence

and fear of death in adolescence. The findings indicate a negative correlation between self-transcendence and fear of death. The results allow to identify self-transcendence as a resource for solving psycho-corrective goals with young people having the increasing fear of death.

**Key words:** adolescence, fear of death, resource, self-transcendence, sense.

**General formulation of research and its topicality.** The problems of both the sense of life and the fear of death are becoming relevant earlier than in the crisis of middle age, namely in adolescence. The radical changes in political, economic and spiritual spheres of the society entail dramatic changes in the values and actions of people. It is especially expressed in the period of adolescence, as young people are the least integrated into social relationships, the least stable in their views, behavior and relation to the world around them. Thus, at a young age, a person begins to think about the values and sense of his life and tries to identify and find them in any way [1].

Regarding the fear of death, many different facts indicate the importance of studying the attitude to death in adolescence. The lives of modern youth are in the situation of constant threats of terrorist acts, regular wars in a relative geographical proximity, natural disasters and catastrophes - everything, even without experimental verification, suggests the actualization of thoughts about death [4, 5].

Fear of death is complex, individual experience, a phenomenon of human consciousness. It was considered by Z. Freud, O. Fenickel, J. Watson, M. Heidegger, I. Yalom, V. Frankl, A. Kholmogorova, S. Rubinstein, R. Kastenbaum, D. Templer, K. Horney, W. Florian, S. Kravets, P. Wong.

Self-transcendence is a person's ability to realize values, to find the sense of life somewhere outside himself: in the past, in suffering, in love to work or to people. It was studied by such psychologists as V. Frankl, I. Yalom, R. May, A. Maslow, A. Petrovsky, V. Znakov.

**Setting of the problem and the aim of the article.** At a young age a person thinks about the sense of life and he is dependent on the thoughts related to death. That is, on the one hand, the situation in the country and in the world, and on the

other hand, the lack of meaning in life actualizes and exacerbates the fear of death. Self-transcendence is a source of sense and realization of values in the environment. Therefore, it is important to consider the connection between self-transcendence and fear of death in the period of adolescence.

**Aim:** to explore the correlation between self-transcendence and fear of death of an individual on the example of young people.

**Discussion and Results.** The sample consisted of forty people aged 20 to 25 years, including 22 women and 18 men.

Research methods and techniques:

1) "Existence scale (SH test)" (A.Lengle and K.Orgler in the adaptation of I.Mainina). The scale of existence consists of four scales: self-distancing, self-transcendence, freedom and responsibility. The test scales, according to V.Frankl, correspond to four anthropological abilities that are inherent in each person [2].

2) "Attitude to Death" (Death Attitude Profile Revised in the adaptation of K.Chistopolskaya). The DAP-R method measures people's beliefs about death. The author divided the beliefs into 5 groups and, accordingly, into five scales:

- The approval of the approach of death - faith in paradise and union with God after death;

- The avoidance of the topic of death;

- Fear of death;

- The adoption of death as an escape from the burdens of everyday life;

- Neutral acceptance - the perception of death as a natural inevitability [3].

3) "Fear of Personal Death Scale" (adaptation of K.Chistopolskaya).

The questionnaire contains 31 statements, which is a continuation of the phrase: "Death scares me because ...". This is a multidimensional method of studying the fear of death: on the personal (personality and body), interpersonal (fear of oblivion and fear of death of loved ones) and suprapersonal (transcendence and punishment after death) levels [3].

### **Experiential outcomes**

Correlation analysis was performed using Spearman's criterion. Table 1

presents the correlations that have reached statistical significance.

Table 1

Correlation analysis of the correlations between self-transcendence and fear of death

Scales of methods	Spearman's ratio (r)
"Fear of death" and "self-transcendence"	-0.75 *
"Fear of death due to consequences for the individual" and "self-transcendence"	0.35 *
"Fear of death due to transcendental consequences" and "self-transcendence"	-0.69 *

\* coefficients are statistically significant ( $p \leq 0.05$ )

The data presented in Table 1 show that the indicator of the scale "self-transcendence" is negatively correlated with the indicator of the scale "fear of death due to consequences for the individual" ( $r = -0.35$ ). This means that the more a person is capable of self-transcendence, the less he experiences the fear of death because of the consequences for the individual. This correlation exists because self-transcendence is the ability to find sense not in the desires, intentions and actualization of the individual, but on the contrary in "going beyond yourself", in search of meaning in the environment: people, things.

The indicator of the scale "self-transcendence" is negatively correlated with the indicator of the scale "fear of death due to transcendental consequences" ( $r = -0.69$ ). It means that the more an individual is capable of self-transcendence, the less he worries about the transcendental consequences after death. Transcendental consequences are a person's fear of the unknowable, fear of the afterlife. Nowadays, the spread of many concepts about life after death, the predominance of science over religion, the lack of a scientific answer to this question cause young people to feel uncertainty. Self-transcendence presupposes the realization of values, orientation in one's actions towards sense, and this helps a person, in this case, to focus on the present. The more a person finds meaning in the present, the less he worries about what existence will be after death.

Spearman's correlation analysis found that the correlation between self-transcendence and fear of death was statistically significant ( $r = -0.75$ ). This suggests that there is a negative association between self-transcendence and fear of death in subjects. It means that the more a person is capable of self-transcendence, the less he fears death.

## **Conclusions**

1. There is a negative correlation between self-transcendence and the cause of fear of death in the consequences for the individual. It indicates that the more a person has developed the ability to self-transcendence, the less he worries about the consequences for himself as a person after death.

2. There is a negative connection between self-transcendence and such a cause of fear of death as transcendental consequences. This indicates that the more a person has developed the ability to self-transcendence, the less he worries about what will happen to him after death. The prospect of further research is to investigate the relationship between self-transcendence and fear of death in samples of other age groups.

3. The correlation analysis has shown that there is a negative correlation between self-transcendence and fear of death in young people. The more developed the ability to self-transcendence, the lower the fear of death.

## **References**

1. Gavrilova T.A. Ekzistencialnyj strakh smerti i tanaticheskaya trevoga: metody issledovaniya i diagnostiki. *Prikladnaya psikhologiya*. 2001. #6. S. 1-8.
2. Majnina I.N. Adaptaciya Shkaly ekzistencii A.Lengle, K. Orgler k russkoyazychnoj vyborke: diplomnaya rabota. Moskva: MGU, 2007.
3. Chistopolskaya K.A., Enikolopov S.N., Nikolaev E.L., Semikin G.I., Khramelashvili V.V., Kazanczeva V.N., Zhuravleva T.V. Adaptaciya oprosnikov «Otnoshenie k smerti» i «Strakh lichnoj smerti» na russkoyazychnoj vyborke. *Suicidologiya*. 2014. Tom 5, # 2. S. 60-69.
4. Yalom I. Vglyadyvayas v solncze: zhizn bez strakha smerti. Moskva: Eksmo, 2012. 352 s.
5. Yalom I. Ekzistencialaya psikhoterapiya. Moskva: Nezavisimaya firma «Klass», 2000. 346 s.

## SOME ASPECTS OF THE RELIABILITY OF MACHINE TRANSLATION FOR JAPANESE LANGUAGE

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**Анотація. Дитиняк Т.С., Лученко О.О. Деякі аспекти надійності машинного перекладу з японської мови.**

У статті пояснюються складнощі та нюанси перекладу японської мови за допомогою систем машинного перекладу, таких як Google Translate. Проаналізовано проблеми, які можуть виникнути у не носіїв мови та тих, хто не володіє попередніми знаннями японської при спробах скористатися машинним перекладачем. Ввічливий стиль, що використовується в японській мові, складає значну частину цієї проблеми, оскільки в інших мовах його використовують значно менше. Пропуск членів речення (еліпс) та висококонтекстуальність японської мови перешкоджає системі машинного перекладу повністю передати довершене значення між двома мовами різного ступеню контексту – японською та англійською. Висновок, підкріплений вищезазначеними проблемами, показує, що якість машинного перекладу може суттєво відрізнятися залежно від мовної пари, переклади можуть містити помилки, а значення може просто викривитися, за відсутністю можливості визначити контекст.

**Ключові слова:** японська мова, переклад, Перекладач Google, машинний переклад.

**Abstract. Dytynyak T., Luchenko O. Some Aspects of the Reliability of Machine Translation for Japanese Language.**

The article will explain the difficultly and nuances of interpreting Japanese using a machine translation system, such as Google Translate. It analyzes the problems that may arise when non-native speakers and those who do not have prior knowledge of Japanese attempt to use a machine translator. The honorific speech used in Japanese is a large part of the problem due to the lack of such in other languages. Omission of words (ellipsis) and a high context of the language prevents machine translator from conveying the fully unabridged meaning between two languages of different contexts, Japanese and English. The conclusion, supported by the issues stated above, shows that quality of machine translation can vary significantly depending on the language pair, give translations that contain errors, and the meaning can simply be altered because there is no way to incorporate context.

**Key words:** Japanese, translation, Google Translate, machine translation.

**General formulation of research and its topicality.** In today's era the average person has access to more information than has ever been available before, we can instantly find the most recent articles, news, and any other literature from around the world. However, this information may be locked behind a language barrier which makes it unavailable for a nonnative speaker of the target language. To resolve this problem a number of applications were invented including the world's most used machine translation systems – Google Translate. Google Translate, being the most popular and developed translation services available to the common user, generally works well but the accuracy of its translations varies from language to language. While the quality of French, Spanish, and English language pairs is almost 90% accurate [9], the accuracy of Japanese is noticeably inferior to human translation. The honorific speech, frequent omission of words and high context communication makes Japanese considerably more difficult for a non-human translator to interpret the unabridged meaning and maintain the original tone.

**Setting of the problem and the aim of the article.** The paper analyzes the problems that may occur when non-native speakers and those who do not have prior knowledge of Japanese make a translation with a help of a machine translator. The aim of the article is to research the reasons for significant inaccuracies of Japanese-English machine translation.

**Discussion and Results.** In 2016, Google introduced a Neural Machine Translation (GNMT) system that improves translation quality by using artificial neural network. The service supports 103 languages and processes about 500 million requests every day [8]. Instead of translating text word by word, the new GNMT translates the entire sentence as a unit of translation, considering the context which is derived from existing database of previously translated material [3]. After the completion of the system training and its official launch, Google analysts presented a detailed analysis of the GNMT results. The most popular language pairs, Spanish-English or French-English, showed the largest gains, with an accuracy score of 85–

87% [9]. Other language pairs, unfortunately, do not show such a good progress, and Japanese is one of them. The conclusion was made that Google Translate works quite well with languages similar in structure, on the other hand translation is noticeably inferior to human translation with radically different language systems (for example, Japanese-Russian or Japanese-English).

Out of all the obstacles that appear when attempting to ascertain an accurate Japanese-English translation, the complexity of language styles is probably the most common. There is a specific grammatical category in Japanese called *keigo* (敬語). *Keigo* is the honorific system of Japanese used to express the level of politeness. The dictionary definition of *an honorific* is “A title or word implying or expressing high status, politeness, or respect” [4]. Most languages use them up to some extent to express respect or esteem. What makes Japanese unique is the number of honorifics used in daily conversation, their importance which stems from Japanese culture, and the variety to pick from. *Keigo* has played a sociolinguistic role for hundreds of years and currently is used in various situations: as a sign of respect to elders, to indicate the seniority of a household member, to show affection, and as an expression of politeness. For instance, an honorific suffix 様 [-sama] is used to address a person of higher rank, a guest, or a customer, さん [-san] is a title of respect to address a person of the same rank, 君 [-kun] is used by senior people to address their juniors (although there is no rule, *kun* is used generally for addressing male counterparts), 先輩 [-senpai] refers to the elder colleagues, 先生 [-sensei] is used to refer to or address teachers, doctors, politicians, lawyers, and other authority figures, 上 [-ue] literally means “above” and denotes a high level of respect, especially towards older siblings. All these honorific titles have no equivalents in English as it is limited to “Mr.”, “Ms.”, or “Dr.” which is not as versatile and does not provide as much context. Let us demonstrate these issues more clearly by providing an example of a Google translation presented at (fig.1):

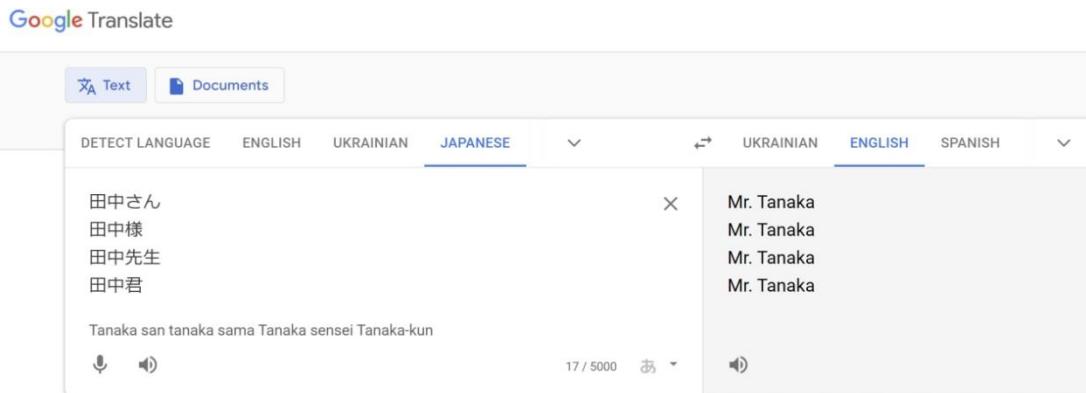


Fig. 1. The example of Google translation made for different honorific suffixes.

Not only are translated titles identical, some of them (君, 先生) are not even close to convey the original meaning, and there is no way to get an explanation. The use of honorific titles is not the only way to express politeness in Japanese. A specific conjugation, including adjunction of the polite prefixes “*o*” and “*go*” to the stem of the verb, can also express the polite, humble, or honorific style of somebody’s speech. Consider the following examples:

すみません、田中先生はいますか。 *Sumimasen, Tanaka-sensei wa imasuka.*

すみません、田中先生はいらっしゃいますか。 *Sumimasen, Tanaka-sensei wa irasshaimasuka* [1].

Both sentences mean “Excuse me, is Mr. Tanaka here?” but when the first one sounds fairly neutral, the second expresses the respect towards someone of higher position. This nuance is nearly impossible to translate into English using only the equivalent phrases without giving an explanation. Even more egregious, when given the second phrase, Google Translate interprets it as “Excuse me, is there Mr. Tanaka?” which is semantically incorrect.

Another misleading aspect of the Japanese language that makes it very difficult to translate into English is its preference for omission: things are often implied by context and mutual understanding but not expressed verbally. In Japanese, you can make a complete sentence without the subject, so you do not have to keep using it throughout the sentence. If you use the subject even though you do not need to, it sometimes changes the meaning from what you are trying to say. Omission of subject and object exists in English as well, but its rates are four times lower than that of

Japanese. Generally speaking, *who did what to whom* is rarely expressed in Japanese [6]. A good example here will be a simple phrase お腹が空いた (*onaka ga suita*) which we understand as “I am hungry”. But there is no “I am” in this sentence. It was omitted as the subject is clear to the listener. On the other hand, literal translation of “I am hungry” 私はお腹が空いた (*watashi wa onaka ga suita*) would sound redundant and robotic to a native speaker. Consider one more example: 明日電話するね。*Ashita denwa suru ne.* This is an informal way to say “I’ll call you tomorrow,” however neither “I” nor “you” is present in the original sentence: both first and second person pronouns were omitted. This exemplifies a pro-dropping tendency in Japanese language. If a noun phrase has been introduced in earlier sentences or is known from the context, it will undergo omission in later sentences. Furthermore, as shown in the example below, the whole main clause can be deleted if the message conveyed is understood from the situation.

A: 昨日 パーティーにこなかったね。*Kinō pātī ni konakatta ne.*

B: うん、ちょっと忙しかったから（いけなかった）。*Un, chotto isogashiikatta kara (ikenakatta).*

A: You didn’t come to the party.

B: Yeah, (I couldn’t come) because I was busy [5].

This creates an unfavorable situation for those who decide to use machine translation service as it has no ability to retrieve a hidden subject. Even when it does a good job with simple common phrases, when the source gets complicated, more and more errors occur. It is especially noticeable when the omission alters the grammar of the sentence [6].

Everything mentioned above leads to even broader topic on the accuracy of Japanese translation which is the contextuality of language. Japanese, unlike English, is a high-context language, meaning it is dependent on connotation and is based on cultural motivation. The cultural context is highly relevant to understanding a discourse in Japan, and even if a high number of homonyms is used in speech, the meaning can still be understood by a listener who knows the context [7]. Anthropologist Edward T. Hall, who identified this notion of high-context and low-

context cultural communications, explained how people in different countries decode messages based on their cultural expectations. In his book *The Silent Language* (1959) low-context communication is believed to rely on more direct messages dependent on the words being spoken, whereas high-context communication consist of contextual elements that help people to understand the meaning [2]. Human translators are usually aware of this cultural difference and can acquire the skill of interpreting it through practice. On the other hand, machine translation, especially new GNMT system, only uses preexisting database to analyze and pick the appropriate interpretation of the source. Due to this difference in high and low-context languages, a machine translated text from English into Japanese has a significant chance of being misunderstood and incorrectly interpreted.

**Conclusions.** A beautiful Japanese saying 「一を聞いて十を知る」 “*Ichi wo kiite juu wo shiru*” can be interpreted as “Appreciate ten from hearing one,” and it is a perfect and concise summary of its context-heavy nature which includes abundance of honorific categories and frequent omission of important for understanding parts of speech. This raises a number of challenges for non-native speakers who decide to use online translation services. *The main issues that emerge from the use of machine translation, such as Google Translate, are its quality which depends significantly on the language pair, translations that contain significant errors, and finally, the meaning can simply be “lost in translation” because there is no way to incorporate context.*

## References

1. Coto Japanese Academy. (2016). *An Introduction to Japanese Keigo*. Available at: <https://cotoacademy.com/japanese-keigo/> .
2. Hall, E.T. (1959). *The Silent Language*. New York: Doubleday.
3. Le, Q., & Schuster, M. (2016). *A Neural Network for Machine Translation, at Production Scale*. Google AI Blog. Available at: <https://ai.googleblog.com/2016/09/a-neural-network-for-machine.html>.
4. Lexico dictionary. Oxford University Press. Available at: <https://www.lexico.com/en/definition/honorific>.
5. Makino, S., and Michio, Ts. (1989). *A Dictionary of Basic Japanese Grammar: 日本語基本文法辞典*. Tokyo: The Japan Times.
6. Nariyama, S. (2009). *How can we know who did what to whom in Japanese? (The Grammar of Omission: Less is More)*. Tokyo: Meijishoin.
7. Nishimura, S., Nevgi, A., & Tella, S.

Communication style and cultural features in high/low context communication cultures: a case study of Finland, Japan and India. *Uudistuva ja kehittyvä ainedidaktiikka: Ainedidaktisen symposiumi* (8.2.2008 Helsingissä. Osa 2; №. 299). Helsinki, 783-796. 8. Turovsky, B. (2016). *Ten years of Google Translate. Google The Keyword.* Available at: <https://blog.google/products/translate/ten-years-of-google-translate/>. 9. Wu, Y., Schuster, M., Chen, Z., Le, Q., Norouzi, M., Macherey, W., Dean, J. (2016). *Google's Neural Machine Translation System: Bridging the Gap between Human and Machine Translation.* Available at: <https://arxiv.org/abs/1609.08144v2>.

УДК 159.99

## THE RELATIONSHIP OF EMPATHY AND EMOTIONAL INTELLIGENCE

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### **Анотація. Фурсова К.С. Взаємозв'язок емпатії та емоційного інтелекту.**

У статті розглядаються поняття емпатії та емоційного інтелекту, взаємозв'язок між цими феноменами, виникнення та трансформації цих понять. Показано, як впливають ці феномени на повсякденне життя людини, на взаємовідносини людей. Подано практичне дослідження наявності взаємозв'язку між емпатією та емоційним інтелектом.

**Ключові слова:** відносини, емоційний інтелект, емоції, емпатія, комунікація

**Abstract. Fursova K.S. The relationship of empathy and emotional intelligence.**

The article considers the concepts of empathy and emotional intelligence, the relationship between these phenomena, the history of origin and transformation of these concepts. It is shown how these phenomena affect the daily life of people, the relationships of people. A practical study of the relationship between empathy and emotional intelligence is presented in the article.

**Key words:** communication, emotional intelligence, emotions, empathy, relations

**General formulation of research and its topicality.** Empathy is an integral and important component of communication, establishing a relationship with others. Empathy makes it possible to predict the actions of other people, to assume their thoughts and statements, to understand the reasons for their actions. Similarly,

empathy helps a person to be socially developed and active.

A person who has empathy, is less aggressive, more inclined to help, shows a high level of humanism, can identify and learn the individuality of the other person and thus find the ways to influence him.

In contrast to empathy, emotional intelligence, as a subject of socio-psychological research, is a relatively new, little-studied phenomenon. At present, there are different approaches to understand the nature and structure of emotional intelligence, however, a single agreed theory of emotional intelligence has not been developed yet. The need to study emotional intelligence is dictated by the demands of practice, which are to determine the factors influencing the effectiveness of professional activities and socio-psychological adaptation of an individual. The relationship between these phenomena is the key to a deeper understanding of both phenomena and a better mastery of these skills.

**Setting of the problem and the aim of the article.** The object-matter: empathy. The subject-matter: the relationship between empathy and emotional intelligence. The objective is to determine the role of empathy in the structure of emotional intelligence.

**Discussion and Results.** The history and content of the concept of "empathy" can be most fully reconstructed by adopting as a starting "point of restoration" at the turn of the XIX-XX centuries the problem of the subject and the method of humanities, including psychology. This issue is the birthplace of the concept of empathy and therefore the authentic context of understanding its primary forms and "innate" methodological status: empathy is thought of as a general method of psychology, correlated with experience as its subject [3].

At the first stage of formation, the meaning of the concept of "empathy" is determined by the concepts of "feeling into" as defined by T.Lipps and "empathy" as defined by V.Dilthey. For all their differences, both concepts define the approach to empathy as a specific method and phenomenon of cognition, which forms the appropriate direction of research [6].

The second direction of research, in psychology chronologically later, is

defined by the concept of "sympathy" and "associated" with the development of moral feelings and altruistic behavior (G.Spencer, A.Smith, A.Schopenhauer, etc.). Analyzing their work, T.Gavrilova notes that "sympathy" is understood by them as a property of a human soul and is seen as a regulator of relations between people in a society, the foundations of conscience, altruism, justice [2].

The concept of empathy became widespread in the first decade of the XX century. Priority in its development is attributed to T.Lipps and E.Titchener. The latter translated the German word "Einfühlung" into "empathy", with which T.Lipps described the process of understanding of works of art, objects of nature, and later, in 1903, a man by man. Thus, the term "empathy" replaced the term "sympathy" and pushed it out of scientific use [5].

The analysis of research has shown that some psychologists, e.g., T.Shibutani, consider empathy in the emotional aspect, defining it as projecting oneself into the objects of social reality, the others, like T.Ribot, A.Vallon, T.Gavrilova and V.Kuzmin, as the basis of helping behavior. Such psychologists as A.Orlov and M.Khazanova, supporters of the cognitive direction, interpret empathy as a process of understanding, "cognitive reconstruction of the inner world of another person, the ability to imagine the behavior of others". According to T.Gavrilova and L.Streletskaya, in foreign psychology the most common in the cognitive aspect is the understanding of empathy as a perceptual act characterizing the ability of an individual to evaluate the feelings and thoughts of another in imaginary plan or as social understanding, communication in the inner plane [4].

The following components of empathy can be emphasized:

- emotional (the ability to recognize and accept different emotional states of another person; passive compassion, devoid of an effective beginning);
- cognitive (the ability to delve into the thoughts, feelings and actions of the partner; perception and understanding of his inner world, the manifestation of compassion);
- behavioral (the possession of forms of communication that facilitate the mental state of another person; help, assistance) [1].

The most popular definition of empathy at the moment is the following: empathy – conscious empathy for the current emotional state of another person without losing a sense of origin of this experience. Accordingly, an empath is a person with a developed ability to empathize.

Searching the abilities related to the socio-emotional sphere of psyche has been conducted in psychology since the early XX century. H.Gardner was especially close to the concept of emotional intelligence, distinguishing between intrapersonal and interpersonal intelligence within the framework of personal intelligence. The abilities included by him in these concepts are directly related to emotional intelligence. Thus, intrapersonal intelligence is interpreted by him as an access to the own emotional life, to affects and emotions: the ability to distinguish feelings instantly, name them, transfer into symbolic codes and use as means of understanding and managing own behavior.

In 1990 P.Salovay and J.Mayer proposed a unitary concept, "emotional intelligence". They consider emotional intelligence as a substructure of social intelligence, which includes the ability to track both own and others' feelings and emotions, distinguish them and use this information to direct thinking and action.

In 1995 D.Goleman changed and popularized the first model of emotional intelligence. He added enthusiasm, perseverance and social skills to such components as identification and expression of emotions, regulation of emotions, the use of emotional information in thinking and acting. Thus, he combined the cognitive abilities included in the model of P.Salovey and J. Mayer, with personal characteristics. Later, D.Goleman refined on the structure of emotional intelligence. Currently, it includes such 4 components of emotional intelligence as self-awareness, self-control, social sensitivity, relationship management, and 18 related skills.

26 three and four-year students were diagnosed as part of the study.

Analyzing the results obtained by the method of "Diagnosis of the level of empathy" it was found that 15% of the students have an average level of empathy, 85% - have a high level of empathy, and 0% - low. The following results were obtained using the "Emotional Intelligence Test" method: low level of emotional

intelligence - 18%, medium level - 30%, high level - 52%. The results of comparing the level of empathy and the level of emotional intelligence are shown in table 1.

Table 1

Indicators of the level of empathy and the level of components of emotional intelligence

	Emotional intelligence
Empathy	0,45*

Note: \* $p \leq 0,05$

As it is seen, empathy and emotional intelligence have a direct relationship, that is statistically significant.

**Conclusion.** Thus, empathy is a conscious empathy for another person's current emotional state. Whereas emotional intelligence is the ability to track own and others' feelings and emotions and distinguish them. In practice, these two phenomena have been found to be directly related.

#### References

1. Vanersholt G. *Jempatija kak sovokupnost mikroprocessov* // K. Rodzher i ego posledovateli: psihoterapija na poroge XXI veka (pod red. D. Brjeziera). M., "Kogito-centr", 2005.
2. Gavrilova T. P. Ponjatie jempatii v zarubezhnoj psihologii (istoricheskij obzor i sovremennoe sostojanie problemy) // *Voprosy psichologii*. 1975. № 2. S. 145.
3. Eleferenko I.O. *Jempatija*. – SPb.: Garuda, 2003.
4. Osnovy praktychnoyi psychologiyi. / Panok V., Tytarenko T., Chepelyeva N. ta in.: Pidruchnyk . – K.: Lybid, 1999. – 536s.
5. Jetchegoen G. – Jempatija // *Zhurnal prakticheskoy psichologii i psichoanaliza*. – 2003. – № 1.
6. Jusupov I. M. Vchuvstvovanie, proniknovenie, ponimanie. Kazan, 1993.

УДК 334.722:614.44/.46-042.3](477+100)

## SITUATION OF ENTREPRENEURS WITH THE INTRODUCTION OF LOCKDOWN AND QUARANTINE RESTRICTIONS BY THE GOVERNMENT IN UKRAINE AND IN THE WORLD

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**Анотація. Гончаренко А. В. Стан підприємців з впровадженням державою**

## **локдауну та карантинних обмежень в Україні та світі.**

На сьогоднішній день не залишилося жодної людини, яка не відчула б змін, введених після поширення COVID-19. Впровадження обмежувальних заходів змусило багатьох підприємців зменшити або навіть припинити свою діяльність. Це мало значний вплив як на окремих людей, так і на економіку в цілому. Так почалася коронавірусна криза. З огляду на ситуацію, з мінімальними змінами, багато підприємців негативно відреагували на рішення про введення повторного локдауну після деякого послаблення обмежень. У цій статті ми спробуємо розкрити, як підприємці справлялися під час карантину.

**Ключові слова:** локдаун, коронавірусна криза, масові страйки, обмежувальні заходи.

**Abstract. Goncharenko A.V. Situation of entrepreneurs with the introduction of lockdown and quarantine restrictions by the government in Ukraine and in the world.**

Nowadays there is absolutely not a single person left who would not feel the changes introduced since the spread of the COVID-19. The introduction of restrictive measures forced many entrepreneurs to reduce or even stop their activities. This has had a significant impact on both individuals and the economy as a whole. This is how the coronavirus crisis began. Given the situation with minimal changes, many entrepreneurs reacted negatively to the decision to introduce repeated lockdown after some easing of restrictions. In this article we will try to reveal how entrepreneurs coped during the quarantine.

**Key words:** coronavirus crisis, lockdown, massive strikes, restrictive measures.

### **General formulation of research and its topicality.**

In the modern world, the words like quarantine or lockdown no longer surprise anyone. Everything that humanity has faced at the present stage is a test for everyone.

**The relevance:** At the moment when the global coronavirus crisis arose, the problem of finding solutions to get out of this situation appeared. The **object-matter** of the article is a situation of entrepreneurs during the quarantine.

The **subject-matter** of the article is peculiarities of behavior of entrepreneurs to overcome difficulties during the quarantine.

The **purpose** of the article is to identify the situation of entrepreneurs during the lockdown and quarantine measures; to study the behavior of entrepreneurs in Ukraine and in the world. The research **tasks** of this article are:

1. defining the real situation of entrepreneurs during the quarantine;
2. assessment of the support of entrepreneurs from the government in Ukraine

and in the world;

3. identifying ways of maintaining entrepreneurial activity during the quarantine;

4. generalizing statistical information on changes in the number of operating enterprises during the quarantine.

**The methods** of the research are analysis, synthesis and comparison.

**The materials** of the article include data from the Ministry of Economic Development of Ukraine and official statistics sources and web-sources.

**Discussion and results:** The beginning of a global pandemic has challenged the whole world. At the beginning of 2020, a new virus, COVID-19, came to Ukraine. As in the rest of the world, our government began to look for a solution to stop its spreading. In March, Ukraine introduced strict quarantine restrictions. Among them: the closure of schools and higher educational institutions, all trade establishments, except grocery stores, pharmacies and gas stations; ban on public transport; closure of borders etc. Restrictions have negatively affected the activities of many enterprises. Ilya Neskhodovskiy, expert of the Reanimation Package of Reforms, said that in the period from March to May small shops, cafes, bars and restaurants suffered the most [5]. Private entrepreneurs took the hardest hit. It was easier for large enterprises, although most of them suffered losses, considering the need to pay salaries to employees, a quick transition to remote work and many other factors, such as falling demand, loss of residents, etc. It would seem that businesses, especially restaurants and cafes, that provided delivery services would only increase their income, but this is not the case. If before quarantine, delivery was relevant for those who were nearby and for large orders, then during quarantine the distance for delivery increased and orders were minimal. That is, much more resources were spent.

Realizing the plight of the business sector, the government did not stand aside. It is obvious that in the more developed countries the financial support was greater. For example, in France the government allocated 345 billion euros to support business. Of these, 300 billion – for state guarantees of loans to enterprises, especially

small and medium-sized businesses, another 45 billion – for direct assistance to enterprises. 2 billion was allocated to support microbusiness [4]. Taking into account the limitation in the Ukrainian budget, the government found another way to help the business sector and introduced tax breaks for the quarantine period and so-called credit holidays [4]. And also in June, private entrepreneurs who had no employees and who suffered from the introduction of quarantine could receive financial assistance from the state – up to UAH 11,000 for 4 months of downtime [3]. Such things partially helped to cope with difficulties and be able to work during the easing of quarantine measures, however, tightening of restrictions in the fall was perceived by entrepreneurs more negatively. If for the first time, enterprises were closed due to an epidemiological situation in fear and uncertainty, at the second closure everyone had already forgotten the original fear. Massive strikes began. People took to the streets and blocked roads demanding a work permit.

The coronavirus pandemic has hit the economy hard. The new crisis has affected even those companies whose well-being was not in doubt before. So, what did the pandemic teach business and its representatives? There are many things entrepreneurs faced during the coronavirus crisis, such as:

- online work: During the period of restrictions associated with the coronavirus, demand from offline has shifted to online. For many companies, the development of the online business component has become the key to surviving the crisis. Beauty industry, which was supposed to freeze during the quarantine period, surprised everyone. When it became impossible to personally visit the beautician, but the desire of clients to look good remained, many salons introduced an unusual online service: everything needed for the cosmetic procedure was delivered to the client's place, and the beautician online told how to perform all necessary procedure.

- business diversification: During this crisis, those companies that have focused on one product or one market have suffered the most. For example, the previously successful short-term rental company Airbnb was hit hard by travel restrictions due to the pandemic. As a result, the company had to lay off 25% of its employees. [6]

- transition to remote work: At the beginning, the question was whether people could

work from home as efficiently as in the office. The results exceeded expectations: with a competent organization of the workflow, the efficiency of remote employees increased, and companies were able to save on rental payments by giving up part of the office space. As a result, some enterprises have completely abandoned offices, leaving only the remote work format [6].

The coronavirus has caused a very serious economic crisis. The International Monetary Fund estimates that the global economy decreased by 3% in 2020. [1] It is the worst recession since the Great Depression of the 1930s. One by one global brands began to declare bankruptcy: in particular, the well-known Cirque du Soleil, the popular car rental company Hertz Global Holdings Inc (HTZ), the world's most famous cruise company Norwegian Cruise Line Holdings and others. Ukrainian enterprises have also experienced the harmful effects of quarantine. During this year, 400 institutions have already gone bankrupt. A third, namely 210 enterprises, have already gone bankrupt during the quarantine. But everything is learned by comparison. The coronavirus crisis has not been the most disastrous for Ukrainian businessmen over the past decade. According to the Ministry of Justice, there is a gradual decrease in the number of liquidated enterprises every year, starting from 2015 to 2020. If in Ukraine, 4219 enterprises were liquidated due to bankruptcy in 2015, then in 2020 there were only 210 such companies [1].

**Conclusions.** After conducting the research, we realized that the global situation had a significant impact on the business sector and the economic situation around the world. Despite the fact that many new problems have fallen on the shoulders of the state, requiring immediate solutions, the government has not stood aside and is ready to help entrepreneurs who conduct their business honestly. Ukrainian business is not in the worst situation now, but it still has something to overcome in order to survive. Problems always generate new directions of development, therefore we are confident that with the end of these temporary difficulties the whole world will reach a new level.

## References

1. Bankrotstvo v cifrah: chto strashnee koronakrizisa [Bankruptcy in numbers: what's worse than

the coronavirus crisis]. 24jekonomika, 2020. Available at: [https://economy.24tv.ua/ru/bankrotstvo-v-cifrah-chto-strashnee-chem-krizis-covid-19\\_n1417192](https://economy.24tv.ua/ru/bankrotstvo-v-cifrah-chto-strashnee-chem-krizis-covid-19_n1417192). 2. Dlja FOP otmenili ESV na karantine: kak jeto rabotaet (ob#jasnenie nalogovoj) [SSP in quarantine were canceled for private entrepreneurs: how it works (tax explanation)]. AIN, 2020. Available at: <https://ain.ua/2020/03/26/dlya-fop-otmenili-esv-kak-eto-rabotaet/>. 3. Kak FOP poluchit' do 11 000 grn pomoshhi po chastichnoj nerabotosposobnosti iz-za karantina [How to private entrepreneurs to get up to UAH 11,000 of assistance for partial inoperability due to quarantine]. AIN, 2020. Available at: <https://ain.ua/2020/06/18/kak-poluchit-pomoshch-fop/>. 4. Koronavirus: Francija vydeljaet 345 milliardov evro dlja podderzhki biznesa [Coronavirus: France allocates 345 billion euros to support business]. Jekonomiceskaja Pravda, 2020. Available at: <https://www.epravda.com.ua/rus/news/2020/03/18/658243/>. 5. Protesty FLP: pochemu nedovol'stvo predprinimatelej rastet [Privat entrepreneur's protests: why entrepreneur's discontent is growing]. Slovo i Dilo, 2020. Available at: <https://ru.slovoidilo.ua/2020/12/22/mnenie/politika/protesty-flp-pochemu-nedovolstvo-predprinimatelej-rastet>. 6. Uroki koronakrizisa: chemu pandemija nauchila biznes [Lessons from the coronavirus crisis: what the pandemic has taught business]. VC, 2020. Available at: <https://vc.ru/trade/140615-uroki-koronakrizisa-chemu-pandemiya-nauchila-biznes>.

УДК 61:37-055.2] (091)

## HISTORY OF SELF-REALIZATION OF WOMEN IN MEDICINE

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### **Анотація. Гайденко В. Є. Історія становлення жінки в медицині.**

Історія становлення жінки в медицині, здобуття нею медичної освіти показує, який нелегкий та тернистий шлях їй довелося пройти. Колись медицину вважали прерогативою винятково представників сильної статі. Тож займатися лікуванням, звичайно, окрім акушерства, жінкам суворо заборонялося. В сучасній медицині та медичній освіті кількість жінок, навпаки, перевищує чоловіків, і цей розрив широку зростає. Це робить тему розвитку жіночої вищої медичної освіти досить актуальною для дослідження. Метою даного дослідження стало виявлення характерних рис та загальних тенденцій в історії здобуття жінками права на вищу медичну освіту. Дослідження спирається на історичні та історіографічні джерела, які відображають різні аспекти історії жінок в медичній освіті.

Об'єктом дослідження цієї роботи став історичний та сучасний етапи становлення медичної жіночої освіти та безпосередньої роботи жінок у професії лікаря. В ХХІ ст. медицина України та світу все більше набуває жіноче обличчя і аналіз історії цього процесу демонструє значну роль самих жінок в ньому. Головною рушійною силою для отримання жінками права на вищу медичну освіту були їхня самомотивація та активна суспільно-політична позиція.

**Ключові слова:** історія становлення жінки в медицині, розвиток жіночої вищої медичної освіти, здобуття жінками права на вищу медичну освіту, аспекти історії жінок в медичній освіті, перші жінки-медики.

**Abstract. Haidenko V.Ye. History of self-realization of women in medicine.**

The history of a woman's self-realization in medicine, her medical education shows she had to go through a very difficult path. Medicine was once considered the prerogative of only the stronger sex. Therefore, women were strictly forbidden to practice medicine besides the obstetrics. In modern medicine and medical education, on the other hand, the number of women exceeds men, and this gap is growing every year. This makes the topic of the development of women's higher medical education quite relevant for research. The aim of this study was to identify the characteristics and general trends in the history of women's acquisition of the right to higher medical education. The study is based on historical and historiographical sources that reflect various aspects of women's history in medical education. The object of study of this work was the historical and modern stages of the self-realisation of women's medical education and the direct work of women in the medical profession. In the 21st century Medicine of Ukraine and the world is increasingly gaining a female face and the analysis of the history of this process shows the significant role of women themselves in it. The main driving force for women to obtain the right to higher medical education was their self-motivation and active socio-political position.

**Keywords:** the history of a woman's self-realization in medicine, the development of female higher medical education, women's acquisition of the right to higher medical education, aspects of the history of women in medical education, the first female doctors.

**General formulation of research and its topicality.** Nowadays, it is difficult to imagine medicine without women. But this was not always this way. The history of self-realization of the woman as a professional physician showed she had to go through a difficult path. The medical profession used to be considered the prerogative of men, which was primarily due to the ban on women's higher education. This problem began to be studied in the 19th century, but it has not been

fully studied yet and it is still relevant today. In modern medicine and medical education, on the other hand, the number of women exceeds that of men, and this gap is growing every year. But today, despite a large number of women in medicine, some areas remain inaccessible to them, there is an advantage based on sex in employment and dismissal or hidden discrimination in pay and others. This makes the development of women's higher medical education and the self-realization of women in medicine a very relevant and interesting topic for research.

The study is based on historical and historiographical sources that reflect various aspects of women's history in medical education. To achieve this goal, general scientific and scientific-historical methods and approaches were used, namely: analytical method, comparative method and others.

**Setting of the problem and the aim of the article.** The problem of this work is the discrimination of women in the medical area. It is impossible to begin the analysis of the current situation without studying the past situation of women. As it is seen from the history of self-realisation of women in the medical area, she was not perceived as a specialist, she was forbidden to study in medical universities and work in official medicine.

Many people believe that medicine is a male profession even today. Mostly, male doctors specialize in more important and well-paid areas of medicine, such as neurosurgery, cardiovascular diseases.

The aim of this study was to identify the characteristics and general trends in the history of women's acquisition of the right to higher medical education. Also, to explore sources and literature in order to know about the peculiarities of becoming a female doctor in the area of health care, to pay attention to the problem of the women's movement to get an access to medical professions, which can provide modern women (current physicians and students of medical schools) with effective examples of fighting for their rights and with a source of inspiration and development of self-identification in the professional environment.

**Discussion and Results.** Women have devoted themselves to medicine since ancient times, and some of them even gained fame for their learning and practical

success. The earliest mentions of women doctors were found in the clay tablets of Mesopotamia in the second millennium BC. In ancient Egypt, the names of such female doctors as Merit-Ptah and Peseshet were known [7, p. 192]. The relevant title of Peseshet was "lady overseer of women doctors", which indicates that women occupied a separate place in medicine. Most likely, they were engaged in the treatment of gynecological diseases and obstetrics.

In ancient Greece medical practice and education were also the prerogative of the men, therefore women were not allowed to go to school. But that didn't stop the sharp-witted girls. The legend about Agnodice (Agnodike), who lived in the 4th century BC and received medical training in secret, says that she dressed up as a boy in order to be able to listen to the lectures of experienced doctors [4, p. 74].

In the 9th century Fatima al-Fihri established a mosque and a school, which later became a university with a medical faculty. Today it is the world's oldest higher education institution [8, p. 128].

In Ukraine during the Kievan Rus' there were also examples of women who showed themselves as doctors in practical medicine and science. For example, Volodymyr Monomakh's granddaughter Eupraxia Mstislavivna was interested in medicine of her ancestors since young age. She read and translated Galen works into Slavic, and she received the nickname of Dobrodeia of Kyiv among the Greeks for her success in medical practice. Based on her knowledge of the manufacture of medicinal substances, she wrote a treatise entitled "Alimma", i.e. "Ointments". This work is considered to be the first medical treatise in the history of Europe written by a woman [3, p. 437].

During the late Middle Ages and the Renaissance, the question about the place of women arose with the development and spread of the universities in Europe. Italian Dorotea Bucca was the dean of the medical faculty of the University of Bologna for 46 years in the 14th century, one of the oldest and most prestigious universities in Europe. In general, Italy was famous for its women doctors. They were especially tolerated in Salerno, there was the first medical school in Europe. A lot of women scientists came out of this school. Trottula of Salerno was a medical

practitioner who lived in the 12th century, she is the author of textbooks on gynecology [11, p. 42-57]. Rebecca de Guarna (the 13th century) is the author of treatises on fever and urine diagnostics [14]. Mercuriade (the 14th century) wrote treatises on fever and wound healing. Abella (also in the 14th century) wrote a treatise "On the Nature of Human Sperm". It is believed that these women not only studied but they also taught at the Salerno Medical School. But the rights of these women to medical practice were quite limited. They were usually allowed to treat only female patients, and they even risked being punished for their practice outside of Italy.

In the other European countries women also fought against the ban on medical education. The German Dorothea Erxleben, due to her perseverance, obtained the right to study at the university from the King of Prussia and in 1741 she became the first woman doctor in Western medicine with a higher education. She published a treatise in which she appealed to men to support women's desire for education, and to women to be more determined in their aspirations.

Women tried to gain knowledge secretly and practiced medicine illegally, sometimes even renouncing their female identity and disguising themselves as men. An example of such a fate was a famous British physician James Barry. During his long career as a military surgeon, he reached the position of chief inspector of military hospitals. It became known that he was a woman only after his death. Her real name was Margaret Bulkley. At the age of 19, she pretended to be a man to study at Edinburgh University School of Medicine. She achieved amazing success in a purely male profession of military surgeon [9, p. 14], [12].

In the 19th century universities in some countries opened their doors to women. Thus, in Brazil in 1834 the first woman with a higher medical education was the Frenchwoman Marie Durocher, and in the United States in 1846 – the Englishwoman Elizabeth Blackwell.

However, the society of many countries was quite sceptical about women's aspirations to get into the male profession. For example, a 19th-century newspaper article entitled "Ladies Also Want to Cut Up Corpses" said that women receiving

medical education were asexual, shameless creatures who defamed the noble title of lady by their appearance.

In the Russian Empire in 1872 the Higher Women's Medical Courses at the Medico-Surgical Academy in St. Petersburg were established [5, p.78-83]. But, despite the fact that the women of these courses received medical knowledge, they could only teach in junior classes or become midwives. In order to become real doctors, the women of that time went to study in the countries where women were allowed to study at universities, received higher medical education there, and then returned and confirmed their diplomas at local universities [10, p. 887].

In 1896 Sofiya Okunevs'ka-Morachevs'ka, who received her higher education in Geneva, became the first such woman doctor in Ukraine. In addition to practical medical activities in Ukraine and abroad, Sofiya Okunevs'ka was also involved in science and support for other women. For example, she introduced treatment of the cervix with radium according to the method of Marie Skłodowska-Curie. Sofiya Okunevs'ka spent the last years of her life in Lviv, where she took an active part in organizing training courses for Sisters of Charity and Midwives [13, p. 53-65].

Kharkiv in the 19th century clearly manifested itself as a centre of medical science and education, which was associated with the activities of the first university in Ukraine. The teachers of the medical faculty of Kharkiv National University have always been distinguished by their loyalty to women in education. At every opportunity, the professors of our medical faculty advocated for giving women the right to study with men. But the government banned it, despite numerous requests from women [2, p. 126-135].

In 1905 women were finally allowed to enter universities as free students. In the same year the Kharkiv Medical Faculty entered the first three listener Vira Nosenko (22-year-old daughter of Kharkiv clerk), Ganna Pluzhnykova (20-year-old farmer's daughter from Voronezh), Ester Radevych (18-year-old Kharkov tradesman's daughter) [1, p. 336]. The following year, 192 students began their studies, one of whom was Kateryna Bokarius, the sister of Professor Bokarius.

In 1908 the ban on admission was restored and a commission was set up to check the admission of documents of female students. Almost half of them were expelled for the lack of grounds for admission. Other girls were allowed to stay, but they had to study separately from the boys and only in the free time of the professor. The first medical institute in Ukraine was organized by the Kharkiv Medical Society, which consisted almost entirely of either employees or students of Kharkiv University. The institute was opened in 1910. This institution trained about 2,000 women doctors during the decade of its existence.

In 1920 the medical faculties of Kyiv and Kharkiv Universities were merged with the Women's Institutes of these cities and transformed into independent medical institutes. Thus, the Institute of Public Health in Kyiv (1920) and the Kharkiv Medical Institute (1921) appeared. Entrants of both sexes were admitted to these institutions, and education was free. Women and men in Soviet medical schools were equal.

In modern Ukraine the number of women in medicine is growing rapidly and this trend will only grow judging by the high demand for medical education among women. Thus, in the 2019/2020 academic year, the share of Ukrainian-speaking girls and boys in the senior courses of our medical faculty was almost equal, and in the first year the percentage of girls was already more than 85%.

A similar situation is observed in the other medical universities in Ukraine and around the world. For example, in the United States, 2017 was a turning point, when more girls than boys entered medical schools for the first time.

**Conclusions.** In the 21st century Medicine of Ukraine and the world is increasingly gaining a female face and the analysis of the history of this process shows the significant role of women in it. The main driving force for women to be entitled to higher medical education was their self-motivation and active socio-political position. This path of transformation, which lasted for hundreds of years, was quite difficult for women. But women's persistence and society's willingness to support them allowed women to succeed.

In my opinion, there are specialties in medicine that are really more suitable for

men (for example, surgery, resuscitation, traumatology and others), but there are many areas where women are undoubtedly more popular (pediatrics, obstetrics, gynecology and others). The reasons are quite objective: women are more empathic than men. Men have been very successful in the areas where courage, determination and physical strength are required.

It seems to me that now, when the doors of universities are opened to both men and women, when they have equal rights to enter, study, and have equal opportunities for further independent practice and research, medicine is developing and improving faster. We have come to gender equality, and this certainly contributes to the development of our society, science and improving the quality of life of the population.

## References

1. Belozerov, I. V., Posohov, S. I., Procenko, E. S., Kirichenko, M. I. (2020). Medicinskij fakultet Karazinskogo universiteta 1805–1920 godov : monografija. Pod obshh. Red. Belozerova, I.V., Harkov : HNU imeni V. N. Karazina, 336 (in Russian).
2. Drach, O.O. (2009). Vyshha zhinocha osvita v Kharkovi (druga polovyna XIX - pochatok XX st.): makro- i mikroanaliz problemy. [Sumska starovyna], 28-29, 126-135 (in Ukrainian).
3. Gajdaj, L. (2000). Istoriya Ukrayiny v osobax, terminax, nazvax i ponyattyax., Luczk: Vezha, 437 (in Ukrainian).
4. Greenhill, William Alexander. (1867). Dictionary of Greek and Roman Biography and Mythology. Little: Brown and Company, T. 1., C. 74.
5. Mikhnevych, L.V. (2015). Vytoky vyshchoyi zhinochoyi osvity v Ukrayini (kinecz XIX – pochatok XX st.)[Yurydychna Ukrayina], Kyiv, 7, 78-83(in Ukrainian).
6. Haidenko, V. Ye. (2020). Shlyax zhinky do vyshhoi medychnoyi osvity. XVII Mizhnarodna naukova konferenciya studentiv, molodykh vchenykh ta fakhivciv «Aktualni pytannya suchasnoyi medycyny», yaka prysvyachena 215-richchyu zasnuvannya medychnogo fakultetu Kharkivskogo nacionalnogo universytetu imeni V. N. Karazina. [26-27 bereznya 2020 r., m. Kharkiv, Ukrayina]. Kharkiv: KhNU imeni V. N. Karazina, 69–70 (in Ukrainian).
7. Karin Klenke, (2011). Women in Science Throughout History. Women in Leadership: Contextual Dynamics and Boundaries. [Emerald Group Publishing], 192-350.
8. Kenney, Jeffrey T, Moosa, Ebrahim. (2013). Islam in the Modern World. Routledge, 128.
9. Loseva, S. (2015). Dovrachebnaja tajna. [Kommersant Weekend], 21 serpnja, 27, 14. (in Russian).
10. Lykhachova, O.J. (1836-1904). Materialy dlya istoriyi zhinochoyi osvity v Rosiyi, (1086-1856), S.-Peterburg, 887 (in Ukrainian).
11. Rowland, Beryl. (1979). Exhuming Trotula, Sapiens Matrona of Salerno. [Florilegium]. T. 1. C.42-57.
12. Strahovskaja, O. (2017). Pervaja zhenshhina-hirurg vsju zhizn vydavala sebja za

muzhchinu. Tolko tak ej udalos probitsja v professiju. [Meduza], 25 iulja. (in Russian). 13. Voznyuk, V. O. (2002). Velych i syla Sofiyi Okunevskoyi. Do dzherel kultury Bukovyny. Chernivci, 53—65, [Bukovyna], (2000), 24 travnya, 138, 1, 3. (in Ukrainian). 14. Whaley. L. Women and the Practice of Medical Care in Early Modern Europe, 1400—1800.

УДК 37.018.43

## **DISTANCE LEARNING IS A TENDENCY IN THE 21ST CENTURY EDUCATION**

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**Анотація. Куцина К. О. Дистанційне навчання – тенденція в освіті XXI століття.**

Дистанційне навчання для більшості учнів та викладацького складу стало викликом у професійному плані. У статті розглядаються проблеми та їх рішення під час онлайн-навчання та наводяться певні статистичні дані, які дозволяють нам оцінити актуальність порушуваних питань. Також були розглянуті деякі освітні платформи. Даний вид навчання розширює можливості та забезпечує перспективи в майбутньому розвитку технологій та методик. У зв'язку з пандемією дистанційна форма навчання вийшла на перше місце в усьому світі та її можна розглядати як самостійну форму навчання, яка, безумовно, приведе до істотних змін традиційних форм освітнього процесу в усіх сферах діяльності людини.

**Ключові слова:** дистанційне навчання, фріланс, Інтернет, освітня платформа, освітній процес, пандемія

**Abstract. Kucyna K.O. Distance learning is a tendency in the 21st century education.**

Distance learning has become a challenge for most students and teaching staff professionally. The article concerns some problems and their solutions during online learning and contains statistics that helps to assess the relevance of issues raised. Several learning platforms were also considered. This type of learning increases opportunities and provides perspectives in the future development of methods and technologies. In connection with the pandemic distance learning has taken the first place in the whole world and it can be considered as an independent form of learning that will certainly lead to significant changes of educational process in all areas of human activity.

**Key words:** distance learning, educational process, freelance, Internet, learning platform,

pandemic

**General formulation of research and its topicality.** First, the humanity has faced a problem of getting education in the process of the pandemic. Epidemics happened before, for example, the black plague in the 14th century and the Spanish flu at the beginning of 20th century. At the moment of those diseases the education reduced to attending parish schools, gymnasiums and universities. The only way out of this situation in the 21st century for the combination of learning and the process of combating the pandemic is distance learning.

### **Discussion and Results.**

*Distance learning* is a set of educational and methodological measures for learning and teaching students who live far from an education centre. It takes place using technologies and teaching methods with a minimum number of compulsory lessons. This type of learning is between full-time form of education and part-time form of education. [1]

Distance learning is not something new in our world. Online courses, conferences and master-classes already exist, and they all use Internet resources. Freelance is developing (when it's not necessary to leave home in order to do work). Educational process has erased boundaries and expanded horizons for gaining new knowledge.

The Ukrainian education system taking into account the pandemic could restructure and adapt to distance learning. It concerns both schools and higher education institutions. At the same time the education system has faced such problems as:

- ➔ Professional training for teachers and students
- ➔ Technical issues
- ➔ Education programs didn't include a form of distance learning and required adjustments
- ➔ Creation and development of learning apps and platforms that make online classes possible

## ➔ Issues of psychological adaptation to a new form of learning

Currently everybody has a computer but a culture of using it is different. In order to give online classes, skills must be more improved than an average user's skills on technology. For a variety of reasons, for example, the age of a computer user, not everybody can do it. With reference to students, they are more receptive to get information on the Internet. The feature is that they got used not to educational but to entertaining kind of information (for example: computer games, music, films, series and so on).

Earlier in order to get education at schools and higher education institutions teachers didn't involve learning with computer technology, therefore as a result, it has created certain difficulties during distance learning. Especially the lack of experience has affected the initial phase of online learning.

According to the results of the survey of parents that was held by the office of the education ombudsman during the period from 8 to 13 April in 2020, we can see that only 25% of respondents had online communication with a teacher and in 8% of cases there wasn't any assessment and reports about doing homework at all. The graph below shows that the total sum is more than 100% because it was possible to choose several answers. [5]

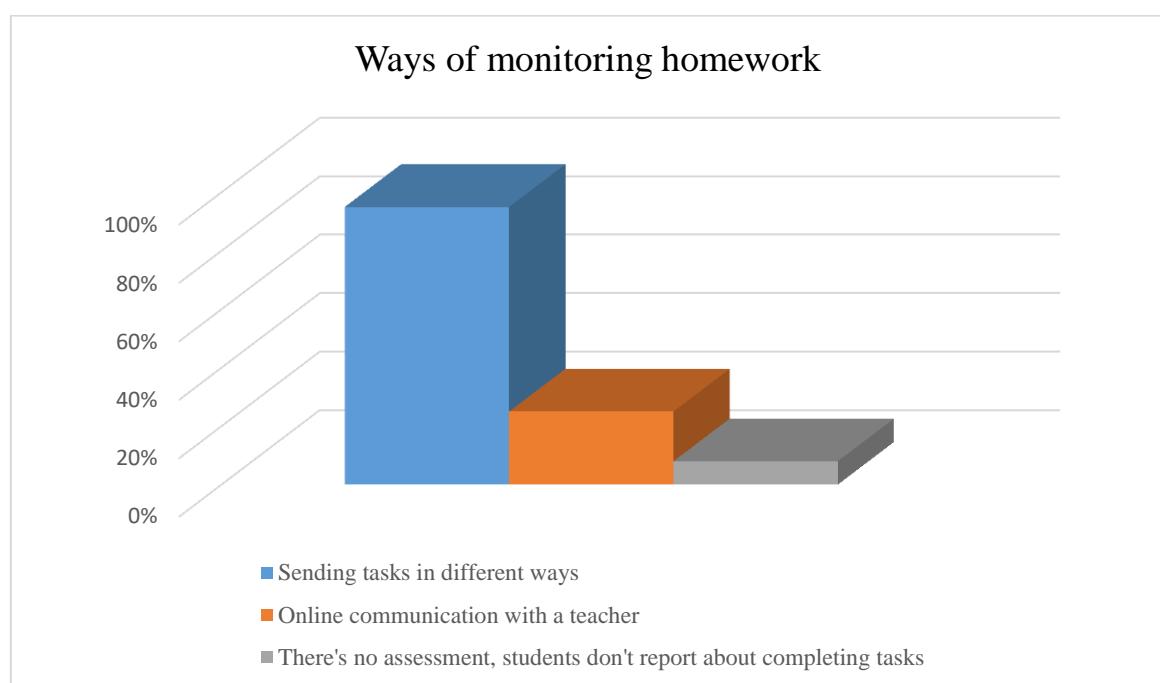


Fig. 1. Ways of monitoring homework

Teachers of higher education institutions have adapted to the innovation more quickly than others. Therefore, in the future during training of teaching staff it's necessary to take into account technical issues, namely computer training. With reference to students in the education program such a course as informatics should be made some changes (for example, training not only such basic programs as Microsoft Word, Power Point and Excel but various hidden functions of programs such as Google Meet, Zoom, Skype and so on).

There have been many technical issues that still exist. One of the main concerns is the Internet. Now and again the Internet isn't available for many students and lecturers, data transfer rate is low or the provider often assists low-quality services. Mobile Internet depends on a package of services, a signal of distribution network and technical properties of a gadget.

Every user has different computer equipment that affects the quality of audio and video signal that creates difficulties in the process of distance learning. There can be various unforeseen circumstances (for example, the absence of power supply).

Educational process includes assimilation of material, its consolidation and verification at certain hours. The education program is based on it. Distance learning can't keep within an ordinary form of learning because time isn't enough in connection with diverse reasons. Therefore, education plans need be reconsidered either in the direction of increase of time for classes or in the direction of compression of material.

Increase of time for classes will lead to a fast fatigue of students that reduces learning of education programs. Compression of material creates a possibility of losing important knowledge that is necessary for a future job of a student. So in this matter it's necessary to find the middle ground.

At the beginning of distance learning schools and higher education institutions had a problem with the lack of learning platforms. As is well known, demand breeds supply that's why such platforms started to develop actively and appear new ones. Let's see two examples of the most commonly used platforms:

## **Moodle**

It's a free system of electronic learning that is suited to both the organization of education for higher education institutions or education centres and for corporate learning. It is configured more difficult than other commercial platforms. Many years later a strong community has formed that creates new modules, or plugins, for a platform. A module is a so-called ZIP- archive that adds new functions or changes a design during the installation. Nowadays the system Moodle is translated more than into 100 languages and consists of 1500 plugins. [4]

## **Google Classroom**

It's a free service for schools and high education institutions as well as for non-commercial organizations. In addition, it's available to anyone who has a personal account Google. Due to this service the communication between students and teachers can occur without attending schools or higher education institutions in person. [3]

For the development of distance learning it's necessary that there are many learning platforms and they take into account features of various education programs of schools and higher education institutions. It would be useful if some educational materials were still shown on these platforms after the lockdown. In that way we will be able to adapt students to distance learning that will take its place in the educational process in the future. [2]

This new form of learning has identified poor discipline among students at once, namely low attendance rate, lack of focus, low motivation and infringement of academic integrity that certainly influences on the quality of the educational process. The only way to solve these problems is developing a system of distance learning. Having corrected the mistakes mentioned previously it'll be able to improve discipline between the students and increase the efficiency of distance learning.

**Conclusions.** In a short period of time of distance learning we can draw our preliminary conclusions:

- Distance learning will let teaching staff open their flamboyant and strong sides.
- This form of learning will let new areas in computer technologies improve in the

future.

- Distance learning is a way of the future because this method is perspective and progressive. Even now employers have introduced practices that workers must have certificates about participation in online courses, conferences, symposiums and master-classes because all that is entered into their resume.
- This form of learning lets students improve autonomous decision-making, self-discipline and develop human capacity and personality.

## References

1. Zagviazinskij, V. I. (2008). Pedagogicheskij slovar' / pod red. V.I.Zagviazinskogo, A.F.Zakirovoj. – M.: Akademija – 343p. 2. Kanavo V. «Dostoinstva i nedostatki distacionnogo obuchenija cherez Internet». Available at: <http://www.curator.ru/doplus.html>. 3. Ispolzovanie Google Classroom v obrazovatelnom processe. Available at: <http://ino.rsvpu.ru/programma/> ispolzovanie-google-classroom-v-obrazovatelnom-processe. 4. Obzor 6 platform i servisov dlja onlajn-obuchenija: vozmozhnosti i reshaemye biznes-zadach. Available at: <https://www.ispring.ru/elearning-insights/platorma-onlain-obucheniya>. 5. Rezultaty optyuvannya batkiv «Navchannya ditej pid chas karantynu» sluzhboyu osvitnogo ombudsmena. Available at: <https://eo.gov.ua/2020/04/17/rezul-taty-optyuvannia-bat-kiv-navchannia-ditey-pid-chas-karantynu/>

УДК 27–3 Антоній Великий

## LIFE OF SAINT ANTHONY THE GREAT (AROUND 251 - AROUND 356), AS A SOURCE OF PRAYER

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**Анотація. Кузьменко Є. О. Житіє святого Антонія Великого (блізько 251 – близько 356) як джерело молитви.**

Стаття присвячена актуальним проблемам, що пов'язані з витоками, історією і класифікацією християнських молитов. Житіє преп. Антонія Великого склав свт. Афанасій, єпископ Александрійський у 356–357 pp. (невдовзі після смерті подвижника). У подальшому воно отримало надзвичайну популярність, ставши зразком для написання інших Житій святих, а також було перекладено мовами різних народів. Головна порада, яку преп. Антоній

Великий дає своїм учням полягає у тому, що стаючи на шлях будь-якого подвигу або чесноти її не потрібно вимірювати часом. Важливими аспектами молитви на яких наголошується у Житті є постійність і наполегливість. Преподобний зазначає, що для того, щоб не лінуватися необхідно пам'ятати про смерть, яка може прийти у будь-який час, і суд після неї. Святий проводив час у постійному каятті через те, що пам'ятав свою грішну природу, і що тільки Господь є непогрішним, а також близькість смерті і слова Ісуса Христа, у яких він закликав до покаяння. Преподобний Антоній Великий також не забував благодарити і вдавати хвальбу Творцеві за усі його благодіяння, випробування та виконані—не виконані прохання, щоб не бути «у його очах» не вдячним сином. Важливу роль у житті подвижника відігравала прохальна молитва. Святий говорив, що не потрібно у наших проханнях до Бога просити про тлінні, тілесні речі, натомість необхідно прохати про духовне. Тому спираючись на Священне Писання та Житіє преп. Антонія Великого автор статті розробляє нову класифікацію основних типів і видів молитов: (1) покаянна; (2) благодарствено-хвалебна; та (3) прохальна молитви. Остання містить значну кількість видів (виділені на основі аналізу тексту джерела), серед яких: (1) молитва про захист і збереження від нападів і явлень нечистої сили; (2) укріплення у трудах і випробуваннях; (3) розрізnenня духів; (4) вигнання злих духів із людей; (5) зцілення тілесних хвороб; (6) допомогу у побутових проблемах тощо.

**Ключові слова:** Благодаріння, Бог, Житіє, молитва, покаяння, прохання, хвальба.

**Abstract. Kuzmenko Ye. O. Life of Saint Antony the Great (around 251-around 356) as a source of prayer.**

The article deals with current issues related to the origins, history and classification of Christian prayers. The life of Saint Anthony the Great was written by St. Athanasius, Bishop of Alexandria in 356-357 (shortly after the ascetic's death). It became extremely popular becoming a model for writing other Lives of Saints and was translated into different languages. The main advice of St. Anthony to his disciples is not to measure by time the way of any feat or virtue. Permanency and perseverance are important aspects of prayer that are emphasized in the Life. The Saint notes that in order not to be lazy, it is necessary to remember the death that can come at any time and the judgment after it. The Saint spent time in constant repentance because he remembered his sinful nature and only the Lord was infallible, as well as the nearness of death and the words of Jesus Christ in which he called for repentance. Saint Anthony the Great also did not forget to thank and praise the Creator for all his good deeds, trials and fulfilled – unfulfilled requests, so as not to be “in his eyes” an ungrateful son. Pleading prayer played an important role in the life of the ascetic. The Saint said that in our requests to God we should not ask for perishable, carnal things, but we should ask for spiritual things. Based on the Holy Scriptures and the Life of Saint Anthony the Great, the

author of the article develops a new classification of the main types and kinds of prayers: (1) penitential; (2) thanksgiving; and (3) pleading prayers. The last one contains a significant number of species (selected on the basis of analysis of the source of the text), including: (1) prayer for protection and preservation from attacks and phenomena of evil spirits; (2) strengthening in works and tests; (3) the distinction of spirits; (4) casting out evil spirits from people; (5) healing of bodily diseases; (6) help with household problems, etc.

**Key words:** Thanksgiving, Lord, Life, prayer, penitence, pleading, praising

**General formulation of research and its topicality.** St. Anthony the Great (around. 251 – around 356) is one of the most famous saints in Christianity. He is considered the founder of hermit monasticism, often called the "flower of the Desert". The saint spent most of his life in ascetic deeds (repentance, humility, fasting, prayer, etc.). Information about them can be found mainly in his Life, which was written by St. Athanasius of Alexandria (around 295 - 373) on the basis of personal memories of the ascetic, eyewitness accounts, etc. [8 p. 87]. An important place in the work is occupied by the theme of prayer as one of the main virtues in the spiritual life of man, but despite the fact that Life has been the subject of much research, prayer itself has not been the subject of special study. This work is extremely important for prayer studying because it contains a tremendous spiritual experience and because it is one of the earliest and the most influential examples of biographical works of Christian literature. and therefore a good deal of its characteristics will become typical of the Lives of Saints. In addition to information about the ascetic deeds of the saint, it contains a significant amount of information about the daily life of Egyptian monks of the 3rd – 4th centuries.

The life of St. Anthony the Great was the object of study of a large number of researchers, but it should be noted that they did not focus on the Life of the Saint as a source of prayer [3, p. 659; 8]. Mainly, they focused on the Life of St. Anthony the Great as a source on the history of asceticism highlighting the general aspects of the founder of hermit monasticism life, characterizing issues related to prayer only in passing.

**Setting of the problem and the aim of the article.** The object of this study is

the Life of St. Anthony the Great as a source of prayer. The subject of the study are the types of prayers contained in the Life of the Reverend. The aim of the study is to develop a classification of the main types of prayers in Byzantine Christianity based on the Life of the Holy Ascetic.

Achieving this goal is possible only if the following tasks are performed:

- 1) characterize the concept of prayer in the Life of Prep. Anthony the Great;
- 2) identify the main types of prayers, based on the Life of the ascetic, as well as analyze and characterize them.

The scientific novelty of our work is to develop a new classification of the main types of prayers in Byzantine Christianity on the basis of the Holy Scriptures and the Holy Tradition of the Church (hagiography (Life of St. Anthony the Great) and theological works). Also, the scientific novelty of our article is to determine the role and place of prayer in the life of St. Anthony the Great and the Egyptian ascetics of the end of the 3rd – the first half of the 4th century.

## **Discussion and Results.**

### **The Life of St. Anthony the Great as a historical source.**

Saint Anthony the Great (around 251 – around 356) is considered the founder of hermit monasticism [3, p. 659]. Information about his life is contained mainly in the Life written by St. Athanasius of Alexandria (around 295 - 373), according to A.A. Voitenko, approximately in 357, while Robert C. Gregg notes that the possible time of writing the Life of the Saint is 356 [3, p. 659; 9, p. 2-3]. Information about the life and exploits of the monk can also be found in the Greek versions of Αποφθέγματα των ἁγίων γερόντων (literally "Sayings of the Holy Elders"), or "Alphabetical Paterik", a Coptic collection of speeches by St. Anthony the Great, "Lavsaika" St. Palladium, Ep. Eleonopolsky, "History of the Monks" by Rufinus of Aquileia, in the work of Blessed Jerome "About famous men", as well as in the Arab-Jacobite synaxarium, etc. However, these evidences are largely incomplete and fragmentary [3, p. 659; 4; 6; 9; 10].

The Life of St. Anthony the Great is considered one of the earliest and most influential examples of biographical works of Christian literature. It has a significant

number of features that will become typical of the Lives of the Saints in the future. Literary sources of Life are praise or encomiums, biographies of pagan authors, the Holy Scriptures. The purpose of its writing was to create a model to follow. “The Life” was translated into Latin and Oriental languages.

The important significance of this work is that it testifies to the change of the main type of holiness from martyrdom to monastic and saintly deeds [8, p. 87].

The Life of St. Anthony the Great is an extremely important source in the study of various aspects of the ascetic's spiritual life (fasting, prayer, almsgiving, humility), and the advice he gave to his disciples is invaluable.

### **The concept of prayer in the Life of St. Anthony the Great and general rules for its implementation.**

St. Anthony the Great said that being on the path of any feat of virtue, including prayer, it should not be measured by time (this advice is one of the main that can be found in the Life of an ascetic), and being for a long time in performing a feat it is necessary to exalt oneself, thinking that one has reached a certain peak, or has done something great. the peaks themselves, as a rule, no longer reach) [6, p. 21, 36-37; 9, p. 36-37, 43-44]. You can fast, pray, humble all your life, but you don't get any benefit from it. Why did a person all his life struggled in the above, or in other virtues, and did not receive a reward. The answer can be found in the Gospel of Matthew (Matthew 6: 5) [2, p. 1017].

It states that he who does something to show off or do alms, pray, etc., he already receives a reward on earth in the form of praise from people and so on. That is why such a person will no longer receive benefits in eternal life. Instead, according to the reverend, every day, as if starting anew asceticism, it is necessary to struggle with even greater persistence [6, p. 21; 9, p. 36-37]. St. Anthony did that, fulfilling one of the instructions of the Apostle Paul, which is contained in his epistle to the Philippians (Phil. 3:13) [2, p. 1288].

Permanence and perseverance are very important aspects of prayer as the saint emphasizes. The saint prayed often and for a long time, sometimes all day and night remembering the words of the Apostle Paul [2, p. 1297; 6, c. 12, 15, 39, 111; 9, p. 32-

34, 45, 79]. That is why believers need to pray steadily every day. For this purpose the Holy Fathers developed special morning and evening prayer rules. Failure to comply with them is a serious loss. It is a sin for man, and sin is death. In this context, it should be noted that St. Anthony the Great argued that in order not to be lazy (in the performance of prayer) it is necessary to remember the death constantly that may come at any time and the future judgment after it (1 Cor. 15:31) [2, p . 1259; 6, c. 40; 9, p. 45].

### **Repentant prayer in the Life of St. Anthony the Great.**

St. Anthony the Great remembered well: (1) his sinful nature, and the fact that only the Lord is holy and sinless, instead all people are sinners from birth; (2) the proximity of death; and (3) the words of Jesus Christ, from which He began His sermon: "Repent, for the kingdom of heaven is at hand" (Matt. 4:17), and therefore throughout his life he struggled in repentance, shedding bitter tears day and night. for his sins without any hope for salvation [2, p. 1014; 6, c. 111; 9, p. 79]. St. Ignatius (Brianchaninov) analyzing the above-mentioned quote from the Gospel of Matthew, writes: "The Lord has done everything for our salvation. He reconciled us to God, prepared and obtained for us the Kingdom of Heaven, and therefore there is only one work left for people - repentance... "[7].

Despite the duration of the feat (the Saint was in ascetic works from 18 or 20 years before his death, at the age of about 105), the monk did not think that he had achieved anything, but every day he began his work as if he had not yet undertaken them fulfilling one of the instructions of the Apostle Paul (Phil. 3:13) [2, p. 1288; 6, c. 9, 21; 9, p. 31, 36-37].

### **Thanksgiving prayer of praise in the Life of Prep. Anthony the Great.**

There are many instructions on the necessity of giving thanks and prise to the Lord for everything in the Life of St. Anthony the Great. And there are some examples of these prayers.

St. Athanasius of Alexandria notes that the monk never boasted when his request was heard and he did not complain when the Lord did not answer his prayer, but the ascetic always thanked for everything and praised the Creator [6, p. 99-100,

109, 120, 131-132; 9, p. 73, 78, 83, 88-89].

The reverend also said that thanksgiving and praise for fulfilled or unfulfilled requests and for any good deeds should be given not to him, because he does not give people what they ask, but to God, because the Lord heals him through believers [6 , c. 99-100; 9, p. 73].

### **Prayer in the Life of St. Anthony the Great.**

The life of a saint contains a large number of examples of supplication prayer. St. Anthony the Great gave advice to his disciples on what not to ask for and what to ask for in prayer. In one of his messages he noted that it is not necessary to ask about our bodily needs but it is necessary to focus on the spiritual [6, p. 205].

In his prayers the reverend asked the Lord to strengthen, protect and protect him from demons and evil spirits. All his life until his death the saint was subjected to fierce attacks by demons but the monk had an unshakable faith that the Lord is always near and helps him to survive [6, p. 15-16, 24-28, 31-32; 9, p. 33-34, 38-42]. He often said that in living an ascetic life it is necessary to pray to God to give him the gift of discernment of spirits, because not every spirit can be trusted (1 John 4: 1), and also because demons often came to him under the guise of angels, warriors, women, animals, giants, various household items were called the power of God and tempted him [2, p. 1221; 5; 6, c. 16, 24-25, 28-29, 66, 71-74; 9, p. 34, 38-40, 57, 60-61].

St. Anthony the Great created the sign of the cross together with the prayer, which contained the name of the Lord Jesus Christ in order to be sure of the authenticity or falsehood of the ghosts and visions that appeared to him. The saint was convinced that the name of the Lord and the sign of the cross were intolerable for evil spirits and therefore as soon as he did it the demons in various forms disappeared [5; 6, c. 31, 47, 60, 66, 74, 76, 104, 129; 9, p. 41-42, 48, 54, 57, 61-62, 75, 88].

There are many examples in the hagiographic literature of demons being saints to seduce them even in the image of Jesus Christ (God) as it was with the ascetic Valens (see Lavsaik). Isaac of Pechersk (+1088) and others. [1, p. 26-27; 4, c. 125-128; 10, p. 84-86].

There are many examples of the expulsion of evil spirits from people and healing with God's help and his prayers in the Life of St. Anthony the Great [6, p. 86-87, 100-102, 106-109, 119-120, 131-132; 9, p. 67, 74-75, 77-78, 83, 88-89]. In this context both the saint's prayer and the faith of those who needed to be healed were equally important. An integral part of the saint's prayer during the exorcism of evil spirits was the invocation of the name of Christ because it was intolerable for them, because Jesus Christ according to St. Anthony the Great coming into this world and resurrected made them weak and powerless [6, p. 76; 86-87, 108-109; 119-120, 131-132, 138; 9, p. 62, 67, 77-78, 83, 88-89, 92].

In the course of time when the number of people who came to the saint for help and the number of healings were increased he began to worry about being offended by the sins of vanity and pride. He moved to another place where he was not known, but no matter where he went the fame of his ascetic life and healing caught up with him quickly [6, p. 87-88; 9, p. 67-68].

In the Life of the saint you can find the examples of domestic miracles which became with the help of his prayers. It is worth mentioning the case when in the desert opened a stream, and all the thirsty monks, who were already preparing for death, were able to drink water after the prayer of St. Anthony the Great [6, p. 94-95; 9, p. 71].

The saint did not boast when the Lord heard his prayers and healed people but he did not murmur if he was not heard, but instead called on his spiritual children to be patient. He always explained that it is not he who helps to heal but God [6, p. 99-100; 9, p. 73]. The desire of St. Anthony the Great and other monks to live with modesty without worldly glory and not to exalt themselves above others were their integral feature.

**Conclusions.** Thus, the Life of St. Anthony the Great, which was composed by St. Athanasius of Alexandria in 357, is one of the earliest and most influential examples of biographical works of Christian literature and has a significant number of features that later became typical for the Lives of the Saints and it is an extremely important source in the study of prayer. It contains a known amount of information

about it, including the general rules of its implementation and the problems that often arise when a person prays.

Based on the Bible and the Life of the Ascetic we can propose a new classification of the main types of prayers in Byzantine Christianity: (1) penitential; (2) thanksgiving; and (3) solicitation, as well as a significant number of species of the last one. Its peculiarity is that we give the penitential prayer in it, as the most important for every believer, the first place, although, in the vast majority of other classifications, the first is the prayer of supplication, then there is a prayer of thanksgiving, and the penitential is usually put at the end.

## References

1. Artamonov Ju. A. Isaakij // Pravoslavnaja jenciklopedija pod redakcij Patriarha Moskovskogo i vseja Rusi Kirilla. 2013. T. 27. S. 26-30. 2. Biblija. Svjato-Uspenskaja Pochaevskaia Lavra, 2013. 1376 s. 3. Vojtenko A. A. Antonij Velikij // Pravoslavnaja jenciklopedija pod redakcij Patriarha Moskovskogo i vseja Rusi Kirilla. 2008. T. 2. S. 659–664. 4. Palladij Eleonopol'skij, episkop. Lavsaik, ili Povestvovanie o zhizni svyatyh i blazhennyh otcov. M.: Blagovest, 2013. 384 s.
5. Prepodobnyj Antonij Velikij. Bor'ba svyatogo s diabol'skimi koznjami // Azbuka very. Available at: [https://azbyka.ru/otechnik/Antonij\\_Velikij/](https://azbyka.ru/otechnik/Antonij_Velikij/).
6. Prepodobnyj Antonij Velikij. Zhitie i poslanija. M: OOO «Sintagma», 2010. 256 s.
7. Svt. Ignatij (Brjanchaninov). Pouschenie 1 v Nedelju po Bogojavlenii o pokajanii. Asketicheskaja propoved'. T. 4 // Pravoslavnaja onlajn-biblioteka «Svjatootecheskoe nasledie». Available at: [http://www.biblioteka3.ru/biblioteka/ignatiy\\_br/tom\\_4/txt01.html](http://www.biblioteka3.ru/biblioteka/ignatiy_br/tom_4/txt01.html).
8. Shvec V., arhimandrit, Sorochan S. B. Vvedenie v agiografiju. Har'kov: Majdan, 2018. 368 s.
9. Gregg R. C. Athanasius: The Life of Antony and the Letter to Marcellinus. New York: Paulist Press, 1980. 171 p.
10. Meyer R. T. Palladius, the Lausiac History. New York: Newman Press, 1965. 270 p.

УДК 930:61

# «PROVOCATION ACTIVITY» IN THE RUSSIAN EMPIRE REVOLUTIONARY MOVEMENT: THE HISTORIOGRAPHY OF THE PROBLEM

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**Анотація. Ланько Д.В. «Провокаторство» в революційному русі Російської**

## **імперії: історіографія проблеми.**

У статті проаналізовано історію дослідження «провокаторства» в революційному росії Російської імперії. Охарактеризовано основні підходи, характерні для історичних досліджень цього явища у дореволюційний та радянський період, проаналізовано стан досліджень «провокаторства» на сучасному етапі в українській та російській історіографії. Відзначено, що більшості сучасних російських досліджень властивий розгляд «provocation activity» виключно в контексті методів боротьби поліції проти нелегальних організацій, тоді як вплив цього явища на розгортання революційних рухів в імперії залишено поза увагою. Вказано, що українська історіографія наразі не має комплексних спеціальних досліджень «provocation activity» в українському національному русі імперської доби та його впливу на діяльність українських партій та організацій початку ХХ ст.

**Ключові слова:** агент поліції, історіографія, «provocation activity», провокація, революційний рух,

**Abstract. Lanko D.V. «Provocation activity» in the russian empire revolutionary movement: the historiography of the problem.**

The present article deals with the “provocation activity” study history in the Russian Empire revolutionary movement. The main approaches characteristic of historical research of this phenomenon in the pre-revolutionary and Soviet period are characterized, the state of research of “provocation activity” at the present stage in Ukrainian and Russian historiographies is analysed. It is revealed that most modern Russian studies consider "provocation activity" only in the context of police methods against illegal organizations, while the impact of this phenomenon on the revolutionary movements' development in the empire is ignored. It is pointed out that Ukrainian historiography currently does not have comprehensive special studies of the “provocation activity” in the Ukrainian national movement of the imperial era and its influence on the activities of Ukrainian parties and organizations of the early twentieth century.

**Key words:** «provocation activity», provocation, police agent, revolutionary movement, historiography.

**General formulation of research and its topicality.** The end of the XIX-beginning of the XX century. was a completely new stage of the Ukrainian national movement. Due to its politicization, the persecution of the movement by the authorities intensified and took on new forms. Various methods of covert surveillance, including with the help of internal human intelligence assets, have been actively used by law enforcement agencies of the Russian Empire since the second

half of the nineteenth century against general imperial socio-political movements.

The provocation activity problem has always been in the focus of academic attention, which explicates the topicality of our scientific endeavor, as the relevant study projects were initiated still in the pre-revolutionary period. At that time, it was conducted mostly by lawyers, because it was a phenomenon that actually existed, without having a well-established definition in the Russian Empire legislative system. The main purpose of the research in this period was to find a formal analogy to the concept of “provocation activity” in current legislation. There was a discussion between the lawyers about the provocateurs` actions classification in accordance with the law, determining their accountability before the law for participation in illegal organizations. In particular, one of the controversial issues was the equation of the “provocation activity” with “criminal solicitation”. The term "criminal solicitation" was often used in cases where the accused was a police agent detained along with members of illegal organizations, which he himself had detected [9].

**Setting of the problem and the aim of the article.** During the Soviet period, the history, organization and methods of the tsarist police were studied quite actively. Significant attention was paid to the “provocation activity” [11, 12]. A distinctive feature of the research on this phenomenon during this period was the focus exclusively on Russian parties and organizations. In particular, the methods used by revolutionary figures organizations to identify and neutralize provocateurs were actively studied [14]. The studies of the Soviet period were characterized by the identification of “provocateurs” with all members of the internal human intelligence assets, which coincides with the meaning given to this term by the Russian revolutionaries of the late nineteenth and early twentieth centuries.

In modern Russian historiography, significant attention is paid to the functioning of the political investigation police of the imperial era [6]. The issue of “provocation activity” is also quite popular, in particular in studies of provincial law enforcement [3]. In this connection, the aim of our work is to comprehensively analyze the above phenomenon and to reveal its key peculiarities within the framework of the Russian empire revolutionary movement from the historiography

perspective.

**Discussion and Results.** An important achievement of Russian historiography of the modern period is the return to the discussion of the “provocation activity” concept meaning. In particular, researchers such as Y.F. Ovchenko [5] and A.V. Vikharev [2] analyzed the understanding of this term by various social groups: government officials, the Police Department workers, illegal political organizations figures and commoners. However, the analysis of the commoners` and revolutionaries` position by these researchers was conducted solely on the basis of sources authored by government officials or law enforcement officers. This illustrates the general tendency of modern Russian historiography, which tends to consider “provocation activity” in the police struggle against illegal organizations methods context, ignoring the influence of the phenomenon on the revolutionary movements’ development in the empire.

In modern Ukrainian historiography, the problem of “provocation activity” has been considered mostly in the context of the research focusing on the Russian Empire police history, or on the persecution of Ukrainian political parties and organizations. Separately, the “provocation” as a method of police activity was considered by O.F. Ovsienko [4]. In the context of the study of the Russian Empire government policy regarding Ukrainian political parties and the methods used by the police to obstruct their activities, the problem of “provocation activity” was considered by O.P. Sarnatsky [7], L.V. Stromilyuk [8]. In the context of the history of the tsarist police in general, it was considered by M.G. Shcherbak and O.F. Ovsienko [13], O.M. Bandurka [1], O.M. Yarmysh [15]. However, there are currently no comprehensive special studies of “provocation activity” in the Ukrainian national movement of the imperial era and its impact on the activities of Ukrainian parties and organizations of the early twentieth century.

M.G. Shcherbak, researching the methods of work of the security departments, considers a work of the internal agency and, in fact, a “provocation activity” separately. He does not use the term “provocateur” in a relation to specific individuals whom he cites as the examples of agents. However, he points out that in

addition to monitoring and transmitting information obtained to the security departments, the agents also "imitated the revolutionary movement in the cases when it did not exist". As an example of the "provocation" itself Scherbak offers a situation when the worker's apartment had been bombed before being checked, also he mentions the examples when a certain revolutionary group was created upon an order and supervision of the police department just from the start [13].

The article by O.M. Fedkov "Life and everyday anxieties of the provocateur Joseph Baranovsky" has to be also mentioned, because in Ukrainian historiography this is one of the few examples of a detailed analysis of the particular provocateur activities. Based on archival documents that contain information about the activities of Baranovsky, the author correlates them with information about the work of individual parts of The Ukrainian Social-Democratic Union. This allows us to make conclusions about the extent to which the activities of the provocateur Baranovsky, who not only had passed information to the police but also had actively participated in the work of the Party, influenced the process of persecution of the Ukrainian Social-Democratic Union by the police. Fedkov notes that actually the provocative activity within the Party ultimately led to the cessation of its functioning [10].

In the work "A punitive apparatus of autocracy in Ukraine in the late nineteenth - early twentieth century" O. N. Yarmysh pays considerable attention to the "provocation activity", mostly identifying it with agential work in general. He draws attention to various aspects of how the police used this method, in particular the fact that it was often used by the police in order to be able to detain revolutionaries on a regular basis and thus "earn ordens". It analyzes the work of individual police chiefs in the field of agential surveillance and the documents that regulated their activities. However, although the territorial study of O. N. Yarmysh concerns the Ukrainian provinces, he does not dwell in details on the issue of the activities of provocateurs in Ukrainian parties and organizations [15].

Of great importance for the historiography of this question is the work of O. P. Sarnatsky, dedicated to various aspects of the persecution of Ukrainian political parties by the government of the Russian Empire. In the general context of the study,

he also pays attention to the provocation activity, citing specific examples of the activities of provocateurs within Ukrainian parties, as well as to the consequences that they had led to. However, a detailed analysis of the "provocation activity" as an integral phenomenon was not in the purpose of this study [7].

**Conclusions.** Therefore, since the beginning of the twentieth century, in historiography the two main approaches to the consideration of "provocation activity" were set. The first involves the study of this phenomenon in the context of police activities; the second is a view of "provocation activity" from the retrospective of revolutionary movements. The first approach is currently prevalent in Russian historiography, which is characterized by a narrowing of the meaning of "provocation activity" to the operational and tactical methods used by the police to counter the illegal activities of revolutionaries. For Ukrainian historiography, due to the lack of special research on "provocation activity", it is impossible to determine the dominant direction. Depending on the main purpose of research related to provocative activities, researchers pay attention to both aspects of the problem.

## References

1. Бандурка, В. А. Поліція в Україні: історико-правове дослідження (початок XVIII ст. - 1917 р.) / О. М. Бандурка, В. А. Греченко, О. Н. Ярмиш. Харків: Золота миля, 2012. 616 с. 2.
- Вихарев А. В. К вопросу о «привокации» в деятельности органов политического сыска России в начале XX века // Вестник Чувашского университета. Гуманитарные науки. 2008. № 1. С. 20-23. URL: <https://cyberleninka.ru/article/n/k-voprosu-o-provokatsii-v-deyatelnosti-organov-politicheskogo-syska-rossii-v-nachale-hh-veka> (дата звернення: 16.07.2020).
3. Коновалов Ф. Я. Секретная агентура провинциальных губернских жандармских управлений в начале XX в. (на материалах Вологодского губернского жандармского управления) // Historia Provinciae – Журнал региональной истории. 2019. Т. 3. № 1. С. 86–145. URL: <http://hpchsu.ru/arkhiv/zhurnal-regionalnoy-istorii-t-3-1/sekretnaya-agentura-provintsialnykh-gubernskikh-zhandarmskikh-upravleniy-v-nachale-xx-v-na-materiala/> (дата звернення: 16.07.2020).
4. Овсієнко О. Ф. Привокация як основний метод діяльності царської таємної поліції (1907-1910 рр.) // Проблеми історії України XIX - початку ХХ ст. 2000. № 1. С. 173-192.
5. Овченко Ю. Ф. Привокация на службе Охранки // Новый исторический вестник. Москва, 2003. № 1 (9). URL: <https://cyberleninka.ru/article/n/provokatsiya-na-sluzhbe-ohranki> (дата звернення: 16.07.2020).
6. Перегудова З. И . Политический сыск в России (1880 - 1917).

Москва: Российская политическая энциклопедия, 2000. 432 с. URL:  
[https://www.gumer.info/bibliotek\\_Buks/History/pereg/index.php](https://www.gumer.info/bibliotek_Buks/History/pereg/index.php) (дата звернення: 16.07.2020). 7.

Сарнацький О. П. Царизм та українські політичні партії (1900-1917). Запоріжжя: ЗНТУ, 2006. 709 с. 8. Стромилюк Л.В. Боротьба таємної поліції Російської імперії проти українських політичних партій (1900-1914). Автореф. дис. на здобуття наук. ступеня канд. іст. наук. Київ, 2007. 16 с. 9. Урисон И. С. Агент-провокатор по действующему уголовному праву // Право. Еженедельная юридическая газета. Санкт-Петербург, 1907. № 32 URL:  
[https://viewer.rusneb.ru/ru/000200\\_000018\\_RU\\_NLR\\_DIGIT\\_115603?page=3&rotate=0&theme=white](https://viewer.rusneb.ru/ru/000200_000018_RU_NLR_DIGIT_115603?page=3&rotate=0&theme=white) (дата звернення: 16.07.2020). 10. Федьков О. М. Життя і повсякденні тривоги провокатора Йосипа Барановського (з історії Української соціал-демократичної Спілки РСДРП) // Гуржіївські історичні читання. Випуск 4, 2011. С. 108-110. 11. Членов С. Б. Московская охранка и ее секретные сотрудники: по данным Комиссии по обеспечению нового строя. Москва: Отдел печати Московского совета Р. и К.Д., 1919. 92 с. 12. Щеголев П. Е. Охранники и авантюристы. М.: Издательство политкаторжан, 1930. 160 с. 13. Щербак Н., Овсієнко О. Жандармсько-поліцейські органи на Україні на початку ХХ ст. та основні напрями їх діяльності // Вісник Київського університету. 1992. № 5. С. 23–28. 14. Эренфельд Б. К. Тяжелый фронт: из истории борьбы большевиков с царской тайной полицией. Москва, 1979. 15. Ярмиш О. Н. Каульний апарат самодержавства в Україні в кінці XIX – на початку ХХ ст. Харків: Консум, 2001. 288 с.

УДК 159.99

## ON DEFINING THE CONCEPT OF POSITIVE PSYCHOLOGICAL FUNCTIONING

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**Анотація. Малофейкіна К. О. Визначення концепту позитивного психологічного функціонування.**

Стаття розкриває питання концептуалізації поняття позитивного психологічного функціонування особистості. Показано, що початок концептуалізації цього конструкту припадає на формування гуманістичної парадигми в психології, але і досі поняття позитивного функціонування не визначено однозначно, та, загалом, в науковій літературі вживается безсистемно. Тож метою статті було прояснення концепту позитивного

психологічного функціонування. В результаті теоретично обґрунтовано двофакторну структуру позитивного функціонування.

**Ключові слова:** благополуччя, позитивна психологія, позитивне психологічне функціонування, риси особистості.

**Abstract. Malofeikina K.O. On defining the concept of positive psychological functioning.**

The article reveals the conceptualization of the notion of positive psychological functioning of a person. It has been shown that the beginning of the conceptualization of this issue falls on the formation of the humanistic paradigm in psychology, but still the concept of positive functioning is defined ambiguously and is used unsystematically. Therefore, the purpose of the article is to clarify the concept of positive psychological functioning. The two-factor structure of positive functioning has been theoretically substantiated.

**Key words:** personality traits, positive psychological functioning, positive psychology, well-being.

**General formulation of research and its topicality.** 21<sup>st</sup> century's great turn in psychology is turn from describing what is wrong with a person, where is his or her illness ("negative describing"), towards looking more precisely at what gives a person their power. New type of psychology was called "positive psychology" and appeared on the merge between ages. However, some positive aspects of a person had been started to discuss much earlier, in so-called humanistic and existentialistic directions of psychology.

The main question of this new approach is that what is good for people and how to reach it? It is a formulation of a problem of well-being, which is contrary to position of so-called ill-being psychology. What was that position? There were questions as "What's wrong with a person?", "Why people are violent?", "Where deviations come from?", "How can we treat that deviation?". The central concept of this problem field is positive psychological functioning (PPF). However, there are still a lot of questions about what is PPF, how to define it, what is its structure etc.

**Setting of the problem and the aim of the article.** Since the beginning of psychoanalysis, various variants of abnormal development began to be put forward, as well as their pole – mature personality traits. So, for Freud, mature personality

traits were considered the ability to love and work, for Adler – social interest, for Fromm – the ability to use their forces freely and independently of external control, be guided by reason, see people as they are, mastery of productive love and the presence so called "existential needs", which are a resource of activity for a person [14].

However, all these concepts were focused on the problems of personality development, and not on its strengths, and the mature, positive personality traits comes as subject only with the establishment of humanistic psychology.

The concept of PPF, thus, appeared quite early. The beginning of it we can consider in Roger's "fully functioning person" and Maslow's "self-actualization". Still researchers did not get the unified conceptualization of PPF. However, many articles use this notion with connection to other psychological, social or physiological issues, what produces some kind of confusion and uncleanness.

Therefore, the aim of the paper is to clarify the concept of positive psychological functioning.

**Discussion and Results.** The beginning or better to say the premise of PPF is in humanistic psychology. Thus, Rogers and Maslow criticized all previous psychology for the lack of orientation towards the positive in a person. They put forward their own concepts that described a person from the point of view of his maximum flourishing.

Let us look at Rogers' theory of a fully functioning person. Rogers believed that certain conditions in our environment in early childhood compel us to act in such a way that our parents would approve, and not in the way that our organismic tendency to growth and development requires, thus interfering with the natural desire for the fullest development. But three conditions – unconditional acceptance, empathy and congruence – determine the development of personality (coming from the inside), in which a person is open to experience, lives life in contact with the world, without prejudices, trusts feelings, is creative and generally satisfied with life and feels it completeness [12].

Maslow, however, without constructing a pathological picture at all, described

the features of a self-actualizing person, i.e. a person who realizes his potential most fully. The traits are following: 1) more efficient perception of reality and more comfortable relations with it; 2) acceptance of self, others and nature; 3) spontaneity, simplicity, naturalness; 4) problem centering; 5) the quality of detachment, the need for privacy; 6) autonomy (independence of culture and environment); 7) continued freshness of appreciation; 8) mystic experiences (peak experiences); 9) gemeinschaftsgefühl; 10) interpersonal relations; 11) the democratic character structure; 12) discrimination between good and evil; 13) philosophical, unhostile sense of humor; 14) creativeness; 15) the transcendence of culture, resistance to enculturation [9].

As we can see, this list includes many characteristics that describe the positive aspects of human development, and not just a set of "socially desirable" characteristics, but such which, according to Maslow's observations, are signs (contribute?) to self-actualization as functioning in the most "human" mode. This is another feature of humanistic theories ("positive"): these theories, unlike their predecessors, focus on the most human, spiritual, that was previously practically ignored.

Humanistic psychology became a very influential trend in psychology, and further views and developments (including psychoanalysis itself) were largely transformed thanks to Rogers and Maslow [7].

Trying to generalize all the knowledge that describes the positive pole of human functioning, Ryff in the 80s created the so-called concept of "psychological well-being." In it, she described several factors that contribute to well-being. These are autonomy, self-acceptance, purpose in life, environmental management, personal growth and positive relationships [13].

Around the same time, Diener came up with a concept that was significantly different from those previously described – subjective well-being. Under this concept, he combined the cognitive assessment of life in general (life satisfaction) and the emotional criterion – how much positive emotions prevail over negative ones (affect balance) [4]. Having spread, this criterion of the positive pole of human being has

become the most popular among all.

The previous criteria were more objective, and methodologically traced back to a group of philosophical theories called objective list theories. These theories describe human well-being in terms of specific criteria – the characteristics of either the person himself or his environment. On the one hand, such criteria are easier to control, but their disadvantage is that it is difficult to compile an exhaustive list (it is no secret that many factors affect well-being), besides, their selection is rather subjective (the scientist who composes the criteria is oriented, as a rule, theory), and there is also a question of uniqueness (for some people at a certain period of time, one thing may be important, and for others – another; without considering this, we equalize everyone under the average). Diener's concept avoids all these problems because a person himself evaluates his life and satisfaction with it, relying on internal, subjective criteria, and at the exit gives a generalized self-assessment of how much he “likes to live”.

Another significant step towards PPF the creation of the theory of psychological resources and psychological capital [8]. This line of research focuses on the concept of resources – psychological variables that help one cope with life's difficulties and maintain well-being.

Based on these and related studies, Seligman in the 90s of the previous century proposed a new direction in psychology – positive psychology. In a keynote article from a new journal on positive psychology, Seligman and Csikszentmihalyi substantiated the need to change the focus of psychology from studying various forms of psychological pathologies to exploring positive qualities. Thus, they included three directions in the problem field: 1) the study of positive emotions, 2) the study of positive traits (in particular, strengths of character and virtues), and 3) the study of positive social institutions [7].

As you can see, Diener's research belongs to the first group, and Ryff's and her predecessors to a certain extent to the second. Later, in the new Journal of Positive Psychology, Linley et al. defined positive psychology as “the scientific study of optimal human functioning” [7].

Along with the term “optimal functioning” many authors use the term “positive functioning” as a synonym (see [7], [1]). There are reasons for this. For example, in programmatic articles on positive psychology such as Linley or Seligman, the phrase “positive and negative aspects of functioning” is often used. However, the definition of this term either varies significantly from article to article, or is absent altogether, and now is not clearly enshrined.

Thus, Neff et al. study the relationship between self-compassion and PPF, while they do not give a definition, but present as PPF such variables as happiness, optimism, positive and negative effects, wisdom, initiative in personality development, curiosity and positive poles of the Five-Factor Inventory scales [11].

Kashdan, following Peterson & Seligman, defines PPF as “high frequency of positive subjective experiences, such as being challenged, experiencing autonomy, feeling good, and exercising human strengths such as courage, wisdom, and a sense of humor” [5, p. 791], and the research operationalizes it through positive affect, subjective well-being, curiosity, hope and optimism, reward responsiveness, drive, and fun seeking.

Casellas-Grau et al. define PPF as “a study of the conditions and processes that contribute to the flourishing or optimal functioning” [2, p. 136]. At the same time, they associate flourishing with positive dispositional characteristics such as optimism, hope and resilience. They also point out that PPF usually means “the result of these conditions and processes and it is assessed by asking patients about their positive subjective states like well-being (WB) or happiness” [2, p. 137]. In their study, they divided indicators of PPF into 3 groups: positive dispositional characteristics, positive subjective states (WB and happiness), and positive life changes.

Merino & Privado have developed a scale of PPF, based on the Ryff’s psychological well-being and Hobfoll’s psychological resources theory. This measure included such variables as vitality, creativity, self-esteem, humor, enjoyment, resilience, optimism, purpose in live, autonomy, curiosity, environmental mastery [10].

Laktionova & Matyushina present another side of PPF. They conceptualize PPF through notions “happiness”, “subjective well-being”, “psychological well-being” and “personality well-being”. The following components of PPF were described: 1) emotional (as emotional satisfaction); 2) cognitive (satisfaction with life); 3) personality traits (that participate in shaping person's imagine of well-being); 4) biological (psychophysiological); 5) inter-personal; 6) motivation and needs; 7) self-actualization; 8) moral and ethical; 9) external factors [6].

As we see, some concepts rely on positive, mature, adaptive resources, traits and psychological resources (i.e., on some procedural characteristics of functioning), some on resulting ones (happiness, subjective well-being, satisfaction, etc.). Before moving on to the main thesis, we would like to describe another theory that relates to psychological well-being. Chen et al. discussed the problem of the relationship between psychological (personality traits) and subjective (a person's perception of life) well-being [3]. They concluded that the two types of well-being are strongly correlated at the level of a common construct (global well-being), which means that both constructs have a right to exist.

Given the criticism of Ryff's theory (the structure of its conceptualization is not always confirmed, which means psychological well-being, as she understands, can be described by other constructions), as well as the study by Chen et al., we propose to consider PPF as a two-factor structure: one factor is responsible for the procedural characteristics (psychological well-being, psychological resources, positive personality traits), and the second for some resultant variable (subjective perception of how well life is going). Thus, we define PPF as a combination of psychological resources, positive characteristics of the mind and personality, as well as subjective perception of the results of the work of resources and characteristics, which forms two factors – PPF as an ongoing process and PPF as a result.

**Conclusion.** We have examined the origins of the concept of PPF, as well as its understanding by modern scientists. This concept is conceptualized in many ways, but previous research, in our opinion, covers it only partially. A more structured and complete consideration of PPF has been drawn. This will help creating a single scale

and unifying multiple developments in this problem field, which, in turn, will facilitate the task for further researchers, as well as make it possible to conduct meta-analytical studies. The disadvantage of this study is its exceptional theoretical character. Therefore, the immediate prospect is to test our argumentation empirically.

## References

1. Baer, R. A., & Lykins, E. L. M. (2011). *Mindfulness and positive psychological functioning*. Designing positive psychology: Taking stock and moving forward, 335-348 (in English).
2. Casellas-Grau, A., Vives, J., Font, A., & Ochoa, C. (2016). *Positive psychological functioning in breast cancer: An integrative review*. The Breast, 27, 136-168 (in English).
3. Chen, F. F., Jing, Y., Hayes, A., & Lee, J. M. (2013). *Two concepts or two approaches? A bifactor analysis of psychological and subjective well-being*. Journal of happiness studies, 14(3), 1033-1068 (in English).
4. Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). *Subjective well-being: Three decades of progress*. Psychological bulletin, 125(2), 276-302 (in English).
5. Kashdan, T. B. (2002). *Social anxiety dimensions, neuroticism, and the contours of positive psychological functioning*. Cognitive therapy and Research, 26(6), 789-810 (in English).
6. Laktionova E. B., & Matjushina M. G. (2018). *Teoreticheskij analiz podhodov k issledovaniju problemy pozitivnogo funkcionirovaniya lichnosti: schast'e, psihologicheskoe blagopoluchie, subektivnoe blagopoluchie* [Theoretical analysis of approaches to the study of the problem of positive functioning of the personality: happiness, psychological well-being, subjective well-being]. Izvestija Irkutskogo gosudarstvennogo universiteta. Serija: Psichologija – Irkutsk State University Bulletin. Series: Psychology, 26, 77-88 (in Russian).
7. Leontiev, D. A. (2012). *Pozitivnaja psihologija povestka dlja novogo stoletija. Psihologija* [Positive psychology agenda for the new century. Psychology]. Zhurnal Vysshej shkoly ekonomiki – Journal of the Higher School of Economics, 9 (4), 36-58 (in Russian).
8. Leontiev, D. A. (2016). *Samoreguljacija, resursy i lichnostnyj potencial* [Self-regulation, resources and personality potential]. Sibirskij psihologicheskij zhurnal – Siberian Psychological Journal, 62, 18-37 (in Russian).
9. Maslow, A. (1970). *Motivation and personality*. New York, Harper & Row (in English).
10. Merino, M. D., & Privado, J. (2015). *Positive Psychological Functioning. Evidence for a new construct and its measurement*. Annals of Psychology, 31(1), 45-54 (in English).
11. Neff, K. D., Rude, S. S., & Kirkpatrick, K. L. (2007). *An examination of self-compassion in relation to positive psychological functioning and personality traits*. Journal of research in personality, 41(4), 908-916 (in English).
12. Rogers, C. (1961). *On Becoming a Person: A Therapist's View of Psychotherapy. A Way of Being* (in English).
13. Ryff, C. D. (2014). *Psychological well-being revisited: Advances in the science and practice of eudaimonia*. Psychotherapy and psychosomatics, 83(1), 10-28 (in English).
14. Shtepa O. S. (2008)

*Osobystisna zrilist': Model'. Opytuval'nyk. Trening (monografija) [Personality maturity: Model. Questionnaire. Training (monograph)]. L'viv: Vydavnychij centr LNU imeni Ivana Franka (in Ukrainian).*

УДК 343.1

## JURY TRIAL IN UKRAINE: REALITIES AND PROSPECTS

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**Анотація. Мірзабекова К.С. Суд присяжних в Україні: реальність та перспективи.**

Стаття присвячена дослідженню та аналізу інституту суду присяжних в Україні. Одним з ключових завдань роботи є вивчення процедури розгляду/перегляду кримінального процесу судом присяжних, що є затвердженім правовою системою України, та виявлення недоліків існуючої моделі з фокусом на зміненнях, що є запропонованими. Актуальність цієї розвідки полягає головним чином у тому, що інститут присяжних залишається одним з небагатьох інститутів, що не буди реформованими та переглянутими за все час свого існування, хоча наразі існує очевидна у цьому необхідність. Автор доходить висновку, що головною проблемою ісуючої моделі цього інституту є застарілі правила функціонування та результируча функціональна неефективність. Крім того, залучення суду присяжних сьогодні є, вочевидь, занадто обмеженим.

У розвідці здійснюється комплексний аналіз ісуючої моделі суду присяжних у глобальному скопусі. Реконструйовано модель, що є функціонуючою на Україні, детально проаналізовано процедуру відбору відповідних посаді громадян – потенційних присяжних, права та обов’язки присяжних, існуючі обмеження. Водночас виявлено та розглянуто недоліки ісуючої системи, висвітлено головні питання, які необхідно вирішувати, та окреслено шляхи розв’язання таких проблем. Розроблено системний підхід до імплементації змінень до процедури навчання та відбору присяжних, до спектру їхніх обов’язків, а також до безпосередньо системи інституту як такого. Проаналізовано правові засади такого типу реформування.

Доведено, що система суду присяжних дійсно вимагає реформування. Водночас обґрунтовано той факт, що копіювання зарубіжного досвіду щодо відповідної правової бази, яка не є адаптованою до української реальності, має негативний ефект. Наголошується на тому, що поряд з постійним вдосконаленням необхідно більше уваги приділяти побудові

позитивного іміджу інституту, долучаючи щонайбільше громадян до виконання функцій присяжних, навіть звертаючись до механізмів соціального заохочування громадян.

**Ключові слова:** правосуддя, реформи, слідство, суд, суд присяжних.

**Abstract. Mirzabekova K.S. Jury trial in Ukraine: realities and prospects.**

The article is dedicated to the research and analysis of the institute of jury trial in Ukraine. One of the main tasks of the article is to study the procedure for reviewing criminal proceedings by a jury, which is established by the legislation of Ukraine, as well as to identify the shortcomings of the existing model and consider the proposed changes. The relevance of this study lies primarily in the fact that the institution of the jury remained one of the few institutions that have not undergone reforms and revisions during its existence, although there is an objective need for this. According to the author, the main problem of the existing model of this institution is outdated regulation and its inefficiency. In addition, the use of juries is currently too limited.

The author studies the existing models of jury trials in the world, establishes the model used in Ukraine, analyzes in detail the procedure for approving lists of citizens – potential jurors and their selection for the trial, the rights and responsibilities of jurors, existing restrictions, the procedure for jurors. At the same time, the shortcomings of the existing system are considered, the main problems are identified, and ways to solve them are proposed. There has been designed a systematic approach to the implementation of changes in the procedure for training and selection of jurors, their responsibilities, as well as in the system of the institute itself. Bills on making changes to the existing system are analyzed.

It turns out that the modern jury system really needs to be reformed. At the same time, it was noted that the usual copying of foreign experience and legislation, which is not adapted to Ukrainian realities, will have a negative effect. Moreover, in addition to regulatory improvements, it is necessary to pay attention to building a positive image of the institution and involving as many citizens as possible in the implementation of the functions of the jury, including through the introduction of additional social guarantees for active citizens.

**Key words:** court, criminal proceedings, jury trial, justice, reforms.

**General formulation of research and its topicality.** The main institution for the administration of justice and the protection of human rights in a democratic society is the court. In turn, there is undeniable importance for a fair jury trial. However, at present the main problem of the jury trial in Ukraine is its inefficiency. As Ukraine has embarked on a path of reform, it is necessary to think about making certain changes to the existing procedure for criminal proceedings by a jury, which

explicates the actuality of the present work.

**Setting of the problem and the aim of the article.** The jury trial was conducted by A.A. Solodkov, I.R. Volosko, L.R. Shuval'ska, A.B. Voinarovych, I.E. Slov'ska, V.I. Shishkin, S.O. Ivanytsky and others. In their works, the authors investigate the institution of a jury trial in the constitutional, procedural, historical aspects, as well as analyze foreign experience of the jury trial.

In this connection, the purpose of our paper is to study and analyze the current state of the jury in Ukraine, highlighting specific problems of the existing model of the jury, reviewing the relevant bills and changes proposed to address them, and their evaluation.

**Discussion and results.** There are still a number of problems in Ukraine's judicial system that need to be addressed, and one of them is the functioning of a jury trial.

At present, the jury in Ukraine administers justice on the principles that have existed since Soviet times, when the functions of the jury were performed by so-called lay judges. However, today, according to many scholars, such a system is inefficient and needs to be reformed. According to the Constitution of Ukraine, the people are directly involved in the administration of justice through juries. [1] A jury trial is a form of exercise of judicial power in which non-professional judges participate in the resolution of the case. There are two models of jury trial in the world: Anglo-American and European (continental). [2]

The classic Anglo-American model, as well as its slightly modified variations, have been introduced in the United States, Great Britain, Canada, Belgium, Spain, Russia and other countries.

The peculiarities of such a model are that the competencies of professional judges and juries are differentiated, juries pass a verdict, which is usually unmotivated, and such a verdict can be revoked, as a rule, only in the presence of significant violations of procedural law. The number of jurors in the Anglo-American model is higher than in the European model. The classic number is 12, but in the legal systems of different countries, it may change.

The verdict of the jury in this model is the decision of the jury, which takes it independently, without the participation of professional judges. Thus, the jury answers the question of the guilt of the defendant in the crime. This gives grounds to call them "judges of fact". At the same time, professional judges act as "judges of law" because they determine the specific type of punishment and decide other issues that require special knowledge in the field of law, if the jury has ruled on the guilt of the person. [3]

In turn, the European model is widespread in France, Germany, Austria, Denmark, Italy, etc. It is characterized by the creation of a single panel, which consists of professional judges and jurors, who jointly decide on the fact (on the guilt or innocence of the person) and the law (classification of the crime and determination of punishment). The number of jurors in the continental model usually reaches 7, but this figure may also vary. In this model, jurors and professional judges jointly review the circumstances of the crime, examine the evidence, and then make a decision based on a joint meeting.

The Criminal Procedure Code of Ukraine provides for a jury trial as a special procedure for proceedings in a court of first instance. In accordance with Part 2 of Art. 383 of the CPC of Ukraine the jury is formed at the local general court of first instance. [4] Criminal proceedings are instituted by a jury at the request of the accused, consisting of two judges and three jurors, for crimes punishable by life imprisonment. Criminal proceedings against several defendants are also heard by a jury against all defendants if at least one of them has requested such a trial. Thus, we can say that the European model of jury trial operates in Ukraine.

As of April 22, 2020, the Criminal Code of Ukraine includes only 17 articles that provide for life imprisonment. Such articles are: encroachment on the territorial integrity and inviolability of Ukraine (Part 3 of Article 110); encroachment on the life of a statesman or public figure (Article 112); premeditated murder (Part 2 of Article 115); rape (Part 6 of Article 152); sexual violence (Part 6 of Article 153); terrorist act (Part 3 of Article 258); falsification of medicines or circulation of falsified medicines (Part 3 of Article 3211); encroachment on the life of a law enforcement officer, a

member of a public formation for the protection of public order and the state border or a serviceman (Article 348); encroachment on the life of a journalist (Article 3481); encroachment on the life of a judge, lay judge or juror in connection with their activities related to the administration of justice (Article 379); encroachment on the life of a defense counsel or a person's representative in connection with activities related to the provision of legal assistance (Article 400); resistance to the chief or forcing him to violate official duties (Part 5 of Article 404); violation of the laws and customs of war (Part 2 of Article 438); use of weapons of mass destruction (Part 2 of Article 439); genocide (Part 1 of Article 442); encroachment on the life of a representative of a foreign state (Article 443); mercenary (Part 3 of Article 447). [5]

Therefore, at the moment there are only 17 corpus delicti that can be heard by a jury. In this regard, scientists are debating whether to expand this list.

Part 1 of Article 63 of the Law of Ukraine "On the Judiciary and the Status of Judges" stipulates that: "A juror is a person who, in cases specified by procedural law, and with his consent decides cases in court with a judge or is involved in justice." [6] A juror may be a citizen of Ukraine aged 30-65 who permanently resides in the territory under the jurisdiction of the relevant court and speaks the state language. At the same time, there are certain restrictions: jurors may not include persons recognized by a court as having limited legal capacity or incapacity, who have chronic mental or other illnesses that interfere with the performance of the jury's duties, have an outstanding or outstanding criminal record. penalties for committing corruption offenses and representatives of certain professions (for example, judges, prosecutors, lawyers, notaries, servicemen, deputies). Jurors are not required to know the law.

To approve of the list of jurors, the territorial office of the State Judicial Administration of Ukraine applies to the relevant local councils, which must provide an answer within two months. Lists of jurors are formed of persons who meet all the requirements and have agreed to be jurors. In case the local council does not make a decision on approving the lists of jurors within the specified period, the territorial department of the State Judicial Administration of Ukraine shall address this issue to

the relevant regional council. The list of jurors is approved for three years and revised if necessary. After approval, such a list is sent to the appropriate court.

The right to a jury trial is explained to the accused by the prosecutor and the court. If the accused wishes the criminal proceedings to be conducted by a jury, the presiding judge shall order the summons to summon seven jurors, determined by an automated court document management system from among the persons included in the jury list. [4] The procedure for involving jurors in the performance of duties in court is determined by the Law of Ukraine "On the Judiciary and the Status of Judges". In turn, the procedure for forming a jury for a specific criminal proceeding is provided by the Criminal Procedure Code of Ukraine.

The selection of jurors from among seven persons determined by the automated document management system is carried out after the opening of the court session. As a result of the selection, there are three main jurors and two spare ones. Reserve jurors are permanently in the seats allotted to them during the trial and may be included in the main jury before the verdict is passed if there is a need to replace one of the main jurors. At the end of the selection, the jury takes an oath. The presiding judge must explain to the jury their rights and responsibilities.

According to Part 1 of Art. 386 of the Criminal Procedure Code, the jury has the right to participate in the examination of all information and evidence at the hearing, take notes during the hearing, with the permission of the presiding judge to ask the accused, victims, witnesses, experts, other interrogated persons, ask the presiding judge to clarify the rules of law to be applied in resolving issues, legal terms and concepts, the content of the documents announced at the hearing, the signs of the crime in which the person is accused.

At the same time, the jury has a number of responsibilities. These include: truthful answers to the questions of the presiding judge and participants in the proceedings regarding possible obstacles to his participation in the trial, his relations with persons involved in the criminal proceedings, awareness of his circumstances of the criminal proceedings, and the presiding judge's request for necessary information about myself; observance of order in court. Also, the juror shall not be absent from

the courtroom during the trial, communicate without the permission of the presiding judge with persons who are not members of the court in relation to criminal proceedings, collect information that one hundred criminal proceedings, out of court and to disclose information relating to the criminal proceedings and which became known to the jury in connection with the performance of his duties. If the jury fails to comply with the above requirements, he may be removed from further participation in the criminal proceedings.

Both professional judges and jurors enter the deliberation room. During the meeting, they vote together on all issues under Art. 368 of the Criminal Procedure Code, which includes both "questions of fact" and "questions of law" (as if there was an act in which the person is accused, whether the accused is guilty, what punishment should be imposed, etc.).

All issues are resolved by a simple majority of votes. No member of the jury shall have the right to abstain from voting, except when the question of the measure of punishment is being decided, and the judge or juror has voted to acquit the accused. In the absence of judges from the majority of the court that has rendered its decision, the presiding judge is obliged to assist the jury in drafting the judgment. [4]

Thus, criminal proceedings are conducted by a jury in Ukraine. However, the scientific community and the representatives of the state agree that this system needs significant reforms, because today there are doubts about its effectiveness in the form in which it exists. To address these issues, several bills have been developed that the authors believe will help change the situation.

The main novelties among the proposed changes are as follows. First, the authors propose to expand the list of criminal cases that can be heard by a jury, adding to crimes punishable by life imprisonment, crimes punishable by more than 10 years in prison. It is also proposed that a jury be appointed automatically to hear such criminal cases. And only at the request of the accused will the case be considered not by a jury, but by a panel of three judges. [7]

Increasing the competence of jurors in the number of criminal proceedings they have the right to hear should increase public confidence in the court in Ukraine, as

jurors (i.e. citizens themselves) will play a key role and have a significant impact on justice in key categories of cases. Therefore, the democracy guaranteed by the Constitution of Ukraine will also extend to the judiciary.

The next change is to form jury lists based on voter lists, as jury lists are now approved by local councils with the consent of the citizens themselves who want to become jurors, creating a shortage of jurors in Ukraine. There is a problem of non-involvement of citizens and their lack of motivation. According to the drafters of the bill, this problem can be solved by turning the right of a citizen to be a juror into a duty.

However, in our opinion, there are some additional problems. Although a juror is not required to have a legal education, a person's basic understanding of what he or she is doing is essential for the administration of justice. There is not enough brief explanation by the presiding judge of the rights and duties of the jury. The general legal ignorance of our citizens and misunderstanding of the processes taking place during the trial can pose a serious threat to justice.

This problem could be solved by introducing the obligation to take special training courses, which would explain to potential jurors the procedure, the crucial role of the jury in the administration of justice, give an understanding not only of actual responsibility for certain violations, but also moral responsibility to society. Otherwise, such a change in the system can backfire: instead of comprehensive consideration and a fair decision, the crowd effect can be reproduced, when only 1-2 jurors have real influence and their own opinion, and everyone else simply agrees with the most confident and charismatic individuals or makes decisions based on their own sympathies.

However, the actual organization of such courses will also have a number of issues that will need to be addressed, such as whether to pay individuals for the time spent on the courses. Nor will employers be happy with the dismissal of their employees, despite the obligation to dismiss a juror while performing his or her duties in the administration of justice.

The next change will be to increase the number of jurors from 3 to 7 and

reduce the number of judges from 2 to 1. At the moment, the jury is not actually an independent unit in the process. They are constantly under the influence of two judges, do not consult independently and cannot make their own decisions. In addition, in the modern format, judges make up almost half of the panel - 2: 3 and have a significant vote. Increasing the number of jurors to 7 aims to guarantee their independence from the influence of judges. Also, in the case of reform, the jury will sit separately and will not pass a verdict, but a verdict - a jury decision on guilt or innocence those of the defendant in the commission of a criminal offense. [8]

So, we can say that it is proposed to change the model of the court to the classic Anglo-American. Of course, under the conditions of Ukrainian realities one can simply copy a model that is successfully operating in other countries. [9] We need to tailor change to our culture and society. But despite the fact that this initiative has many nuances and needs many refinements, the main direction of change is clearly positive.

**Conclusions.** The modern jury system really needs to be reformed. However, among the proposed improvements, along with unequivocally positive ones, there are rather ambiguous proposals, for example, a proposal to turn a citizen's right to be a juror in criminal proceedings into a duty. Of course, we can cite the experience of many countries that actively use such a system, but it is still debatable how this novel will be perceived by society. Therefore, such rules should be introduced with some caution.

It is also necessary to pay attention to creating a positive image of the jury. It is essential to create conditions so that the duty was sufficiently honorable and its performance was reimbursed. The law now provides for monetary compensation for the work of a juror, and the employer is obliged to dismiss the juror, with all benefits and guarantees at the place of work, for the duration of his duties in the administration of justice. But obviously this is not enough to motivate citizens to become jurors at their own free will.

## **References**

1. Constitution of Ukraine of June 28, 1996 № 254k / 96-VR URL:

<https://zakon.rada.gov.ua/laws/show/254к/96-вр> 2. Solodkov, A.A. Modern world models of jury trial. Scientific Bulletin of the International Humanities University. Ser.: Jurisprudence. 2014. №10-2 Volume 2. P. 133-135. 3. Grubinko, A.V., Yarchuk, N.M. Problems and prospects of introduction of jury trial in the judicial system of Ukraine: foreign experience and domestic practice. Legal scientific electronic journal. 2014. №1. P. 11-15. 4. Criminal Procedure Code of Ukraine: Law of Ukraine of 13.04.2012 № 4651-VI URL: <https://zakon.rada.gov.ua/laws/show/4651-17>. 5. Criminal Code of Ukraine: Law of Ukraine of April 5, 2001 № 2341-III URL: <https://zakon.rada.gov.ua/laws/show/2341-14>. 6. On the Judiciary and the Status of Judges: Law of Ukraine of June 2, 2016 № 1402-VIII URL: <https://zakon.rada.gov.ua/laws/show/1402-19>. 7. On Amendments to Certain Legislative Acts to Ensure the Participation of Jurors in the Administration of Justice: Draft Law of Ukraine of 16.01.2020 № 2710-1 URL: [http://w1.c1.rada.gov.ua/pls/zweb2/webproc4\\_1?pf3511=67835](http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=67835) 8. On the jury trial: Draft Law of Ukraine dated 12.07.2020 № 3843 URL: [http://w1.c1.rada.gov.ua/pls/zweb2/webproc4\\_1?pf3511=69465](http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=69465) 9. Karpenko M.I., Bandurovich A.V. Jury trial in Ukraine. Legal science. Criminal procedural law. 2013. №6. P. 53-59.

УДК 304.2

## **PERCEPTION OF ONE ASPECT OF M. MCLUHAN'S MEDIA THEORY – "GLOBAL VILLAGE" IN THE PRESENT**

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**Анотація. Мітіна В.В. Сучасне сприйняття одного з аспектів медіа-теорії „глобального села” М. Маклюена.**

У заключній частині "Галактики Гутенберга: створення друкарської людини" канадський комунікатор передбачає занепад книжкової культури, замість якої виходять електронні носії інформації. Історичні джерела сходяться на думці, що для людей рукописної культури, які мають можливість висловити критичну точку зору на питання дослідження, не дивно, що розширення наших різноманітних органів чуття відбувається за допомогою електрики. Спираючись на власні теоретичні погляди М. Маклюена, які зазначаються в книзі «Галактика Гутенберга», ми бачимо, що розширення наших почуттів, а саме виведення їх у суспільство, в свою чергу, залежить від швидкого розвитку нанотехнологій.

**Ключові слова:** М. Маклюен, засоби масової інформації, всесвітня павутинна, інформація, світова спільнота.

**Abstract. Mitina V.V. Perception of one aspect of m. McLuhan's media theory – "global village" in the present.**

In the final part of "The Gutenberg Galaxy: The Making of Typographic Man", the Canadian communicator foresees the decline of the book culture, instead of which comes the electronic media. Historical sources agree that for people of manuscript culture, who have the opportunity to express a critical point of view on the research question in writing, it is not surprising that the expansion of our diverse senses occurs through electricity. Based on M. McLuhan's own theoretical views, which are noted in the book "Gutenberg's Galaxy", we see that the expansion of our feelings, namely bringing them out to society, in turn, depends on the rapid development of nanotechnology.

**Key words:** M. McLuhan, mass media, world wide web, information, world community.

**General formulation of research and its topicality.** According to M. McLuhan, a famous Canadian scientist, with the process of emergence and development of audiovisual communication such as film, television, radio, telephone, photography, the dominance of the printed word finished and the revival (at another level) of oral culture and natural perception of the world begins but with the help of electronic media. In Gutenberg's Galaxy, he writes: "... under the influence of electrical technology, we become like people of primitive culture in our ordinary daily experiences and actions. This influence penetrates us not through our thoughts and thoughts, to which we have learned to be critical, but through our daily sensory life, where the matrices of our thinking and behavior crystallize." [1]

Another issue is the timeliness and quality of the media's response to events that take place in their truthful coverage. No wonder they say: "Enlightened - means armed." But if reliable information is silenced, then the consequences can be irreparable. And all because any information can become both an elixir of life, and a terrible poison. But M. McLuhan also foresaw the perceived danger of the future global flourishing of the Internet and highly developed modern technologies, spreading to the peak of popularity and began to manipulate humanity more effectively, which is completely a negative factor in the modern stage of civilization.

**Discussion and Results.** No wonder the theorist introduced the concept of "global village" to reflect the essence of the new communication situation, and

subsequently cultural, formed as a result of the promotion and introduction of electronic social networks, the world system of integrated networks - the Internet. Every day, people communicate and, thanks to the advent of electronic media, instantly exchange information and news from any continent to a specific part of the world, ignoring the vast distances between them, because on the Internet - the physical distance between individuals plays a significant role. The globe, populated by countless people, can be compared to an interactive global village. Undoubtedly, one of the most significant advantages of the globalization of information processes of the Internet resource is the improvement of the speed of online dissemination of information among the population, which can be easily found on any website, as well as analyze and respond to diverse situations in the world. countries.

"Modern people don't live in divided isolated worlds but in the pluralism of worlds and cultures – the discovery of electromagnetic waves has again created a" field of simultaneity "in all human activities, the human family now exists in a global village"; "We live in the only limited space where you can hear the sounds of tribal drums" - this is what the philosopher said about the new electronic platform, which was formed through the transformation of written and printed means of communication into television and mass media. Later McLuhan called this process a metaphorical expression - "global village". [ 2, 3]

Mr. M McLuhan introduced this concept to reflect the new communication and cultural essence that was formed as a result of the introduction and propagation of the world wide web - the Internet and social media networks.

Everyday people exchange information and news instantly, despite the distance between them, thanks to the advent of electronic media. That is why the globe inhabited by countless people can be compared to an interactive global village.

One of the most significant advantages of the globalization of information processes of the Internet resource is the acceleration of online dissemination of information. It can be easily found on any website and respond to diverse situations in the country or world.

However M. McLuhan was also aware of and foresaw the dangers of the future

global flourishing of the Internet, highly developed modern technologies which after its spread became an effective means of manipulating humanity.

Unfortunately, along with the desired broadening of the horizons and knowledge of the consumer of information, electronic networks litter the human mind. And the biggest problem is that most people don't notice the difference between using Internet resources to find useful information and a waste of time.

Today not only young people but also other generations are actively flowing into the wide information space using it in various spheres of life, from learning to everyday life. We solve a significant quantity of daily tasks even without leaving home, thus making our lifestyle less mobile. It is still negatively associated with the physical health of the nation. Also, offline communication "face to face" is often replaced by virtual, which gives several socio-psychological problems: conflict behavior, depression, difficulty adapting in society, the emergence of discomfort in the absence of Internet access, and more.

A great role is also given to the freedom of media response on the stage, to see the truthful visibility. It's not for nothing that it seems: "The information is out of shape." And from if the information is reliable, then the inheritance may be wrong.

One more problem of the rapid evolution of this phenomenon is the contribution of the "global village" to various interethnic and intercultural conflicts, cultural fragmentations, or cultural predominance of leading countries with higher economical and social development levels than countries under development process.

According to world statistics, one of the leading positions in the ranking of the most communicatively developed continents is occupied by the United States and Europe. American statistics show that approximately 79% of the population continuously use social networks and Internet resources. The situation is similar in Europe - 76% of Europeans have a fixed connection to the high-speed "world wide web".

Today we certainly have a great influence of the United States in making important decisions on the course and resolution of conflict situations, which, unfortunately, are developing in the modern world and are based on different bases.

For example, religious (Israel and Pakistan), economic (Qatar and UAE), military (Ukraine and Russia).

It is through the dissemination of operational information from emergencies that geographical distances are disappearing at lightning speed and important global management decisions are being made, despite the territorial remoteness from the point of conflict.

However there are places where the concept of "global village" is not correct to apply in practice. For example, in African countries such as Kenya and Tanzania, where wild tribes have survived to this day, the development of modern communication technologies and mobile communications has not reached a certain level, and the ability to transmit relevant information is virtually absent, so news of any internal events in these territories are spreading among the world community at a much slower pace and, as a result, their processing and decision-making is carried out in other time parameters, slower.

**Conclusions.** Therefore to better understand the level of impact of modern information technology on the world community, we can propose to supplement the theory of "global village" M. McLuhan by applying the analogy with the real village and the different degrees of street lighting in it. Illuminated streets in the "global village" can be considered countries with modernized media facilities and interactive communications. Instead unlit streets are areas with limited access to electrification, the use of computers, electronic communications and other media resources.

## References

1. Grabowska K. Concept of the "global village" by GM McLuen. Collection of theses of the international scientific conference for young students and students "Philosophical vimir technology" (30 leaves - 1 breast, 2016), 2016 - pp. 41-42.
2. Hendricks Beth Marshall McLuhan & the Global Village Concept Retrieved – 2018. Available at: <https://study.com/academy/lesson/marshall-mcluhan-the-global-village-concept.html>.
3. McLuhan Marshall The Gutenberg Galaxy: The Creation of Human Printed Culture. - K.: Nika-Center, 2003 .-- 432 p. Available at: [http://yanko.lib.ru/books/media/mcluhan=galaktika\\_gutenberga.pdf](http://yanko.lib.ru/books/media/mcluhan=galaktika_gutenberga.pdf).

## **LEGAL ERRORS IN JUDICIAL PROCEDURE BASED ON ANALYSIS OF US CASE LAW**

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**Анотація. Мицавка Ю.Ю. Юридичні помилки при здійсненні правосуддя на основі аналіза прецедентного права.**

Аналіз статті свідчить, що допущення юридичної помилки при здійсненні правосуддя є безумовною шкодою не лише авторитету судової влади, але й правам людини, інтересам суспільства та держави в цілому, оскільки це не відповідає меті правосуддя – забезпечення справедливості. В Україні, як і в будь-якій системі правосуддя в іноземній країні, судді можуть допускати юридичні помилки при здійсненні правосуддя. Стаття зачіпає проблеми реалізації конституційних прав людини у сфері здійснення правосуддя та відсутність доступного правового механізму виправлення правової помилки при відправлення правосуддя, в тому числі, якщо правова помилка є очевидною або надзвичайно критичною.

**Ключові слова:** судова помилка, суддя, правосуддя, прецедент, правопорушення.

**Abstract. Mytsavka Y.Y. Legal errors in judicial procedure based on analysis of us case law.**

The paper shows that making a legal mistake in the administration of justice is an unconditional damage not only to the authority of the judiciary, but also to human rights, the interests of society and the state as a whole, as it does not meet the goal of justice – justice. In Ukraine, as in any system of justice in a foreign country, judges can make legal mistakes when administering justice. The paper touches upon the problems of realization of constitutional human rights in the field of justice and the lack of an available legal mechanism to correct a legal error in the administration of justice, including if the legal error is obvious or extremely critical.

**Key words:** judicial error, judge, justice, precedent, judicial misconduct

**Setting of the problem and the aim of the article.** The study was based on statistics, information from the annual reports of the organization for monitoring the observance of ethical rules, the results of a scientific study by US scholars (S. Gray, W. Roch) on legal errors in US justice and US case law.

The purpose of this study is to clarify the views on the legal errors of the US judicial system and to determine the approach of American scholars to a doctrinal understanding of this negative phenomenon.

**Discussion and Results.** The structure of the American judicial system is quite complex, because its construction depends primarily on the administrative-territorial structure of the country. As you know, the United States of America is a federal state, which consists of 50 subjects of the federation and one federal district of Colombia. The function of justice in the United States is vested in state courts (district courts), appellate courts, and the Supreme Court. There are 94 counties in the United States, which are grouped into 12 regional ones. There are district courts in each district (94 of them, respectively), and in each regional district there are appellate courts (12 of them, respectively). Supervision of a judge's compliance with ethical rules of conduct is the responsibility of overseeing the conduct of judges, which are established and operate in each state (they may be named differently in each state). From the analysis of statistical research [p. 1245-1246; 14] it follows that the main problem for disciplinary hearings in the United States remains the applicants' misunderstanding of their main function - to verify the legitimacy of a judge's ethical conduct and to comply with procedural rules for the administration of justice. At the same time, most of the applicants interpreted the disciplinary body as an opportunity to review the court decision rendered in the completed case. These conclusions are based on the analyzed annual report of the Commission for the Supervision of the Conduct of Judges of Texas [p. 18; 1], according to which 88% of the applicants' complaints were rejected, of which: 1) 62% of applications were clearly unfounded, as established by the results of the previous inspection; 2) 26% of applications were rejected due to the closure of disciplinary proceedings at the stage of preliminary investigation. Inadmissible complaints can be divided into the following groups: 1) complaints filed against the commission by judges of actions that cannot be considered by a disciplinary body within the limits of its powers; 2) complaints that have the character of an appeal (actual review of the court decision in order to reassess the evidence and already established facts, verification of the

decision for legality, etc.); 3) clearly unfounded complaints, ie complaints, the content of which allows to conclude that there are no signs of a disciplinary offense before the violation of the procedure for bringing a judge to disciplinary responsibility; 4) unfounded complaints, ie complaints that do not contain sufficient evidence to establish that a judge has committed an offense. According to a study by the Maurice A. Dean School of Law at Hofstra University, in the administration of justice, judges commit violations of rules of conduct of a rather varied nature; sometimes their actions are "unusual" or even extraordinary. For example, in the case of the review of disciplinary proceedings against Municipal Judge A. Eugene Hammermaster [2], the Supreme Court of Washington found that during the trial of twelve defendants, they were asked to pay a fine on time or be imprisoned for life. During the hearing, the judge admitted that he was aware of the lack of a sanction for late payment of a fine in the form of life imprisonment, as well as the lack of such powers of a municipal judge. However, for his defense, he argued that he justified his action by seeking to influence the accused in order to prevent the consequences of evasion, and also wanted to warn the defendants of the serious consequences of taking actions to avoid responsibility. The judge noted that the law provides for freedom of communication between the judge and the participants in the process, one of the defining elements of which is the freedom to choose certain arguments. The court agreed with the defendant judge on the part concerning freedom of communication with the defendants, but rejected the rest of the arguments. The Supreme Court emphasized that intimidation or threats against defendants or other participants in the case, regardless of the purpose of such conduct (prevention of other offenses, incitement to procedural conduct, etc.), is a clear abuse of power, even if the judge considers these methods to be the only means of enforcement. procedural order and statutory rules. The judge noted that he was independent in the administration of justice, so bringing him to justice by imposing a sanction was an encroachment on the independence of the judiciary. The Washington Supreme Court rejected his objection on the grounds that judicial independence did not allow a judge to use intimidation or threats as tools to ensure a fair trial. The respondent judge

argued that all judges are independent of any influence by any other subject of law, even a disciplinary body, because they cannot be sanctioned for decisions made under Article 3 of the US Constitution.

However, the US Supreme Court has emphasized that Article 3 of the Constitution is not to be construed as equating the status of a judge with that of an "absolute monarch". A judge cannot and should not restrain his conduct only through possible appeals of his decisions. If Article 3 of the Constitution were interpreted in the sense in which it is interpreted by the respondent judge, everyone would lose understanding of the reason why there can be no legal mechanism for disciplinary proceedings within the judiciary, but only for appellate proceedings. The court recalled that disciplinary hearings do not review court decisions. They are designed and operated to prevent legal errors on the part of judges in future trials, while the appellate review is designed to ensure a fair hearing within the ongoing process for certain participants in the case. In a disciplinary case against Judge James Best, [3] the Louisiana Supreme Court ruled that the judge had exceeded his discretion. In the circumstances of the case, the judge invited all those present in the courtroom to rise if they considered the defendant guilty of a legal offense. In the disciplinary proceedings against Judge Ronald Gill, the respondent judge stated in his judgment that all fines should be \$ 1, together with the amount of the court fee of \$ 21. The order was issued ten days after the mayor submitted a plan to the city department that deprived the judge of health insurance payments for non-payment of contributions. Before the order was overturned, nineteen cases were fined \$ 1, although the offenses included robbery, looting, and attacks, not only on civilians but also on police. The Missouri Supreme Court noted that the judge's conduct exceeded his discretion because the judge did not act on his own discretion, but for private gain to force the city's health department to pay for health insurance under violence that was not punishable by a fair sanction. In Rafael v. State, [4] the judge ordered the witness to be imprisoned and placed in a detention cell to secure her appearance at the next court hearing because she abused alcohol, which prevented the defendant's guilt from being resolved without her testimony. The Supreme Court of Alaska [5] ruled that the

judge's actions were illegal because they clearly exceeded his authority. The Supreme Court emphasized that it did not matter which, in the judge's opinion, the participants' conduct was provocative or illegal, as the judge must act within the limits of his legal powers and not exceed them. Standard legal errors include failure of judges to notify defendants of their fundamental rights, sentencing in excess of the sanction limit [7], admitting a guilty plea in a form that does not comply with the hearing procedure [2], conducting absentee proceedings [2], and violating procedural rules of procedure [8], ignoring the law and facts and showing indifference in criminal and juvenile cases [9], accepting a guilty plea without a written form and others [10]. Particular attention is drawn to the category (literally translated) of "gross legal errors". In the Ukrainian grammatical form, this sound is not correct, so it is better to conditionally call this category of legal errors as "critical legal errors". The peculiarity of these categories of errors is the application of exceptions to the general rule, which provide for the inadmissibility of reviewing the final court decision, which has entered into force. In case of a critical legal error, the applicant is given the right to appeal the court decision. "Critical legal errors" is an evaluative concept, the definition of which is not provided for in US law. However, the state supreme courts have developed their own approach to understanding this concept, according to which ignoring constitutional rights is a sufficient basis for recognizing the existence of a critical legal error in the administration of justice. In the case of Judge Preston Aucoin, [11] the Louisiana Supreme Court ruled that there was a critical error of law in his actions, as he ordered a criminal case to be heard immediately after the defendants pleaded not guilty. Due to the short period of court hearings, the defendants were unable to present their line of defense to the court. The Supreme Court ruled that the defendants' right to a defense had been violated, so the Commission's imposition of a sanction on the judge was justified.

In the case of the Mississippi Judicial Conduct Review Commission against James E. Wells, [12] the Mississippi Supreme Court ruled on a critical error of law in a criminal case in which a defendant was found guilty without trial. In the case of the Nevada Judicial Discipline Review Commission v. James Enearl [p. 3; 13], the

Supreme Court of Nevada ruled that there was a critical legal error in the judge's actions, as he, without the participation of defense counsel, canceled the period after which the convict could count on parole. Among other precedents, state supreme courts have identified a critical error of law as: finding a defendant guilty of a crime without a lawyer and in a criminal case that has not been formally opened; sentencing under an invalid law; failure of the judge to take active measures in case of non-payment of the fine; denying the defendant participation in the cross-examination of a police officer; conviction of a person for actions that were not recognized as an offense, etc. [p. 1271; 14]. One of the types of legal errors of a judge, US scholars single out a court decision under the influence of dishonesty. The essence of this category of errors is that the judge, exercising legal powers and making decisions, satisfies a personal selfish purpose, regardless of form and appearance [p. 1265; 14]. Examples are cases of court decisions for revenge or rejection of a request for a jury trial or revenge on a former employer and other cases [p. 1266; 14].

**Conclusions.** The main purpose of the Judicial Conduct Commission is to prevent unfair trials in the future, while appellate courts review judicial decisions and discuss the completeness of the facts and the circumstances relevant to the case. application of legal norms. Given the analyzed case law of US courts, the legal nature of a legal error may be the dishonest attitude of the judge to his duties or the insufficient level of qualification required, at least for the consideration of a certain category of case, including ignorance laws or current changes in the legal framework of the state. In this regard, judicial oversight organizations have developed an approach according to which not every violation of rules by a judge can be the subject of a sanction for non-compliance with formal rules: minor misconduct by judges is not considered within disciplinary proceedings. This is due to the fact that the "mistake" is considered in the philosophical and legal aspect, and not only in the formal (everyone is wrong disciplinary body in considering the application for violation and encourage the assumption of systematic violations, the independence of the judiciary would be in danger"). The disciplinary authorities decided that formal non-compliance with a rule of conduct for judges should be considered in the light of

its content, including the gravity of the violation and the consequences it had or could have led to. Based on this approach, in terms of doctrinal approach and US case law, we can identify the following types of legal errors of US courts: 1) the influence of the judge on the participants in the process with the application of measures that exceed his powers and are not consistent with judicial ethics; 2) improper exercise of discretionary powers; 3) obvious legal error; 4) standard legal error; 5) decision-making under the influence of bad faith; 6) critical legal error; 7) contempt for the participants in the trial. The question of whether a mistake was made in the administration of justice (and its severity) is decided by the state disciplinary authorities individually for each judge, because otherwise (ie in the case of judges being disciplined for every violation of formal rules) this procedure will become a threat. for judicial independence. In our opinion, such an approach is reasonable and logical. Disciplinary proceedings against judges and discussions about the presence of errors in a judge's actions should require, in addition to a detailed procedure, a prior examination of the nature of the judge's conduct and the consequences, including potential, that have led or may have led to such conduct. U.S. scholars emphasize that only in the case of legal errors, the procedure for imposing sanctions on a judge can be violated. In the case of committing an intentional offense, then the decision on the imposition of sanctions is outside the powers of the organization to monitor the judge's compliance with the rules of ethical conduct. Based on the analysis of US case law, it can be established that the distinction between judicial errors and offenses is based on the form of guilt (American legal theory does not operate with such a concept). A legal error can occur if a judge is negligent in considering and making a court decision. It is quite possible to trace this in the above precedents, where judges, using various measures (both legal and non-legal), nevertheless tried to ensure the implementation of the function of justice. A completely different question arises as to how legitimate such behavior was, but it goes beyond this study. The specificity of these precedents is that the departure from the powers was deprived of a systematic nature within a single process, in contrast to the systematic nature of illegal actions within a single trial and against one or more

participants in the case.

## References

1. Hall D. (2020). 2020 annual report State Commission on Judicial Conduct. Available at: <http://www.scjc.texas.gov/about/annual-reports/>;
2. Supreme Court of Washington. (1999). Decision In the Matter of the Disciplinary Proceeding Against A. Eugene HAMMERMASTER, Municipal Court Judge. No. JD # 15. Available at: <https://law.justia.com/cases/washington/supreme-court/1999/985-p-2d-924-0.html>
3. Supreme Court of Louisiana. (1998). In the Matter of Judge James BEST. No. 98-O-0122. Available at: <https://caselaw.findlaw.com/la-supreme-court/1430350.html>
4. Supreme Court of Alaska. (2002). In the Matter of Wilfred Raphael v. State Alaska. No S-8645. Available at: <https://www.courtlistener.com/opinion/1255925/raphael-v-state/>.
5. Supreme Court of Alaska. In the matter of the proceedings pursuant to AS 22.30.011(b) in relation to Dale O. Curda, Judge of the Superior Court, Fourth Judicial District. No S-9907. Available at: <https://www.courtlistener.com/opinion/2632299/in-re-curda/>.
6. Supreme Court of Mississippi. (2000) In the Matter of Miss. Com'n on Jud. Performance v. Neal. No 2000-JP-01062-SCT. Available at: <https://casetext.com/case/miss-comm-on-jud-performance-v-neal>.
7. Supreme Court of Iowa. (2000). In the Matter of the Inquiry Concerning Sandra Holien, District Associate Judge. No 00-0231. Available at: <https://www.courtlistener.com/opinion/1862090/in-re-inquiry-concerning-holien/>.
8. Supreme Judicial Court of Massachusetts. (1979). Inthe Matter OF Margaret C. Scott. Available at: <https://law.justia.com/cases/massachusetts/supreme-court/1979/377-mass-364-2.html>.
9. Supreme Judicial Court of Maine. (1985). Matter of John W. Benoit Jr. 487 A.2d 1158. Available at: <https://law.justia.com/cases/maine/supreme-court/1985/487-a-2d-1158-0.html>.
10. Supreme Court of Louisiana (2000). In the Matter Judge Preston Aucoin. No. 99-O-3084. Available at: <https://www.courtlistener.com/opinion/1626860/in-re-aucoin/>?
11. Mississippi Supreme Court. (2001). In the Matter MississippiCommission on Judicial Perfomance v.James E. Wells.No. 2001-JP-00229-SCT. Available at: <https://www.courtlistener.com/opinion/1859822/comn-on-judicial-performance-v-wells/>?
12. Supreme Court of the State Nevada. (2003). In the Matter of the Honorable James Enearl, Justice of the Peace, East Fork Justice Court, County of Douglas, State of Nevada, Respondent, P. 3.
13. Roche W.(1976). Judicial Discipline in California: A Critical Re-Evaluation. Loyola of Los Angeles Law Review, rev. 192, P. 210.
14. Gray C. (2004).The Line Between Legal Error and Judicial Misconduct: Balancing Judicial Independence and Accountability. Hofstra Law Review: Vol. 32, Iss. 4, Article 11, P. 1245-1280.

# **TECHNOLOGY OF CASE MANAGEMENT IN SOCIAL WORK AS A CONDITION FOR THE FORMATION OF PSYCHOLOGICAL HEALTH OF THE FAMILY**

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**Анотація. Оксененко І.О. Технологія кейс-менеджменту у соціальній роботі як умова формування психологічного здоров'я сім'ї.**

Метою нашого дослідження є виявлення ефективності соціальної допомоги методом «кейс-менеджменту» у порівнянні з класичним методом роботи з точки зору впливу на поліпшення психологічного здоров'я родини. Авторкою розкривається специфіка групи ризику як соціального феномену. Розроблено типологію сімей груп ризику. Розвідка актуалізує проблему вивчення сімейного благополуччя через фокус на ключових характеристиках релевантних моделей кейс-менеджменту. Детально описано стратегії, що детерміновано зазначеною методичною базою, з експлікацією функціонального навантаження технології кейс-менеджменту як підґрунтя створення психологічного здоров'я у домені інституту сім'ї, що аналізується у термінах сучасної антропоцентричної парадигми.

**Ключові слова:** група ризику, кейс-менеджмент, психологічне здоров'я, сім'я, соціальна робота, технологія, типологія.

**Abstract. Oksenenko I.O. Technology of case management in social work as a condition for the formation of psychological health of the family.**

The purpose of our research is to reveal the efficiency of social assistance, using the method of “case-management” in comparison with classical methods from the point of view of expected influence on the improvement of psychological health of families. The author explicates the peculiarities of groups of risk as a social phenomenon. There has been a typology of group of risk families developed. The study actualizes the issue of considering family welfare through focusing on key characteristics of case-management models. Strategies determined by the above-mentioned methodological basis are described in detail with a special emphasis laid on explicating the functional charge of the technology of case-management as the foundation of creating psychological health in the domain of the family institution, which is analyzed in terms of modern anthropocentric paradigm.

**Key words:** case-management, group of risk, psychological health, social work, technology,

typology.

**General formulation of research and its topicality.** One of the most important factors in social development is human health – physiologically and psychologically. Health is a complex phenomenon that combines medical, psychological, pedagogical, social and other components.

The concept of psychological health was introduced by I. Dubrovina who emphasizes that the basis in this respect is the development of personal individuality. I. Dubrovina states that the psychological aspect of this phenomenon, in contrast to medical, sociological, philosophical ones, is that "psychological health", as a characteristic feature of personal manifestations, is determined by the following criteria: the level of emotional, volitional and cognitive spheres of personality, adequate to age; ability to plan their activities; positive self-concept; ability to self-regulate mental states; ability to reflect and empathize; formation of communication skills; self-criticism and independence [1].

O. Losev notices that the personality is such a uniqueness and uniqueness, which is not only the carrier of consciousness, thinking, feelings, etc., but also the subject who relates himself to himself and his environment [2].

The first domain of manifestation and formation of a personality is the family, and quite frankly it can be argued that the psychological health of the family determines the formation and development of psychological health of the child, and the psychological health of adult family members affects the formation of psychological health in a family. All this explicates the topicality of our research carried out within the framework of the modern anthropocentric paradigm in all the complexity and integrity of its facets.

**Setting of the problem and the aim of the article.** Psychological health of a family is considered to be a comprehensive indicator of socio-psychological activities of its members in family relationships, in the social environment, in professional activities, reflecting the psychological well-being of the family. Psychological health ensures normative regulation of the behavior and activities of all family members.

The psychological health of the family reflects the qualitative dimension of the social and psychological-pedagogical processes that take place in it. Therefore, the dysfunction of the family for any reason can lead to a violation of the psychological health of each member. Of course, psychological health in the family primarily affects the development of children and, consequently, the development of future society. In this connection, the aim of the present paper is to analyze the specificity of the technology of case-management in social work as a pre-requisite of forming family psychological health, outlining its perspectives and fields of applicability.

**Discussion and Results.** Maintaining, supporting and preserving psychological health of families can in some cases be complicated by the influence of both external and internal family circumstances. In particular, this applies to families at risk. These include:

- families in which a non-native child is brought up (families of guardians, adoptive parents, in which children are brought up by non-native parents (stepfather or stepmother), foster families, family-type orphanages);
- low-income families;
- large families;
- families raising children with special needs;
- single-parent families;
- young families, etc.

The procedure for identifying families (persons) in difficult life circumstances, providing them with social services and providing social support to such families (persons), approved by the Cabinet of Ministers of Ukraine №896 of November 21, 2013, defines categories of families considered to be potential recipients of social services as at risk families. Potential clients of social service centers include families whose members are: a single mother (father); children separated from their families who are not citizens of Ukraine and have declared their intention to apply to the competent authorities for recognition as refugees; disabled adults and disabled children; persons, including children, victims of violence, abuse and trafficking; parents whose children have been selected without deprivation of parental rights;

parents who have filed for divorce or are in the process of divorce; parents-migrant workers; sentenced to imprisonment or imprisonment for a definite term, or persons who have returned from places of imprisonment or are in places of pre-trial detention; guardians (trustees) of children separated from their families; families in which children are in boarding schools or are registered there.

Comprehensive social and psychological support and support from relevant specialists – social workers, psychologists, rehabilitation specialists, social educators, speech therapists, etc. can be the key to effective assistance in overcoming the crisis in a single family.

With the reform of the system of social services in Ukraine, a fairly new social technology for our society is becoming widespread. It is the method of case management or the case management method. This technology in social work with families has already proven to be an effective way to address a number of issues related to the organization of individual care, which is implemented through the participation of clients in the process of solving their problems and teamwork. Case management is environmentally friendly in supporting customers by communicating and finding available resources to achieve quality and effective results. As a method of teamwork, case management comprises the involvement of various resources and specialists (psychologists, lawyers, teachers and other, directly, family members) in the process of solving the client's life situation.

In our country, the system of providing social services on case management technology was introduced on January 1, 2020, which makes studying the peculiarities of its application, in particular, possibilities of using case management to shape psychological health of families, quite relevant and novel.

According to the outcomes of our investigation, it is crucial to carry out research that intends to determine the effectiveness of social assistance by the method of case management. Research focuses, in this connection, can involve the following:

- existing concepts of mental health and conditions for formation at the family level;
- problems of families in the context of their impact on the psychological health of its members;

- forms and methods of diagnosing the psychological health of the family,
- concepts and principles of work on the case management system in modern social work;
- psychological features of providing social services to families according to the scheme of the main models of case management: intensive intervention, clinical model, model focused on strengths, and universal brokerage model;
- important personal characteristics of the case manager and the results of the study of the impact of his activities on strengthening the psychological health of families on the example of working with families "at risk";
- methods of optimization of social work on case management technology in order to improve the psychological health of family members - recipients of social services.

The subject matter of our research is psychological health of families receiving social services. The object, then, is changes in psychological health of families from "risk groups", social work with which is organized according to case management technology.

The following locations were selected as the research base: Kharkiv Charitable Jewish Foundation "Hesed - Shaare Tikva" (Kharkiv) and Charitable Foundation "Hesed-Nefesh" (Poltava). These funds work to provide social services to various categories of the population, mainly: people with disabilities, the elderly, families at risk.

Hesed-Shaare Tikva has formed a family service that has been operating on a case-management system basis for eight years, has an internal resource infrastructure and covers more than 100 cases per year. Instead, Hesed-Nefesh Charitable Foundation works with families according to the standard scheme of social support.

Preliminary and final testing is planned in families with different types of social support ("traditional" and case management) to diagnose psychological health of families.

**Conclusions.** Summarizing the above, the results we have received allow us to make the further assumptions:

- case management technology is more effective in shaping psychological health

- of the family, compared to traditional methods of organizing social work;
- a condition for the effectiveness of case management is a higher level of involvement of family members in overcoming family problems through the targeted formation of a responsible position.

## **References**

1. Dubrovina, I.V. (2014). *Prakticheskaja psihologija v labirintah sovremennoj obrazovanija*. [Practical psychology in the labyrinths of modern education]. M.: Gnosis.
2. Dubrovina, I.V. (2009). Psichicheskoe i psihologicheskoe zdorov'e v kontekste psihologicheskoy kul'tury lichnosti [Psychic and psychological health in the context of psychological culture. *Vestnik prakticheskoy psihologii obrazovanija*. №3(20), July-September. 44-49.
3. Torohtij, V. S., Prohorova, O. G. (2008). *Psihologicheskoe zdorov'e sem'i* [Psychological health of a family]. St Petersburg: Neva.
4. Zakon Ukrayni «Pro social'ni poslugi» [Elektronnij resurs]. Vidomosti Verhovnoi Radi Ukrayni (VVR). – № 2671-VIII (17.01.2019). Rezhim dostupu do resursu: <https://zakon.rada.gov.ua/laws/show/2671-19>.
5. Pidval'na, Ju. V. (2019). Social'na robota z «sim'jami grupi riziku». Portal naukovih chasopisiv CDPU im. V.Vinnichenka.
6. Oficijnij sajt Case Management Society of America [Elektronnij resurs]. – Rezhim dostupu do resursu: <https://www.cmsa.org>
7. Krivokon', N.I. (2019). *Kejs menedzhment (vedennja vypadku) ta supervizija v konteksti reformuvannja social'nih poslug v Ukrayni. Reformuvannja sistemi social'nih poslug v Ukrayni: problemi ta]*. Chernigiv: ChNTU, Rozd.1. S. 7 – 21.

УДК 811.111'276.6:33

## **BUSINESS ENGLISH: THE FUNDAMENTAL TOOL FOR THE INTERNATIONAL BUSINESS**

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**Анотація. Онищенко В.А. Ділова англійська мова: головний інструмент для міжнародного бізнесу.**

У статті розглядається концепція використання ділової англійської мови, визначаються її особливості, розкриваються її наслідки та вивчається ділова англійська як фактор розвитку у бізнесі. У дослідженні наводяться причини використання англійської мови для розвитку бізнесу. Крім того, зазначається практичне використання англійської мови для ведення бізнесу. Автор дійшов до висновку, що використання саме англійської мови у бізнесі відкриває не тільки нові інформаційні ресурси, а й надає різноманітні привілеї

для подальшого розвитку особистості як керівника та компанії. Подальші дослідження будуть присвячені темі запровадження ведення бізнесу із застосуванням англійської мови на початковій стадії розвитку компанії.

**Ключові слова:** англійська мова, бізнес, знання, міжнародний рівень, переговори, розвиток.

**Abstract. Onyshchenko V.A. Business English: the fundamental tool for the international business.**

The article deals with the concept of using Business English, determines its features, reveals its consequences and studies Business English as an integrated factor for developing one's business activity. The study gives reasons of practical using English for one's business developing. In addition, the practical use of English as a language for running business is highlighted. The author concluded that the use of the English language in business did not only discover new information resources, but also it provided various privileges of the further development for both an individual as a leader and a company. Further research will focus on implementing of managing business with the use of English at the early stages of the company development.

**Key words:** business, communication, development, English, international level, knowledge.

**General formulation of research and its topicality.** According to the amount of native speakers, today the most spread language is Chinese, however it's not common to hear the Chinese language beyond but Chinese communities. Therefore, English is the most widespread language in the world. There is no way to estimate the exact number of English speakers all over the world. It shows that approximately it equals 350 million native English speakers. Moreover, over 400 million people use English as a second language. People cannot assume the significance of English based on the number of how many people speak it. That's why we should take into account the significant use of the English language.

We should note that the main language of news and information in the world is English. This is the language of business and administration. The process of world globalization puts business English on the top of business organization and development relations: 75% of business correspondence, signing contracts between companies from different countries, negotiations, documents and 90% of information

on the Internet are presented in a foreign language. Moreover, English took leading positions in a business environment from the middle of the last century. Due to the different economic sources it can be concluded that today English is used by about 600 million people around the world. More over, today English is officially accepted by 20% of the population. That is why it is useful to enhance your English knowledge.

**Setting of the problem and the aim of the article.** So, scientists F. Sharifian, N. Hornberger and S. McKay paid their attention to English as an international language. Aspects of the international language importance in global teams were revealed in the studies of S. Chen, R. Geluykens and C. Choi.

Researcher P. Rogerson-Revell took his view on using the English language for the international business. V. Bhatia and S. Bremner devoted their several studies to the concept of teaching Business English. A. Kankaanranta, L. Louhiala-Salminen highlighted the use of English in multinational companies. Y. Luo and O. Shenkar considered an international language and organization in a global context in their studies.

So, the analysis of the researches proved that the problem of the possibilities of using Business English as an effective tool for improving the quality of running the international business had not studied yet.

Therefore, today the problem of using Business English as the fundamental tool for the international business is becoming relevant in the process of the world globalization.

The subject of the article is the international business. The object of the article is Business English: the fundamental tool for the international business. The aim of the article is to reveal the possibilities of using Business English as an effective tool for improving the quality of running the international business. The main tasks of research are:

1. The global reasons of using Business English for business.
2. Business English: considerable aspects.
3. The demonstrative privileges of using Business English for the international

business.

**Discussion and Results.** Nowadays it is impossible to assess the fact how fundamental knowledge of the English language is useful for everyone who is interested in doing the international business. So, the knowledge of foreign languages, primarily English, is becoming a prerequisite for the successful development of any person's career and business in general. In the context of the country, the economic transition from industrial production to an innovative economy requires the adult population with excellent English skills that is able to cooperate with foreign companies [3, pp. 321–339].

To clarify the problem, we need to take into account the definition of business English. In general, business English is a form of the English language which especially suits to the international trade, commerce and finance. The following features can be estimated as business English:

- use of special business vocabulary;
- specific form of oral and written speech;
- structure of negotiations, business letters;
- correct use of terms in speech [1, pp. 136–156].

So, it is important not only to learn basics of ordinary English, but also to learn a more difficult version of it if you want to deal with interstate affairs. Speaking English in the business world means learning how to hold back on colloquial expressions or one's fuzzy pronunciation as well as knowing the correct definitions in professional areas such as logistics, numbers, human resources [5, pp. 606–625]. Indeed, one may encounter negotiations or presentations at the stage of business participation. In addition, this stage involves writing official letters, signing contracts with foreign partners, business correspondence. The vocabulary takes a great part in business communication as well as the ability to apply communication skills. Specialists in companies need to know the legal terminology for signing contracts and agreements. It is also important to note that the professional terminology in different branches in the world industry can mean different definitions [2, pp. 679–695].

Even the implementation of English as a method of the business improvement will strengthen the relationship between domestic and foreign entrepreneurs. But it should be noted, that the knowledge of English will be of the great benefit not only in business, but also in a social sphere. In addition, many domestic specialists convinced that the knowledge of English was a bonus for increasing wages.

Moreover, it is considered a good practice for individual entrepreneurs to cooperate with foreign companies, enter the European and world markets, and diversify their activities abroad. At the moment the development for one's business is impossible without the cooperation with foreign partners, suppliers, the participation in international exhibitions and conferences which give great opportunities for advertising products and activities of companies as maintaining the healthy competition and transition to a leading position [6, pp. 1448–1469].

Therefore, there are many options for the company's development - from expanding the number of partners and cooperation with foreign companies to opening branches in other countries. It is easier to promote one's business and conquer markets when the owner speaks English.

**Conclusions.** So, it becomes more obvious every year that the fruitfulness of the business communication is impossible without a confident knowledge of the **Business** English language and its correct use in negotiations, business meetings and presentations at the international level.

Thus, the author concluded that:

1) a leader with his knowledge of English can analyze the Western market independently, learn successful business models and then introduce modern trends in his company.

2) the knowledge of English allows people to understand partners better and run the business without using translators' help. In addition, if you know the specific of the business English it will be easier to communicate with potential partners developing good contacts or expressing one's ideas and intentions accurately using correct grammatical structures and a vocabulary in statements.

3) it is important to attract investments in order to develop any business.

English will strengthen one's ability to engage the investors' and partners' right in your product. In addition, you can defend your development independently and present any project. In this case, the company attracts potential partners' special attention and a negotiation process is fast and efficient [4, pp. 267–269].

## References

1. Алвессон, М., & Кäрреман, Д. (2000). Такінг the лінгвістіс турн ін організатіонал ресеарч чалленгес, респонсес, сонсеуенцес. [Taking the linguistic turn in organizational research challenges, responses, consequences]. *Йоурнал оф Аппліед Бехавіорал Сциенце*, 36 (2). 136–156.
2. Чен, С., Гелуукенс, Р., & Чои, С. (2006). The імпортантце оф лангуаге ін глобал тимс: А лінгвістіс перспективе. [The importance of language in global teams: A linguistic perspective] *Манагемент Інтернатіонал Ревіew*, 46(6). 679–695.
3. Луо, Y., & Шенкар, О. (2006). The мултінатіонал сорпоратіон ас а мултілінгуал коммуніту: Лангуаге анд організатіон ін а глобал контекст. [The multinational corporation as a multilingual community: Language and organization in a global context]. *Йоурнал оф Інтернатіонал Бусінес Студіес*, 37(3). 321–339.
4. Піеккарі, Р., & Тітзе, С. (2011). A world оf languages: Implications for international management research and practice]. *Йоурнал оф Ворлд Бусінес*, 46(3). 267–269.
5. Тензер, Н., & Пуделко, М. (2015). Леадінг асрасс лангуаге баррієрс: Манагінг лангуаге-індуцед емотіонс ін мултінатіонал тимс. [Leading across language barriers: Managing language-induced emotions in multinational teams.] .*The Леадершип Куартерлу*, 26(4). 606–625.
6. Жанг, Л. Е., & Пелтокорпі, В. (2015). Мултіфацетед еффектс оф хост соунтру лангуаге профіціенсу. [Multifaceted effects of host country language proficiency].*The Інтернатіонал Йоурнал оф Нуман Ресоурце Манагемент*, 27(13). pp. 1448–1469.

УДК 342.722

## INTERNATIONAL LEGAL REGULATION OF WOMEN'S HEALTH RIGHT

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**Анотація. Пуряданах Можде. Міжнародно-правові засади гарантування права жінки на охорону здоров'я.**

У фокусі статті – проблема міжнародного правового гарантування прав жінок на охорону здоров'я з акцентом на природі та причинах зазначеного питання. Зазначається, що

у багатьох суспільствах статус жінки та її соціальні ролі розцінюються занадто низько. Таке знецінювання жінки часто приводить до знецінювання її прав, зокрема права на доступ до інформації, адекватне харчування та забезпечення послугами у царині охорони здоров'я, включаючи планування сім'ї, що забезпечується жінці самим фактом заключення міжнародних договорів урядами держав. У скопусі сучасного правознавства з його гарантуванням статевої рівності авторкою розроблено таксономію факторів небезпеки для жіночого здоров'я, які класифіковано як правопорушення щодо жінки. В результаті нашого аналізу зроблено висновок, що можуть спостерігатися поодинокі випадки правопорушень зазначененої групи, зважаючи на недостатній обсяг послуг системи охорони здоров'я, що надаються, необхідної інформації, технологій гідного рівня. Наголошується, що незаможні жінки та жінки молодого віку для підтримки мінімального рівня життя вдаються до виконання низькооплачуваної роботи, часто пов'язаної з екологічними ризиками. Багато з них стають легкою здобиччю на рижах проституції, стають жертвами насилля. Тому надзвичайно важливим з точки зору міжнародного права є питання всебічної охорони здоров'я жінки. Акцентується необхідність стимулювання жінок до проактивного користування своїми правами щодо охорони здоров'я як аспекту функціональної реалізації глобальної культури рівності та демократії ХХІ століття.

**Ключові слова:** жінка, законодавство, здоров'я, міжнародна угода, права людини

**Abstract. Mojdeh Pooryazdankhah. International legal regulation of women's health right.**

The article focuses on the issue of the international legal regulation of women's rights for health and welfare with a special emphasis on the nature and the causes of the problem. It is pointed out that many societies attribute low status to women and their social roles. This "devaluation" of women often leads to denying their rights such as the right to access information, adequate nutrition and health services, including family planning, to which they are entitled by the very fact that their governments sign international agreements.

In terms of modern human rights law, guaranteeing equality between sexes, there is a taxonomy of health disadvantages of women classified as injustices developed. As a result of our analysis, it is concluded that women's rights in the health care sector may be violated due to lack of certain health services, information about health care options, appropriate technology means. Taking into account the fact that today the ranks of the poor are disproportionately filled with single women as heads of households, it is emphasized that such poor women, as well as young girls, resort to coping strategies which include recourse to low-paid jobs in environments fraught with known risks to their own health, and to that of future generations. Many of them are proved to be easy prey to the rising number of prostitution rings, and are victims of violence, accentuated in

crisis periods such as ethnic conflicts and wars. The outcome is that when judging state compliance with human rights instruments relating to health, it is essential that women's health be seriously considered. In this connection, women should be encouraged and supported to take advantage of the many basic human rights and freedoms that empower them to realize their own health goals. Ultimately, one of the key dynamic features of the human rights framework is the possibility of using it in a proactive way in which a culture of equal worth and dignity of all human beings is fostered and the principle of non-discrimination, whether this concerns access to existing goods and services or allowing for participation and freedom of choice, is respected. It is obvious that globally, women need urgent action in this respect.

**Key words:** health, human rights, international agreements, regulations, women.

**General formulation of research and its topicality.** The understanding of "health" in international legal practice is conditioned by the definition of health employed in the Constitution of the World Health Organization (WHO), which was signed on 22 July 1946 and entered into force on 7 April 1948. In broad terms, health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The legal implication of a broad concept of health is that states have duties both to promote health, social, and related services, and to prevent or remove barriers to the realization and maintenance of women's physical, mental, and social well-being. The challenge of securing women's health directs attention not simply to physical and mental health services, but to the justice of the foundations upon which societies function.

The modern era of rights that can be applied to women's health may be said to have commenced with the adoption of the United Nations Charter in 1945. Earlier international instruments addressed the rights of women but did so from a predominantly paternalistic perspective that protected women from such risks as night-time employment. In 1948, the Universal Declaration of Human Rights was adopted by the United Nations General Assembly. It was emphatic in condemning discrimination on grounds of sex, and set forth a network of rights relevant to the promotion and protection of health. The Declaration was developed into international

human rights law by two general Covenants, both adopted by the General Assembly in 1966, namely the International Covenant on Civil and Political Rights (the Political Covenant) and the International Covenant on Economic, Social and Cultural Rights (the Economic Covenant).

The leading modern instrument on women's equal rights, derived from the Universal Declaration, is the Convention on the Elimination of All Forms of Discrimination against Women (the Women's Convention), adopted in 1979. The Women's Convention is the definitive international legal instrument [2; 5; 7] requiring respect for and observance of the human rights of women. This Convention is universal in reach and comprehensive in scope. The Convention is the first international treaty in which Member countries, known as States Parties, assume the legal duty to eliminate all forms of discrimination against women in civil, political, economic, social and cultural areas, including health care and family planning.

The Women's Convention obliges States Parties in general "to pursue by all appropriate means and without delay a policy of eliminating discrimination against women", and in particular "to eliminate discrimination against women in the field of health care in order to ensure ... access to health care services, including those related to family planning" [4. p. 28]. States Parties thereby assume obligations reliably to determine risks to women's health. Means chosen by States Parties to attack dangers to health will be determined by national considerations, such as women's access to appropriate health care, patterns of health service delivery and the epidemiology of women's morbidity and mortality. The emerging international imperative is that the means chosen by states should lead to the promotion and protection of women's health [1] and should enhance the dignity of women and their capacity for self-determination, which explicates the topicality of our paper.

**Setting of the problem and the aim of the article.** At the same time, rights to repeal laws, practices that impair women's well-being are rights that are relevant to women's health. Rights to access health through education and health services are also necessary. When women experience disadvantage in contrast to other members of their families, they will be considered to suffer discrimination because they are

women [3; 6]. When their families or communities are disadvantaged in contrast to others, women suffer compounded disadvantages related to such features as race, class and, for instance, geographical location. The WHO understanding of health transcends the elimination of disease and infirmity, and addresses physical, mental and social well-being. Accordingly, our aim is to reveal and enhance attention to be paid to the full range of human rights that go beyond the provision of medical, nursing and related health services, contributing in different ways and at different levels to the achievement and maintenance of women's health as defined by WHO.

**Discussion and Results.** Therefore, rights relevant to the protection of women's health, include: the right of women to be free from discrimination; rights relating to individual freedom and autonomy, including rights for survival, liberty, security, rights regarding family, and rights to information and education; rights to health care and the benefits of scientific progress; rights regarding women's empowerment, including the rights to freedom of thought and assembly and the right to political participation.

Concerning pervasive neglect of women's health, health is an outcome of a combination of factors. The elements that condition health go beyond physiological factors: gross national product, wealth distribution and access to income-earning capacity and opportunities, availability of and access to educational resources, urban and rural living environment and physical infrastructure, and, for instance, political structures through which individuals and groups can influence distribution of resources that affect health status. Circumstances affecting health can accordingly be analyzed through various statistical indicators of social and economic functioning and at different levels of abstraction.

In some regions of the world, women are seen as relatively insignificant. At the individual level, women are often conditioned to suffer low self-esteem, to accept an inferior status as natural and to find in the birth of daughters a source of failure, apology and distress. Families identify themselves through names often derived from and continued by the male line. Legal, religious and cultural doctrines may reinforce the devaluation of daughters. Devaluation of women of all ages moves beyond

matters of status and spiritual concerns into the area of material interests when daughters cost dowry payments so that they may marry into other families. Money spent on education earns no return for the family when women leave the family on marriage, are unemployable when unmarried, or become outcasts through pregnancy before marriage. Daughters-in-law warrant no investment when they may die through pregnancy, become infertile or suffer infections or disgrace that lead to divorce or abandonment by their husbands. The cumulative impact of women's multifaceted disadvantages and their devaluation within legal, religious and cultural traditions and socioeconomic systems result in many women being denied health as understood by WHO. Their disadvantages spiral downwards, in that their liability to death in pregnancy or to infertility contributes to their devaluation, while their devaluation contributes to poor health and greater liability to illness and premature death. Neglect of women's health in pregnancy and childbirth may be rationalized by acceptance of the natural order or divine will that destines women to liability to death in childbearing.

Thus, there is a real need at national, regional and international levels to improve the prevention, diagnosis and treatment of illnesses in women and to extend research on diseases and conditions that affect women.

Risk factors for poor health can be analyzed by reference to a wide variety of criteria, and women at risk can be classified by such features as age, socioeconomic status, literacy and educational status, family structure and ethnic grouping. A number of features that condition adverse health consequences for women at different points in their life cycle are identified. They are health risks in infancy and childhood; health risks of adolescence; health risks of women at work; reproductive health risks (epidemiological and comparable data show how lack of basic obstetric services, prenatal care and related reproductive health services result in unnecessarily high rates of maternal mortality and morbidity).

In this connection, there is another serious issue. It is violence against women, i.e. physical and psychological injuries caused by violence against women, including assaults by husbands, though in some communities, however, physical force is not

considered a wrongful act and assaultive men attract no stigma or condemnation.

As a result of our thorough analysis conducted, we have come up with principles for the promotion and protection of women's health. They draw on national women's health policies and experience in the development of the Principles for the Protection of Persons with Mental Illness and for the Improvement of Mental Health Care (90) which were prepared under the auspices of the Commission on Human Rights in close collaboration with WHO and adopted by the United Nations General Assembly. Principles on the promotion and protection of women's health could address the following issues: health considerations important to women at different stages of their life cycle; the need to determine the special impact on women of routine health procedures and products; the importance of improving research on women's health requirements; the need to consider women's health requirements and circumstances in the development of research protocols; the importance of basing health policies on the most up-to-date scientific and technological knowledge.

There are also health service factors such as the importance of treating women with dignity and respect, including the provision of adequate information; rights of women as patients and the importance of confidentiality and privacy. At the same time we must take into account conditions affecting the health and well-being of women. They are the importance of ensuring a healthy and safe working environment; the importance of eliminating traditions and practices that have detrimental health consequences for women; the ability to identify and respond appropriately to women who live in abusive environments.

On the basis of the above principles for the promotion and protection of women's health, a set of guidelines might be developed for the legal promotion of women's health in particular areas, such as women's occupational health, health of girls and reproductive health care. For example, guidelines for comprehensive reproductive health laws may be particularly important in view of legal impediments to women's access to reproductive health services. Such laws would encourage reduction of pregnancy-related deaths and sickness, and would provide services that promote reproductive health. United Nations documentation draws on extensive

worldwide evidence to reach the conclusion that "the ability to regulate the timing and number of births is one central means of freeing women to exercise the full range of human rights to which they are entitled".

Women's right to control their fertility through the prohibition of all forms of discrimination against women may therefore be a fundamental key that opens up women's capacity to enjoy other human rights and to achieve the physical, mental and social well-being that is the essence of health.

The poor state of women's health in many regions of the world, including deprived socioeconomic populations, can be seen as one result of women's inability to protect their own interests and those of groups in which women form the majority.

Legislative methods of protecting women's health rights range from recourse to limited international and regional judicial or quasi-judicial processes to the application of broader means of furthering accountability, such as through reporting requirements under international and regional human rights treaties to which they are parties. The application of human rights law at all levels is needed to develop consensus and to crystallize the content of human rights relevant to women's health.

In this connection, our outcome is that there are cumulative ways in which consensus can be developed about the need to remedy the injustices associated with the neglect of women's health. First, international protection: state compliance with treaty obligations to implement human rights is monitored by the committees established under the various treaties. The members of these committees serve in their capacity as experts and not as representatives of governments. There are also United Nations bodies that are established under the United Nations Charter that provide opportunities for exposure of the injustice of the neglect of women's health. The Commission on the Status of Women meets annually and is composed of government representatives from Member countries.

Second, it is regional protection. Regional human rights conventions have been applied only sparingly to violations of women's rights, and even less to rights regarding women's health. There are opportunities at regional levels, however, that do not necessarily exist at international level for the promotion and protection of

women's health. Geographical proximity, cultural similarity and economic interdependence can all facilitate the regional development and application of human rights standards to women's health. Advocates are just beginning to use regional human rights systems to establish legitimacy of women's rights within regional cultures, and a great deal can be done to use these systems for the promotion and protection of women's health (the Council of Europe, for instance, has a Steering Committee for Equality between Women and Men, and the Organization of American States has a Commission on Women). Third, it is National protection. Ethical guidelines, Education and training, Strengthening professional accountability

**Conclusions.** International human rights relevant to women's health are worth little where there are no enforceable duties to make them effective. In fact, international, regional and national legal instruments and institutions offer a variety of opportunities to establish standards for observance of human rights and to hold States to account for levels of respect for human rights that prevail within their territories. Failures to enforce standards of observance may be due in part to institutional defects, but may be due in larger part to lack of initiatives to use available legal mechanisms to identify the low health status of women that constitutes a violation of international human rights law, to enforce legal remedies for violations and to require maintenance of legal standards. It has been proved that current initiatives exist to enhance women's health through human rights law. At the national level, health care associations provide legal services to women to educate them about their legal rights and to advance legal protection of their health and well-being. Internationally, medical associations are developing programs to promote the role of medical ethics in the protection of human rights, educating their members in the role of medical ethics in practice and research. The need for vigorous and sustained scrutiny of women's health status is considerable at national, regional and international levels. Effort for advancement requires resources of many types, including education of health professionals in human rights law and education of human rights advocates in how to acquire and interpret health data and extract legally significant elements. For that matter, health professionals and human rights advocates

should inform advocacy with health data by employing their knowledge of prevailing and achievable practices and the goals of inter-national human rights treaties.

## References

1. African Charter on Human and Peoples' Rights. Organization of African Unity, 1981 (Document CAB/Leg/67/3/Rev.5).
2. Constitution of the World Health Organization. In: Basic Documents, 39th ed. Geneva, World Health Organization, 1992.
3. Convention Against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment. In: Human rights – a compilation of international documents. Geneva, United Nations, 1993: 293.
4. Declaration on the Elimination of Violence against Women, adopted by the United Nations General Assembly, 20 December 1993 (Resolution 48-104).
5. Hannum, H. (1992). *Guide to international human rights practice*. Philadelphia, University of Pennsylvania Press, 1992.
6. Health dimensions of economic reform. Geneva, World Health Organization, 1992.
7. Sherwin, S. (1992). *No longer patient: feminist ethics and health care*. Philadelphia, Temple University Press.
8. Sureau, C. (1989). Activities of the Committee for the Study of Ethical Aspects of Human Reproduction. *International journal of gynecology and obstetrics*, 28, 299-307

УДК 342.4

## THE CONSTITUTION AS A TOOL FOR REFORMING THE ECONOMY UNDER THE CONDITIONS OF TRANSITIONAL DEMOCRACY: UKRAINIAN EXPERIENCE

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**Анотація. Пустовалова І.С. Конституція як інструмент реформування економіки в умовах демократії переходу: досвід України.**

Стаття присвячена аналітичному дослідженю специфічних характеристик Конституції України як механізму реформування економіки у контексті демократичного транзиту, який продовжується у нашій державі. Автор концентрується на компаративному вимірі зазначененої проблеми, висвітлюючи конвергентні та дивергентні риси структурно-zmістової організації Конституції у різних країнах у хронологічному вимірі. На основі проведеної розвідки зроблено висновок про особливості саме українського конституційно-правового регулювання економічної системи з акцентуацією специфіки побудови реформованої економічної системи транзитної демократії на основі системи принципів правової

демократичної держави.

**Ключові слова:** демократія, Конституція, реформа, транзит, Україна.

**Abstract. Pustovalova I.S. The Constitution as a tool for reforming the economy under the conditions of transitional democracy: Ukrainian experience.**

The article is dedicated to analytically studying the peculiar characteristics of the Constitution of Ukraine as a mechanism of reforming the national economy in the context of the democratic transit that is taking place in our state nowadays. The author lays a special emphasis on the comparative dimension of the above-mentioned issue, revealing convergent and divergent features of the structural and content organization of Constitutions in various countries within the framework of the chronological approach. On the basis of the conducted analysis it has been concluded that there are certain distinctive peculiarities that are pertinent specifically to the Ukrainian constitutional and legal regulation of the economic system. Together with this, the peculiarities of building a new reformed economic system of a transit state on the basis of the principles of a democratic country have been accentuated.

**Key words:** Constitution, democracy, reform, transit, Ukraine.

**General formulation of research and its topicality.** In Western democracies the full-scale implementation of the concepts of social power (Italy, France, FRN) and the welfare state (Great Britain, Canada, USA) in the second half of the twentieth century as a subject of constitutional and legal regulation has been substantially enlarged through a wide range of social and economic relations and the corresponding enrichment of the content of the third generation constitutions compared to their forerunners. This process acquired additional stimuli under the conditions of the "socialist tabor" revolution, when the transition of post-socialist states from a monist (unipartisan, non-competitive) to a pluralist (big-partisan, competitive) political systems was accompanied by a transition from a directive and non-competitive to a pluralist political system, from a directive-planned to a market economy. As a result, the fourth-generation constitutions, which were intended to confirm the revolutionary changes that had taken place in the social order of the "old" and "new" democracies, duly emerged, becoming an interdisciplinary scientific research focus for many decades ahead, which explicates the topicality of our work.

**Setting of the problem and the aim of the article.** Such a new approach to

social and economic issues was more concentrated on, and, thus, contributed to the emergence of a new trend in constitutional and legal science, which was called “constitutional economics”. In this connection, the aim of the present paper is to reveal the peculiarities of the functional content of the Constitution as an instrument of reforming economy in the context of transition processes particularly in Ukraine as today this trend is one of the most dynamically developing, focusing on a wider range of problems and developing new political and legal concepts.

**Discussion and results.** In the mid-1990s, in the middle of the radical socio-economic transformations in the countries of Western Europe and the adoption of new constitutions, a debate arose between the so-called “negative” and “positive” constitutionalists on the role of the constitution in the economic transition process.

The representatives of “negative” constitutionalism (B. Weingast [10], D. North [7], etc.) argued that constitutions, being the most important elements of the mechanism of establishing reliable social obligations, give economic subjects the consistency, necessary for the negotiation of investment treaties and long-term contracts, which are vital for the initiation of economic reforms and their success. Such reforms, like any other political activity of the state, are influenced by the time factor, i.e. the presence of a significant temporal lag between the moment of making a political decision at the start of reforms and the moment of receiving the first positive results from the implementation of the decision made. The Constitution, as an act characterized by an increased stability, allows this problem to be solved by increasing the stability of both the political and economic systems and limiting the discretionary power of the state.

In fact, “positive” constitutionalists (C. Holmes, J. Hellman et al.) raise the question of whether such a limited power is able to carry out economic reforms because the scale of tasks associated with simultaneous political and economic transition requires sufficient capacity and flexibility of the state power in order to ensure the implementation of sometimes unpopular political decisions. In particular, Holmes asserts that the magnitude of tasks associated with simultaneous political and economic transition requires sufficient capacity and flexibility of the state power, in

order to pass an important political choice [3]. For his part, J. H. Hellman has been a leader in the field of public administration for many years. Hellman tried to empirically verify whether the pace of constitution-making had any influence on the process of economic reforms in 25 post-socialist countries and assumed that the postponement of the adoption of new post-socialist constitutions did not prevent economic development [4]. His research does not prove that post-socialist constitutions hindered economic reforms, but points to some positive aspects of their influence on economic processes. In general, Hellman's conclusions can be seen as a preliminary confirmation of the arguments presented by negative constitutionalists.

In other words, the first approach is reduced to arguments for the speedy adoption of a permanent constitution as a legal basis for radical political and socio-economic reforms, whereas the other one suggests postponing the process of creating a new constitution until the goals of social and economic transition are achieved or, as an alternative, proposes adopting timecasual constitutions (the so-called "timecasual constitutionalism").

Our internal experience is clear evidence of the transition from "positive" to "negative" constitutionalism. In the first period after the proclamation of Ukraine's independence (September 1991-June 1995) Ukrainian constitutional and legal doctrine in the practice of state building was dominated by "positive" constitutionalism. It was first manifested in the attempts to "adapt" the Constitution of the Ukrainian SSR of 1978 to the new realities of the society by mass changes and additions to its text. And then, when the amount of amendments exceeded the amount of the original text, the Constitutional Treaty was established as an hour-long, compromise document of a constitutional nature that was in force before the adoption of the new Constitution.

It is worth mentioning that the reform of the economic system in Ukraine began before Ukraine gained its independence. Thus, the Law of Ukraine of June 24, 1990 [4] abolished the law of Ukraine. The second chapter of the Constitution of the Ukrainian Soviet Socialist Republic of 1978 was suspended [5]. The economic system stipulated that the basis of the economic system of Ukraine was constituted by

the socialist ownership of the means of production in the form of the state (international) and collective and cooperative societies. That state property is the joint property of all the people of the state, the main form of social and political property, and that the state has contributed to the development of collective and cooperative property and its convergence with the state property. This very law suspended Chapter 16 of the Constitution "The state plan of economic and social development of Ukraine" and Chapter 17 "The state budget of Ukraine". After Ukraine's independence was proclaimed, the dismantling of the social and economic system continued. Thus, the Law of June 19, 1992 [6] formalized the socio-economic system of Ukraine. Article 59 of the Constitution of the URR was withdrawn [6] that stipulated that the citizens had to protect and strengthen the socialist property, to fight against the theft of state and public property, to value the public good. However, after quickly changing the Basic Law of the Radyanka period, the parliament of the XIth convocation was unable to adopt the new Constitution of Ukraine for many reasons, in the main because of its obvious differences in the key issues of state-building and social order. At the same time there was a crisis of power that ended with the early elections of the parliament and the head of state (by the way, in February and June 1994).

At this time, the idea of adopting a "minor constitution", i.e. a constitutional act regulating, like in Poland, only the principles of the organization of state power and local self-government and not covering the economic and social subsystems of the social order, developed turbulently. This idea was implemented in the form of the Constitutional Treaty of June 8, 1995. [7], where the regulation of the economic order was limited by the recognition of the principle of economic competitiveness (Article 5). Signing the Constitutional Treaty allowed for the removal of social and political pressure in the society and more effective interaction between the power structures, but it did not create a legal framework for the further development of economic relations.

During the period of Kravchuk's presidency (1991-1994) Ukraine lost 45.6% of GDP of 1990. [8, c. 46]. In 1993 the average monthly income per capita in Ukraine

was the equivalent of 15 US dollars. However, with the adoption of the Constitution of Ukraine in June 1996 the economy ceased to decline and the stabilization phase began. Of course, this thesis can be disputed but the statistical data are very convincing. Thus, while in 1995 the industrial production fell by 11.5%, in 1996 - 5.1% [9], the inflation rate was 401% in 1994, 281.7% in 1995, and in 1996-1997 - 39.7% and in 1997. In general, it was only 2% [10, p. 294]. To fulfill the requirements of Article 99 of the Constitution of Ukraine in the autumn of 1996 the national monetary unit hryvnia was introduced, which contributed to the stabilization of the financial system and stabilization of economic sovereignty of our state.

**Conclusions.** To recapitulate, the above empirical data analyzed provides the basis for refining J. Hellman's conclusion, at the same time serving as grounds for clarifying the scholar's assumption: not only the postponement of the moment of adoption of the new, post-socialist constitution did not impede the economic development of the country, the adoption of such a constitution did not hinder economic reforms. The new Basic Law, although adopted with a significant hesitation, had an indirect positive impact on the efficiency of those reforms, creating a value-oriented and institutional-functional basis for the relevant structural and sectoral changes, which was reflected in the growth of macroeconomic indicators. On the whole, the political and legal experience of Ukraine is valid evidence of the benefit of "negative" constitutionalists. Indeed, our analysis of the functional charge of the Constitution as an evolutionary tool under the transitional democracy circumstances has revealed that the delay in adopting the Constitution leads to a standstill in the implementation of economic transformations and thus to a standstill in the economic development of the state, which is currently at the stage of its socio-economic, public and political transition.

## References

1. Dedeckayev, V. (2016). Ekonomika Ukrayni v pershomu desyatirichchi nezalezhnosti [Economy of Ukraine for the first decade of the independence]. *Finansove pravo*. 8, 135-137.
2. Hellman, J. S.(1997). *Constitutions and economic reform in post-communist countries. The rule of law and economic reform in Russia* / eds. K. Pistor, J. D. Sachs. Boulder: Westview Press
3. Holmes, S. (1995). Conceptions of democracy in the draft constitutions of post-communist countries. *Markets,*

*states and democracy. The political economy of post-communist transformation / ed. B. Crawford.* Boulder: Westview Press. 4. Konstitucijniij Dogovir mizh Verhovnoju Radoju Ukrains'ki ta Prezidentom Ukrains'ki pro osnovni zasadi organizacii ta funkcionuvannja derzhavnoi vlasti i miscevogo samovrjaduvannja v Ukrains'ki na period do prijnattja novoii Konstituciij Ukrains'ki vid 08.06.1995. Vidomosti Verhovnoi Radi Ukrains'ki. 1995. № 18. St. 133. 5. Levic'ka, N.M. (2010). *Istorija Ukrains'ki. Ukrains'ka v sviti: istorija i suchasnist'* Kiiv: Kondor. 6. Mel'nik, T.O. (2012). Ekonomika Ukrains'ki v period nezalezhnosti: vtrati, prorahunki i perspektivi rozvitu. *Aktual'ni problemi ekonomiki*, 8 (134), 42-49. 7. North, D. C. (1990). *Institutions, institutional change and economic performance*. New York: Cambridge University Press. 8. Pro vnesennja zmin i dopovnen' do Konstituciij (Osnovnogo Zakonu) Ukrains'koi RSR: Zakon Ukrains'koi RSR vid 19.06.1992 № 2480-XII. Vidomosti Verhovnoi Radi Ukrains'ki. 1992. № 35. St. 514. 9. Pro zmini i dopovnennja Konstituciij (Osnovnogo Zakonu) Ukrains'koi RSR: Zakon Ukrains'koi RSR vid 24.10.1990 № 404-HII. Vidomosti Verhovnoi Radi Ukrains'ki. 1990. № 45. St. 606. 10. Weingast, B. (1993). Constitutions as governance structures: The political foundations of secure markets. *Journal of Institutional and Theoretical Economics*, 149, 286–311.

УДК 378.091.212.7.015.3:005.332.4

## THE IMPACT OF COMPETITION ON ACADEMIC PERFORMANCE AND STUDENTS' ATTITUDES

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**Анотація. Садовська А. Є. Вплив конкуренції на академічну успішність та ставлення студентів.**

Робота вивчає вплив ступеня конкуренції студентів на досягнення у навчанні. Мета дослідження - дослідити фактори, що впливають на успішність студентів.

Розвиток індивідуалістичного ставлення до конкуренції і самостійності може визначати успішність і успіх студентів, а не колективістські цінності. Аналіз показав зв'язок між освітнім прогресом та бажанням опановувати знання, отримувати високі академічні результати та самостійно будувати носія в конкурентному середовищі. Ми також можемо бачити, що важливість оцінки результатів навчання студента може також позитивно вплинути на його успішність. Дослідження мотивації навчальних досягнень дедалі більше зосереджуються на цілях студентів. Більша частина цього дослідження була зосереджена на двох конкретних типах цілей досягнення: цілях завдань та цілях здібностей. У цьому огляді

ми пропонуємо отримати більш глибоке розуміння мотивації та досягнень на факультеті, якщо ми розглянемо соціальні цілі, визначені як сприймані соціальні цілі для досягнення в навчанні, на додаток до завдань та здібностей. Ми розглядаємо дослідження теорії цілей досягнення, соціальних цілей, соціальних мотивів та соціальних впливів на ставлення та поведінку студентів, пов'язані з факультетом, щоб сформувати гіпотези про попередні наслідки. Крім того, ми обговорюємо способи впливу навчального середовища на соціальні цільові орієнтації студентів.

Тільки інтеграція всіх теорій з глибоким аналізом та ізоляцією всього позитивного, що вони містять, здатна дати більш-менш повну картину детермінації поведінки людини.

**Ключові слова:** навчальні досягнення, конкуренція, мотивація, соціальна ціль студентів.

**Abstract. Sadovska A.E. The impact of competition on academic performance and students' attitudes.**

In this paper, we study the impact of the degree of students' competition on the teaching achievements. The study aims to investigate the factors influencing students' academic performance.

The development of individualistic attitudes of competition and self-dependence can determine student performance and success rather than collectivistic values. The analysis has shown a connection between educational progress and desire to master knowledge, get high academic results and build carrier independently in competitive environment. We also can see that importance of estimating the results of student's education can also positively influence his academic performance. Research on academic achievement motivation has increasingly focused on students' goals. Most of that research has focused on two particular types of achievement goals: task goals and ability goals. In this review, we propose that a more thorough understanding of motivation and achievement in schools can be developed if we examine social goals—defined as perceived social purposes for academic achievement—in addition to task and ability goals. We review research on achievement goal theory, social goals, social motives, and social influences on students' school-related attitudes and behaviors to develop hypotheses about the antecedents and consequences of social goals. In addition, we discuss ways in which the learning environment may influence students' social goal orientations.

Only the integration of all theories with deep analysis and isolation of all that is positive that they contain is capable of giving a more or less complete picture of the determination of human behavior.

**Keywords:** academic achievements, competition, motivation, students' social goal.

## **General formulation of research and its topicality.**

Decades ago, classic studies in the field of educational research concluded those teachers' expectations about students' attitudes and behaviors may explain students' effective academic achievement.

In modern foreign studies of educational motivation, the most popular are two theories: the theory of self-determination (hierarchical self-determination theory) and the theory of achievement goal orientation

"They set the landscape motivate research to teaching, are the basis for the development of tools measuring the learning motivation, while focusing on different aspects of the concept. Self-determination theory is aimed at studying the reasons that encourage learning activities, whereas the theory of achievement is targeted orientation focuses on the goals, the achievement of which the training activities are aimed"[2, c. 5]

Since the cognitive revolution took hold in psychology in the late 1960s and early 1970s, a number of social-cognitive theories of motivation have emerged (Dember, 1974). Self-efficacy studies (Bandura, 1986), attribution theory (Weiner, 1985), expectancy-value theory (Eccles et al., 1983), and achievement goal theory (Ames, 1984; Dweck & Elliott, 1983; Maehr, 1984; Nicholls, 1984) are four prominent examples of such theories. These conceptions of achievement motivation are clearly related to earlier and current theories of motivation that include needs, such as the need for achievement, the need for mastery, and the need for autonomy (e.g., Deci & Ryan, 1985; McClelland, 1961, 1985), but the social cognitive theories place more emphasis on students' beliefs about their abilities and their perceptions of contextual factors in the achievement situation. Although a number of theories of motivation have enhanced our understanding of student motivation and achievement, achievement goal theory is the one that focuses most directly on students' perceptions about the reasons for engaging in academic work. In this article we will use achievement goal theory as our guiding theoretical framework.

In the past several years a number of valuable studies have been conducted to develop various models to evaluate the students' performance by taking various

factors like family pay, direction from parents, the teacher-student ratio, distance of school and gender of students, but these studies have not investigated on learning facilities, communication skills and proper guidance by parents. Only a few studies have been conducted on these variables in the world [1, c. 22].

### **Setting of the problem and the aim of the article.**

Students' motivation is one of the most difficult pedagogical problems of the present. The relevance of the chosen topic is dictated to us by the factors which we see in our modern society. Firstly, some students who are studying in their specialties previously had no idea about their future profession. Secondly, outdated educator's attitude toward the student. The learning process should become not just teaching, but a kind of psychological projection.

The purpose of this work is to determine the role and value of motivation in the process of improving the quality of student learning, defining the essence of such a process as competition and its impact on student motivation.

### **OBJECTIVES OF THE STUDY**

1. To study the academic performance of the students.
2. To investigate the factors like learning facilities, communication skills and proper guidance from parents that influence students' academic performance.

Thus, this research aims to investigate the factors influencing students' academic performance.

The research will give the benefits for the lecturers and students for the Faculty of Sociology. The findings can recommend them the options for better way of teaching method to meet the needs of student and also helps the lecturers to predict the students' performance in learning based on the students' perceptions.

On the other hand, this research can provide the students the best learning methods in order that they can achieve higher academic achievements. [4, c. 31].

### **Discussion and Results.**

From a psychological point of view, crucial for the university system of vocational training experts' questions, are the organizations of independent work of the student's personality over a drawing of a professional plan for the adoption of the

tasks assigned to them by society, to form a style of their future professional activity.

When considering the modern education system and analyzing the forms of motivation directly to the higher education institution can offer a way to improve it in the field, as the competition.

The study of the phenomenon of social competition involves identifying its essence. The concept of competition is derived from the word show jumping, which means overcoming obstacles. In practice, this is a joint overcoming of obstacles with competitors, allowing identifying the best of them. In our case, the university is the interested partly in identifying the best candidate, creating a playing field and forming the rules of the game. Competitors are forced to accept these rules. [3, c. 11].

Students may perceive a broad variety of reasons for trying to succeed academically. For example, a student may believe that the purpose of doing well in school is to demonstrate how smart one is; or, academic success may represent the opportunity to learn new and interesting information. Out of this broad variety, there are a number of specifically social purposes that students may perceive as reasons for engaging in academic work. A student may believe that one should try to succeed so that one can become a productive member of society (a social welfare goal). Or a student may believe that the purpose of academic achievement is to bring some degree of honor to one's family (a social solidarity goal). Another student may believe that the purpose of doing well in faculty is to gain the approval of peers or teachers (a social approval goal). These different perceived reasons for trying to succeed academically can all be thought of as goals that students pursue in achievement situations, and these different goals can affect students' cognitions, behaviors, and motivation in different ways. [3, c. 10].

### **Conclusions.**

Some students feel so much pressure to succeed at academic competitions that they put everything else on hold. They might give up extracurricular activities, sports, musical interests, drama or community events to focus solely on academic challenges. Some schools make matters worse by limiting social activities and reducing programs in the arts to make more room for competitive academic courses.

Competition can be negative when it leads to unbalanced living or forces students to give up their other interests. Parents and teachers can encourage students to have a balanced approach to preparing and executing academic challenges, without sacrificing their other passions.

So, what are the competitive benefits for the student? The needs for self-affirmation, the needs for security, personal growth, and the needs for respect in society, for interpersonal relationships, and the need for self-realization dominates among students. Knowing the given needs of students, it is absolutely possible to say that competition among students is the main type of increasing motivation.

It is helpful for the student to immerse himself in a highly competitive environment to determine his perceived capabilities and abilities, and to develop and use them correctly.

### **References.**

1. Anderman E.M., Koenka A.C. (2017) The Relation Between Academic Motivation and Cheating // Theory Into Practice P. 95-102.
2. Broh B. A. (2002, January). Linking extracurricular programming to academic achievement: Who benefits and why? [Electronic version]. Sociology of Education. v. 75.
3. Cekun V. I (1976) Individualno - psihologicheskie osobennosti i vzaimootnosheniya studentov. (Opyit sotsialno-psihologicheskogo issledovaniya) / V. I. Sekun. – Minsk: Vyisheysh. shkola, – 188 s.
4. Nikitina O.P. (2015) Osobennosti formirovaniya uverennosti v sebe studentov // Pedagogicheskoe obrazovanie v Rossii. 1 S. 136-138.

УДК 159.98 (166)

## **BULLYING ON THE INTERNET**

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### **Анотація. Савченко І.Є. Булінг в Інтернеті.**

У статті розглядаються причини існування кібербулінгу: поширення брехні про когось, надсилення повідомлень або погроз, видання себе за когось. Основна увага спрямована на огляд причин та наслідків кібербулінгу. Також висвітлюються методи захисту себе від цькування в Інтернеті, протистояння хейту та тролінгу та як можна допомогти іншим в таких ситуаціях. Робота дає читачу інформацію щодо питання, як

пристрась підлітків до соціальних мереж з дефіцитом в них компетентності та розумінням необхідності підтримки етикету. Стаття привертає нашу увагу щодо випадків насилия. В подальшому вона надасть батькам як правильно реагувати на цікування своєї дитини. Крім того, у статті розглянуто можливість підвищення усвідомленості користувачів, підтримання на розуміння необхідності поважних відносин між людьми(на Інтернет – майданчиках з відсутністю модераторів та правил поведінки), можливість припинення поширення негативних, небезпечних коментарів.

**Ключові слова :** кібербулінг, цікування, Інтернет, хейт, тролінг.,

**Abstract. Savchenko I.E. Bullying on the internet.**

The article deals the reasons for the existence of cyberbullying: spreading lies about someone, sending messages or threats, pretending to be someone. The focus of this article is on reviewing the causes and consequences of cyberbullying. It also covers methods of protecting yourself from harassment on the Internet, confronting hate and trolling, and how you can help others in such situations. The work provides the reader with information on how adolescents' passion for social networks with their lack of competence and understanding of the need to maintain etiquette. The article draws your attention to cases of violence. It will further provide parents with the right way to respond to their child's bullying. In addition, the article considers the possibility of raising user awareness, maintaining an understanding of the need for respectful relationships between people (on the Internet - sites without moderators and rules of conduct), the possibility of stopping the spread of negative, dangerous comments.

**Key words:** cyberbullying, harassment, Internet, hate, trolling.

**General formulation of research and its topicality:** Consider in general the concept of cyberbullying. Cyberbullying is bullying using social networks, messengers, and mobile phones. Spreading lies about someone, sending messages or threats, impersonating someone else are all signs of cyberbullying. Are each of us cyberbullying? Yes of course. Some write horrible comments under the photo, others on the contrary – can pretend to be us. How to protect yourself from harassment on the Internet, resist hate and trolling. This either and other ones are considered to further consider.

**Setting of the problem and the aim of the article:** cyberbullying as one of the causes of suicide in adolescents and nervous system disorders.

**Objective of our work is** to show teenagers that cyberbullying can be stopped

and not be trolled.

This article discusses the following **tasks**:

- research on the consequences of cyberbullying;
- consideration of specific cases;
- methods of protection against harassment.

**Research methods:** theoretical analysis, review of scientific literature and articles on the Internet on the prevention of cyberbullying.

**Material:** research of various Internet resources, articles and information on bullying in general.

**Discussion and results:** Let's start by defining what bullying is all about and the difference between trolling online and in the real world. Bullying is aggressive behavior, mostly of adolescents, towards another child, accompanied by constant physical and psychological exposure. There are actually many reasons, and anyone can become a victim. It is very important to distinguish bullying from the usual teenage quarrel. If a child is systematically teased, deliberately not accepted into the team, intimidated, blackmailed, even beaten - this is a sign of bullying. Cyberbullying has the same symptoms, but only on the Internet. The difference is that on the Internet, people can be represented by anyone: a friend, brother, colleague [1].

With the development of modern electronic technology, violence is common committed by means of electronic means of communication called cyberbullying, which can manifest itself in various forms:

- fights - the exchange of short angry remarks in chats, forums, discussion groups;
- attacks - repeated offensive SMS messages, in messengers, constant calls;
- slander is the dissemination of derogatory false information through text messages, photos, videos using electronic means of communication;
- reincarnation into a specific person using their account in social networks, blogs, mail, instant messaging system.

In our opinion, the main reason for cyberbullying is the lack of any responsibility. There is currently no legal mechanism to prosecute online harassment.

Intimidation can occur at any time of the day or anywhere. The worst case scenario is when it happened when the child was alone. After all it may seem that there is no way out.

How to detect signs of cyberbullying? Cyberbullying has several manifestations:

- 3) sending threatening text messages;
- 4) distribution of pornographic videos and photos;
- 5) sending rough messages;
- 6) creating groups of hatred for a particular child;
- 7) provoking teenagers to suicide;
- 8) creation of fake pages in social networks [2, p.138].

But in 98% of cases it is only Internet intimidation and no more. Often children believe in “Blue Whale” death groups and participate. How to protect yourself from harassment on the Internet? First of all, warn yourself against sending information to the network. There are things that are not talked about on the Internet. We need to be critical of the information that is available. Not everything written online is true. What are the general reasons why it is difficult for children to admit to bullying by teenagers? To begin with, fear has all this. Fear that adults will not understand the meaning of the problem, fear of being ridiculed, of being punished. At the heart of all the reasons for silence is fear for oneself. In turn, this is a consequence of low self-esteem. After all, such children are chosen to bully. The fight against cyberbullying is complicated by impunity on the Internet - space, because everyone can pretend to be anyone [3, p. 39].

Some strategies that will help protect yourself and your family from harassment are offered to you.

1. Try to talk about it. Be honest with your parents, because maybe they were in such a situation.
2. Keep calm and take care of yourself. If a bully offends, sometimes the best protection is to keep calm. Ignoring can happen, because it is the reaction that is least expected.

### 3. Do not clarify the relationship yourself.

How can my friends be protected if they suffer from cyberbullying? First, try to offer support. It is important to listen to your friends. Help them think about what they can say and to whom. Most importantly, remind them that you support them and want to help. It should be remembered that in certain situations the consequences of cyberbullying can be life threatening. Your words of support can be crucial.

In order to understand at least a little bit what bullying is and its consequences, we propose to consider 2 cases of bullying: physical violence and psychological:

- Adolescents always waited for the student in the yard of the educational institution and beat because of the high, in their opinion, academic success. This is physical violence. As a result, fear and apprehension of going outside and poor school performance due to skipping classes.
- A group of girls in the classroom discuss a weekend party and share photos, ignoring one girl whom the children chose not to invite, pretending she did not exist. This ignorance is repeated every time. This is psychological violence. As a result, low self-esteem.

**Conclusions:** While the Internet can be a great resource to help students prepare for tests, it is still important for them to be safe. Cyberbullying is a serious problem, so it is important for parents, teachers and students to understand how to deal with it. The most common form of cyberbullying is the creation of fake pages, the distribution of intimate photos, trolling and the publication of videos of fights. UNICEF[4] has so far conducted a survey and found that one in five adolescents is a victim of online bullying. In addition, a third of respondents use social networks to get rid of negative feelings. Keep in mind that you can seek help from parents, teachers, or even friends if you are being bullied online.

### References

1. Evaluating the Effects of the Olweus Bullying Prevention Program on Middle School Bullying. Access mode: <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi>?
2. Rose, C. A., & Espelage, D. L. (2012). Risk and protective factors associated with the bullying involvement of students with emotional and behavioral disorders. *Behavioral Disorders*, 37, [133–148].
3. Король А. Причини та наслідки дослідження явища булінгу // Відновне правосуддя в Україні. – 2009. – № 1 – 2. –

190 с. Access mode [https://rescentre.org.ua/images/Uploads/Files/poperedzhenya\\_dl/buling\\_article](https://rescentre.org.ua/images/Uploads/Files/poperedzhenya_dl/buling_article).

4. Булінг – важлива проблема для дітей в Україні. ЮНІСЕФ розпочинає кампанію проти булінгу. Access mode: [https://www.unicef.org/ukraine/ukr/media\\_31252.html](https://www.unicef.org/ukraine/ukr/media_31252.html).

УДК 930:61:2–14(7/8)«18/19»

## **AN INSIGHT INTO THE STUDY OF THE CULT OF ASCLEPIUS IN AMERICAN HISTORIOGRAPHY (LATE 19TH CENT.– EARLY 20TH CENT.)**

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**Анотація. Семененко О.В. Вивчення культу Асклепія в американській історіографії (остання чверть XIX ст.– початок ХХ ст.).**

Відкриття в археології античності останньої чверті XIX – початку ХХ ст. пробудили інтерес американської наукової спільноти до культу давньогрецького здравносного бога Асклепія. Оскільки в країні були відсутні спеціалізовані установи, американські вчені долучилися до археологічних розкопок античних пам'яток пізніше, ніж це зробили західноєвропейські дослідники. Завдяки заснуванню Інституту археології та шкіл досліджень класичних наук в Афінах і Римі, які стали першими археологічними установами США, американська історична наука збагатилася комплексом речових джерел, що відкрило для учених нові можливості для вивчення вищезазначеного культу. В останній чверті XIX ст. та на початку ХХ ст. відбулося суттєве зрушення у підходах до вивчення культу здравносного божества, а саме, вищезазначена проблематика стала предметом дослідження для істориків та археологів, які почали вивчати культ Асклепія у контексті історії релігії. До цього часу культу здравносного божества здебільшого вивчали лише філологи-класики, як складову давньогрецької міфології. Саме протягом останньої чверті XIX – початку ХХ ст. були досліджені походження культу Асклепія та його сутність; функції, які він виконував у давньогрецькому суспільстві; призначення будівель, які розташовувались на території асклепіонів. Першими помітними працями американських вчених з дослідження культу Асклепія стали роботи класичних істориків-археологів А. Мерріама, Л. Дайера, Е. Волтон. Остання, зокрема, написала першу дисертацію у США, присвячену вищезазначеному культу, в якій зібрала всі відомі на той час літературні, епіграфічні та нумізматичні джерела з даної

проблематики. Незважаючи на те, що наукове середовище того часу не завжди висловлювало свою думку, апелюючи до наукового доробоку своїх попередників, але такі вчені, як А. Мерріам, Е. Волтон у своїх працях активно полемізували з колегами щодо окремих аспектів культу.

**Ключові слова:** Асклепій, історіографія, культ, медицина, релігія.

**Abstract. Semenenko. O.V. An Insight into the Study of the Cult of Asclepius in American Historiography (late 19th cent. – early 20th cent.).**

Discoveries in the archaeology of antiquity in the second half of the 19th and early 20th centuries awakened the interest of the American scientific community in the cult of the ancient Greek healing god Asclepius. Since there were no specialized institutions in the country, American scholars joined the archaeological excavations of ancient monuments later than Western European ones. The establishment of the Institute of Archaeology and the Schools of Classical Studies in Athens and Rome which became the first archaeological institutions in the United States enriched American historical scholarship with a number of material sources, opening new opportunities for scholars to study the aforementioned cult. In the last quarter of the 19th century and the beginning of the 20th century there was a significant shift in approaches to the study of the cult of the healing deity, namely, the above-mentioned problematic became a subject of research for historians and archaeologists, who began to study the cult of Asclepius in the context of religious history. Before that time the cult of the sane deity had been mainly studied only by classical philologists, as a component of ancient Greek mythology. It was during this period that the origins of the Asclepius cult and its essence; the functions it fulfilled in ancient Greek society; the purposes of the buildings that were located on the territory of Asclepius were investigated. The first notable works of American scholars on the study of the Asclepius cult were the works of the classical archaeological historians A. Merriam, L. Dyer and E. Walton. The latter, in particular, wrote the first dissertation in the United States devoted to the abovementioned cult, in which she collected all known literary, epigraphic and numismatic sources on the subject at that time.

**Key words:** Asclepius, cult, historiography, medicine, religion.

**General formulation of research and its topicality.** In the last quarter of the 19<sup>th</sup> century there was a rise in interest in ancient history prompted by the major archaeological discoveries of Heinrich Schliemann.

The religion of ancient Greece was one of the most important fields of ancient history. In particular, scientists were interested in the cult of the healing deity Asclepius who occupied an important place in the ancient Greek pantheon. Since the

5th century B.C., temples of Asclepius were actively built on the territory of Ancient Greece and its city states on the Black Sea coast. Archaeological excavations which were carried out at the locations of the aforementioned temples brought to historical science a new, previously unexplored set of material sources. The period from the 1870s to the 1930s was one of the most important periods in the history of the study of Asclepius cult, since the first attempts to investigate the cult from the perspective of religious history were made precisely at that time. During this period, the figure of Asclepius as a deity, the structure of asklepeions and their functions were studied for the first time in a comprehensive way.

In the process of studying the available information resources, there haven't been found any publications which would contain ordered information on the historiography of the cult of Asclepius. At the same time, this subject has been studied by scientists from various fields (philologists, historians, physicians), but again, these studies do not contain any systematic information about the scientific heritage of the cult of Asclepius.

**Setting of the problem and the aim of the article.** The purpose of this article is to study some of the first significant works on the cult of Asclepius in the North American historical scholarship in the late 19th cent. – early 20th cent. In order to achieve this goal, it is necessary to carry out the following tasks: to study the peculiarities of the research of the cult of Asclepius by American scholars in the late 19th and early 20th centuries; to identify what aspects of the cult were of primary interest to researchers.

The cult of Asclepius has always occupied an important place in the ancient Greek pantheon. But despite its social importance, this phenomenon remained outside of the domain of interest of the scientific community for a long time. However, everything changed radically in the last quarter of the 19th century, when specialists in antiquity from European countries initiated expeditions to study a number of ancient Greek monuments. Their initiative was supported by the governments of Greece, Germany and France, which financed archaeological expeditions to explore ancient Greek city states [2, p. 2]. Great Britain and the USA joined the scientific

community a few years later [3, p. 217]. In 1879, the Archeological Institute of America was founded in the USA, it became the first organization devoted to the archeology in this country. In 1882, on the initiative of the AIA the American School of Classical Studies was opened in Athens with professor Eliot Goodwin becoming its first director. Later, in 1895 the American School of Classical Studies was founded in Rome. Thus, American scholars began continuous archeological excavations in 1896 [5, p. 8].

The largest temples dedicated to Asclepius were located in Athens, Epidaurus and Pergamum [1, p. VI]. The first excavations connected with the Asclepius cult were carried out in 1876–77 by the expedition of the Athenian Archaeological Society in Athens. [2, p. 3]. In 1881 the Athenian Archaeological Society began excavations of the temple of Asclepius in Epidaurus. [3, p. 217]. During the 1880s – 1890s the archaeological excavations were carried out at the sanctuaries of Asclepius in Boeotia (Orkhomenos), Lokrida (Navpaktos) and Attica (Munichia, Eleusine) [9, p. 939, 940, 943, 944]. Thus, by the time American scholars established their own archaeological expeditions there had been a large amount of archeological material which required further translation and study.

Consequently, a number of successful archaeological excavations were carried out at the locations of the above-mentioned temples, the results of which became a subject of active study by scientists of the time. The material found during the archaeological excavations required further processing and study.

**Discussion and Results.** In the last quarter of the 19th century the first works dedicated to the cult of Asclepius appeared.

In 1885, American classicist A. Merriam published an article in which he examined a Phoenician inscription of the 4th century B.C. found in Larnaca during archaeological excavations of the temple of the goddess Astarte in 1879. The inscription represented a report of the temple expenses which contained a paragraph dedicated to "Kelaoim". In the Corpus Inscriptionum Semiticarum the term "Kelaoim" was interpreted as scorta virilia – male prostitutes. A. Merriam disagreed with this translation of the aforementioned term, and supported the viewpoint based

on M. Helevi, who argued that the term "Kelaoim" referred to the dogs that guarded the temple of Astarte [8, p. 285]. In his study A. Merriam cited the hypothesis of the French archaeologist S. Reinach, who went further in his conclusions, and stated that the dogs were kept in the temple not just to protect the latter, but they were considered sacred. A. Merriam gave a number of arguments in defense of the aforementioned theory. Although the inscription was found on the site of the temple of Astarte, the goddess might have been associated with the Phoenician deity Eshmun. C. Rhine believed that Eshmun was identified with Asclepius, and the dog was his representative at the time when the cult of Asclepius came to Greece, and the inscription in question proves this connection. In particular, he argued that the dog played a significant role in the cult of Asclepius in the early period of its existence, but that the figure of the snake subsequently took its place. A. Merriam gave a number of arguments in support of S. Reinach's hypothesis. Thus, he relied on the evidence of Aelian, who claimed that in Sicily the temples of Hephaestus and Adranus contained dogs [8, p. 286].

Thus, A. Mariam concluded that the history of Sicily points to Phoenician influence on early Sicilian cults. It was believed that dogs could sense a person's character, distinguish a good person from a bad one. In support of his words the scholar cited the hypothesis of the French Orientalist Ch.S. Clermont-Anne, who argued that dogs played an important role in the cult of Asclepius, as the god was nurtured by a dog, relying on the archaic form of the name Asclepius "Aischlabois" from the Corinthian inscription [8, p. 287]. This form of the name of the god corresponded to the Hebrew term "ich-kalbi" – "man-dog". This inscription confirmed the importance of the status of the dog in the ancient Greek and Phoenician religions [8, p. 287].

Therefore, the scientific significance of A. Merriam's article is that not only did he raise the question of the importance of the place occupied by the figure of the dog in the cult of Asclepius, but also considered the syncretism of the ancient Greek cult of Asclepius and the Phoenician cult of Eshmun.

In 1891, Louis Dyer, an American historian, published a book, dedicated to

Greek gods and newly excavated ancient Greek sanctuaries. It was one of the first comprehensive works on the ancient Greek religion in English language at the time. Having spent some time in Greece as a student of the American School of Classical Studies, L. Dyer had opportunity to get acquainted with the newest archeological sources excavated at the shrines of major Greek deities [6, p. 471]. A key note which can be traced through all of Dyer's book is an idea about "merciful gods". The scholar stated that Greeks celebrated kind, gentle and sympathetic gods way more often, than they did the fierce ones. And Asclepius, in particular, belonged to that category of deities. L. Dyer represented Asclepius as a nature-god, a friend of humans similar to Prometheus. The dual nature of Asclepius who was half-human himself made him stand at the border between the world of mortals and the world of gods [4, p. 237].

Speaking about the cult of Asclepius, L. Dyer underlined that despite the severance which existed between temple and secular medicine, physicians and priests interacted on many occasions. Physicians considered Asclepius their patron, and priests often used means of secular medicine as supportive therapy in asclepeions [4, p. 243].

Despite the lack of critical approach, L. Dyer's work is an important source on studying the cult of Asclepius and religious feelings of ancient Greek people correspondingly.

In 1894, Alice Walton, an ancient historian and archaeologist from the United States, published the first monograph on the cult of Asclepius in the Greco-Roman world. Her work was the first study of the Asclepius cult in which all the aspects of it were examined. E. Walton used all the literary, epigraphic and numismatic sources known at the time that contained information on the cult of Asclepius [7, p. 138]. She compiled an exhaustive index of references to his existence in ancient literature and epigraphy, which became the basis for further works on this subject. One of the main merits of Walton's work is the compilation of a catalog of temples and sanctuaries of Asclepius in Greece and beyond, with references to literary, epigraphic and numismatic sources. For a century, E. Walton's work was the only one to contain a

list of the sanctuaries of Asclepius in Western Europe. Her catalog is still a valuable, though incomplete source of information about the Asclepius cult [10, p. 2].

**Conclusions.** In terms of drawing conclusions from this study and outlining prospects for further research in this direction, on the wave of interest in ancient history, caused by important archaeological discoveries on the territory of former Ancient Greece, the first publications of American scholars appeared, containing specific results of research on this subject matter.

With the establishment of schools in Athens and Rome, American archaeologists were able to get engaged in the study of ancient Greek history. Historians compared data from material and written sources and began to investigate the cult of Asclepius from the perspective of religious history.

The scientific environment of that time was characterized by significant limitations not only to the direct results of archaeological excavations, but even to the publications of scholars (representatives of various sciences), who covered various aspects of almost any problem (including the cult of Asclepius). Besides, some authors covered only their own point of view thereby, virtually ignoring the scientific heritage of others, but such scholars as E. Walton and A. Merriam continued the tradition of studying the cult of Asclepius by their predecessors and polemic on certain aspects of the cult.

Our further scientific research is expected to focus on revealing the influence of the Asclepius cult on the development of modern medicine, religion, history and other dimensions of life activity.

## References

1. Brownen, L.W. (2003). *The Appeal of Asclepius and the Politics of Healing in the Greco–Roman World*. Dr. Philos. Sci. Diss. Texas. 348 p. 2.
2. Caton, R. (1900). *The Temples and Ritual of Asklepios at Epidauros and Athens*. London: Cambridge University Press Warehouse.
3. Davidson, Th. (1880). The Recent Excavations and Discoveries at Athens and Olympia. *Journal of the American Geographical Society of New York*, 12, 217–233.
4. Dyer, L. (1891). *Studies of the Gods in Greece at Certain Sanctuaries Recently Excavated*. London: Macmillan and Co.
5. First, Second, and Third Annual Reports of the American School of Classical Studies at Athens. 1881–1884. (1886). Cambridge, 30 p.
6. Fowler, W.W. (1891). Dyer's Studies of the Gods in Greece : [review]. *The*

*Classical Review*, vol. 5, issue 10, 470–473. 7. Harrison, J.E. (1895). A. Walton on the Cult of Asclepius : [review]. *The Classical Review*, vol. 9, № 10, 138. 8. Merriam, A.C. (1885). The Dogs of Aesculapius. *The American Antiquarian and Oriental Journal*, vol. VII, № 5, 285–290. 9. Semeria, A. (1986). Per un censimento degli Asklepieia della Grecia continentale e delle isole. *Annali della scuola normale superiore di Pisa. Classe di lettere e filosofia*, 3.16, 931–958. 10. Walton, A. (1895) *The Cult of Asklepios*. New York: Gynn & Company.

УДК 719(091)(477.4/.7)«186/191»

## THE CULT OF DEMETER IN MEGARA

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### **Анотація. Семибратьська А. І. Культ Деметри у Мегарах.**

У цій статті авторка розглядає низку питань, пов'язаних з дослідженням культу Деметри у Мегарах. Цей культ жіночого грецького божества викликає особливу зацікавленість, оскільки він містить процес з'єднання образів загальногрецької богині Деметри та місцевого жіночого божества плодючості. В результаті критичної оцінки стану розробки проблеми культу Деметри, упорядкування та систематизації джерельної бази разом аналітичної розвідки зроблено висновок про те, що ключовою особливістю культу, що вивчається, є збереження, разом з функціями, які були завжди притаманні Деметрі, специфічних рис мегарського жіночого божества, які надалі разом із самим культом були перенесені у колонії. У роботі використано загальнонаукові методи, включаючи аналіз, синтез, індукцію, дедукцію, типологічний, а також спеціально-історичний хронологічно-реконструктивний метод для відтворення досліджуваних історичних процесів.

**Ключові слова:** Деметра, культ Деметри, Мегара, релігія, стародавня Греція.

### **Abstract. Semybratska A.I. The cult of Demeter in Megara.**

In the present article the author considers a number of essential questions connected with researching the cult of Demeter in Megara. The above-mentioned cult of the female Greek deity has been in the focus of scientific attention for hundreds of years due to the fact that it integrates the process of combining images of Panhellenic goddess Demeter with the local female fertility deity. AS a result of critically evaluating the state of the academic research concerning the issue of the Demeter cult, organizing and systematizing the corresponding source basis together with analytically studying the problem domain it has been concluded that the key peculiarity of the cult

under consideration is the preservation of specific features of the Megarian female deity coupled with the functions which have always been inherent in Demeter and which eventually are transferred to the colonies together with the cult itself. In the work we turn to both general scientific methods, including analysis, synthesis, induction, deduction, the typological method, and the special historical chronological-reconstructive method with the purpose of reconstructing the historical processes analyzed.

**Key words:** Ancient Greece, cult of Demeter, Demeter, Megara, religion.

**General formulation of research and its topicality.** Issues related to the study of religion in ancient societies are still relevant today. Ancient Greek society was characterized by a close connection between religion, politics, social life and culture. Consequently the study of ancient Greek religion is an important component for understanding the essence of ancient Greek civilization. The Olympic pantheon of gods has a large number of female images, and the study of separate cults of a goddess allows us to explore the peculiarities of her veneration in each particular region. The research of the cult of Demeter is highly essential in the context of the study of ancient Greek religion, because its theological image was one of the key gods in the Olympic pantheon. The study of the Megara variant of the cult of the goddess allows to make a comparative analysis of the classical goddess's cult with it.

**Setting of the problem and the aim of the article.** Nowadays history provides many questions about the functions of the goddess Demeter, her role for the Greeks. It should also be noted that there are a lot of discussions about the origin of the image of the goddess. The cult of the goddess hasn't fully studied yet. Due to the division of the image of the goddess Demeter into several important components, namely such archetypes as: Demeter-woman, mother, primordial, etc., we can conclude that image of goddess, forming in the II millennium BC., could influence on other cults of the female deity that existed among the ancient Greeks. It is possible because of the multifaceted archetypes of the goddess and their usage not only in historical research, but also in modern psychology and philosophy. In this analysis our special attention is paid to the study of the Megarian version of this cult, as well

as its archetypal characteristics, while in historiography more attention is paid directly to the functions of the goddess in the archaic and classical eras.

The subject of the article is the Megarian cult of the goddess Demeter. Its object is the essential origin specificity of the image of the goddess Demeter and her intrinsic theological functions.

The aim of the article is to reconstruct the image of the Dorian goddess Demeter and her functions as a local fertility deity. The above requires solving the following research tasks: to study the history of the origin of the image of Demeter; to trace the process of the cult formation; to describe the features of the cult and to analyze their functions by working with sources

**Discussion and Results.** The origin of the image of the goddess Demeter has deep historical roots. It has many archetypes and is reflected in myths and ancient Greek (and even pre-Greek) legends about the goddess Demeter [12; II, 25, 4]. The term of archetype, which dates back to the traditions of ancient Greek thinkers, plays a leading role in understanding the concept of the image of the goddess Demeter and the ability to analyze it in terms of modern science. The image of the goddess consists of such archetypes as: goddess-mother, goddess-educator, goddess-woman, goddess-protector, etc. The archetype of the mother is dominant, which is confirmed by the inseparability of the image of the goddess with her daughter Persephone [2, p. 198-199].

The analysis of the archetypes of the goddess allows us to understand the essence of her functions, as well as the essence of the cult festivals dedicated to her. It is possible to highlight the features of the Megarian perception of this deity through its comprehensive analysis.

It is worth pointing out that the image of Demeter is quite ancient. It was known in the II millennium BC. This statement can be made on the basis of archaeological excavations. In 1939, in Pylos, on the Mycenaean tablet of the II millennium BC the inscription "da-ma-tc da 40" "a field of 40 tac" was found. In that way the last word means measuring of area. So we can conclude that the goddess "Damater", or Mother of the Fields, existed in the II millennium [9, p. 279].

Besides the main name of the goddess, there is another Demeter relevant cult: Chloe, meaning «greens» sowing", Carpophora – "giver of fruit", Fesmophora – "legislator", "organizer", Sito – "bread", "flour" [ 3, p.188]. Our analysis of the cult names of Demeter allows us to reveal the diversity of its main functions, and on this basis – to find specific features in the Megarian cult.

Greek policies were largely isolated from each other, so they often had peculiarities in the formation of their religious views. The fact that the cult of Demeter Maloforos is found in Megara and the two Megara colonies, solves the debatable question of it as a special Megara variant of the cult of the goddess Demeter.

In ancient times there was a tradition of building religious buildings in honor of various gods. The Goddess Demeter wasn't an exception. The sanctuaries of Demeter, the so-called "megarons", were built in Megara [13, p. 333 - 334]. Megarons (Greek Megaron – a large hall) were Greek houses of rectangular plan with a hearth in the middle – from which originated the name of the city.

In his description, Megar Pausanias mentions the buildings of the Mycenaean era as the sanctuary of Demeter. Probably, these sanctuaries belonged to the Achaeans. The Dorians began to use them to honor their deity. It is obvious that the Dorians had a cult of the female deity, which controlled fertility, including earthly, and the fact that this deity had much in common with the goddess Demeter, later contributed to his identification with this goddess.

I must admit that the buildings, associated with the cult of Demeter, were not only in the city but also behind the city walls. Pausanias described the temple of Demeter Maloforos that was situated near the road, leading to the harbor. Undoubtedly the temple was ancient, as it was significantly destroyed in the time of Pausanias. It was also quite difficult to determine where the name of the goddess originated. As one of the main pastimes of the ancient Greeks was cattle breeding, Pausanias connected with it the origin of the goddess' name. The first part of the name "Maloforos", according to Pausanias, came from mh'lon (in the Dorian dialect was lon) meaning "sheep" [12; I, 44, 3].

Several researchers believe that the name "Maloforos" is still associated with the concept of an apple [15, p. 84]. In addition, there are hymns dedicated to Demeter. In one of them there are words that reflect the idea of the goddess who "brings apples", in other words the goddess of fertility [6, p. 482 - 483]. But all versions cannot be fully trusted as they are both only linguistically confirmed. There is no other evidence to prove the high plausibility of this or that version.

When we speaking about the Megarian cult, we must pay attention to the fact that in the era of colonization it was transferred to different colonies. This was due to the fact that the inhabitants of the colonies did not lose touch with the metropolis. The Greeks brought not only the way of life and traditions to new lands, but also the peculiarities of religious beliefs and culture. The cult of Demeter Maloforos remained in Byzantium and, especially, in the Sicilian city of Selinunte. It is known that Megara in the second half of VIII century BC founded the colony of Megara Gibleyski, which, in its turn, became the founder of the already Sicilian colony of Selinunt in the second half of VII century BC [13, p. 337 - 338].

During the excavations of Selinunte, the sanctuary of Maloforos was studied in greater detail. Firstly, as in Megara, the sanctuary was located behind the city wall and had a number of similar features. Secondly, the unique inscription on the wall, which dates back to the V century BC, has a unique meaning. The inscription was made in honor of the military victory. The grateful inhabitants of the city listed those gods and goddesses to whom, in their opinion, they had owed their victory. Among those was the name Maloforos. It seems particularly interesting that the name of Demeter is not mentioned. From the above it is possible to conclude that to a greater extent the natives of Megar preserved the original version of the cult of Maloforos, and only later researchers have associated it with the cult of Demeter [13, p. 336-337]. We can deduce, thus, that Maloforos has a much broader function, being not only the patron saint of fertility, but also a goddess-protector, which has, moreover, a connection with the world of the dead. This is quite all-natural for the cult of fertility, which traces the connection between birth and death.

Probably, this connection with the afterlife, with the conception of its eternity, gave her, like other chthonic gods, a special importance, contributing to more serious and meaningful perception of their images. If the breakthrough of "earthly prosperity" could be understood by ancient Greeks, the world of the unknown, the world inhabited by the shadows of the dead, caused a special trembling and reverence, which determined the special character of the cult of fertility.

Conclusions. To sum it up, as a result of our research we can conclude that the cult of Demeter Maloforos was formed in Megara. The cult, apparently, originates in the period of the "dark ages", and later, in the archaic period, completes its formation and is transferred in the process of establishing colonies to new territories.

In the period of its origin, this cult originates from the most ancient beliefs, which came from the primitive society era. It is plausible that it was in the Cretan-Mycenaean period when the cult of the goddess formed the patroness of fertility, which also carries the features of the goddess-protector, a guardian. At the same time, on the basis of the research of the cult of Selinunte, it can be assumed that she could have served as a defender in military affairs and navigation. This cult was later extrapolated onto the classical cult of Demeter, which introduced certain features of the classical patroness of earthly fertility.

Consequently, having emerged as an ancient local deity of fertility, and later merging with the image of the goddess Demeter, which is characteristic of the Greek religion, the image of Demeter Maloforos retains its features of the ancient local component. Taking all this into account, we can come up with a conclusion that Demeter was a Dorian goddess, identified with local cults of fertility.

## References

1. Bolen, D. (2008). Bogini v kazhdoi zhenshine. Novaya psihologiya zhenshiny. Arkhetipy begin. [A new philosophy of a woman. Archetypes of goddesses]. Kyiv: Sofiya. (in Russian).
2. Burkert, V. (1993). Grecheskaya religiya: Arkhaika i klassika [Greek religion. The archaic and the classic]. Kharkiv: Vydatets Savchuk O.O. (in Russian).
3. Gomer (1984). Gimn V. [Hymn V.]. Moskva: Khudozhestvennaya literatura. (in Russian).
4. Greyvs, R. (1992). Mify Drevney Gretsii [Myths of Ancient Greece]. Moskva: Progress. (in Russian).
5. Zav'yalova, V.P. (2009). Kallimakh i yego gimny [Kallimakh and its hymns]. Moskva: GLK. (in Russian).
6. Kun, N.A. (1987). Legendy i

Mify Drevney Gretsii [Legends and myths of Ancient Greece]. Kyiv: Veche. (in Russian). 7. Lauenshtayn, D. (1996). Elevsinskiye misterii [Eleusinian mysteries]. Kharkiv: Enigma. (in Russian). 7. Lyubker, F. (2005). Real'nyy slovar' klassicheskikh drevnostey [Real dictionary of classical antiques]. Moskva: Eksmo. (in Russian). 8. Meletinskiy, E.M. (2009). Poetika mifa [Poetics of myths]. Kyiv: Feniks. (in Russian). 9. Pavsaniy (1996). Opisaniye Ellady [The description of Hellas]. Lviv: Ladosmir. (in Ukrainian). 10. Pal'tseva, L.A. (2014). Kul't Demetry Maloforos v Megarakh [The cult of Demeter Maloforos in Megara]. Kharkiv: Enigma. (in Russian). 11. Frezer, Dzh. (2006). Zolotaya vety'. Issledovaniye magii i religii [Golden branch. Researching the magic and religion]. Kyiv: Veche. (in Ukrainian). 12. Yadgarov, S.V. (2011). Mifologiya Drevney Gretsii [Mythology of Ancient Greece]. Lviv: Ladosmir. (in Ukrainian). 13. Yakovlev, V.V. (2012). Drevnegrecheskaya mifologiya [Ancient Greek mythology]. Kharkiv: Vydavets Savchuk O.O. (in Russian)

УДК 371.31

## CHALLENGES OF DISTANT LEARNING

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### **Анотація. Шапарнева Л.Д. Виклики дистанційної освіти.**

Дистанційна освіта являється необхідним явищем в наш час, проте вона зустрілась із великою кількістю критики та суперечок. В цій статті ми розглянемо такі аспекти як труднощі дистанційної освіти, майбутні можливості впровадження дистанційної освіти для України та які способи існують для подолання проблем, що пов'язані з онлайн-освітою. В першій частині статті, ми будемо говорити про труднощі, з якими зустрілась дистанційна освіта на різних своїх рівнях (дошкільна освіта, середня школа, старша школа, вища освіта та неформальна освіта). В другій частині статті, ми ретельно розглянемо різні проблеми кожної сфери дистанційної освіти. Ми опишемо такі проблеми як людський фактор, технічні проблеми, складнощі з онлайн-системами для освіти та потенційні варіанти розвитку дистанційної освіти в Україні. У статті розглядається як можна покращити рівень дистанційного навчання в Україні, як ми можемо бути найкращими з приводу впровадження різних онлайн-платформ для освіти у всьому світі. Тема дистанційної освіти дійсно важлива в ці дні, адже кожен інститут освіти зустрілася із різними проблемами і ми повинні знати, як вирішили ці складнощі.

**Ключові слова:** дистанційне навчання, ефективне навчання, онлайн-освіта, інтернет-

платформи.

**Abstract. Shaparneva L.D. Challenges of distant learning.**

Distance learning is necessary object in nowadays, but it projects a lot of criticism and controversy. In this article we will consider such aspectslike challenges of distance learning, future opportunities for Ukraine and how solve the problems of distant learning. Firstly, we say about challenges, which arise in different levels of education (preschool education, primary school, high school, higher education and non-formal education). Secondly, we throughly studied different problems in each sphere of distance learning. We described such problems like human factor, technologies problems, problem with online-systems for education and potential variants of development distance learning in Ukraine. The article deals with the ways how we can improve level of distant learning in Ukraine, how we can implement different online platform for studying all over the world. This topic about distant education is really important in these days, because each education institution faced with different problems and we need to know how to solve these issues.

**Key words:** distant learning, effective learning, online education, online platforms.

The COVID-19 epidemic has made its adjustments to the ordinary lives of absolutely all people. Quarantine has provided many new opportunities, but also created new economic, social and organizational problems.

The relevance of distance education is, first of all, that this problem is global, and therefore the discussion of this issue must also be perceived through the prism of globality. Second, the duration of the pandemic has not yet been determined; this means adapting to existing changes and getting the most out of them.

Quarantine conditions have had a strong impact on education both in Ukraine and in other countries. Distance learning, which became the only option for receiving education during the quarantine period, was at absolutely all levels of education – preschool, school, special and higher education, as well as non-formal education.

It is thought that distance learning should not be viewed only through the prism of forced implementation and negative impact. Of course, full distance education cannot work, because in the field of preschool and school education, the full transition to online learning will not be effective, because at this age students need to form communication links, and this will be impossible with distance learning. With regard to higher and non-formal education, it can be said that this part of the students

is somewhat easier to translate into this format.

The introduction of distance education is really necessary, despite the epidemic. The best option that will be useful to absolutely every layer of students is to combine learning formats. Due to this, the stages of socialization will be observed, as well as the full mastery of technical and Internet tools that are needed at this time. Of course, for the successful implementation of this form of training it is necessary to conduct analytical and research work, also requires a large number of resources for the implementation of this project and several years for development and implementation.

Due to the sudden appearance of distance education, absolutely every party has experienced discomfort due to an incompletely established algorithm for distance education. The problems encountered by applicants, educators, governing bodies and other people will be listed below.

Absolutely all participants of the educational process faced with problems due to the need of the distance learning: teachers, students, school administrations, organizers of non-formal education institutions and students' parents. One of the problems is the organization, and it was necessary to react very quickly. How to organize the learning process with minimal costs, both time and money have become a major dilemma. The search for possible platforms for conducting classes, making changes to the existing curriculum, organizing new teaching methods caused difficulties. The second problem was the effectiveness of such a learning process. This aspect follows from the first problem - the effectiveness of the perception of the material consists of a large number of different factors - it is both technical features and individual characteristics of the learner and teacher. The third problem I can call the difficulty of adaptation, which was the most difficult moment. The two categories that were most vulnerable were junior high students and older teachers. It is quite difficult to teach children at all, and without eye control - even more so. Unfortunately, parents cannot fully control their children's behavior during the school day due to work, and teachers in the distance format do not always succeed. Therefore, it is necessary to make more efforts for the effectiveness of the educational

process. There are no such difficulties with older children, students and non-formal learners, as this group of learners is more aware of the importance of the knowledge gained. The only problems of these categories can be only individual characteristics of the person if he does not perceive distance learning as a full-fledged education [1].

The second side, which is difficult to adapt to, is older teachers. Although in the XXI century few people do not know how to use messengers or social networks, but there are some. This category does not have some computer and Internet technology, nor can it psychologically switch to another format of learning, and also does not have enough time to adapt.

So, in my opinion, the part that has suffered the most from the form of distance education is the sphere of preschool and school education due to the above-mentioned factors. As for higher and non-formal education, the situation is better: it is easier for applicants for this type of education to switch to distance learning. First, it should be said that both students and members of non-formal education groups do not fully socialize, as schoolchildren do not need. It should also be noted that due to the individual characteristics of students and students of non-formal education (for example, age and a conscious desire to acquire knowledge) facilitates the introduction of distance learning. However, for some students studying technical specialties it will be difficult to conduct practical and laboratory work in an online format, so when implementing distance education it is also necessary to take into account this aspect.

Non-formal education has hardly been affected, as most courses and workshops have existed online, because in today's pace of life, it is not advisable to spend time and money on the road, because it is possible to obtain information from anywhere in the world. Therefore, in my opinion, non-formal education can also be used as an example for the implementation of certain measures to implement distance learning. Problems of distance learning can be considered at the macro-, meso- and micro-levels. Problems of economic nature (financing of technical equipment for conducting, financing of teachers due to the increase in the number of teaching hours) - all this is considered a macro-factor. Mesopotamians are an opportunity for rapid adaptation. Teachers do not need complete retraining as online teachers, they only

need the ability to accept changes and adapt to them. Microfactors are individual characteristics of each person, which are usually impossible to influence through organizational and financial gains, because it is a lack of motivation from both teachers and students, unwillingness to adapt to new changes in the educational process on both sides [2].

The disadvantages of this type of training are, first of all, that not all disciplines are possible in a distance format (for example, chemistry, physics, sports, etc.) - for this the curriculum must be completely restructured, and additional conditions must be created for more effective perception. educational material (for example, provide students with the necessary equipment to be able to conduct laboratory and other experiments at home, taking into account all the rules of life safety); distance learning really requires quite high resources of any plan, a disadvantage is also the dissatisfaction of the audience with the course of distance education, which is a possible reason for the loss of authority of the Ministry of Education.

But the benefits, that is, the positive aspects of distance education are there. The 21st century is a time of digital technologies, and on the one hand it is right to gradually introduce technical elements and developments into the education system. Although distance education is inconvenient at some points, it has positive features - for example, saving time (no need to spend time on the way to your school), saving resources by the educational institution (if there is a format of distance learning, no longer need an audience, as was before, and this indicates the economy of heating, light, etc.), the development of the technical sphere and technical skills in society. Achievements can be considered demand in the market of technical developments. Even at the end of the quarantine, all online learning platforms will remain and be used, and this is an opportunity to develop the country's IT sector.

At the beginning of the introduction of distance education, only ordinary messengers and services for video calls were used. A good reason for both individual IT professionals and the country (provided that this platform can reach the international level) is to create optimal applications for online learning. Such platforms should include the possibility of correspondence both in private with the

teacher and in a collective conversation with colleagues; the possibility of video calls, the availability of an electronic board with success, the ability to teach training materials and conduct tests. That is, it is necessary to create an electronic analogue of an educational institution, where students can use all the functions of the educational institution - it is the acquisition of knowledge and socialization processes [3].

I believe that distance education can be perceived not as a forced process, but as an innovation that will help improve the level of education and make it more convenient. The combination of distance and full-time courses will significantly help to change the attitude of students to the learning process. Now learning is not just about gaining knowledge, but also caring for pupils and students, facilitating the educational process and finding mutually beneficial agreements.

Thus, distance education is a new stage in the transformation of the already traditional form of education into a new one, which will help to encourage education, as well as significantly facilitate this process. In my opinion, blended learning is an important step for a progressive society, the processes of which are based on technical and Internet tools; in this way it will be more useful to implement the latest technologies, but also to pay attention to the necessary processes of offline interaction.

Transformation of full-time education into distance learning is quite a possible process in the future, even with the disappearance of the pandemic, in addition, in practice it is quite possible. With the help of technical means it is possible to create platforms that can completely replace educational institutions, but it takes time, large financial contributions and motivated professionals (various specialists, such as teachers, psychologists) It will take more than one year to implement a full-fledged format of distance education, because the effectiveness of this process requires careful study of the weaknesses of distance format and get rid of them, because poor education can have a negative impact on a generation of applicants. It is also important to analyze whether it is potentially possible to switch completely to distance learning, if not, to conclude how to combine the two formats. In general, the idea of distance learning has the right to be implemented, and after the situation in

2020 there is a reason to start preparing for this form of education.

## References

1. Дистанционное обучение как инновационный подход в реализации непрерывного образования. URL: <https://cyberleninka.ru/article/n/distantsionnoe-obuchenie-kak-innovatsionnyy-podhod-v-realizatsii-nepreryvnogo-obrazovaniya>.
2. Дистанционное обучение как современная педагогическая технология. URL: <https://cyberleninka.ru/article/n/distantsionnoe-obuchenie-kak-sovremenennaya-pedagogicheskaya-tehnologiya>.
3. Дистанционное обучение: форма, технология, средство. URL: <https://cyberleninka.ru/article/n/distantsionnoe-obuchenie-forma-tehnologiya-sredstvo>.

УДК 902.01

## GLASS CUPS OF WEKLICE TYPE IN THE CHERNYAKHOV CULTURE: A CHRONOLOGICAL ASPECT

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**Анотація. Щепаченко В. І. Скляні чащі типу Weklice у черняхівській культурі: хронологічний аспект.**

У статті представлена спроба перегляду хронології існування скляних чащ типу Weklice у черняхівській культурі. Посудин цього типу відомо небагато. Нещодавно на сході України було виявлено ще дві чащі, одна з яких походить із датованого комплексу. Дата цього комплексу та нові дослідження скляного посуду в ареалі культури Черняхів/Синтана-де-Муреш, а також у римських провінціях дозволяють скорегувати хронологію скляних чашок типу Weklice відповідно до наших сучасних уявлень.

Скляні чащі типу Weklice, швидше за все, з'явилися в ареалі культури Черняхів/Синтана-де-Муреш не раніше, ніж у фазі C3. Це підтверджують ряд факторів, в тому числі датування комплексів із артефактами цього типу, хронологія напівсферичних посудин із оплавленим краєм вінець у черняхівської культурі, а також датування сировини, з якого були виготовлені окремі вироби цього типу. Датування комплексу із поховання 211 могильника Війтенки, що відповідає третій четверті IV ст. або фазі C3/D1, поки що, визначає верхню хронологічну межу їх існування в ареалі культури Черняхів/Синтана-де-Муреш. Цілком можливо, що такі чащі з'явилися та існували на Дніпровському Лівобережжі дещо

пізніше, ніж в інших районах черняхівської культури. Серед центрів їх виробництва сьогодні, з рівною можливістю, можна вважати як провінційно-римські майстерні, так і майстерню в Комарові.

**Ключові слова:** пізньоримський час, черняхівська культура, скляні чаші, тип Weklice.

**Abstract. Shchepachenko V. I. Glass cups of Weklice type in the Chernyakhov culture: a chronological aspect.**

Article presents an attempt to revise the chronology of the Weklice type cups in the Chernyakhov culture. Vessels of this type are not numerous there. Recently two more cups were discovered in Eastern Ukraine, one of which come from dated assemblage. The date of this assemblage and the new investigations of the glassware in Chernyakhov/Sântana-de-Mureş area as well as Roman provinces allow correcting the chronology of Weklice type glass cups according to our modern knowledge.

The glass cups of the Weklice type most likely had appeared in the Chernyakhov/Sântana-de-Mureş area no earlier than at the C3 phase. The number of factors, including the dating of complexes containing them, the chronology of hemispherical vessels with fire-rounded rim in the Chernyakhov culture and the dating of raw materials used for making individual artefacts of this type confirm that. The date of the complex from grave 211 of Vijtenki burial ground, which corresponds to the third quarter of the 4<sup>th</sup> century or phase C3/D1, so far determines the upper chronological boundary of their existence in the Chernyakhov/Sântana-de-Mureş area. It is quite possible that such cups appeared and existed in the Dnieper left bank region somewhat later than in other areas of the Chernyakhov culture. Among the centres of their production today, with an equal possibility, may be considered both the provincial-Roman workshops and the workshop in Komariv.

**Key words:** Late Roman Time, Chernyakhov culture, glass cups, Weklice type.

**General formulation of research and its topicality.** During the last two decades, glassware from Chernyakhov/Sântana-de-Mureş area was attracting a significant scientists' attention. A large quantity of publications dedicated to this topic, which has appeared over this time, suggests about that. There are studies of origin and manufacturing technology of glass vessels [31, p. 203-217; 27, p. 299-315; 29, p. 141; 28, p. 193-199; 32, p. 257-264; 30, p. 182-208], articles devoted to elaborating of their typology and chronology [8, p. 48-86; 22, p. 89-106; 9, p. 83-109; 23, p. 123-154] and publications of new finds [24, p. 65-74; 26, p. 111-120] among

them. In this regard, it is relevant to mark previously unknown types of glassware and determine their chronological position among the antiquities of the Chernyakhov culture, which have a significant influence on the reconstruction of cultural processes in Eastern Europe in Late Roman times.

**Setting of the problem and the aim of the article.** T. Stawiarska distinguished the “Weklice” type among other glass finds of Roman time from modern Poland territory in the end of last century [38, p. 135-136]. Vessels of this type are not numerous: there are only five artefacts that can be confidently associated with Weklice type. Three of them come from Chernyakhov/Sântana-de-Mureş area. All of them are very different and only their hemispherical shape, the same way of decoration (applied trails), similar pattern composition (in the shape of a sinusoid or wavy zigzag) and some other technological features (fire-rounded rim and pontil-mark) previously allowed us to assume their morphological similarity and to incorporate them in one type (Weklice) [34, p. 81-82].

The type got its name from the eponymous burial ground of the Wielbark culture, in one of whose burials (grave 82) the vessel of this type was first discovered. The polish scientist suggested dating this glass find to the C2 phase (all the dates of the “barbarian” complexes indicated in the publication corresponds to the Central European system of relative chronology, which is based on the developments of K. Godłowski and J. Teiral [10; 40]) [38, p. 135]. Although, authors of excavations of burial ground date the complex to the phases C1b-C2 [18, p. 141-142] or C1b-C2/C2a [19, p. 131-132].

Meanwhile, relatively recently researchers of Chernyakhov antiquities have demonstrated that glass cups with fire-rounded rim appear in culture area somewhat later, at the phase C3 [23]. In this regard, it seems necessary to revise or clarify the dating of Weklice type vessels, known in the Chernyakhov culture. This is the purpose of our study.

**Discussion and results.** The glassware forms, which can be identified as cups of the Weklice type, were discovered in Chernyakhov/Sântana-de-Mureş area earlier than in neighbouring Poland. In 1986, the results of the excavations of Dancheni

burial ground (*Dănceni, raionul Ialoveni, Republica Moldova*), which is situated between the Dniester and the Prut rivers, were published. The hemispherical cup of light green, transparent glass, decorated with applied trails in the shape of a sinusoid or wavy zigzag was uncovered there, in grave 169 among other grave goods [25, p. 64, pl. XXXI. 10]. M. Shchukin and T. Shcherbakova, who elaborated the chronology of the site and the periodization of its functioning, pointed out the absence of exact analogies of the bowl found in this burial. Authors proposed to consider cups of the Eggers 200 type and beakers of the Eggers 188-190 types among the objects close to it in form and system of ornamentation and assumed that a specimen from the Dancheny burial ground may occupy an intermediate position in the development between these types of glassware. On this basis, they dated the find to the boundary of the C1 and C2 phases [35, p. 192]. The authors attributed the complex to the stage Ib of the relative chronology of the burial ground, which is synchronized with the phase C1b [35, fig. 10; p. 210].

Two more vessels of this type have been relatively recently discovered in burials of Vijtenki burial ground on the Dnieper left bank [34]. The authors of the excavations attributed one of these complexes, grave 211, to the second stage of burial ground functioning, which corresponds to the phases C3-C3/D1 [16, app. 4-5; 15, p. 95-96]. This dating of the complex is beyond doubt; however, it can be somewhat specified. Among other well-dated grave goods from this burial a multipart antler comb with a semicircular back without shoulders (type IB1a according to G. Nikitina [20, p. 147-160]) and two identical bronze two-pieced fibulae with returned foot (type Б2б according to E. Gorokhovski [12, p. 35]) can be considered as well (Appendix 2; Fig. 2).

The lifetime of multipart antler combs of the Nikitina IB1a type E. Gorokhovski associated with first three phases of relative chronology of Chernyakhov burial grounds in Ukrainian forest-steppe or phases C2 and C3 [12, p. 42-44]. R. Shishkin noted that for multipart antler combs without shoulders “the main chronological principle is the tendency to an increase in the height of the head (back) [37, p. 244]. According to observations made by O. Petrauskas the ratio of

height and width of antler combs, which existed in Chernyakhov culture at the C2 phase, on average, is about 0.33, at the C3 phase – 0.25-0.45 (on average – 0.36) and at the D1 – 0.51 and higher [23, p. 126]. The ratio of height and width of antler comb from grave 211 of Vijtenki burial ground is about 0.53, which probably indicates its later chronological position, possibly within the phases C3/D1-D1 (Appendix 2: 3).

The fibulae with returned Gorokhovski Б foot have a long period of existence in Chernyakhov culture. Their variations with semi-circular in section back (Б26) widely occurred at the third (“Kosanovskaya”) phase of relative chronology of Chernyakhov burial grounds in Ukrainian forest-steppe [12, p. 44]. Nevertheless, single finds of such items are known at the final stages of Chernyakhov culture [12, p. 45]. Thus, the most probable date of this complex is within the C3/D1 phase, which corresponds to the third quarter of the 4<sup>th</sup> century CE.

The complexes containing cups of similar shape with fire-rounded rim in Chernyakhov/Sântana-de-Mureş area are dated in different ways. Some researchers suggest that such products appear at the stage of culture formation, at the phase C2 [12, p. 42-43; 11, p. 132; 17, p. 65]. Others believe that they appear during the culture’s heyday, at the phase C3 [21, p. 265, fig. 15; 23, p. 123-154]. The second opinion seems to be more convincing to us.

The hemispherical shape and a fire-rounded rim of these vessels find parallels among glassware from different regions of Roman Empire. C. Isings suggest that cups of similar shape with out-turned and cracked-off unworked rim (type Isings 96) with abraded, applied, pinched or mould-blown decoration as well as undecorated existed within the Empire during the 3<sup>rd</sup> – 4<sup>th</sup> centuries CE [13, p. 113-115, 131-133]. B. Rütti believed that such vessels (type AR 60 according to author’s typology) appeared there already in the mid of 2<sup>nd</sup> century CE and existed until the early 5<sup>th</sup> century CE [33, p. 330-333]. The hemispherical shape of these artefacts remained unchanged for a long time, which makes it impossible to establish a more detailed chronology of their evolution.

In this case, the researchers’ observations concerning the distribution of the glassware with fire-rounded rim in various regions of Empire are of particular

interest. In particular, S. Fünfschilling notes that cups, bowls and plates with fire-rounded rim were widespread in North-Western Switzerland during the 1<sup>st</sup> – 3<sup>rd</sup> centuries CE, while later, in the 4<sup>th</sup> century CE, they were almost completely replaced by vessels with cracked-off rim. The renaissance of beakers with fire-rounded rim, after their disappearance at the end of the 3<sup>rd</sup> century CE, was in the second half of the 4<sup>th</sup> – early 5<sup>th</sup> centuries CE [7, p. 54-56]. I. Lazar also emphasizes that although the glassware with fire-rounded rim existed in Slovenia during the 1<sup>st</sup> – 4<sup>th</sup> centuries CE, it became widespread in the 2<sup>nd</sup> – 3<sup>rd</sup> centuries CE [14, p. 18]. Products with cracked-off rim virtually completely dominated among glassware in Roman Britain and Pannonia in the 4<sup>th</sup> century CE [3, p. 12-13; 2, p. 56-58, pl. II: 17-20; 4, p. 260; 5, p. 224, 226].

All these observations are local and can't fully characterize the pattern of distribution of the vessels with fire-rounded rim within the Empire, and nevertheless, it can be assumed that their popularity had significantly decreased by the end of the 3<sup>rd</sup> – beginning of the 4<sup>th</sup> centuries CE in some provinces.

The situation in the Chernyakhov culture, where cups with fire-rounded rim appeared in the second quarter of the 4<sup>th</sup> century CE [23], looks opposite in this case. Previously, scientists have already indicated that such artefacts occurred in Chernyakhov/Sântana de Mureş area later than within the Empire [29; 30, p. 190].

In the light of abovementioned, the dating of Weklice type cup from grave 169 Dancheni burial ground raises some doubts. The burial was destroyed in antiquity and didn't contain any well-dated grave goods except for the glass vessel. Its dating, in the absence of certain analogies, based on the authors' intuitive assumptions about the morphological similarity of this item and vessels of the Eggers 188-190, 200 type, seems to be incorrect today. Taking into account results of modern investigations, this artefact, as well as other hemispherical bowls with fire-rounded rim in the Chernyakhov culture, should probably date no earlier than the second quarter of the 4<sup>th</sup> century CE or to the phase C3.

Some scholars associate the manufacture of glassware with 'hot' decoration with the provincial-Roman glassworking technology [30, p. 187-188; 39, p. 98],

which may indicate the import origin of glass cups of the Weklice type in the Chernyakhov culture. Nevertheless, such artefacts could be produced in the Komariv workshop (*Комарів, Кельменецький район, Чернівецької області, Україна*) as well. Glass vessels with fire-rounded rim and applied decoration, according to O. Rumyantseva, were among the probable products of this workshop [32, p. 260]. The fragment of upper part of Weklice type cup from grave 110 of Vijtenki burial ground is made of glass of HIMT series, in particular of its first subgroup with high concentrations of iron, manganese, titanium and other oxides [30, tab. 2, fig.5]. The raw glass of the first subgroup of HIMT series also has been recorded in Komariv, albeit in a small amount [31, p. 306].

**Conclusions.** The glass cups of the Weklice type most likely had appeared in the Chernyakhov/Sântana-de-Mureş area no earlier than at the C3 phase. The number of factors, including the dating of complexes containing them, the chronology of hemispherical vessels with fire-rounded rim in the Chernyakhov culture and the dating of raw materials used for making individual artefacts of this type confirm that. The date of the complex from grave 211 of Vijtenki burial ground, which corresponds to the third quarter of the 4<sup>th</sup> century or phase C3/D1, so far determines the upper chronological boundary of their existence in the Chernyakhov/Sântana-de-Mureş area. It is quite possible that such cups appeared and existed in the Dnieper left bank region somewhat later than in other areas of the Chernyakhov culture. Among the centres of their production today, with an equal possibility, may be considered both the provincial-Roman workshops and the workshop in Komariv. Nevertheless, there are still too few finds of such items to draw definitive and unambiguous conclusions about their chronology and origin. Perhaps, new discoveries and investigations will shed more light on the issues, which we interested in.

#### *Appendix 1*

#### **Glass cups of Weklice type in Chernyakhov culture**

**Vijtenki** (*burial ground; Війтенки, Валківський район, Харківської області, Україна*)

##### **Grave 110**

*Condition:* fragment of upper part of the vessel, burnt, melted.

*Form:* hemispherical cup.

*Surface*: is affected by weathering, has traces of being on fire.

*Glass colour*: colourless with a greenish tint, transparent.

*Glass mass*: contains inclusions of individual bubbles no more than 1 mm in size.

*Rim*: fire-rounded.

*Decoration way*: applied glass threads of the same colour as colour of the vessel.

*Pattern composition*: glass thread form a sinusoid / wavy zigzag composition.

*Parameters (cm)*: glass thickness (*rim/wall*) – 0.25/0.15

### **Grave 211**

*Condition*: intact form. *Form*: hemispherical cup.

*Surface*: is slightly affected by weathering that hinder the determination of real colour of the vessel.

*Glass colour*: colourless with a greenish tint, transparent.

*Glass mass*: contains inclusions of individual bubbles no more than 2 mm in size.

*Rim*: irregular, slightly out-turned, fire-rounded.

*Base*: plain, slightly concave. Stability on a horizontal surface provides with a small area at the bottom of the vessel; has a pontil-mark.

*Decoration way*: applied glass threads of the same colour as colour of the vessel; the bottom part of the vessel was marvered after decoration.

*Pattern composition*: glass thread form a sinusoid / wavy zigzag composition, which evenly encircle the vessel's surface. The pattern starts at the bottom of the vessel.

*Parameters (cm)*: height – 5.8; rim diameter – 8; diameter in the middle of the height – 6.9; base diameter (*diameter of the stable surface*) – 2; glass thickness (*rim/wall/base*) – 0.25-0.3/0.2/0.4.

**Dancheni (burial ground; Dănceni, raionul Ialoveni, Republica Moldova**

### **Grave 169**

*Condition*: intact form. *Form*: hemispherical cup.

*Glass colour*: light green, transparent.

*Rim*: irregular, out-turned, fire-rounded.

*Base*: plain, slightly concave. Stability on a horizontal surface provides with a small bottom area.

*Decoration way*: applied glass threads of the same colour as colour of the vessel.

*Pattern composition*: glass thread form a sinusoid / wavy zigzag composition, which evenly encircle the vessel's surface. The pattern starts at the walls of the vessel.

*Parameters (cm)*: information absent.

*Source*: 25, p. 64, pl. XXXI. 10.

### *Appendix 2*

#### **Well-dated finds from the grave 211 of Vijtenki burial ground**

##### **9) Bronze two-pieced faceted fibula with returned foot (39m/2015)**

*Bow* arched, arcuate, cross-section of *bow* – segment. In the place where the *receiver* and the *spring* are attached, the fibula has three rectangular platforms. The *receiver* is attached with wire. At the point where the *spring* is attached, the body is riveted into a plate with a hole. The *spring* has an iron axle, 12 turns on each side, *overhead imitations* and a lower double *bowstring*. There are *retainer rings* at the ends of the *axle*. *Parameters (cm)*: body length – 3.7; width of the blank – 0.5; spring length – 4.

#### **10) Bronze two-pieced faceted fibula with returned foot (44m/2015)**

*Bow* arched, arcuate, cross-section of *bow* – segment. In the place where the *receiver* and the *spring* are attached, the fibula has three rectangular platforms. The *receiver* is attached with wire. At the point where the *spring* is attached, the body is riveted into a plate with a hole. The *spring* has an iron axle, 12 turns on each side (the end of the spring on the right side is broken off), *overhead imitations* and a lower double *bowstring*. There is *retainer ring* at the left end of the *axle*. *Parameters (cm)*: body length – 3.9; width of the blank – 0.5; spring length – 3.6.

#### **11) Multipart antler comb (48m/2015)**

*Back shape*: semicircular.

*Feet*: straight.

*Comb construction*: two external one-piece plates cover seven insert plates. Ten bronze pins connect the construction. There is an antler core in the back of the comb.

*Pins* are made of a bronze plate twisted into a tube.

The external cover plates are decorated with circular patterns.

*Parameters (cm)*: height – 6.1; height of the back – 3.6; width – 11.4; thickness – 0.9.

### **References**

1. Ambroz A. K. (1966). *Fibuly yuha evropeiskoi chasti SSSR II v. do n. e. IV v. n. e.* [Fibulae of South European part of USSR (2<sup>nd</sup> BC – 4<sup>th</sup> CE)]. Moskva.
2. Barkóczi L. (1988). *Pannonische glasfunde in Ungarn*. Budapest.
3. Cool H. E. M. (1995). Glass vessels of the fourth and early fifth century in Roman Britain. Foy D. (ed.) *Le verre de l'antiquité Tardive et haut moyen age*. Musée archéologique départemental du Val d'Oise, 11–26.
4. Dévai K. (2016). Glass vessels from Late Roman times found in Pannonia. *Acta Archaeologica Academiae Scientiarum Hungaricae*, 67, Budapest, 255–286.
5. Dévai K. (2017). Glass vessels from Late Roman graves in the Hungarian part of the Roman province Pannonia. Wolf S., Pury-Gysel A. (eds) *Association Internationale pour l'Histoire du Verre. Annales du 20e Congrès 2015*, Romont, 222–229.
6. Foster H. E., Jackson C. M. (2009). The composition of “naturally coloured” late Roman vessel glass from Britain and the implications for models of glass production and supply. *Journal of Archaeological Science*, 36, 189–204.
7. Fünfschilling S. (2015). *Die römischen Gläser aus Augst und Kaiseraugst*. Augst.
8. Gavritukhin I. O. (1999). *Khronologicheskie indikatory finala chernyakhovskoy kultury* [The

- chronological markers of the final of Chernyakhov culture]. Levada M. (ed.) *Sto let chernyakhovskoy culture – One hundred years of the Chernyakhov culture investigations*, Kiev, 48–86. (in Russian). 9. Gavritukhin I. (2017). Glass vessels of the final of the Chernyakhov culture. *Na hranicích impéria. Extra fines imperii. Jaroslavu Tejralovi k 80. narozeninám*, Brno, 83–109.
10. Godłowski K. (1970). *The chronology of the Late Roman and Early Migration periods in Central Europe*. Kraków. 11. Gomolka-Fuchs G. (1999). Gläser der Sîntana de Mureş-Černjachov-Kultur aus Rumänien und der Republik Moldavien. Gomolka-Fuchs G. (ed.) *Die Sîntana de Mureş-Černjachov-Kultur. Akten des Internationalen Kolloquiums in Caputh vom 20. bis. 24. October 1995*. Bonn, 129–142. 12. Gorokhovski E. L. (1988). Hronologija chernyahovskih mogilnikov lesostepnoj Ukrayny [The chronology of burial grounds of the Chernyakov culture in Ukrainian Forest-Steppe]. Baran V. D. (ed.) *Trudy V Mezhdunarodnogo kongressa arheologov-slavistov – Proceedings of the Fifth International Congress of Slavic Archeologists*, T. 4, Kiev, 34–46. (in Russian). 13. Isings C. (1957). Roman glass from dated finds. *Archaeologica Traiectina*, II. Groningen–Djakarta. 14. Lazar I. (2003). Rimsko steklo Slovenije [Roman glass of Slovenije]. Ljubljana. 15. Lyubichev M. V. (2019). *Rannjaja istorija dnepro-doneckoj lesostepi I – V vekov [Early history of the Dnieper-Donetsk forest-steppe of the 1<sup>st</sup> – 5<sup>th</sup> centuries CE]* (Ostrogothica-Serie (Bände), 2). Kharkov. 16. Lyubichev M. V., Schultze E., Gella E. I. (2019). Pozdnie pogrebeniya mogilnika Voytenki i poslednyaya faza chernyakhovskoy kultury v lesostepi mezdu Dneprom i Severskim Dontsom [Late burials of the Voitenki burial ground and the last phase of the Chernyakhov culture in the forest-steppe between the Dnieper and the Seversky Donets rivers]. Petrauskas O. V., Hopkalo O. V., Horbanenko S. A. (eds): *Starozhytnosti varvarskykh plemen u pershii polovyni I tys. n. e.: do 90-richchia V. D. Barana – Antiquities of barbarian tribes in the first half of the first millennium CE: to the 90<sup>th</sup> anniversary of V. D. Baran* (Oium, 6), Kyiv, 13–49. (in Russian). 17. Magomedov B. V. (2001) *Chernyakhovskaya kultura. Problema etnosa [The Chernyakhov culture. Ethnicity problem]*. Lublin. 18. Natuniewicz-Sekuła M., Kontny B. (2010) „Jeździec bez głowy” et alii, czyli znaleziska ostróg z cmentarzyska kultury wielbarskiej w Weklicach. Urbaniak A., Prochowicz R., Jakubczyk I., Levada M., Schuster J. (eds) *Terra Barbarica. Monumenta Archaeologica Barbarica, Series Gemina*, Tomus II. Łódź–Warszawa, 333 – 345. 19. Natuniewicz-Sekuła M., Okulicz-Kozaryn J. (2011). *Weklice. A cemetery of Wielbark Culture on the Eastern Margin of Vistula Delta (Excavations 1984-2004)*. Warszawa. 20. Nikitina G. F. (1969). Grebni chernyakhovskoy kultury [The antler combs of the Chernyakhov culture]. *Sovetskaya Arkheologiya – Soviet Archaeology*, 1, Moskva, 147–160. (in Russian)
21. Petrauskas O. V. (2003). Die Gräberfelder der Černjachov–Kultur von Kosanovo und Gavrilovka – eine vergleichende Studie zu Chronologie, Bestattungssitten und ethnokulturellen Besonderheiten. *Bericht der Römisch-Germanischen Komission*, Bd. 84, 224–362. 22. Petrauskas

O. V. (2016). Skliani posudyny typu Eggers/230 v cherniakhivskii kulturi: khronologichnyi aspect [The glass vessels of Eggers/230 type in the Chernyakhiv culture: chronological aspect]. Petruskas O. V., Hopkalo O. V., Horbanenko S. A. (eds) *Cherniakhivska kultura – Chernyakhiv culture*, Oium, 5. Kyiv, 89–106. (in Ukrainian). 23. Petruskas O. V. (2017). Übergang von der stufe C2 zu C3 in der Černjachov-Kultur (auf dem Beispiel der Glasschalen mit Ringboden). *Ephemeris Napocensis*, XXVII, Cluj-Napoca, 123–154. 24. Petruskas O. V., Pasternak V. V. (2003). Skliani posudyny mohylnyka cherniakhivskoi kultury Velyka Buhaivka v Serednomu Podniprovi [Glass vessels of the burial ground of the Chernyakhiv culture Velyka Bugaivka in the Middle Dnieper]. *Arkheolohiia – Archaeology*, 4. Kyiv, 65–74. (in Ukrainian). 25. Rafalovich I. A. (1986). *Dancheny. Mogilnik chernyakhovskoy kultury III – IV vv. n. e.* [Dancheni. The burial ground of the Chernyakhov culture of the 3<sup>rd</sup> – 4<sup>th</sup> centuries CE]. Kishinev. 26. Reida R. M., Heiko A. V., Sapiehin S. V. (2018). Deiaki khronoindykatory druhoi polovyny IV-V st. z Shyshatskoho mohylnyka [Some chronological markers of the second half of the 4<sup>th</sup> – 5<sup>th</sup> centuries CE from Shishaki burial ground]. Lyubichev M., Myzgin K. (eds) *Khronologiya i monetnye nakhodki pozdnerimskogo vremeni i epokhi Velikogo pereseleniya narodov. Aktualnye arkheologicheskie issledovaniya v Tsentralnoy i Vostochnoy Evrope – The chronology and monetary finds of late Roman times and the Great Migrations period. Current archaeological investigations in the Central and Eastern Europe* (Ostrogothica-Serie (Hefte), Heft 3), Kharkov, 111 – 120. (in Ukrainian). 27. Rumyantseva O. S. (2016). Litoe steklo s poseleniya chernyakhovskoy kultury Komarov: prestizhnaya posuda ili syre steklodelatelnoy masterskoy? [The cast glass finds from the site of the Chernyakhov culture at Komarov: the luxury glassware or the raw material for the glass workshop?]. *Kratkie soobshcheniya Instituta Arkheologii – Brief reports of the Institute of Archeology*, 245, 299–315. (in Russian). 28. Rumyantseva O. S. (2017). Riflenye formy i nakhodki riflenogo stekla s poseleniya chernyakhovskoy kultury Komarov: k voprosu o khronologii i vidakh produktsii stekolnoy masterskoy [The dip-moulded forms and the finds of the dip-moulded glass the site of the Chernyakhov culture at Komarov: on the question of chronology and types of products of the glass workshop]. In: Gavritukhin I. O., Lopatin N. V., Oblomskiy A. M. (eds) *Ranneslavianskiy mir. Arkheologiya slavyan i ikh sosedey – Early Slavic world. The archaeology of the Slavs and their neighbours*, 19. Moskva, 193–199. (in Russian). 29. Rumyantseva O. S. (2017). Steklodelie za limesom: novye dannye ob organizatsii proizvodstva i khronologii masterskoy v Komarove [Glassworking beyond the *limes*: the new data about production organisation and chronology of the glass workshop at Komarov]. *Stratum plus*, 4, 141–164. (in Russian). 30. Rumyantseva O. S., Lyubichev M. V., Trifonov A. A. (2018). Khimicheskiy sostav stekla arkheologicheskogo kompleksa Voytenki 1 i proiskhozhdenie sosudov chernyakhovskoy kultury (predvaritelnye itogi issledovaniy) [The chemical composition of the glass from archaeological complex Vojtenki 1 and

the origin of the vessels of the Chernyakhov culture (the preliminary results of investigations)]

Lyubichev M., Myzgin K. (eds) *Khronologiya i monetnye nakhodki pozdnerimskogo vremeni i epokhi Velikogo pereseleniya narodov. Aktualnye arkheologicheskie issledovaniya v Tsentralnoy i Vostochnoy Evrope – The chronology and monetary finds of late Roman times and the Great Migrations period. Current archaeological investigations in the Central and Eastern Europe* (Ostrogothica-Serie (Hefte), Heft 3), Kharkov, 182–208. (in Russian). 31. Rumyantseva O. S., Shcherbakov I. B. (2016). Steklo-syrets s poseleniya Komarov na Srednem Dnestre: khimicheskiy sostav i dannye o kharaktere i khronologii steklodelatelnogo kompleksa pozdnerimskogo vremeni [The raw glass from the site at Komarov at the middle Dniester: the chemical composition and the data about the character and the chronology of the glassworking complex of Late Roman time]. *Stratum plus*, 4, 203–217. (in Russian). 32. Rumyantseva O., Belikov S. A. (2017). Late Roman workshop at Komarov (Middle Dniester) and the problem of the origin of ‘barbarian’ facet cut beakers. Wolf S., Pury-Gysel A. (eds) *Association Internationale pour l’Histoire du Verre Annales du 20e Congrès 2015*, Romont, 257–264. 33. Rütti B. (1991). *Die römischen Gläser aus Augst und Kaiserburg. Augst*. 34. Shchepachenko V. (2020). Glasschalen vom Typ Weklise aus den Gräbern 110 und 211 des Spätkaiserzeitlich-/Frühvölkerwanderungszeitlichen Gräberfeldes Vojtenki 1. *Študijné zvesti archeologického Ústavu Slovenskej Akadémie Vied*, 67 (1), 77–102. 35. Shchukin M. B., Shcherbakova T. A. (1986). K khronologii mogilnika Dancheny [To the chronology of the Dancheni burial ground]. Rafalovich I. A. *Dancheny. Mogilnik chernyakhovskoy kultury III – IV vv. n. e. – Dancheni. The burial ground of the Chernyakhov culture of the 3<sup>rd</sup> – 4<sup>th</sup> centuries CE*, Kishinev, 177–208. (in Russian). 36. Shishkin R. G. (1999). Klassifikatsiya i tipologiya trekhloynykh grebney chernyakhovskoy kultury [The classification and the typology of the three-layer combs of the Chernyakhov culture]. In: M. Levada (ed.) *Sto rokiv vyvchennia kultury poliv pokhovan na Ukraini – One hundred years of studying the culture of burials fields in Ukraine*. Kyiv, 43–48. (in Russian). 37. Shishkin R. G. (2002). Khronologicheskiye priznaki trekhloynykh grebney chernyakhovskoy kultury [The chronological features of the three-layer combs of the Chernyakhov culture]. Suchasni problemy arkheologii – The modern problems of archaeology. Kyiv, 244–245. 38. Stawiarska T. (1999). *Naczynia szklane okresu rzymskiego z terenu Polski*. Warszawa. 39. Stawiarska T. (2014). Roman and Early Byzantine glass from Romania and Northern Bulgaria. *Bibliotheca Antiqua*, vol. XXIV. Warsaw. 40. Tejral J. (1986). Fremde Einflüsse und kulturelle Veränderungen nördlich der mittleren Donau zu Beginn der Völkerwanderungszeit. *Archaeologia Baltica*, VII, 175–238.

## SOME RISKS OF LEGALIZATION OF CRYPTOCURRENCY IN UKRAINE

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**Анотація. Шульга Д.О. Деякі риски легалізації криптовалют в країні.**

Статтю присвячено правовому статусу та ризикам і проблематиці легалізації Bitcoin в Україні. Проаналізовано підходи до визначення правової природи криптовалюти в різних країнах світу та законопроекти про обіг криптовалют в Україні. Здійснено теоретичний аналіз підходів до правового регулювання використання криптовалют у світі та ключових аспектів визначення правового статусу bitcoin в Україні. Досліджено проблематику легалізації криптовалют. Зроблено висновок, що легалізація криптовалют на національному рівні передбачає доцільність оновлення національного законодавства про платіжні засоби, оподаткування, захисту прав приватних осіб і компаній як учасників фінансових відносин.

**Ключові слова:** біткоїн, віртуальні активи, гроші, криптовалюта, правовий статус.

**Abstract. Shulga D.O. Some risks of legalization of cryptocurrency in Ukraine.**

This article is devoted to the legal status and general risks and issues of legalization of Bitcoin in Ukraine. The approaches to the definition of the legal nature of cryptocurrency in the different countries and bills on cryptocurrency circulation in Ukraine are analyzed. A theoretical analysis of the legal regulatory approaches to cryptocurrency usage in the world and the principle aspects of the determination of the legal status of Bitcoin in Ukraine are examined. The issue of cryptocurrency legalization has been studied. The conclusion is drawn that the legalization of cryptocurrency at the national level provides for the expediency of updating national legislation by the means of payment, taxation and protection of the rights of individuals and companies as participants in financial relations.

**Key words:** bitcoin, cryptocurrency, legal status, money, virtual currency.

**General formulation of research and its topicality.** The active development of information technologies and the formation of new types of economic, financial and credit activities has led to the emergence of an alternative form of traditional monetary forms – virtual currencies. The study of the phenomenon of cryptocurrency began in the 1980s. However, this term has remained new in understanding and insufficiently researched. [1]

The European Court of Justice has ruled that Bitcoin is a currency or a mean of payment, and it is not a commodity. However, according to current European Union law cryptocurrency is a commodity.

Many scientific works of economists and other scientists are devoted to the history of the development and functioning of cryptocurrency (M. Swan [15], A. Tapscott, D. Tapscott [16], P. Vigna [21]).

Cryptocurrency is a digital currency, which is encrypted and protected by special algorithms that operate independently of the Central Bank [9]. The most common type of cryptocurrency has become "bitcoin".

The spread of cryptocurrency market practices in the world's leading countries, the rapid growth of Bitcoin capitalization and the simplicity of mining processes are factors of steady growth of demand for electronic currency, and as a result an increase in the monetary equivalent of its value. Anyhow, all mentioned above processes lead to transformation of the economy. Ukraine isn't an exception, because our country is among the top ten countries in the world in terms of the number of virtual currency uses. [4, p. 11] In this context, it is socially important to regulate properly the processes of cryptocurrency circulation, and development of the issue of cryptocurrency legalization in our country is a relevant one.

Recently, a large number of journalistic articles have been devoted to the problems of legal regulation of bitcoin in Ukraine and in the world, but thorough scientific research has not yet been conducted. Among the scientific studies of the problems of legal regulation of Bitcoin in Ukraine should be mentioned the works of I. M. Doronin [3], A. T. Protsenko [10], D. S. Vakhrushev [17], S. B. Veprev and V. O. Perov [18].

**Setting of the problem and the aim of the article.** Active use of cryptocurrency in Ukraine as a mean of payment creates a risk of violation of the rights and freedoms of citizens as participants in trade and monetary relations, potential consumers of purchased products and may harm the financial interests of the state. Due to this, it remains quite problematical for state to introduce organizational and legal mechanisms to ensure the orderliness and transparency of financial and

monetary relations and the issue of proper regulation of the legal status of cryptocurrency. By the way, the world practice proves that states, which have already legalized Bitcoin and use it officially, have a legitimate source of budget replenishment.

**Discussion and Results.** We attract your attention on the fact that the international community has not identified common approaches to regulating the circulation of cryptocurrencies yet.

The European Central Bank in its research on virtual digital currencies «Virtual currency schemes – a further analysis» doesn't make an unequivocal decision on the use of virtual currencies, warning about the risks of payment security and potential threats in settlement transactions [5].

As for Ukraine, it should be noted that according to Article 99 of the Constitution of Ukraine, the national currency of Ukraine is the Hryvnia [7].

Similarly, Section 1 of Article 192 of the Civil Code of Ukraine establishes that the legal monetary unit, which is compulsory to accept at face value throughout Ukraine, is the hryvnia. Article 3 of the Law of Ukraine "On Payment Systems and Funds Transfer in Ukraine" and the Decree of the Cabinet of Ministers of Ukraine "On the System of Currency Regulation and Currency Control" [2, 12, 13] contain similar provisions. Besides, according to Section 2 of Article 32 of the Law of Ukraine "On the National Bank of Ukraine" the issue and circulation of other monetary units and the use of money substitutes as payment instruments in the territory of Ukraine are prohibited [11].

The National Bank of Ukraine in its clarification on the legality of using cryptocurrency (Bitcoin) of November 10, 2014 in Ukraine compared the virtual currency (Bitcoin) with monetary substitute, that doesn't have any real value and can't be used on the territory of Ukraine as a payment instrument, because it contradicts the norms of Ukrainian legislation. [14]

The first step towards the legal settlement of cryptocurrency status in Ukraine was the draft law № 7183 «On the Circulation of Cryptocurrency in Ukraine» [19] which was registered in the Verkhovna Rada of Ukraine on October 6, 2017.

However, based on the results of the consideration of the bill in the first reading, it was determined that the draft law should be returned for revision, taking into account the comments and suggestions expressed by the Main Scientific and Expert Department.

Later, on December 2, 2020 the Verkhovna Rada of Ukraine in the first reading adopted the draft law as a basis «On Virtual Assets» № 3637 of June 11, 2020 [20]. In the conclusion to the draft law of Ukraine "On Virtual Assets", the Main Scientific and Expert Department generally shares the position of the authors of the legislative initiative on the need to resolve issues related to the circulation of cryptocurrency.

Taking into account world experience and the main trends related to the formation of the legal field of cryptocurrency circulation in Ukraine, we can identify some problems of legalization of cryptocurrencies in our state, such as:

- The main difference between cryptocurrency and other virtual currency is that cryptocurrency is an anonymity of its usage and absolutely decentralized. World experience shows that due to the anonymity of payments, Bitcoin is popular among drug and weapons sellers. There are even specific type of cryptocurrency, which named «Cannabis Coins». This is unacceptable for Ukraine.
- Legalization of cryptocurrencies should ensure the prevention of the formation of a criminogenic component in the national financial system (there is an illegal market for psychoactive substances, drugs and other illicit goods and services; the possibility of forming an illegal bitcoin market in the country remains, and the issue of equating bitcoins to property remains unresolved [6, p. 87]
- There is a danger that part of free investment resources may be directed not to the real sector of the economy or to the stock market, but for financial speculation. By the way, the lack of any legal explanation makes it difficult to fix cryptocurrencies in the assets of companies and makes it unreal to pay taxes. Although, of course, cryptocurrency must be taxed. In order to conduct legal transactions within the country and pay taxes, it is necessary to identify the user, which contradicts the decentralized system (blockchain). [8]

**Conclusions.** The legalization of cryptocurrency at the national level leads to

the need of reformation existing rules of national law by means of payment, taxation and protection of the rights of individuals and companies as participants in financial relations. One of the most problem has still remained the issue of standardization of taxation of cryptocurrency, in particular bitcoin. We believe that the process of legalization of bitcoin in Ukraine should be preceded by a thorough study of the legal, financial and economic consequences of the usage of cryptocurrency in Ukraine. This process is controversial in the world, because some countries have already used cryptocurrency as national or electronic money, but others – haven't legalized it yet.

## References

1. Chapljan, S. (2018). Pravovij status kriptovaljut [Legal status of cryptocurrencies. Foreign trade: economics, finance, law]. Zovnishnja torgivlja: ekonomika, finansi, pravo. № 2. 148- 165. (in Ukrainian). 2. Cy`vil`ny`j kodeks Ukrayiny`[ The Civil Code of Ukraine] vid 16.01.2003 # 435-IV. URL: <http://zakon2.rada.gov.ua/laws/show/435-15/conv/page>.
3. Doronin, I. M. (2017). Vy`kory`stannya suchasny`x texnologij rozpodilenoyi obrobky` dany`x : pravo ta funkciyi derzhavy` [Use of modern technologies of distributed data processing: law and functions of the state]. Informaciya i pravo – Information and law № 2(21), 51-54 (in Ukrainian).
4. Dvulit, Z. P. Peredalo, H. S., Tilips'ka, R. B. Stibel', R. I. (2019). Kriptovaljuta: stan ta tendencii rozvitku [Cryptocurrency: state and tends of development]. Ekonomichna nauka. Ekonomika ta derzhava – Economic science. Economy and state. №1, 10 – 14 (in Ukrainian).
5. European Central Bank (2015). Virtual currency schemes – a further analysis 34 p. Available at: <https://www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf>.
6. Ivancov, S.V. Sidorenko, E.L. Spasennikov, B.A. Berjozkin, J.M. Suhodolov, J.A. (2019). Prestuplenija svjazannye s ispol'zovaniem kriptovaljut: osnovnye kriminologicheskie tendencii [Cryptocurrency-related crimes: key criminological trends]. Russian Journal of Criminology, № 13, 85–93 (in Russian).
7. Konsty`tuciya Ukrayiny` [Constitution of Ukraine]. Vidomosti Verxovnoyi Rady` Ukrayiny`. 1996. # 30. S. 141. URL: <http://zakon5.rada.gov.ua/laws/show/254%D0%BA/96-%D0%B2%D1%80>.
8. Liu, Y. and Tsyvinski, A. (2018). Risks and Returns of Cryptocurrency, Natsional'ne biuro ekonomicnykh doslidzhen' Yel's'koho universytetu, USA, 111—123.
9. Oxford University Press (2005), Oxford English Dictionary, Oxford University Press, Oxford, UK.
10. Procenko, A. T. (2016). Pravove reguluvannya obigu elektronny`x groshej v Ukrayini. Diss. kand. yury`d. nauk. [Legal regulation of electronic money circulation in Ukraine.]. Kyiv. 202 p. (in Ukrainian).
11. Pro Nacional`ny`j bank Ukrayiny` [On the National Bank of Ukraine]: Zakon

Ukrayiny` vid 01.01.2021 # 679-XIV. URL: <https://zakon.rada.gov.ua/laws/show/679-14#Text>. 12. Pro platizhni sy`stemy` ta perekaz koshtiv v Ukrayini [On Paid Systems and Transfer of Use in Ukraine]: Zakon Ukrayiny` vid 03.07.2020 # 2346-III. URL: <https://zakon.rada.gov.ua/laws/show/2346-14#Text>. 13. Pro sy`stemu valyutnogo regulyuvannya i valyutnogo kontrolyu [On the system of currency regulation and currency control]: Dekret Kabinetu Ministriv Ukrayiny` vid 19.02.1993 # 15-93. URL: <https://zakon.rada.gov.ua/laws/show/15-93#Text>. 14. Roz'яснення shhodo pravomirnosti vy`kory`stannya v Ukrayini "virtual`noyi valyuty`/kry`ptovalyuty`" Bitcoin vid 10.11.2014 # n0435500-14. URL: [http://www.bank.gov.ua/control/uk/publish/article?art\\_id=22249610&cat\\_id=80928](http://www.bank.gov.ua/control/uk/publish/article?art_id=22249610&cat_id=80928). 15. Svon, M. (2017). Blokchejn. Shema novoj jekonomiki [Blockchain. New economy scheme]. Moscow: OlimpBiznes. 16. Tapskott, A. Tapskott, D. (2017). Tehnologija blokchejn — to, chto dvizhet finansovoj revoljuciej segodnja [Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is Changing the World]. New York, USA : Jeksмо. 17. Vahrushev, D. S. (2014). Kriptovaljuta jak fenomen sovremennoj informacionnoj jekonomiki: problemy teoretycheskogo osmyslenija. [Cryptocurrency as a phenomenon of modern information economy: problems of theoretical comprehension]. *Naukovedenie*. №. 5. 4–15. (in Ukrainian). 18. Veprev, S. B., Perov, V. A. (2017). *Kriptovaljuta: pravovye i jekonomicheskie vyzovy. [Cryptocurrency: Legal and Economic Challenges]*. Moskva: tipografija «Akademii SK Rossii». (in Russian). 19. Verkhovna Rada of Ukraine (2018), Draft Law of Ukraine " On the Circulation of Cryptocurrency in Ukraine", available at: [http://w1.c1.rada.gov.ua/pls/zweb2/webproc4\\_1?pf3511=62684](http://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=62684). 20. Verkhovna Rada of Ukraine (2020), Draft Law of Ukraine " On Virtual Assets", available at: [https://w1.c1.rada.gov.ua/pls/zweb2/webproc4\\_1?pf3511=69110](https://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=69110). 21. Vigna, P. and Casey, Mi. J. (2016), Epokha kryptovaliuta. Yak bitkoiny i blokchejn zminiuut' svitovyj ekonomichnyj poriado [The Age of Cryptocurrency: How Bitcoin and Digital Money Are Challenging the Global Economic Order]. New York, USA: Picador

УДК 811.134

## **THE BREMEN TOWN MUSICIANS AS A PRECEDENT TEXT IN GERMAN AND RUSSIAN LINGUOCULTURES**

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**Анотація. Смоляник М.С. Бременські музиканти як прецедентний текст в**

## **німецькій і російській мовних культурах.**

Стаття присвячена багатовимірному аналізу прецедентних текстів у розмаїтті їхніх характеристик, особливостей їх функціонування в німецькомовній та російськомовних лінгвокультурах на матеріалі казки братів Грімм «Бременські музиканти». Розглядається поняття «прецедентний феномен» (ПФ), його природа, структура, типи і різні підходи до його дослідження в сучасних лінгвокультурних студіях. Наводяться та аналізуються приклади функціонування ПФ з даної казки в публіцистичному дискурсі. Особлива увага приділяється визначенню типів прецедентних феноменів, включаючи прецедентний текст, прецедентне висловлювання, прецедентну ситуацію, прецедентне ім'я, які актуалізуються у відповідних лінгвокультурах. Встановлено, що основним джерелом ПФ в німецькій лінгвокультурі стала письмова версія казки, а в російській – її музичне перекладення в однайменному мультфільмі.

**Ключові слова:** прецедентність, прецедентний феномен, прецедентний текст, прецедентне висловлювання, прецедентна ситуація, прецедентне ім'я, лінгвокультура.

**Abstract. Smolyanyk M.S. The Bremen Town Musicians as a precedent text in German and Russian linguistic cultures.**

The article is dedicated to multidimensionally analyzing precedent texts in the plethora of their peculiar characteristic features with an emphasis on the specificity of their functioning in the linguocultures of the German and the Russian languages on the basis of the factual material of the fairy-tale by the Brothers Grimm “The Bremen Town Musicians”. In the research fragment it is the concept of precedent phenomena (PPh), their nature, structural properties, types and various approaches to studying them in modern cultural linguistics that are under consideration. There are illustrative examples of the way PPh from the above mentioned fairy-tale function in journalistic discourse are given and analyzed in detail. The author lays a special emphasis on determining types of precedent phenomena that are actualized in the corresponding linguocultures. It has been revealed and substantiated that the main source of precedent phenomena in the German linguoculture is the written version of the fairy-tale, and in the Russian linguoculture the key matrix conceptual grounding has been proved to be its musical arrangement in the cartoon with the same title as the title of the fairy-tale.

**Key words:** precedent, precedent phenomenon, precedent text, precedent statement, precedent situation, precedent name, linguoculture.

**General formulation of research and its topicality.** The relevance of this topic is explicated by the fact that linguoculturology is one of the most actively

developing in recent areas of linguistics, which pre-determines its topicality. This discipline deals with various aspects of the language-culture relationships. Historically, one of the central places in its problems was occupied by the so-called "precedent phenomena" (PPh).

The object of this study was precedent phenomena from the fairy tale "The Bremen Town Musicians", and the subject - their actualization in German and Russian-language journalistic texts.

**Setting of the problem and the aim of the article.** The phenomenon of precedents has repeatedly become the object of attention of both Ukrainian and foreign linguists (L. Brilmayer, D. Gudkov, E. Nakhimova, Yu. Karaulov, V. Kostomarov, V. Krasnykh, Prikhod'ko A.M., G. Slyshkin, W. Wang). The tale "The Bremen Town Musicians" as a precedent text in the German and Russian-speaking linguocultures has not yet been studied, that is why the purpose of our study is to determine the functional features of precedent phenomena from the above work in the both linguocultures.

The term "precedent text" was first introduced into scientific circulation by Yu. Karaulov, who characterized them as texts, the reference to which is repeated many times in discourse [2, p. 264]. The precedent text is interpreted by him as "... a complete and self-sufficient product of speech and mental activity; the precedent text is well known to any average member of the national cultural community, the reference to the precedent text can be repeated many times in the process of communication because of the precedent statements or precedent names associated with this text" [5, p. 83].

**Discussion and results.** In cultural linguistics, to date, considerable experience has been accumulated in identifying and systematizing PPh. Perhaps, the most frequently used in PPh research is the conceptual apparatus that has developed within the framework of the Moscow linguoculturological school. Its representative V.V. Krasnykh defines precedent phenomena as phenomena, objects, statements that are well-known to all representatives of the national-linguistic-cultural community, relevant in the cognitive sense, appeals to which are constantly renewed in the speech

of representatives of a particular national-linguocultural community [3, p. 375].

Perhaps the most successful classification of precedent phenomena belongs to another representative of this school, D.B. Gudkov. Among precedent phenomena, he singles out *a precedent text* (a complete and self-sufficient product of speech-thinking activity), *a precedent statement* (a reproduced product of speech-thinking activity), *a precedent name*, as well as *a precedent situation* ("reference", "ideal" situation with certain connotations) [1, p. 106-110]. There are such major sources of precedent texts as: 1) works of classics of national literature; 2) works of world literature; 3) folk tales; 4) fairy tales of the peoples of the world; 5) works of ancient mythology; 6) the Bible; 7) folk songs; 8) author's songs; 9) Soviet songs; 10) songs of foreign performers, 12) children's songs, lullabies, counting rhymes, 13) feature films, 14) animation films.

Among the sources of precedent texts, folklore and fiction, in particular, fairy tales, play a special role. The fairy tale is one of the most widespread, almost universal literary genres. In it there are plots, images, situations that are specific to each ethnic group, which find their functions in names of heroes, names of animals, plants, localities. Precisely fairy-tales as a genre constitute that common background, against which nationally-conditioned universal perceptions of the world are especially clearly manifested.

In the present article, the Brothers Grimm fairy tale "The Bremen Town Musicians" acts as a precedent text.

The research material was compiled by the archives of the famous German weekly «Die Zeit», as well as the Russian magazine «Ogonyok», which was part of the Kommersant publishing house. The main research method is an electronic search by keywords, in particular, the name of the tale, as well as the alleged precedent phenomena.

On the whole, in the German-language archive, we have found 25 precedent phenomena actualizations from the fairy tale «Die Bremer Stadtmusikanten». Among them there are precedent phenomena of different types.

The precedent saying "Was Besseres als den Tod finden wir allemal" ("Better

than death, we will find anyway") turned out to be especially frequent: *Mit Humor erzählt Michael Schorr von einem späten Aufbruch ins Ungewisse. «Schultze gets the blues erzählt noch einmal das Märchen von den Bremer Stadtmusikanten. Etwas besseres als den Tod finden wir überall. Der Ostler Schultze sucht es in einem Westen, der selbst Hinterwald ist, eine von vielen stillen Pointen des Films* (<https://www.zeit.de/2004/18/Schultze>).

In this fragment, we see that the above phrase was used in the meaning of "forget about the old in order to start life from a new page."

And in the following example, the precedent statement is slightly modified: *Und so geschieht, was passiert, wenn ein originelles Vorbild modisch wird. Ich bin sicher: Die Bremer Stadtmusikanten hätten mit den Worten «Etwas Besseres als Imitationen finden wir überall» die Stadt verlassen* (<http://www.zeit.de/2007/25/SiebeckKochen-25/seite-2>)

In the material we have analyzed we have also encountered an example of a precedent situation – in this case, the specific location of objects in space (the scene when the Donkey perched on the windowsill with its front paws, the Dog jumped on it, the Cat jumped on it, and the Rooster flew up on it): *Dabei fehlt es nicht an Marketing-Ideen. Warum gibt es eigentlich keine gemeinsame, originelle Werbekampagne? Kuhn könnte sich etwas Ähnliches wie die Aufkleber auf den Müllheimern der Innenstadt vorstellen. "Kinder- und Jugendliteratur wäre dann überall sichtbar und Teil des Stadtbildes", sagt sie. Auch von einem Denkmal wurde schon geträumt: vielleicht Pippi, das Sams und Petzi, gestapelt wie die Bremer Stadtmusikanten* (<http://www.zeit.de/2014/29/kinderbuch-hauptstadt-hamburg/komplettansicht>)

There is also a precedent action : Nun fingen sie auf ein Zeichen an, ihre Musik zu machen. Der Esel schrie: Königsberg bleibt deutsch!; der Hund bellte: Raus mit den Gastarbeitern!; die Katze miaute: Die deutsche Frau schminkt sich nicht!; und der Hahn krähte: Die Juden sind unser Unglück! Dann sprangen sie über die Fünf-Prozent-Klausel in die Stube hinein, daß alle morschen Knochen zitterten (<https://www.zeit.de/1967/12/die-bonner-stadtmusikanten/seite-2>)

Yu. Karaulov pointed out the multimedia potential of such texts as one of the criteria for precedence; the fairy tale of the Brothers Grimm is an excellent example of this phenomenon, since several films and cartoons have been created on its basis.

The analysis of the Russian-language material shows that all the precedent phenomena associated with the fairy tale "The Bremen Town Musicians" are quotes from songs from a musical animated film based on its motives (when and where), i.e. are *precedent statements*.

The most common phrase is «Ох, рано встает охрана...» (59 mentions), for example: *Ох, рано встает охрана*, — сетовал мультипликационный персонаж. Решив перенести в сеть методы работы охранных агентств, учредители компании ITSumma сделали все, чтобы хорошо высыпались и сотрудники, и клиенты (<https://www.kommersant.ru/doc/3150203>)

Quite often there are lines “О-ля-ля! Завтра грабим короля!! ” (14 updates): *Болельщиков армейцев на трибунах в эти минуты подбадривала песенка из мультфильма «Бременские музыканты»: «О-ля-ля! Завтра грабим короля!».* Роль настоящих грабителей очередной победы «Реала» в первой четверти исполнили россияне Андрей Воронцевич, Виталий Фридзон, компенсировав отсутствие на площадке главного героя ЦСКА последнего месяца Уимса, Виктора Хряпу Мессина передвинул на позицию легкого форварда (<https://www.kommersant.ru/doc/2390750>)

Another interesting example of the actualization of the precedent statement from this cartoon is found in the following example: *Если близко воробей, мы готовим пущуку.* Итак, в вопросе об открытии/запрещении весенней охоты-2006 единственное, что ясно, что ничего не ясно (<https://www.kommersant.ru/doc/658784>)

As you can see, the Soviet interpretation of the tale “The Musicians of Bremen” entailed the emergence of completely different precedent phenomena than in the German-language original version, which are understandable only to representatives of the Russian-speaking linguocultural community.

**Conclusions.** A precedent text is a text that is significant for a particular

linguistic personality in emotional and cognitive terms, the appeal to which can be repeatedly restored in the process of communication through precedent statements, precedent names or precedent situations associated with this text. One of the main sources of precedent texts is fiction, in particular, the literary tale.

The tale "The Bremen Town Musicians" is a precedent text in both German and Russian linguocultures, but its precedent usage formats are different: in the former linguoculture the emphasis is on the classical written version of the tale, whereas in the latter the corresponding musical animated film has proved to be pre-dominant. In the German linguoculture almost all types of precedent phenomena are represented, in the Russian linguoculture only precedent statements are encountered.

## References

1. Gudkov, D.B. (2003). *Teoriya i praktika mezhkul'turnoj kommunikacii [Theory and practice of cross-cultural communication]*. Moskva: Gnozis.
2. Karaulov, Ju. N. (2007). *Russkij jazyk i russkaja jazykovaja lichnost' [The Russian language and the Russian language verbal studies]*. M.: Izd-vo LKI.
3. Krasnyh, V.V. (2003). «*Svoj» sredi «chuzhih»: mif ili real'nost'*? [*At home among strangers*]. M.: Gnozis.
4. Precedentnoe imja i precedentnoe vyskazyvanie kak simvoly precedentnyh fenomenov / I.V. Zaharenko, V.V. Krasnyh, D.B. Gudkov, D.V. Bagaeva (997) // *Jazyk. Soznanie. Kommunikacija*. M.: «Filologija», Vyp. 1. – 82–103.

УДК 811.161

## THE ARTISTIC EMBODIMENT OF THE SOCIAL MYTH IN THE PLAY

### «ETERNAL MUTINY» BY M. KULISH

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**Анотація. Соколова К.В. Художнє втілення соціального міфу у п'єсі М. Куліша «Вічний бунт».**

Стаття фокусується на проблемі художнього уособлення соціального міфу у п'єсі М. Куліша «Вічний бунт». Драматург у тексті відображає соціальні міфи двадцятих-тридцятих років та висвітлює деякі аспекти суспільства того часу. Через призму іронії він аналізує існуючу на той час тоталітарну систему, розвінчуючи її соціальні міфи. Виявлено, що автор зображує тиск радянської влади на населення. Тоді, коли основні характеристики радянської

ідеології репрезентувалися як на сторінках «соціально замовленої» літератури, так і на сцені радянського театру, М. Куліш намагається донести свою думку до аудиторії унікальними художніми засобами і таким чином вплинути на людську свідомість.

**Ключові слова:** «Вічний бунт», драма, Куліш М., соціальний міф, художність.

**Abstract. Sokolova K.V. The artistic embodiment of the social myth in the play “Eternal mutiny” by M. Kulish.**

The article deals with the problem of artistic embodiment of social myths in the play «Eternal Mutiny» by Mykola Kulish. In the text the playwright considers and analyzes the phenomenon of social myths and their architectonics in the 20-30s, revealing some aspects of the society of that historical period. Through the prism of irony, he reflects upon the totalitarian system, debunks its social myths, and depicts the pressure of Soviet power on the masses. Whereas the features of Soviet ideology were reproduced both on the pages of «socially ordered» literature and on the stage of the Soviet theater, M. Kulish tried to reach the audience through his plays and the influence the artistic formation of human consciousness.

**Key words:** artisiticity, drama, «Eternal mutiny», M. Kulish, social myth.

**General formulation of research and its topicality.** Modern man, like in ancient times, cannot do without mythological principles of understanding reality. It can be argued that at present there are not only social stereotypes, illusions, fantasies, but there are also modern myths. In Soviet literature, social myths were also used. Fiction in the 1920s and 1930s was significantly influenced by the policy of the Soviet Union, so the question of ideologizing the state, creating an image of a leader and loyal people, was the nucleus of literature. The considered work by M. Kulish is an important link in the history of Ukrainian literature. In particular, in the play «Eternal mutiny», the author exposes the features of social myths in the Soviet society, debunking the pressure of the authorities on the masses and extraordinary personalities, which explicates the topicality of the present research.

M. Kulish's drama was studied by such Soviet and emigrant literary critics as D. Vakulenko, N. Kuzyakina, I. Kyselyov, M. Ostryk, Ya. Holoborodko, V. Pratsyovytyi, H. Semenyuk and others. The literary reading of the play «Eternal mutiny» began in 1958. In scientific articles of the first period (M. Ostryk, I. Kyselyov), thematic echoes of the play «Eternal mutiny» with the dramas of

Mykytenko ("Dictatorship", "Cadres", "Girls of our country"). It is at this stage of the play's research that critics note the dominance of Soviet ideology in it. Scientists (N. Kuzyakina, L. Tanyuk) describe in more detail the problem-thematic planes of the playwright's work, in their works there is an analysis of the main characters of the drama, in particular, they focus on the disobedience of Romen and the disclosure of the image of the eternal mutineer. Literary critics note that the drama «Eternal mutiny» was a critical point in M. Kulish's work.

Researchers of the third period of studying the play (T. Plakhtiy, M. Stekh, S. Zablotska) «Eternal mutiny» focus on the tragedy of man in the drama, comparing the characters of the plays "97", "People's Malachiy", "Pathetic sonata" with the characters of the play «Eternal mutiny», and emphasize that revolutionaries are puppets of the Soviet government. Scientists also pay attention to the symbolism of M. Kulish's dramas: blue socialism is a dream of the future, the world is compared to a camera that conveys the idea of the collapse of romantic illusions about the Soviet era.

**Setting of the problem and the aim of the article.** Social propaganda, which is based on a social myth, in those days was almost the main means of persuading people and manipulating their minds. It was almost impossible to fight against it. M. Kulish is one of those creators who paid for their rebellion with their lives. He debunked the social myth of power in his plays instead of showing the real life in Ukraine in the 20-30s of the twentieth century. In the play «Eternal mutiny», the author covers many important issues related to the issues of industrial and agricultural enterprises, communist illusions and harsh reality.

The purpose of this research is to analyze the play «Eternal mutiny» by M. Kulish for the sake of the interpretation of social mythology in it, as the writer was a representative of the intelligentsia that saw a different future for the Soviet Union.

**Discussion and results.** Concerning the social myth interpreted by M. Kulish, the drama of the 20-30s of the twentieth century was an instrument of party propaganda and a means of agitation, but it became possible to say this frankly only

during the independence of Ukraine. Theatrical performances had a great influence on human consciousness. Kulish's drama «Eternal mutiny» (1932) conjures up a social myth, reflecting the Soviet reality, deviating from the parameters established by the authorities.

Social mythology is a phenomenon of ideological practice, which is a consciously purposeful activity to manipulate mass consciousness with the help of social myths specially formulated for this purpose [7]. Many researchers refer to social myths as socio-political, because the need to create them has increased many times with the establishment of a political order based on democracy.

The strengthening of totalitarianism in Ukraine, as in the USSR as a whole, in the 20-30s of the last century is evidenced by the establishment of a communist form of totalitarian ideology; monopolization of power by the Bilshovyk party, removal from the political arena of other political parties; fusion of the ruling party with the state apparatus; nationalization of society, blocking the development of civil society by the state; establishment of monopoly control over the economic sphere by the party-state apparatus, strengthening centralized management of the economy.

M. Kulish describes the realities of the period of time when collectivization, industrialization and famine took place. The authorities decided to finally change life in the country, through the enhanced development of industry. To do this, she intensively began to manipulate the consciousness of the people. Funds for industrialization were "pumped" from the village to the city. The labor of the workers, especially the peasants, was virtually gratuitous. The development of the means of production significantly outstripped the production of consumer goods. The ultra-high rate of industrialization was explained by the party's need to strengthen the country's defense capability in the face of a growing external threat. The leadership of the USSR exploited the labor enthusiasm of people, introduced mass "socialist competition", and tried to demonstrate the advantages of socialism to the whole world. The path defined by the party was presented as the only correct one. Decisions of party congresses and plenums became a guide to action in society and the basis of literary subjects and artistic concepts. Party attitudes gradually acquired the status of

the actual state of affairs, replaced reality, gave the only correct path of development and convinced of its correctness. That is, all spheres of life and creativity were imbued with a social myth.

The playwright debunks the social myth, depicting negative phenomena in the life of socialist society, class morality, leveling the individual and shows the village and factory as they really were in the 30s of the last century.

The reader is presented with students of the Communist University who are walking with "Marxist-Leninist weapons" in their hands. Among them-communal-woman Maika, skeptic Baidukh and "unfinished" romantic Romen. All of them received a "beautiful word from the Central Committee of the CP (B) of Ukraine" and are already ready to go to life with the "Lantern of Leninism" and the "key of Marxism" (Kulish M., 1990, p. 402). But not all of them were aware of the then system that characterized M. Kulish. According to the central character of the drama Romen, the Communist "thinks only about the five-year plan. His eyes are like this, his face is stone, his voice is cold, his boots are fierce" [6, p. 406]. "The communist is the prototype, the beginning of the future sunflower man, you bores! Why do you hide your laughter behind your freebies and your flair in your briefcase? You're wearing masks! Throw them to hell!" - says Romen [6, p. 402]. At the beginning of the play, he does not yet have the same idea of the social illusion that Soviet propaganda created. This will appear later.

Once at the factory, graduates of the Communist university corrected their views, because the action takes place in a maelstrom of social events, where none of the workers even knows how utopian their dreams are. The factory has its own atmosphere, which is based on industrialization, both in the play and in life. Human consciousness is completely controlled by a totalitarian regime. An epiphany comes to Romen when a person dies of hunger during the working day. "An old worker died before he was even seen to the threshold of the shop, and we have already forgotten about him, we are talking about some kind of outfit for the village!.. Are we stale like government crackers, or what is being done?" – he says [6, p. 425]. The climax comes when the hero gets to the village. It is there that Romen opens his eyes to

communism for what it really is. He no longer believes in the social myth that Soviet politics created to manipulate the working people.

At the beginning of the work, we see Romen as an eternal romantic, but pretty soon he turns into an eternal mutineer. The character's dreams were dispelled when he met his friend Haika, who turned from a hero into a nut worker of the socialist system. When the girl who seemed to him a nonexistent ideal turned out to be an employee of the same socialist factory. The last straw for Romen was when he returned from the village, having seen the realities of life in the 30s of the twentieth century. And it would seem that nothing will stop the mutineer now. But the inner fervor was not enough to fight the powerful propaganda. Baidukh's death brought Romen to his knees. He realized that he alone could not convince hundreds of people. This event forced him to return to the factory, where he was so zealously rebelling. M. Kulish portrays the events of his present through the prism of irony. It is not surprising that the play was banned and was not exhibited on stage for quite a long time. In it, we see the social myth that was used to correct the consciousness of Ukrainian Soviet society.

In the play «Eternal mutiny», the author claims that the main goal of the USSR was to impose on people the idea of an ideal socialist society that can be built by yourself. Therefore, this ideology penetrates factories, universities, and villages.

In the work, the social myth performs a number of important functions. Faith in an ideal future is necessary for the people to work, to maintain social order, to legitimize the political system, to broadcast and impose moral norms and values. But the values that the government is trying to impose on the state's labor force do not correspond to reality (a vivid example of this is the party's attitude towards the village). "Romen. I'm also for pace and numbers, but I'm for rhythm. In a word, I am in favor of not twisting the hands on the clock, as impatient children sometimes do, even if they wanted to get to socialism ahead of time. Haika. Unfortunately, you're turning it back. Tell me, Did you prove to me in the countryside that our grain procurement plan is unrealistic, exaggerated, economically unfair for the peasants, almost predatory? Romen. Yes!"[6, p. 435]. It is obvious that Romen does not

renounce the party, he also wants to build socialism together with the state, but not in the way that the Soviet government does. Although to some extent he tries to impose his myth on Haika, Maika, Baidukh, the girl and others, in which socialism is built in a fair way, where there is no predatory method in the countryside, where women should not work in a factory, where heroes remain heroes. But people are so subject to communist propaganda that even real examples of Romen cannot awaken the consciousness of working people. At first, Romen's rebellion woke up in his soul, but later he began to speak not as a "half-finished romantic", but as a realist who keeps up with the times.

No less realistic is Baidukh, who supports his comrade and is ready to go through the path of rebellion with him. He is interested in the result. He may not have fully shared Romen's views, but the party did not inspire confidence in him. Baidukh was only interested in how the riot would end, whether a simple labor force in one person would be able to resist the totalitarian system. "I don't believe in this riot. But I'll go for myself. I just wonder what will come out of it," says Baidukh [6, p. 448]. He has long been disillusioned with the party, but unlike Romen, he does not want to openly rebel, because there may not be a better party. Although he believes in socialism and a socialist future. Baidukh debunks the social myth imposed by the state, because he understands that the future will not be what everyone expects it to be. Maika couldn't be persuaded. It lives by the principles of Soviet power and is guided only by the principles of the Communist Party. Still, their differences with Romn don't give them any reason to think badly of each other.

The highest social purpose of literature and the national struggle for communism is to raise the people to fight for new successes in the construction of communism [4]. The playwright evaded the duties of writers set by the Central Committee, and therefore we meet these requirements in the text, but with an ironic description. H. Osypov notes that "over time, social myths and their practical implementation turn into a sharp contrast with objective social reality, which leads to tragic circumstances for a certain Society of mass death of people" [8, p. 276]. And we see this in the text (Baidukh's death). It is obvious that everything did not stop at

the Baidukh tragedy, which can be seen in the reality that later stopped Soviet politics. The author's goal was to warn the Ukrainian people against the grave consequences of communism. M. Kulish tried to open his eyes to social reality, using irony. Since the drama was seen after industrialization took place, now it can be safely called the history of the 20-30s of the twentieth century.

It is impossible not to pay attention to the symbolism in the drama. The eternal mutiny of Romen can be identified with the eternal mutiny of Ukraine as part of the USSR. Everything around Romen has a dark mood. "Clay. Garbage cans. Dogs carry carrion. Where did I go? Bah! I'm on a walk, and this is the edge of town. There's a cemetery and a field. The sun is setting. It's menacing red and scary. A bird flew between him and me, and a shadow hit me hard in the head. Oh, what a great, terrible mess in the world! Eternal discord in the world!", - he says[6, pp. 442-443]. Along with the eternal rebellion, we observe the eternal discord that Romen also saw. His path as a communist led him into the dark corners of his life.

The playwright focuses on the image of the cemetery, which in the text can be understood as the result of the entire party policy and its consequences: "indeed, roll like a month behind the cemetery" [6, p. 446]. The most striking image-symbol in the drama is the border. The border that cannot be crossed according to the rules of the Communist Party. The border that contains something new and unknown to the Soviet worker beyond its border. The border that only an eternal mutiny will dare to cross. Baidukh claims that "the border itself came running to us." They went to him and were able to come only when Romen gave his speech. But Romen's rebellion dies right at the border. "Romen. Go. Step over. Is it worth running away there to run back tomorrow?" [6, p. 454]. Doubts overwhelm the main rebel and stop right at the border. "I don't want to continue playing the role of a loudspeaker from hidden forces hostile to the revolution. I don't want to amplify their whispers and hisses. I don't want to be a dissonant, a pipe in a young class industrial symphony. I want to go back to my first and last part," says Romen [6, p. 455]. He failed to resist the authorities and cross the border of his hopes. He had to go back and thus give up his views. The riot for Romen is dead. In this context, the border is a transition from rejection of

social myth to social ideals, a life of eternal rebellion in the name of the people. Romen failed to fully defend his interests and convince the masses for their own good. But Baidukh continued his work. He may have paid with his own life, but he still proved that the rebellion lives in him.

**Conclusions.** The social myth was actively introduced into the mass consciousness with the help of drama. The features of soviet ideology were reproduced both on the pages of "socially ordered" literature and on the stage of the soviet theater. M. Kulish tried to reach out to readers/viewers by offering such works as "eternal rebellion" to the public. For a long time, the play was banned, because it was dangerous for the political system and did not fit into the framework of soviet literature. With the help of monologues and dialogues, the playwright accurately reflects the soviet reality and debunks the dictatorship of the proletariat, the party's policy of industrialization. In the play, an important role is played by symbols (coffin, cemetery, border), indicating the hopelessness of the characters in the conditions of a totalitarian regime. But there are no descriptions of home and family as a place where their own principles and spiritual atmosphere prevail. The heroes of the work are residents of dystopian cities, which are characterized by rationalism and programming. The concept of the main character's personality is formed under the influence of "real socialism". Readers are faced with a complex and tense conflict that leads to Romen's personal catastrophe and ends with the death of Baidukh. Romen's tragedy echoes the author's own tragedy.

The dramatic heritage of this writer has been proved to be an important link in the history of Ukrainian literature. Thus, this scientific research is a continuation of the previous papers dedicated to the work of M. Kulish, deepening the study of social myth in the drama of the 20 – 30s of the XX century.

## References

1. Barbakadze, M. (2006) Andriy Synyavskyi (Abram Terts). What is socialist realism? Taken from <http://antology.igrunov.ru/authors/synyavsky/1059651903.html>.
2. Vakulenko, D. (1977) Hero-worker in the drama of I. Mykytenko. *Soviet literary studies*. 3, 12–24.
3. Danylenko, Yu. (2008). Social mythology as a socio-cultural phenomenon (philosophical analysis) (author's abstract of the Abstract of the dissertation of the candidate of philosophical sciences), Kyiv. 42 p.
4. Kyselyov, I.

(1964) *Mykola Kulish*. Kyiv: Soviet writer, 290-326. 5. Kuzyakina, N. (1970). *Eternal mutiny*. Kyiv: Soviet writer, 370 – 395. 6. Kulish, M. (1990) *Eternal mutiny*. Kyiv: Dnipro. 7. Lisnyi, V. (2002). *Philosophical encyclopedic dictionary*. Kyiv: Outline. 494–459. 8. Osypov, H. (2000) *Social myth-making and social practice*. Moscow: Norma. 9. Ostryk, M. (1959). *Drama By Mykola Kulish*. Literature at school. 4, 17–26. 10. Plakhtiy, T. (2003) Poetics of Mykola Kulish's dramas: traditions and innovation (series of articles). Taken from <http://ruthenia.info/txt/biletskv/plahett/ukc.html> 11. Hardworking, V. (1999). *National nature of character*. Lviv: Liga-Press. 12. Stekh, M. (2004). Revolution of the little man. Modernity. 11, 102–118. 13. Tanyuk, L. (2011). Ethical conflicts on a narrowed stage. Man and politics. 5, 3–14. 14. Zablotcka, S. (2007). Symbolism of Mykola Kulish's dramas as an element of the poetics of the absurd. *Scientific notes of Ternop. Nats. Volodymyr Hnatyuk Teaching University*. 22, 17–19.

УДК 811.161.1

## INTERMEDIAL NATURE OF RAP DISCOURSE: THE EXISTENCE OF A LINGUISTIC COMPONENT IN A SYNTHETIC ARTISTIC FORM

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**Анотація. Варлигіна М. Ю. Інтермедіальна природа реп-дискурсу: існування лінгвістичної складової в синтетичній художній формі.**

У статті розглядається російськомовний реп-дискурс як міждисциплінарний об'єкт. Більше за все уваги приділяється інтермедіальній теорії та її типології. Проаналізовано традиційне питання пріоритетності слова чи музики в синтетичній формі. Показано, що російськомовний реп — це особлива синтетична форма, яка завдяки своєму генезису та буттю стала окремим кластером мовного суб'єктивного досвіду.

**Ключові слова:** інтермедіальність, дискурс, герменевтика, реп, синтетична форма.

**Abstract. Varlygina M. Intermedial nature of rap discourse: the existence of a linguistic component in a synthetic artistic form.**

The article deals with Russian-language rap discourse as an interdisciplinary object. Much attention is given to the intermedial theory and a few types of its. The traditional question of the priority of the word or music in a synthetic form has been analyzed. It is shown that Russian-language rap is a special synthetic form, which due to its genesis and existence has become a separate cluster of linguistic subjective experience.

**Key words:** intermediality, discourse, hermeneutic, rap, synthetic form.

### **Setting of the problem and the aim of the article.**

**The purpose of the article** is to provide an overview of rap music as a linguistic object of the research and to reveal its potential for intermedial studies.

**The relevance of the article** is determined by the symptomatic nature of rap as a manifestation of the latest cultural formations in the Russian-speaking culture of the last decades.

### **Discussion and Results.**

Choosing the Russian-language rap discourse as the object of research, we first of all set ourselves the goal of investigating linguistic material that unfolds and is realized in a synthetic form. At first sight, this expansion of research boundaries leads to a shift in the focus of attention from linguistics proper to interdisciplinary discourse analysis and threatens to break with the linguistic field. However, in our opinion, working with the synthetic intermedial form, on the contrary, allows a deeper study of the mechanisms of the realization of the verbal component in discursive practices. Working with material, in our case, with rap discourse — a synthetic verbal-musical form, we do not move away from linguistic discourse analysis, but dissect a living discursive form that is constituted by linguistic and musical components.

In order to talk about the intermedia nature of rap discourse, in the most general form, we will designate the key definition of discourse for the report. In the humanities — and already, in the linguistic scientific knowledge — there is no unified understanding of **discourse**, including due to its productivity as a scientific construct. As a universal correlate, discourse is able to absorb philosophical, sociological, psychological, anthropological, and linguistic projections and generate new thought spaces. For our research, the accumulative and integrative nature of discourse is fundamental.

We adhere to the direction of content analysis of discourse, dating back to the French school of discourse analysis (M. Foucault, M. Péchet, J. Derrida, P. Ricoeur,

P. Serio, J. Lacan, J.-M. Adam, P. Henri, E. Benveniste, A. Borillo, F. Bunier, F. Gaden, J. Guillaume, etc.), in which discourse is understood as a socio-historically determined sphere of human knowledge and communication, as a complex, determined anthropo-socio-cultural education. In a narrower, linguistic channel, we preliminarily understand discourse as a set of texts from a certain field of knowledge, organized rhizomatically.

It is noteworthy that when researchers speak of discourse as “speech immersed in life”, they mostly mean a speech situation, where the verbal component is perceived as a research dominant, logically framed by the framework of non-verbal presuppositions. Here, an analogy with the proposed Gestalt psychology of the universal scheme of figure-background relations is possible, where speech will be a figure, and situations will be a background, that is, the linguistic component is determined and conditioned by the environment, without ceasing to be an organizing nucleus. This example is relevant, for example, to literary artistic discourse, in which the artistic canvas is "shone through" on the subject of extralinguistic sociocultural meanings, but does not cease to be verbal material.

The situation is different when we assume research work with a synthetic conceptual form, in our case, vocal music. The synthetic form is not isomorphic to its individual components. In such an education, for a scientist, the linguistic component is artificially isolated from the form of a higher level of organization, and all of its characteristics flow and are refracted primarily through the prism of this different synthetic form.

For the speaker and listener, there is a process of perception and generation of meaning that is different from the perception of a mono-channel work. Form is an interdisciplinary term, the content of which is difficult to define. As the Lithuanian researcher Ruta Bruzgene notes: “Form can denote both the external image and the internal compositional structure of a work; it is an art, a way to connect parts into a single whole, it is the species-forming principle of each essence.”

For a long time, the issues of the relationship between the arts and the understanding of artistic integrity were considered mainly in the range of aesthetic

problems. In the 60s of the 20th century, an intermedial concept of temporary arts was formed, which densely attracts philosophical and linguistic scientific discourses. As a phenomenon today, **intermediality** continues to gain popularity, revealing its **interdisciplinary potential**.

For us, the approach of the German researcher Werner Wolff turned out to be significant in terms of typology and understanding of intermediality, who in the 2000s proposed a multilevel structure of intermediality in a broad and narrow sense [6].

Without going into the arrangement of his theory, we point out that in the narrow understanding of intermediality, the researcher distinguishes between intermedial reference and plural mediality. Intermediate reference is essentially aimed at works that retain a homogeneous form, and is associated with issues of transposition of one semiotic code into another semiotic plane.

In this vein, N.V. Tishunina considers intermediality as a purely literary phenomenon, proposing to understand it as a special type of intra-textual relations, when the subject of research is the musicality of a literary work, the nature and functionality of ekphrasis in a literary work, ways of recreating one kind of art by means of another, etc. to.[5] However, in W. Wolf's system, another type of intracomposite intermediality is also possible — plural mediality.

For this type, the definition of the researcher N. A. Kuzmina is adequate: "Intermediality is the interaction of sign systems (languages) of different arts that create the integrity of an artistic and aesthetic work a film, a musical work, a comic strip, etc." [3]. Vocal music is essentially a fusion of two semiotic systems and is a type of plural mediality.

Earlier, back in the 80s, S. P. Sher identified three groups of communication between literature and music, one of which is called by the scientist vocal music and is designated as a symbiosis of music and literature. The fusion of the two components problematizes the issue of the primacy of music or words, as the German researcher Sher writes about: "In the case of vocal music, specific theoretical problems arise, for example, the traditional question of the priority of word or music,

various relationships between poetic image, word and sound, and synthesis options ". Equally fundamental is the question of understanding music. "How to" understand "music if there are no words in it, but there are only non-verbal meanings, the individual perception of which cannot be" broadcast "outside your own psyche? [7:441]. It is suggested to consider "intonation" as the object of interpretation in music. Nevertheless, the definition of "music as an art of intonated meaning" by the theorist B.V. Asafiev in no way contributes to the formation of a unified scientific definition of intonation. music? D. B. Gorbatov, for example, explores the thematic and rhematic component as the essential basis of speech and musical intonation.

The question of the conjugation of words and music in a synthetic form is directly related to the understanding of the performative nature of the word, its discursive potentials and, figuratively speaking, phenotypic realization. Working with borderline material, we only feel more acutely the need to define the "territory" and "laws" of interaction of different semiotic systems. Discursiveness as a property of an "embodied", revived abstract linguistic system suits us as a tool for researching speech intentions and dialectical interdependence of the form and content of any utterance.

After we have outlined the reasons for the actualization of vocal music as a linguistic object of research, we can outline the general features of rap as a scientific object and the possibility of identifying rap discourse.

At the moment, being at the beginning of our research path, we have more questions than answers and the concept of rap discourse is a terminological construct that requires careful planning. The corpus of rap music materials, a wide discussion platform among listeners and the diversity of the existence of the rap form indicate the transpersonal, collective, socio-cultural level of the rap phenomenon, which means the formation of its own discursive field. Rap discourse is based primarily on the corpus of musical works. There are several definitions of rap:

1. Rap is a rhythmic recitative, usually performed to music.
2. Rap is one of the elements of hip-hop culture.

The second definition is adequate only privately, since rap as a form of

performance goes beyond the boundaries of hip-hop culture and, therefore, cannot be defined through it. The use of rap as an "insertion" into other musical genres indicates the presence in its form of such cultural meanings that can manifest themselves only in it. We see rap as a musical genre with its own formal solution. It is noteworthy that in rap there is an intra-genre division into alternative rap, rock-rap, pop-rap, experimental rap, gangsta-rap, underground rap, etc.

The basis of rap, its formative characteristic, is the use of recitative. The word recitare in translation from Italian means reciting or reading aloud. In the scientific tradition, as far as we know at the moment, recitative was considered within the framework of aesthetic, musicological studies as a component of the operatic musical form. In a survey description of the relationship between word and music, E. Ruchevskaya opposes recitative to song melody, since in the first there is no chanting. The researcher notes the self-sufficiency of the verbal rhythm and intonation in the recitative as opposed to the chanting text, further delving into the song melody [2].

We did not find any development of the theory of recitative and the meaning of the verbal component in a synthetic form on the material of Russian-language rap. We primarily find the explanation for this in the novelty of rap as a cultural phenomenon in the Russian-speaking environment, and the absence of large and consistent studies of Russian-speaking rap today can be explained by the natural time gap necessary for the emergence and formation of the scientific field in this matter.

Russian-language rap dates back to the 90s, initially being in the status of underground and marginal music. Russian-language rap became widespread and popular in the 2000s and continues to gain popularity in the 2010s. Today, in comparison with other genres, this young musical genre claims to be a tendentious and massive phenomenon.

### **Conclusions.**

The recitative nature of rap re-actualizes the question of the interaction of literature and music, in it the issues of rhythm, intonation, and semantic division are resolved in a special way. In addition, recitative as a format of specific expressive

reading is attractive for its genesis, since despite the musicological interest in this concept in connection with operatic art, the ethno and anthropological roots of recitative in folklore, ritual and ritual art are important to us. Working with the “inner form” of the recitative will provide us with material for developing the cognitive “palimpsest” aspect of rap discourse, in which the speaker and listener perceive the multi-level structure of the rap form and react to it in a special way.

Thus, rap music as a research material and rap discourse as a linguistic object of research seem to us to be a productive and new field for solving intermedial, hermeneutic, cognitive, sociolinguistic problems.

## References

1. Angela Goddard and Neil Carey (2017). *Discourse. The Basics. Defining discourse*. — 2017. 214 p. (in English).
2. E. Ruch'evskaja. (1960) *Slovo i muzyka. [Word and music]* Muzgiz, Leningrad, — 1960. 59 p. (in Russian).
3. Haminova A. A. (2014) *Teoriya intermedial'nosti v kontekste sovremennoj gumanitarnoj nauki [Intermediate theory in the context of modern humanities]*. *Vestnik Tomskogo gosudarstvennogo universiteta*. — 2014. № 389. P. 38-45. Available at: <https://cyberleninka.ru/article/n/teoriya-intermedialnosti-v-kontekste-sovremennoy-gumanitarnoy-nauki-1/viewer> (in Russian).
4. Makarov M. L. (2003) *Osnovy teorii diskursa. [The basics discourse theory]* M.: ITDGK «Gnozis», 2003. 280 p. (in Russian).
5. Tishunina N. V. (2001) *Metodologija intermedial'nogo analiza v svete mezhdisciplinarnyh issledovanij. [Intermediate analysis methodology in the light of interdisciplinary research.]* Serija «Symposium», Metodologija gumanitarnogo znanija v perspektive XXI veka. Sankt-Peterburg, — 2001. Available at: <http://anthropology.ru/ru/text/tishunina-nv/metodologiya-intermedialnogo-analiza-v-svete-mezhdisciplinarnyh-issledovaniy>. (in Russian).
6. Wolf W. (2002) *Intermediality Revisited. Reflections on Word and Music Relations in the Context of a General Typology of Intermediality*. Word and Music Studies. — 2002, P.13-34. Available at: <https://cursointermidialidade.files.wordpress.com/2014/08/wolf.pdf> (in English).
7. Feschenko V.V. (editor) (2015). *Zhivoe slovo: logos - golos - dvizhenie - zhest: Sbornik statej i materialov [Living word: logos-voice-movement-gesture: Collection of articles and materials.]* M.: Novoe literaturnoe obozrevanie, — 2015. 480. (in Russian).

## COPULA OF BEING: FROM PETITIO PRINCIPII TO THE SUBJECT OF RADICAL ONTOLOGY

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**Анотація. Захлипа Д.А. Копула буття: від petitio principii до предмету радикальної онтології.**

Більше століття європейські філософи розробляли нову онтологію, доколи її радикальна форма не була анонсована М. Гайдеггером. Він сприяв реконструкції питання про буття, зараннє включеного у контекст сущого, якому буття мало мелькома навіювати особливу велич або фундаментальну значущість. Однак, цей процес спровокував невирішеність ще однієї проблеми: онтологічної диференції або розмежування буття і сущого. Проект «радикальної онтології», ініційований М. Гайдеггером у 1927 р., але лише обрисно розглянутий у фінальній главі прологу до аналітики «присутності» (*Dasein*), міг би бути взятий у якості пріоритетної точки задля встановлення автономії буття серед варіативних доказів у бік локальних онтологій. Буття, що проникає у філософський дискурс позбавленим своїх власних специфічних характеристик та інструментарію, конотацій та цілей, стає підвладним дії «petitio principii» («передбачення підстави»). Виходячи із цієї логічної помилки, схема «*S e*», у якій буття вчиняє як «*S*», не мусить вимагати детального аналізу за замовчуванням. Гайдеггерівська «вимога підстави» і дотепер є наскрізним інтересом для історії філософії: від проблеми висловлювання та його неприхованої істинності до цілісного погляду на буття, час і негацію відповідно до визначення копули. На противагу феноменологічному позитиву сущого ми окреслюємо радикальну онтологію автономним проектом буття, предмет якого дорівнюється його копулі у негативній формі. Негація – не єдиний і не винятковий вид ніщо, природа якої буде розкрита шляхом імпорту понять ἀλήθεια та φανόμενον. Має бути наміць занотованим і безсумнівним те, що проблема негативної копули як предмету радикальної онтології передує розширенню та екстрапродуктивності філософського дискурсу, незважаючи на недоладність наукової секуляризації. Останнє призвело до дезорієнтації буття серед психологічних, герменевтических та метафізических констант. «Підстави передбачались» [petitio principii], але

не обґрунтовувались.

**Ключові слова:** буття, копула, суще, негація, «petitio principii», радикальна онтологія

**Abstract. Zakhlypa D.A. Copula of Being: From Petitio Principii to the Subject of Radical Ontology.**

For more than a century European philosopher had been developing the new ontology when its radical form was announced by M. Heidegger. He contributed to the rebooting of being-problem had already inserted in the context of essence to which being had to give rise a particular importance or fundamental significance in passing. However, this process has provoked an insolubility of another problem: the ontological differentiation or separation of being and essence. The project of “radical ontology”, initiated by M. Heidegger in 1927, but briefly analyzed in the final chapter of introductory Dasein-analysis, could be taken as its major point for establishing the autonomy of being among the variable evidences regarding to the local ontologies. Being, that penetrates the philosophical discourse without its own specific characteristics and instruments, connotations and purposes, is triggered by the action of “petitio principii” (“foreseeing the basis”). According to this logical fallacy, a scheme “S ε”, in which being acts as an “S”, mustn’t demand a detached analysis by default. Heidegger’s “requirement of justification” or “αἰτεῖσθαι τὸ ἐν ἀρχῇ” has been existing as a cross-cutting concern for the history of philosophy: from the problem of utterance and its explicit verity to the holistic view on being, time and negation in obedience to the definition of copula. In contrast to the phenomenological positivity of essence, we outline radical ontology as an autonomous project of being, the subject of which is equal to its copula in the negative form. Negation is not a sole and exclusive species of nothing, the nature of which will be revealed by importing the concepts of ἀλήθεια and φανόμενον. It should be firmly noted and generally accepted that the problem of negative copula as a subject of radical ontology precedes the extension and extra-productivity of philosophical discourse notwithstanding the drawbacks of scientific secularization. This process has led to the disorientation of being among psychological, hermeneutical and metaphysical constants. “The grounds were assumed” [“petitio principii”] but were not substantiated.

**Key words:** being, copula, essence, negation, “petitio principii”, radical ontology.

*“The wind of being had risen up in the Greek world before the philosophy was given to this meaningless and mysterious verb “to be”, which was able to do so much in the midst of emptiness”* [1, p. 436].

**General formulation of research and it's topicality.** M. Heidegger declared that posing a challenge to the inevitable problem of being wouldn't have lost its

relevance for philosophers alike the connection of being and time which was systematically examined and conveyed by him. It's widely agreed that "sein und zeit" ("being and time") is not a classical juxtaposition such as "being and thinking", "being and phenomena", "being and essence", which are built partly antinomically pursuant to the philosophical tradition. But it can't be argued that a "wende der zeit" (from German – "turning point") of positive philosophy and metaphysics is sprung from the "being and time". What time are we focused on? On the one hand, period of Modernity which aimed to overcome an existential pattern within the question of being beyond the slightest attempts in its detailed and substantive answering, except for Aristotle. On the other side, time that just have been staring in the face of post-philosophical destruction under the onslaught of pointless "chatter". Eventually, "wende der zeit" means the end of mechanic time and regional ontologies provoking a transition to the original project of being and stimulating the renewal of philosophical reflection as a whole.

**Setting of the problem and the aim of the article.** Radical ontology has to occupy conclusively the crucial problematic area, particularly, when it is deprived by the majority its own constituent basics. J. Beaufre insisted: "Area to which the Greeks gave the name of being ... in which something distant and closest was equalized at the birth of the World" [3, p. 341]. The guiding of Greek concepts must be vital and even paradigmatic in this case, "if we do not mean that such Greek thinking is an equivocal or precarious... It is thanks to them we are initially given to be who we are [3, p. 343]. In order for the dynamic flow of being to cease being incommensurate with its bearer, as a philosophy of positivity, which had reached its completion, could cease being an "obstacle" at the turning of time, we should analyze critically its "impersonality" against which F. Nietzsche's litany was directed at his last period: "To fertilize the past, creating the future – let it be my present" [3, p. 351].

**Discussion and Results.** The question of ἀλήθεια (from Greek – "truth") in the Greek meaning was not posed among metaphysical versions of being which could hand it to the mercy of unattainable eternity or philological narratives. Therefore, not only a classic one for philosophy, but constitutive Aristotelian question for the truth

of being in its temporal amplitude and fundamental ontological feature: to express itself phenomenologically in different ways, was recognized by M. Heidegger. Referring to J. Beaufre, “the unconsciousness of being is not a simple inattention, as the reader of “Being and Time” may believe. It has been becoming a matter of being itself, not our case” [4, p. 154]. Thus, our objecting on the question about the second volume of M. Heidegger’s magnum opus three years after the publication of “Being and Time” lays in the fact that our task is not to continue an expansion of unreasonably forgotten narrations, but to restore the question of being at a deeper level. Gaining a full picture of this philosophical act, M. Heidegger had highlighted the subject of radical ontology for the first time since Antiquity, before it was inhibited by the dominance of post-intuition, not reflection again. Our analysis is based solely on the ontological principle of what has been said in passing since the time of Aristotle: “auto men gar ouden estin”, that is “in itself (“S” = being), according to the truth of essence (“S ∈ P” = “petitio principii”), it (being or “S”) is nothing (S is not equal to P → S is nothing)”. It is not enough to pretend spontaneous one in relation to false knowledge, eliminating which everyone can be ready to join the project of radical ontology. An assertion of time as the truth of being should only be a prologue for a sophisticated reader to whom the history of philosophy appears primarily in Greek, with the form and matter, structures of essence, empty verbs, before it can be said that the most odious of questions pertains to being, because it deprives a voice to anyone who does not allow the initial range of its irrefutability. Citing eclectacists, I. Kant pointed out at the menace of such philosophical “adherents”, who exposed their own whims with its help. Consequently, “it must be important to bring to an end this path of thinking once again, clearly understanding how we are capable to do it. But first of all, it is necessary to finalize or complete it at least once generally, in order to be surprised by the phenomenon’s secrecy and to take leave of all illusions which build “nests” in philosophy so stubbornly” [7, 436].

**Conclusions.** For this reason, we could observe a high degree of potential and factual questions which were asked, animated historical debates in which we were engaged, unforeseen and encouraging results which were provided such as:

Ontological decomposition of classical concepts ἀλήθεια and φανόμενον.

Establishing phenomenology as a method of radical ontology.

Isolating copula of being from the essential structure (“S ∈ P”) by representing the logical fallacy “petitio principii”.

Defining and thematizing the subject pretentiousness of radical ontology.

By reducing, constructing and destroying, the identity of being-question can be renewed onwards in its anti-eclectic company against the regional ontologies of essence, “not in an indefinite feeling of possibility... but in the strict sense of another attitude to the same source” [2, p. 176].

## References

1. Beaufret, J. (2007). Dialog s Hajdegerom. Grecheskaja filosofija [Dialogue with Heidegger: Greek Philosophy]. (V. Bystrov, Trans.). Saint-Petersburg: Vladimir Dal'. (Original work published 2006). (In Russian).
2. Beaufret, J. (2007). Dialog s Hajdegerom. Novoevropejskaja filosofija [Dialogue with Heidegger: New European Philosophy]. (V. Bystrov, Trans.). Saint-Petersburg: Vladimir Dal'. (Original work published 2006). (In Russian).
3. Beaufret, J. (2009). Dialog s Hajdegerom. Priblizhenie k Hajdegeru [Dialogue with Heidegger: The Approach to Heidegger]. (V. Bystrov, Trans.). Saint-Petersburg: Vladimir Dal'. (Original work published 2006). (In Russian).
4. Beaufret, J. (2009). Dialog s Hajdegerom. Put' Hajdegera [Dialogue with Heidegger: Heidegger's Way]. (V. Bystrov, Trans.). Saint-Petersburg: Vladimir Dal'. (Original work published 2006). (In Russian).
5. Bibikhin, V. (2009). Rannij Hajdeger. Materialy k seminaru [Early Heidegger. Materials for a Seminar]. Moscow: Institut filosofii, teologii i istorii Sv. Fomy. (In Russian).
6. Cassin, B. (2009). Yevropejs'kyj slovny'k filosofij. Leksy'kon neperekladnostej [Vocabulary of European Philosophies: A Dictionary of Untranslatables]. (Vol. 1). (K. Sihov, Trans.). Kyiv: Dukh i Litera. (Original work published 2004). (In Ukrainian).
7. Cherniakov, A. (2001). Ontologija vremeni. Bytie i vremja v filosofii Aristotelja, Gusserlja i Hajdegera [Ontology of Time. Being and Time in the Philosophy of Aristotle, Husserl and Heidegger]. Saint-Petersburg: Vysshaja religiozno-filosofskaja shkola. (In Russian).
8. Dakhniy, A. (2010). Zapochatkuvannya ekzy'stencijno-temporal'noyi problematy'ky' u filosofiyi Marty'na Gajdeg'era: Marburz'ka lekciya «Ponyattyia chasu» (1924) [Establishment of Existentially-temporal Problematics in Martin Heidegger's Philosophy: Marburg Lecture “The Concept of Time” (1924)]. Sentenciyi. – Sententiae, 23(2), 64–78. (In Ukrainian).
9. Heidegger, M. (2015). Bytie i vremja [Being and Time]. (V. Bibikhin, Trans.). Moscow: Akademicheskij proekt. (Original work published 1927). (In Russian).
10. Heidegger, M. (2012).

Fenomenologicheskie interpretacii Aristotelja. Jekspozicija germenevticheskoy situacii [Phenomenological Interpretations of Aristotle: Initiation into Phenomenological Research]. (N. Artemenko, Trans.). Saint-Petersburg: Gumanitarnaja akademija. (Original work published 1985). (In Russian). 11. Heidegger, M. (2001). Osnovnye problemy fenomenologii [The Basic Problems of Phenomenology]. (A. Cherniakov, Trans.). Saint-Petersburg: Vysshaja religiozno-filosofskaja shkola. (Original work published 1975). (In Russian). 12. Heidegger, M. (2013). Chto takoe metafizika? [What is Metaphysics?] (V. Bibikhin, Trans.). Moscow: Akademicheskij proekt. (Original work published 1976). (In Russian). 13. Kisiel, J.-K. (1995). The Genesis of Heidegger's Being and Time. Berkeley: University of California Press. 14. McNeill, W. (2012). From Destruktion to the History of Being. Journal of Gatherings: The Heidegger Circle Annual, 2, 24–40. 15. Poeggeler, O. (2019). Novye puti s Hajdegerom [New Paths with Heidegger]. (A. Pertsev & O. Matveichev, Trans.). Saint-Petersburg: Vladimir Dal'. (Original work published 1992). (In Russian).

УДК 329 (477)

## **THE WAY CITIZENS FINANCE THE STATUTORY ACTIVITIES OF POLITICAL PARTIES IN UKRAINE**

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**Анотація. Зерницький Р.В. Спосіб фінансування громадянами статутної діяльності політичних партій в Україні.**

Політичні партії – важливий інститут політичної системи. Та для їх функціонування необхідні кошти. І у цьому дослідженні аналізується таке важливе джерело їх надходжень, як внески від громадян. В Україні внески партіям можуть робити як фізичні, так і юридичні особи. Вимоги до потенційних внескодавців та механізм перерахування коштів партіям закріплений на законодавчому рівні. З 2016 року українські партії зобов'язані подавати фінансові звіти, у яких вказуються всі внески на їх користь. Встановлено, що протягом 2019 року 16-м найбільш рейтинговим та медійним партіям («Батьківщина», «Радикальна партія Олега Ляшка», «Слуга народу», «Європейська солідарність», «Опозиційний блок», «Голос», «Самопоміч», «Українська стратегія Гройсмана», «Опозиційна платформа – За життя», «Народний фронт», «Свобода», «Сила і честь», «Партія Шарія», «Сила людей», «Українська галицька партія» та «Наш край») внески зробили 10 533 фізособи та 261 юрособа, що складає близько 0,026% від населення України. Та одне з останніх соцопитувань на тему

фінансування політичних партій демонструє, що частка українців, які готові робити пожертви на користь партій, є значно більшою, й складає близько 12%. Це свідчить про значний розрив між фактичним станом речей та бажаннями і можливостями виборців, що варто взяти до уваги представникам політичних партій для зменшення їх залежності від держави та великого бізнесу. Також виявлено, що середня сума внеску цим 16-м партіям за рік склала близько 200 тисяч грн (блізько 7200 доларів США). У статті вказується, що, враховуючи суспільний інтерес до теми фінансування політичних партій, у майбутньому необхідно буде проаналізувати як змінилася ситуація у 2020 році.

**Ключові слова:** партійні фінанси, політична партія, статутна діяльність, фінансові звіти, фінансування політичних партій.

**Abstract. Zernytskyi R.V. The way citizens finance the statutory activities of political parties in Ukraine.**

Political parties are an important institution of any political system. Their functioning requires sufficient funds. In this connection, the present study analyzes such an important source of their income as contributions from citizens. In Ukraine contributions to parties can be made by both individuals and legal entities. Requirements for potential contributors and the mechanism for transferring funds to parties are enshrined at the legislative level. Since 2016 Ukrainian parties have been required to submit financial reports to indicate all contributions in their favor. It has been established that during 2019 sixteen most rated and media parties (“Bat’kivshchyna”, “Radykal’na partiya Olega Lyashka”, “Sluga narodu”, “Yevropejs’ka solidarnist”, “Opozytsijnyj blok”, “Golos”, “Samopomich”, “Ukrayins’ka strategiya Grojsmana”, “Opozytsijna platforma – Za zhyttya”, “Narodnyj front”, “Svoboda”, “Sy’la i chest”, “Partiya Shariya”, “Sy’la lyudej”, “Ukrayins’ka galyč’ka partiya” and “Nash kraj”) received contributions made by 10 533 individuals and 261 legal entities, which is about 0.026% of the population of Ukraine. But one recent poll on the financing of political parties shows that the proportion of Ukrainians willing to donate to parties is much higher, at about 12%. This indicates a significant gap between the actual state of affairs and the desires and capabilities of voters, which should be taken into account by representatives of political parties to reduce their dependence on the state and big business. It was also found out that the average contribution to these 16 parties for the year was about UAH 200,000 (about USD 7,200). In the paper it is concluded that, given the public interest in the topic of financing of political parties, in the future it will be necessary to analyze how the situation got changed in 2020.

**Key words:** financing of political parties, financial reports, statutory activity, party finances, political party.

**General formulation of research and its topicality.** Political parties are an extremely important part of any political system based on the democratic concept of development. Ukraine, where democratic standards are enshrined at the legislative level, is no exception. At the same time, political parties need resources to carry out their statutory activities. Parties need offices, office supplies, staff, websites, etc. For all this the parties need funds. Parties can receive them from the following main sources: from the state, from citizens (to which, in our case, we include contributions from party members) and from their own earnings (entrepreneurship, sale of goods with their own symbols, etc.). Nowadays, in Ukraine only parliamentary political parties receive funds from the state to carry out their statutory activities, and “own earnings” is not a common source of income for Ukrainian political parties. In this regard, what becomes clear is the **relevance** of the analysis of such an essential source of funding for the statutory activities of political parties as contributions from citizens.

**Setting of the problem and the aim of the article.** The **problem** our study focuses on is, as its **aim**, the analysis of the mechanism of contributions in favor of political parties in Ukraine and its specifics, identifying the number of individuals and legal entities who donate funds to political parties in Ukraine, also taking the amount of their contributions into our research scope. Thus, the results of this work will be useful for representatives of political parties and further research on this topic.

In this respect, according to the current editorship of the Law “On Political Parties in Ukraine” [7], contributions in favor of political parties in Ukraine can be made by citizens personally, as individuals, or through legal entities.

**Discussion and Results.** Individuals who make contributions in favor of parties must be able-bodied citizens of Ukraine who have reached 18 years of age. They must not be citizens of other countries, contribute anonymously or use pseudonyms. Also, they must not be individuals with whom a contract has been concluded for the purchase of works, goods or services to meet the needs of the state or local community for a total of more than fifty living wages for able-bodied persons, established on January 1 of the year in which the contribution is made.

According to the Law, within one year the total amount of contributions in favor of a political party from one individual may not exceed 400 minimum wages established on January 1 of the year in which the contributions were made.

Legal entities through which contributions can be made for the benefit of political parties in Ukraine must not be state or municipal institutions, charitable or religious organizations, unregistered public associations or other political parties. Besides, they must not be local self-government bodies or state authorities and legal entities in which at least 10 percent of the authorized capital or voting rights directly or indirectly belong to the state, local self-government bodies. It is prohibited to make contributions in favor of political parties in Ukraine to foreign states, foreign legal entities, legal entities in which the ultimate beneficial owners are foreigners, and legal entities in which at least 10 percent of the authorized capital or voting rights belong directly or indirectly to non-residents. It is also prohibited to make contributions in favor of political parties to legal entities that control persons authorized to perform the functions of state or local self-government and persons who equate to such (except for MPs, deputies of the Autonomous Republic of Crimea, deputies of local councils, mayors and NSDC staff). According to the Law, within one year the total amount of contributions in favor of a political party from one legal entity must not exceed 800 minimum wages established on January 1 of the year in which the contributions were made.

In order to make a monetary contribution in favor of a political party, an individual or legal entity must transfer funds to the party's bank account. Cash donations to parties in Ukraine are prohibited. The same mechanism is provided for membership fees in favor of parties. The Law states that contributions in favor of parties are also considered works, goods or services in favor of a political party. Their value is determined according to a separately approved methodology [5].

Political parties are required to report all contributions in their financial reports, which they must submit quarterly to the National Agency for the Prevention of Corruption (NAPC) since the beginning of 2016. NAPC is engaged in formal monitoring and analysis of financial reports of political parties in Ukraine. However,

it mainly does a cursory check of the financial reports of political parties, without going into details and nuances. Informal monitoring and analysis is carried out by experts and employees of non-governmental organizations (such as the NGO “CHESNO movement”, the NGO “Eidos”, the NGO “Committee of Voters of Ukraine” and Bihus.info).

The financial reports are the source from which we can find out the number of citizens who finance the statutory activities of political parties in Ukraine and the amount of money they send. However, at the moment it is virtually impossible to conduct a comprehensive analysis of the number of Ukrainians who funded political parties in 2020. In April 2020, the Verkhovna Rada passed the Law which allowed political parties not to submit financial reports until the end of the quarantine imposed to limit the spread of COVID-19. And as of the end of January 2021, the NAPC website does not have a significant part of the parties' financial reports for 2020.

However, we still have the opportunity to analyze the financial reports of the parties for 2019. For this analysis we took the following 16 political parties that had high ratings and/or media activity during 2019: “Bat’kivshchyna”, “Radykal’na partiya Olega Lyashka”, “Sluga narodu”, “Yevropejs’ka solidarnist”, “Opozytsijnyj blok”, “Golos”, “Samopomich”, “Ukrayins’ka strategiya Grojsmana”, “Opozytsijna platforma – Za zhyttya”, “Narodnyj front”, “Svoboda”, “Sy’la i chest”, “Partiya Shariya”, “Sy’la lyudej”, “Ukrayins’ka galyč’ka partiya” and “Nash kraj”. And the results of monitoring their reports for 2019 give us the following figures concerning the number of their donors and the amount of contributions.

Thus, in 2019, only 10 533 individuals and 261 legal entities contributed to the statutory activities of the 16 most rated and media active parties in Ukraine for a total of almost UAH 2.15 billion. It follows that only about 0.026% of the country's population donates to political parties in Ukraine. At the same time, the average amount of contribution in favor of these parties amounted to almost UAH 200,000 (about USD 7,200 as of the beginning of January 2019).

*Table 1*

Number of donors and the amount of their contributions to 16 political parties of Ukraine in 2019” (based on data from the online-resource “Gold of parties” [6])

	Number of individuals-contributors in 2019	Number of legal entities-contributors in 2019	The total number of natural individuals-contributors and legal entities-contributors	Total amount of contributions, UAH	Average amount of contribution from individuals and legal entities, UAH
Bat`kivshhy`na	2281	40	2321	457 351 841	197 049
Rady`kal`na partiya Olega Lyashka	1259	9	1268	289 219 588	228 091
Sluga narodu	97	51	148	252 062 818	1 703 127
Yevropejs`ka solidarnist`	2018	23	2041	247 344 431	121 188
Opozy`cijny`j blok	166	19	185	162 155 139	876 514
Golos	242	12	254	148 908 654	586 255
Samopomich	452	23	475	140 496 649	295 782
Ukrayins`ka strategiya Grojsmana	216	15	231	121 304 898	525 129
Opozy`cijna platforma – Za zhy`tтя	105	11	116	116 374 579	1 003 229
Narodny`j front	196	1	197	102 250 670	519 039
Svoboda	472	3	475	50 045 562	105 359
Sy`la i chest`	165	7	172	36 355 998	211 372
Sy`la lyudej	2212	13	2225	9 666 908	4 345
Partiya Shariya	64	0	64	6 208 043	97 001
Ukrayins`ka galy`cz`ka partiya	493	16	509	5 617 260	11 036
Nash kraj	95	18	113	4 176 766	36 963
<i>total</i>	10533	261	10794	2 149 539 804	199 142

It is noteworthy that monitoring from non-governmental organizations (including the NGO “CHESNO movement” and Bihus.info) since 2017 showed that people close to some parties used personal data of third persons without their knowledge to deposit funds into party accounts and hide information on the real sponsors of political parties [1]. Later, monitoring by the same organizations showed that representatives of some parties agreed with outsiders to make contributions on their behalf in favor of the parties, even if their official annual income was lower than the amount of “donations” [2; 8].

However, opinion polls show that a much larger number of Ukrainians are still willing to make donations to parties in Ukraine than the 0.026% we saw in an analysis of the number of donors to 16 political parties in 2019. Thus, the results of the poll conducted in July 2020 by the Foundation “Democratic Initiatives” named by I. Kucheriv, show that 12% of Ukrainians are willing to make contributions in favor of some political parties [3].

**Conclusions.** In Ukraine contributions in favor of parties can be made by individuals and legal entities. The ones allowed and forbidden to do this is clearly stated in the Law. In favor of the 16 most rated and media active parties in 2019, 10 794 individuals and legal entities (about 0.026% of the country's population) made contributions, and the average amount of the contribution for the year was about UAH 200,000. However, one recent poll on the subject shows that the proportion of Ukrainians willing to donate to parties is much higher, at around 12%. This indicates a significant gap between the actual state of affairs and the desires and capabilities of voters, which political parties should work at in their activities to reduce their dependence on the state and big business. Given the existing public interest in the topic of financing political parties, we see it appropriate to perspective continue to study the issue and in the future to analyze the number of donors of Ukrainian political parties in 2020 and beyond.

## **References**

1. Feshhenko, I., and Kryvko, A. (2018). Vchy`tel`ko moy, sponsor BPP: yak partiya prezy`denta zby`raye mil`jony` . Available at: <https://www.pravda.com.ua/cdn/graphics/2018/04/>

vchytelko\_moja\_sponsor\_bpp/ (in Ukrainian). 2. Feshhenko, I. (2019). Fejkovi vnesky`: shho stalosya, reakciya Ty`moshenko, chy` problema ly`she v "Bat`kivshhy`ni"? Available at: <https://www.chesno.org/post/898> (in Ukrainian). 3. Fond "Demokraty`chni iniciaty`vy" im. Il`ka Kucheriva (2020). Finansuvannya partij - ly`pen` 2020. Available at: <https://dif.org.ua/article/finansuvannya-partiy-lipen-2020> (in Ukrainian). 4. "Komitet vy`borciv Ukrayiny" (2020). "Sluga Narodu" 7 misyaciv zatyaguye z podannym finansovogo zvitu. Available at: [http://www.cvu.org.ua/nodes/view/type:news\(slug:sluha-narodu-7-misiatsiv-zatiahuie-z-podanniam-finansovoho-zvitu](http://www.cvu.org.ua/nodes/view/type:news(slug:sluha-narodu-7-misiatsiv-zatiahuie-z-podanniam-finansovoho-zvitu) (in Ukrainian). 5. Metodologiya vy`znachennya rozmiru (sumy`) vnesku na pidtry`mku polity`chnoyi partiyi u formi robit, tovariv abo poslug (2018). Available at: <https://zakon.rada.gov.ua/laws/show/z1397-18#n14> (in Ukrainian). 6. Onlajn-resurs "Zoloto partij" (2016-2021). Available at: <https://zp.chesno.org/parties/2019/> (in Ukrainian). 7. Zakon Ukrayiny` "Pro polity`chni partiyi" (redakciya vid 01.01.2021). Available at: <https://zakon.rada.gov.ua/laws/show/2365-14#Text> (in Ukrainian). 8. Zernytskyi, R. (2020). NAZK pidozryuye, shho deyaki donory` partiyi Kernesu ye fejkovy`my`. Available at: <https://www.chesno.org/post/4131/> (in Ukrainian)

## **SECTION II**

### **NATURAL SCIENCES**

УДК 57.013

#### **METALLOTHIONEIN: BRIEF OVERVIEW**

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#### **Анотація. Акжигітов Р. А. Металотіонеїни: короткий огляд.**

Дана стаття присвячена вивченю сімейства цитоплазматичних білків - металотіонеїнів (МТ). МТ здатні зв'язувати іони важких металів. Висока спорідненість МТ до них обумовлена вмістом тількиніх груп залишків цистеїну (близько третини від усього амінокислотного складу білкової молекули), які зв'язують окремі іони металів, змінюючи при цьому і конформаційну структуру нативної молекули МТ. У зв'язку з цим, в першу чергу МТ забезпечують захист організму від інтоксикації важкими металами, які при попаданні в тіло в підвищених кількостях здатні порушувати фізіологічний баланс і метаболічний обмін, включаючи летальний результат. Крім того, МТ здатні зв'язувати активні форми кисню, наприклад, супероксид-аніон або гідроксильних радикал, роблячи їх також нешкідливими для організму. Однак, спектр виконуваних ними функцій значно ширший і різноманітніший, практично до участі в канцерогенезі, маючи при цьому як позитивний, так і негативний вплив на організм. До всього іншого варто відзначити, що в цілому роль МТ в організмі тварин вивчена ще не досконально, тому питання про функції, які вони виконують, залишається відкритим. Таким чином, в статті описуються основні структурні і функціональні особливості МТ, які залежать, по-перше, від ізоформи цього білка (основні ізоформи металотіонеїнів: МТ-1, МТ-2, МТ-3 і МТ-4), по-друге, від іона важкого металу, з яким вони пов'язані. МТ здатні зв'язувати як фізіологічні, так і ксенобіотичні важкі метали. До перших належать, наприклад, мідь, залізо і цинк, у той час як до других – миш'як і ртуть. Всі вони (і не згадані) повсюдно зустрічаються в природі, причому в самих різних з'єднаннях, а тварини, в тому числі і люди, які контактиують з таким негативним хімічним фактором середовища, підвергають своє здоров'я і життя небезпеці. У зв'язку з цим, розуміння функціонування МТ і їх функцій є актуальним напрямком в науці.

**Ключові слова:** металотіонеїни, іони важких металів, стрес-фактор, мікроелементи, цистеїн.

**Abstract. Akzhyhitov R.A. Metallothionein: Brief Overview.**

This article is devoted to the study of the family of cytoplasmic proteins – metallothioneins (MTs). MTs are able to bind heavy metal ions. The high affinity of MTs for such ions is due to the content of thiol groups of cysteine residues (about a third of the total amino acid composition of a protein molecule), which bind individual metal ions, thereby changing the conformational structure of the native MT molecule. In this regard, first of all, MTs provide protection of the body from intoxication with heavy metals, which on entering the body in increased quantities can disrupt the physiological balance and metabolic metabolism, up to death. In addition, MTs are capable of binding reactive oxygen species, such as superoxide anion or hydroxyl radical, making them at the same time harmless to the body. However, the range of their functions is much wider and more diverse, virtually up to their participation in carcinogenesis, while having both positive and negative effects on the body. It is worth noting that, on the whole, the role of MTs in the animal organism has not yet been thoroughly studied, therefore the question concerning the functions they perform remains open. Thus, the article describes the main structural and functional features of MTs, which depend, firstly on the isoform of this protein (major isoforms metallothioneins: MT-1, MT-2, MT-3 and MT-4), and secondly – on the heavy metal ion they are bound to. MTs are capable of binding both physiological and xenobiotic heavy metals. The former include, for example, copper, iron and zinc, while the latter – arsenic and mercury. All of them (as well as those not listed) are ubiquitous in nature, and are available in a variety of compounds. Animals, including humans, who come into contact with such a negative chemical factor of the environment, endanger their health and life. In this regard, understanding the functioning of MT and their functions is an urgent direction in science.

**Key words:** metallothioneins, heavy metal ions, stress factor, trace elements, cysteine.

It is a well-known fact that our environment contains elements of the entire periodic table, including heavy metal ions. Therefore, it is not surprising that the development of life forms on Earth is closely related to the influence of heavy metal ions. Some of them, such as zinc, iron, copper, etc. are necessary for the body of plants and animals to function normally (physiologically). This means that heavy metal ions are trace elements and are necessary for the body to participate in biological processes or to build biological molecules [4, p. 41-50]. As trace elements, they are capable of acting as cofactors of proteins [1, p. 513-543]. So, copper is a cofactor of cytochrome c-oxidase and ceruloplasmin [14, p. 620-628], and iron – catalase and other enzymes [13, p. 357-424]. Cofactors participate in the biological

activity of enzymes by being attached to their functional site. However, in concentrations exceeding the physiological value, heavy metal ions are toxic and can be fatal [25, p. 133-164]. In this regard, one of the topical areas in science is the study of the formation of resistance to stress factors, which include heavy metal ions. So, the work by A. I. Bozhkov, et al [4, p. 41-50] shows the formation of resistance to lethal doses of copper sulfate in young and old animals. It is assumed that the formation of this resistance to copper ions is provided, among other things, by the start of the synthesis of specific proteins – metallothioneins (MT). Our purpose is to consider what exactly these proteins are.

Metallothioneins (MTs) are low-molecular weight proteins isolated in 1957 from the cortex of horse kidneys [16, p. 4813-4814]. It was not until that year that their active study began, and new data have been actively growing up to the present day. According to PubMed (NCBI), there are about 20,000 articles on the study of metallothioneins in plant, animal, and prokaryotic cells [22].

It is common knowledge that metallothioneins (MTs) are able to bind metal ions due to the high content of cysteine in their structure [23, p. 2-7]. Four MT isoforms have been found in the human body [12, p. 1-20]. MT-1 and MT-2 are localized mainly in the kidneys and liver. MT-3 and MT-4 are minor isoforms of human MTs. MT-3 and MT-4 are characteristic of unique tissue types [11, p. 650-653]. Thus, MT-3 is localized in the cells of the brain and the central nervous system, while MT-4 – in the squamous epithelium. Squamous epithelium is defined as pathologically altered epithelium of internal organs. In addition, it is assumed that MTs are also involved in the work of memory receptors, and, consequently, in learning mechanisms [7, p. 392-400].

In general, in mammals, one metallothionein (MT) molecule consists of 61-68 amino acids. (Isoforms MT-1, MT-2, and MT-4 include 61-62 amino acids, while isoform MT-3 contains 68 amino acids.) The MT protein sequence consists of 20 cysteine residues (Cys) [9, p. 10-29]. It is known that the MT peptide chain is made up of two domains, which in turn have two clusters:  $\beta$  (beta) and  $\alpha$  (alpha). The  $\beta$ -cluster can bind three divalent metal ions with 9 cysteine molecules (Cys), and the  $\alpha$ -

cluster can bind four divalent metal ions with 11 Cys molecules [12, p. 1-20]. Thus, a total of 20 cysteine residues are present in the metallothionein molecule, and these residues can be located in three different variants throughout its structure [5, p. 10124-10128; 11, p. 650-653]: next to each other (Cys-Cys); through one amino acid residue (Cys-x-Cys); through two amino acid residues (Cys-x-y-Cys).

Thus, upon saturation, the  $\beta$ -domain of MT can bind three ions of divalent metals, for example, cadmium, zinc, and cobalt, and the  $\alpha$ -domain can bind four ions of divalent metals, which in total amounts up to seven ions of divalent metals [11, p. 650-653; 12, p. 1-20]. However, MTs is also capable of binding monovalent and trivalent metals. Hence, the maximum binding of monovalent copper by the  $\beta$ -domain equals 6 ions. The same holds true for the  $\alpha$ -domain. Therefore, the maximum binding of monovalent copper by the  $\beta$ - and  $\alpha$ -domains equals up to 12, while studies for trivalent ions, such as arsenic, showed the maximum amount of binding up to six metal ions in both domains [18, p. 153-172; 20, p. 12473-12483].

Zinc is considered to be the main binding partner for metallothioneins (MTs) in animals. It is a trace element that is needed for the body to function normally. However, other metals, which are not essential for the body or even toxic, have a higher affinity for binding to MT domains. These include the following metals: lead, copper, cadmium, mercury, chromium, bismuth, silver, etc. This may indicate the presence of a protective function in metallothioneins (MT), which is activated when elevated concentrations of toxic metals enter the body [3, p. 739-750; 9, p. 1-117; 19, p. 6947-6957; 20, p. 12473-12483]. Interestingly, in intact young animals, an insignificant content of these proteins in liver cells is observed; however, in old animals or in young animals, which were preliminarily injected with monovalent metal ions in an increased concentration, an increase in the MT content in these cells was observed [4, p. 41-50]. This may indicate that metallothioneins (MTs) are involved in the mechanisms to form resistance to stress factors, i.e. in adaptation.

The structures of all four isoforms of metallothioneins have a high degree of affinity with each other, but there are also characteristic differences. Thus, MT-3 has a glutamate-rich hexapeptide containing the Cys-Pro-Cys-Pro motif, which is absent

in other MTs. The presence of this fragment in MT-3 may be responsible for inhibition of the activity of extracellular growth in primary cultures of neurons [27, p. 1067-1078]. In addition, the Cys-Pro-Cys-Pro motif can also affect other functional differences between MT-3 and isoforms MT-1 and MT-2 [8, p. 2912-2920; 9, p. 1-117;].

Isoform MT-4 is a 62 amino acid single chain protein. Unlike MT-1 and MT-2 molecules, its metal-binding domains are characterized by a higher resistance to demetallization when interacting with ethylenediaminetetraacetic acid (EDTA). In addition, the studies carried out on *Escherichia coli* have shown that MT-4 has a higher affinity for monovalent copper ions rather than divalent zinc ions, which can significantly affect the function of MT-4 in cells. In this regard, metallothionein-4 (MT-4) is considered "copper thionein" and not "zinc thionein", to which three other isoforms belong (MT-1; MT-2; MT-3) [9, p. 1-117; 19, p. 6947-6957; 26, p. 24403-24413].

In general, if we touch upon the functions of metallothioneins (MT), then it should be noted that after the first works devoted to zinc metabolism, important observations were made. They indicated that metallothioneins (MTs) have specific functions. Further, genetic polymorphisms of human MT were described. Some of these polymorphisms have been shown to lead to mutations in proteins, which in turn affect human health. In this way, it has been assumed that MT has a specific role in living organisms [15, p. 1079-1086; 21, p. 55-68].

It has been shown that metallothioneins (MT) are found in both normal and abnormal cells, as well as in blood serum. This is due to the fact that MTs are able to regulate and mediate important cellular processes [28, p. 301-308]. Thus, isoforms MT-1 and MT-2 have been found mainly in the cytoplasm of cells and in some organelles; more precisely, their expression predominates in mitochondria [9, p. 1-117]. In this case, the level of expression, and consequently, the concentration of MT-1 and MT-2, strongly depends on the oxidative status of mitochondria. Having a small molecular size (6-8 kDa), MTs can be transported across the outer mitochondrial membrane, thereby regulating the penetrating properties of the inner

mitochondrial membrane [9, p. 1-117].

The presence of MT isoforms has also been observed in lysosomes, which reveals that MT-1 and MT-2 protect this organelle against oxidative stress by decreasing intralysosomal peroxide reactions due to the fact that these reactions are catalyzed by iron ions. Moreover, MT-3 is shown to ensure the correct performance of the functions of lysosomes in astrocytes and neurons [9, p. 1-117; 28, p. 301-308].

To the above it should be added that the presence of MT-1, MT-2 and MT-3 has also been detected in the nuclei of many cells, for example, in the nuclei of hepatocytes [9, p. 1-117]. It has been shown that under oxidative stress, isoforms MT-1 and MT-2 move rapidly into the cell nucleus through complexes of nuclear pores [6, p. 347-356]. Besides, the results of numerous studies prove that, being localized in the nucleus, the MT-1 and MT-2 molecules play an important role in cell proliferation and differentiation [10, p. 2846-2854], as well as in genotoxicity and cell apoptosis [2, p. 175-184]. At the same time, the MT-3 molecules of the cytoplasm of the cell and nucleus play a significant role in protection against DNA damage and in the regulation of transcription [24, p. 843-851].

The presence of metallothioneins (MT) in the blood (0.01-1.0 ng / L in serum and 0.51-1.86 ng / ml in plasma) is believed to be related to their leakage across the cell membrane during damage or complete destruction of blood cells [9, p. 1-11].

The extensive cellular localization of metallothioneins (MTs), as well as their metal-binding abilities, characterize these proteins as multifunctional proteins that are able to take part in various cellular processes. However, despite their regulatory and protective properties, in some circumstances, for example, during carcinogenesis, MTs can promote tumor progression, that is, have an indirect negative effect on the body. Hence, it leads to the fact that MTs are often called “multipurpose proteins with two faces” [17, p. 586-596].

Summing up, we can say that numerous data indicate the polyfunctionality of metallothioneins (MTs) and their importance for the body. MTs are involved in key processes, such as: detoxification of heavy metal ions; removal of reactive oxygen species (ROS) and reactive nitrogen species (AFA); differentiation, proliferation and

regulation of cell death; migration and invasiveness of cancer cells, as well as in angiogenesis. All of the above is caused by the structural features of different MT isoforms and that their structure is an important component for understanding the operation of MT mechanisms. We can say that the structure of the MTs provides their function, and the function – the structure.

#### References

1. Aggett, P. J. (1985). 1 Physiology and metabolism of essential trace elements: An outline. *Clinics in endocrinology and metabolism*, 14(3), 513-543.
2. Apostolova, M. D., Ivanova, I. A., & Cherian, M. G. (1999). Metallothionein and apoptosis during differentiation of myoblasts to myotubes: protection against free radical toxicity. *Toxicology and applied pharmacology*, 159(3), 175-184.
3. Babula, P., Masarik, M., Adam, V., Eckschlager, T., Stiborova, M., Trnkova, L., Kizek, R. (2012). Mammalian metallothioneins: properties and functions. *Metalomics*, 4(8), 739-750.
4. Bozhkov, A. I., Nikitchenko, Y. V., Klimova, E. M., Linkevych, O. S., Lebid, K. M., Al-Bahadli, A. M. M., Alsardia, M. M. A. (2017). Young and old rats have different strategies of metabolic adaptation to Cu-induced liver fibrosis. *Advances in Gerontology*, 7(1), 41-50.
5. Braun, W., Vasak, M., Robbins, A. H., Stout, C. D., Wagner, G., Kägi, J. H., Wüthrich, K. (1992). Comparison of the NMR solution structure and the x-ray crystal structure of rat metallothionein-2. *Proceedings of the National Academy of Sciences*, 89(21), 10124-10128.
6. Cherian, M. G., Apostolova, M. D. (2000). Nuclear localization of metallothionein during cell proliferation and differentiation. *Cellular and molecular biology (Noisy-le-Grand, France)*, 46(2), 347-356.
7. Choi Y. B., Chen H. S. V., Lipton S. A. (2001). Three pairs of cysteine residues mediate both redox and zn<sup>2+</sup> modulation of the nmda receptor. *Journal of Neuroscience*, 21(2), 392-400.
8. Ding, Z. C., Ni, F. Y., Huang, Z. X. (2010). Neuronal growth-inhibitory factor (metallothionein-3): structure–function relationships. *The FEBS journal*, 277(14), 2912-2920.
9. Dziegieł, P., Pula, B., Kobierzycki, C., Stasiołek, M., Podhorska-Okolow, M. (2016). Metallothioneins in normal and cancer cells. *Springer*, 218, 1-117.
10. Günes, Ç., Heuchel, R., Georgiev, O., Müller, K. H., Lichtlen, P., Blüthmann, H., ... & Schaffner, W. (1998). Embryonic lethality and liver degeneration in mice lacking the metal-responsive transcriptional activator MTF-1. *The EMBO journal*, 17(10), 2846-2854.
11. Jayawardena D. P., Heinemann I. U., Stillman M. J. (2017). Zinc binds non-cooperatively to human liver metallothionein 2a at physiological pH. *Biochemical and biophysical research communications*, 493(1), 650-653.
12. Krężel, A., Maret, W. (2017). The functions of metamorphic metallothioneins in zinc and copper metabolism. *International journal of molecular sciences*, 18(6), 1237.
13. Maehly, A., Chance, B. (1954). Catalases and peroxidases. *Methods Biochem Anal*, 1, 357-424.
14. Maréchal, A., Meunier, B., Lee, D., Orengo, C., Rich, P. R. (2012). Yeast cytochrome

c oxidase: a model system to study mitochondrial forms of the haem–copper oxidase superfamily. *Biochimica et Biophysica Acta (BBA)-Bioenergetics*, 1817(4), 620-628. 15. Maret, W. (2011). Redox biochemistry of mammalian metallothioneins. *JBIC Journal of Biological Inorganic Chemistry*, 16(7), 1079-1086. 16. Margoshes, M. and B.L. Vallee (1957). A cadmium protein from equine kidney cortex. *Journal of the American Chemical Society*, 79(17), 4813-4814. 17. McGee, H. M., Woods, G. M., Bennett, B., Chung, R. S. (2010). The two faces of metallothionein in carcinogenesis: photoprotection against UVR-induced cancer and promotion of tumour survival. *Photochemical & Photobiological Sciences*, 9(4), 586-596. 18. Merrifield, M. E., Huang, Z., Kille, P., Stillman, M. J. (2002). Copper speciation in the  $\alpha$  and  $\beta$  domains of recombinant human metallothionein by electrospray ionization mass spectrometry. *Journal of inorganic biochemistry*, 88(2), 153-172. 19. Mounicou, S., Ouerdane, L., Passagne, I., Szpunar, J., Lobinski, R. (2010). Identification of metallothionein subisoforms in HPLC using accurate mass and online sequencing by electrospray hybrid linear ion trap-orbital ion trap mass spectrometry. *Analytical chemistry*, 82(16), 6947-6957. 20. Ngu, T. T., Stillman, M. J. (2006). Arsenic binding to human metallothionein. *Journal of the American Chemical Society*, 128(38), 12473-12483. 21. Raudenska, M., Gumulec, J., Podlaha, O., Sztalmachova, M., Babula, P., Eckschlager, T., Masarik, M. (2014). Metallothionein polymorphisms in pathological processes. *Metallomics*, 6(1), 55-68. 22. Search for works "Metallothionein" (2020). [Electronic resource] Available at: <https://www.ncbi.nlm.nih.gov/pmc/?term=Metallothioneins> 23. Sigel, A., Sigel, H., Sigel, R. K. (Eds.). (2015). *Metallothioneins and related chelators* (Vol. 5). Walter de Gruyter GmbH & Co KG. 24. Szelachowska, J., Dziegieł, P., Jelen-Krzeszewska, J., Jelen, M., Tarkowski, R., Włodarska, I., ... & Kornafel, J. (2008). Prognostic significance of nuclear and cytoplasmic expression of metallothioneins as related to proliferative activity in squamous cell carcinomas of oral cavity. *Histology and histopathology*, 23, 843-851. 25. Tchounwou, P. B., Yedjou, C. G., Patlolla, A. K., Sutton, D. J. (2012). Heavy metal toxicity and the environment. *Molecular, clinical and environmental toxicology*, 133-164. 26. Tío, L., Villarreal, L., Atrian, S., Capdevila, M. (2004). Functional differentiation in the mammalian metallothionein gene family: metal binding features of mouse MT4 and comparison with its paralog MT1. *Journal of Biological Chemistry*, 279(23), 24403-24413. 27. Vašák, M., Meloni, G. (2011). Chemistry and biology of mammalian metallothioneins. *JBIC Journal of Biological Inorganic Chemistry*, 16(7), 1067-1078. 28. Weryńska, B., Pula, B., Muszczynska-Bernhard, B., Gomulkiewicz, A., Piotrowska, A., Prus, R., ... & Dziegieł, P. (2013). Metallothionein 1F and 2A overexpression predicts poor outcome of non-small cell lung cancer patients. *Experimental and molecular pathology*, 94(1), 301-308.

## AN OVERVIEW OF MANGANESE (IV) OXIDE (MnO<sub>2</sub>): ITS PROPERTIES, SYNTHESIS AND AREAS OF APPLICATION

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**Анотація. Чурсинова Є.В. Огляд оксиду марганцю (IV) (MnO<sub>2</sub>): його властивості, синтез, та сфери застосування.**

Оксид марганцю (IV) (MnO<sub>2</sub>) - найбільш стійке з'єднання марганцю, кристалічна речовина чорно-бурого кольору, широко пошиrena в земній корі у вигляді мінералу піролюзит. Залежно від умов освітлення існує в різних поліморфних модифікаціях, що відрізняються фізичними властивостями. При нагріванні розкладається, поступово відчіплюючи кисень і утворюючи оксид марганцю (III), оксид марганцю (II, III) і оксид марганцю (II). У цій роботі розглянуто марганець і його оксиди та вказано поширення в природі. Розглянуті фізичні і хімічні властивості цих речовин, промислові і лабораторні способи отримання і очищення, застосування, а також біологічна роль і токсична дія.

Оксид марганцю (IV) застосовується для промислового виробництва марганцю; як деполяризатор в "батарейках" (сухих гальванічних елементах); компонент мінеральних пігментів; освітлювач скла.

Отримати речовину можна такими лабораторними методами: Окисленням марганцю (II) до марганцю (IV), Відновлення перманганату калію, Відновлення марганцю (VII) марганцем (II), Розкладання оксиду марганцю (VII), Термічне розкладання перманганату калію, Реакція перманганату калію з пероксидом водню, Електролітичний спосіб отримання марганцю (IV) оксиду, який полягає в анодному окисленні іонів марганцю (II) і наступної взаємодії марганцю (IV) із водою.

**Ключові слова:** Оксид марганцю (IV) (MnO<sub>2</sub>), хімічні властивості, речовини, концентрація.

**Abstract. Chursinova E.V. An overview of manganese (IV) oxide (MnO<sub>2</sub>): its properties, synthesis and areas of application.**

Manganese (IV) oxide (MnO<sub>2</sub>) is the most stable compound of manganese. It is a brown or dark-brown crystalline substance. Manganese (IV) oxide (MnO<sub>2</sub>) is quite widespread in the earth's crust as a mineral called pyrolusite. Depending on the terms of light exposure it is present in different polymorphic modifications that differ in physical properties. It possesses the property to decompose when heated, gradually releasing oxygen and forming manganese (III) oxide,

manganese (II, III) oxide and manganese (II) oxide. In this paper manganese and its oxides are overviewed and the natural occurrence is outlined. Physical and chemical properties of these substances, industrial and laboratory methods of synthesis, production, refining and further application are considered. The biological role and toxic action are described.

Manganese (IV) oxide is used for manufacturing of manganese; as a depolarizer in "batteries" (dry cells), as a component of inorganic pigments made of mineral compounds in textile dyeing and a refining agent in ceramics and glassmaking.

The given substance can be produced using the following laboratory techniques: 1) oxidation of manganese (II) to manganese (IV); 2) deoxidation to potassium permanganate; 3) deoxidation of manganese (VII) by manganese (II); 4) decomposition of manganese oxide (VII); 5) thermal decomposition of potassium permanganate; 6) reaction of potassium permanganate with hydrogen peroxide; 7) the electrolytic method of obtaining manganese oxide (IV), involving anodic oxidation of manganese (II) ions and further interaction of manganese (IV) with water.

**Key words:** Manganese (IV) oxide ( $MnO_2$ ), chemical properties, substances, concentration.

**General formulation of the research and its topicality.** Manganese, as a mineral called pyrolusite, has been known since ancient times. The name Manganese was derived from the German word 'Manganerz' that means manganese ore in the beginning of the XIXth century. The ancient Roman naturalist Pliny mentioned black minerals that were used for the discoloration of the liquid glass mass. In Georgia pyrolusite from the most ancient times served as an adding material in iron production. For a long time pyrolusite was called black magnesia and it was considered to be a sub-type of magnetic iron ore (magnetite). Carl Scheele and Johan Gottlieb Gahn made a great contribution to the discovery of manganese. In 1774 Carl Scheele proved that there was an unknown metal in the ore, and the other Swedish scientist Johan Gottlieb Gahn, while heating hard the mixture of pyrolusite with carbon, obtained manganese dioxide [4].

The **object of the research** in the paper is manganese (IV) oxide ( $MnO_2$ ). The properties of manganese (IV) oxide ( $MnO_2$ ) are the **subject of the research**.

The theme of the given paper is quite topical and relevant since manganese (IV) oxide ( $MnO_2$ ) is well-known and widespread in different industries and has multiple applications in medicine. It is worth mentioning that it is used as a catalyst

in the dehydrogenation of piperidine; it is used for desulphurization of metals; as a component of many ceramic materials; it is used for industrial production of manganese; as a depolarizer in "batteries" (dry cells); as a component of inorganic pigments made of mineral compounds in textile dyeing and as a refining agent in ceramics and glassmaking. Manganese (IV) oxide ( $\text{MnO}_2$ ) [3].

**Setting of the problem and the aim of the article.** The purpose of the article is to describe and give an overview of the properties of manganese (IV) oxide ( $\text{MnO}_2$ ), the laboratory and industrial methods of its production and consider the main areas of its application.

The main tasks of the paper are the following:

- consider the main methods for obtaining manganese (IV) oxide ( $\text{MnO}_2$ ) and the areas of its application;
- describe of the main properties of manganese (IV) oxide ( $\text{MnO}_2$ ).

**Discussion and Results.** There are different manganese compounds. The most stable is manganese (IV) oxide ( $\text{MnO}_2$ ), which is of the brown or dark brown color. It is an amphoteric oxide; however, under normal conditions, it does not exhibit amphoteric properties due to its quite low reactivity towards water, dilute acids  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$ , nitric acid and bases in solutions. Manganese (IV) oxide ( $\text{MnO}_2$ ) is a typical oxidizing agent. It is worth noting that reducing properties are not very characteristic to it [2].

Nevertheless, manganese (IV) oxide ( $\text{MnO}_2$ ) exhibits redox duality.

In an acidic environment, manganese (IV) oxide ( $\text{MnO}_2$ ) is a strong oxidizing agent:



The given reaction is used for obtaining chlorine.

As can be seen from this reaction, manganese dioxide with nonoxidizing acids does not form manganese (IV) salts. Even the concentrated sulfuric acid, which does not usually exhibit reducing properties, when interacting with manganese dioxide causes a decrease in the oxidation state of manganese:



Reducing properties are evident when manganese (IV) oxide ( $\text{MnO}_2$ ) is interacting with a stronger oxidizing agent:



When calcined, manganese (IV) oxide ( $\text{MnO}_2$ ) decomposes:



$\text{MnO}_2$  is used as a catalyst in the oxygen production:



Oxidizing properties of manganese (IV) oxide ( $\text{MnO}_2$ ) are manifested in the reactions of converting manganese dioxide into sulfate at the transitional stage of manganese production:

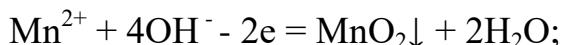
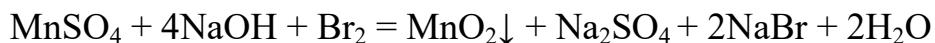


Manganese (IV) oxide ( $\text{MnO}_2$ ) is used for industrial production of manganese; as a depolarizer in "batteries" (dry cells); as a component of inorganic pigments made of mineral compounds in textile dyeing; a refining agent in ceramics and glassmaking [2].

Syntheses of manganese (IV) oxide ( $\text{MnO}_2$ ) can be made in the following ways:

1. The oxidation of manganese (II) to manganese (IV):

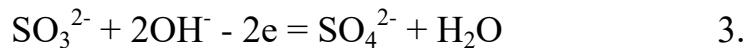
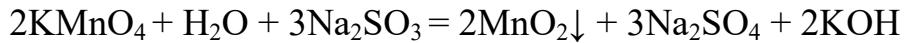
We pour 2 ml of manganese sulfate solution into a test tube, add a little sodium hydroxide and heat it slightly, and then we add dropwise some bromine water to the solution. Afterwards we can observe the formation of  $\text{MnO}_2\downarrow$  precipitate of the brown color.



2. The reduction of potassium permanganate:

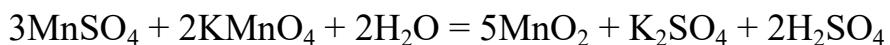
We pour 1 ml of diluted potassium permanganate solution and add the same amount of water. Then we add dropwise some sodium sulfite solution to the test tube. Thus, we can observe the discoloration of the solution and the formation of

$\text{MnO}_2 \downarrow$  precipitate of the brown color.



### 3. The reduction of manganese (VII) with manganese (II):

We pour 1 ml of manganese sulfate solution into a test tube and add potassium permanganate solution dropwise. During the given reaction, we can observe the discoloration of the solution and the formation of  $\text{MnO}_2 \downarrow$  precipitate of the brown color.



### 4. The decomposition of manganese oxide (VII):

We pour a small amount of powdered potassium permanganate onto the asbestos membrane and add a few drops of concentrated sulfuric acid with a pipette. We should be extremely careful! Afterwards, we observe the rapid progress of the reaction with the formation of  $\text{MnO}_2 \downarrow$  dark brown flakes.



### 5. The thermal decomposition of potassium permanganate:

We heat several crystals of potassium permanganate in a test tube. During the given reaction, we can observe  $\text{MnO}_2 \downarrow$  precipitate formation of the brown color and  $\text{O}_2 \uparrow$  gas whitening.



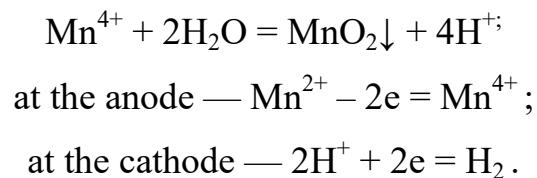
### 6. The reaction of potassium permanganate with hydrogen peroxide.

This synthesis can be made in the laboratory, since it is one of the most obtainable and the given reaction takes place in a neutral medium.

In practice,  $\text{MnO}_2$  catalytically decomposes hydrogen peroxide, as a result, the reaction does not go to the end.



7. The electrolytic method for producing manganese (IV) oxide consists of the anodic oxidation of manganese (II) ions and the following interaction of manganese (IV) with water according to the following reactions:



If manganese sulfate is subjected to electrolysis, the overall reaction is:



The process of electrolytic production of manganese (IV) oxide ( $\text{MnO}_2$ ) is influenced by a number of factors. Among them concentration of manganese (II), pH of the solution, temperature, current density, and electrode material are worth to be mentioned.

Having low concentrations of manganese in the electrolyte, the current efficiency is significantly reduced. Therefore, the presence of manganese sulfate in the solution should not be less than 50-60 g / l.

Depending on the conditions of electrolysis, either some highly dispersed powder or some dense precipitate can be obtained. Besides the layer of oxide can be formed several millimeters deep. Moreover, the dense oxide is more active than the dispersed one.

Manganese (IV) oxide ( $\text{MnO}_2$ ) possesses quite essential properties and is applied in different areas. Manganese (IV) oxide ( $\text{MnO}_2$ ) is a black or brown-black crystalline or amorphous powder. Unlike other manganese oxides, it conducts electricity. Depending on the conditions of its formation, it exists in various polymorphic modifications that differ in physical properties. When heated to a temperature of  $500^\circ\text{C}$ , it begins to split off oxygen and at a temperature of  $535^\circ\text{C}$  it turns into  $\text{Mn}_2\text{O}_3$ , and under strong heating in the air, it turns into  $\text{Mn}_3\text{O}_4$ . Manganese (IV) oxide ( $\text{MnO}_2$ ) reacts with concentrated hydrochloric and sulfuric acids and does not exhibit any change being treated with nitric acid [1].

**Conclusion.** Manganese and its oxides have been given an overview in the paper. It has been given attention to their state in the natural environment, some

physical and chemical properties of these substances have been described, some industrial and laboratory methods for the obtaining and refining have been indicated, the biological role, basic applications and the toxic action have been considered. It has been pointed out that manganese (IV) oxide ( $MnO_2$ ) is one of the most stable compounds of manganese. Manganese (IV) oxide ( $MnO_2$ ) is the only oxide that conducts an electric current. When heated manganese (IV) oxide ( $MnO_2$ ) decomposes, gradually releasing oxygen and forming manganese (III) oxide, manganese (II, III) oxide and manganese (II) oxide. Nanoparticles of manganese (IV) oxide ( $MnO_2$ ) have particular influence on tumours either in a test tube or in a living organism. They can help to destroy gliomas and reduce a negative effect from radial therapy.

## References

1. Kijko, S.M., Nikolajchuk, O.G., and Urzhunceva, V.V. (2012). Laboratornyj praktykum z neorganichnogo syntezu: navchal`nyj posibnyk [Laboratory course on inorganic synthesis: manual] Kharkiv: V.N. Karazin KhNU. 100 p.
2. Suxovyeyev, V.V., Senchenko, G.G., Kovtun G.O., and Pryplavmo S.O. (2000). Metalovmisni likars`ki preparaty`[Metal-containing medicines] Kyiv: P. 244.
3. The Columbia Dry Cell Battery, American Chemical Society. (2020). Available at: <https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/drycellbattery.html>.
4. Cyxanovs`ka, I.V. (2019). Mangan. Farmacevtychna Encyklopediya [Manganese. Pharmaceutical Encyclopedia] Kharkiv: National Pharmaceutical University. Available at: <https://www.pharmencyclopedia.com.ua/article/writer/cixanovska-i-v>

УДК 658

## EXPANDING KNOWLEDGE IN WASTE MANAGEMENT TO IMPLEMENT POSITIVE EXPERIENCE OF EU COUNTRIES

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**Анотація. Гречко А.А. Розширення знань в управлінні відходами для втілення позитивного досвіду країн ЄС.**

Виходячи з досвіду Європейського Союзу в галузі поводження з відходами, можна стверджувати, що свідоме ставлення громадян до проблеми поводження з відходами є одним

із стратегічних напрямків екологічної політики. Підписавши Угоду про асоціацію з ЄС, Україна зобов'язалась змінити стан поводження з відходами на території України та вивести його на рівень європейських держав. Опитування показало, що громадяни України не мають достатніх знань у галузі поводження з відходами, оскільки відсутні знання про сортування, види вторинної сировини, які можна переробити в Україні, відсутність знань призводить до нераціонального споживання та переповнених звалищ.

**Ключові слова:** ТПВ, поводження з відходами, екологічна освіта, звалище, утилізація відходів.

**Abstract. Hrechko A.A. Expanding knowledge in waste management to implement positive experience of EU countries.**

Based on the experience of the European Union in the field of waste management, it can be argued that the conscious attitude of citizens to the problem of waste management is one of the strategic directions of environmental policy. By signing the Association Agreement with the EU, Ukraine has undertaken to change the state of waste management on the territory of Ukraine and bring it to the level of European states. A poll has showed that Ukrainian citizens lack knowledge of waste management such as knowledge of sorting, types of secondary raw materials that can be recycled in Ukraine. This leads to irrational consumption and overcrowded landfills.

**Key words:** MSW, waste management, environmental education, landfill, waste disposal.

### **General formulation of research and its topicality**

On the territory of Ukraine there is a problem of waste management because there are a number of problems: landfills that need to be eliminated for a long time, as their service life has expired, unauthorized landfill. This problem is especially acute in low lands, ravines, fields, untimely removal of solid waste. organized reception sites, unadjusted system of collecting secondary raw materials at collection sites.

Taking into account this problem, it is necessary to turn to the experience of the European Union. Briefly describing it, the following key aspects can be identified: citizens feel the need for separate waste collection, as it is the country's domestic policy. Sorting allows to obtain a new resource - secondary raw materials, recycled the maximum number of times, especially glass and metal products. containers for different types of waste, waste processing plants, organic waste are processed separately through composting, which reduces the amount of methane generated from conventional landfills. As a bonus to get fertilizer and biogas, non-

recyclable waste is sent to incinerators. This reduces waste, obtaining material for road construction, as well as energy which is converted into electricity or energy for heating residential premises. In some places, the use of penalties is applied to the population if they do not comply with the regulations on waste management. In some countries, the usual landfills still remain, but their area has greatly decreased [1].

In Ukraine, waste management is limited to mixed waste collection at reception sites, sometimes there are additional containers for the collection of secondary raw materials, but the lack of awareness in the field of separate waste collection leads to the misuse of these containers. The bulk of waste is taken to the landfill. There is a single functioning incinerator in Kyiv region [2].

On the territory of the city of Kyiv there is an organization «Ukraine without garbage», which has not only established the process of receiving secondary raw materials, but also taxed the acceptance of waste for incineration, as well as environmental education in the field of solid waste management.

### **Setting of the problem and the aim of the article**

The purpose of the work is to analyze the European model of waste management, to assess environmental awareness of the Ukrainians in the field of waste management. In order to move to the European model of waste management, it is necessary to identify weaknesses in waste management and willingness of citizens to implement the concept of life without waste. A separate waste collection system will encourage people to look for the best model for implementing positive experience of other countries.

### **Discussion and Results**

It takes at least 10 years for the European waste management system to work in Ukraine. This time is needed for the transition to a new model of waste management, to restructure outdated waste treatment, to reclaim the existing landfills, to develop a separate waste collection system.

The first step is to build the legal framework. To do this, it is necessary to implement European legislation in the field of waste management. The first law to be implemented is № 2008/98 / EU «On Waste and Repeal of Certain Directives». This

law is fundamental because it introduces new concepts in the field of waste management, prescribes criteria and programs for the completion of waste status and waste prevention.

In Ukraine, at present the hierarchy of waste management is based on liquidation, while in the European Union liquidation takes place only after repeated processing of waste, or for the type of waste that cannot be recycled. In Ukraine, waste is used less often as an energy source during incineration, but, nevertheless, 0.26% of all waste in the country is removed. In the EU this kind of energy is used for heating homes and as other energy sources.

This directive will also expand the responsibility of producers, as a recent campaign on brand audit of waste [3] indicated that many Ukrainian brands should be more responsible in the choice of packaging. As brand audit has shown, a significant amount of waste is disposed of improperly. In some places it is possible to recycle waste, because a significant amount of it – mainly packaging, can be incinerated, or plastic products can become raw materials for new products.

Extended producer responsibility systems are a set of economic, financial, administrative and organizational measures that help producers change the life stage of waste.

Introduction of the National Waste List to replace the State Waste Classifier will harmonize the waste list with the European one and will be used in the system of state statistical accounting, other systems of accounting and certification of waste, maintaining registers of waste generation, treatment and disposal, registers of waste disposal.

Improving state accounting, monitoring, information and maintenance of registers in the field of waste management will contribute to control and responsibility for the state of the field of waste management [4].

This will be the first step towards change in waste management. Further steps will be directed to an increase in the social level of responsibility for waste. Here, the task of environmentalists is to develop environmental education in our country as quickly and widely as possible. Environmental education is one of the priorities of

environmentalists, because it will change the mentality of society.

The problem of environmental education in Ukraine is no less acute than the problem of waste management, but by solving the first, the second problem will be solved. Environmental education is, first of all, a change and harmonization of worldview, according to the Presidential Decree, environmental education from 2021 becomes part of the national education system.

Explanatory training in waste management should begin at school age. However, during the training it is necessary to take into account the age group of the population and the habits of this group of the population, as well as to conduct training with the city-forming, service and migrating population. When all trainings are conducted with different segments of the population, it will be necessary to introduce a system of separate collection of household waste and to reduce payments for the removal of solid waste for separate collection. It is also necessary to create a national platform, which will first show all the places for the collection of secondary raw materials, explaining how to properly sort and update the status of the strategy. Currently, there is an interactive map that contains information about the location of legal and unauthorized landfills.

During the implementation of the national system of solid waste sorting it is necessary to pay attention to the existing places of recycling in Ukraine and to those components that can be recycled. Currently in Ukraine it is possible to sort: glass, paper, plastic, metal. Therefore, it will be expedient to install at least 5 containers for separate types of waste at each site of solid waste collection and to small points for receiving hazardous inorganic waste in each settlement. It is also important to build waste processing and incineration plants in large cities of Ukraine, this will not only help solve the problem of waste accumulation, but also will provide new jobs.

The composting process is important in waste sorting in Ukraine, because it can be used to fertilize the soil. This process can be implemented both within the house, and on the site for garbage removal, if a separate collection of food waste will be introduced.

Also in Ukraine the problem with hazardous waste of the 4th class of hazard

and their utilization is quite acute, there are 235 enterprises in the country that produce this type of waste, so it is necessary to expand agreements with countries, specializing in the disposal of such waste.

Ukraine has every chance to implement a waste management strategy and achieve a European waste management system, minimizing the number of landfills and establishing a system of separate collection.

## **Conclusions**

To reduce the amount of waste in our country, it is necessary to develop the incineration and waste processing industry, to expand the responsibility of citizens for the establishment of natural landfills, organizations involved in the removal of solid waste to develop a system of fines for the lack of tanks for receiving secondary raw materials. We should expand public awareness and introduce a Swiss system that includes penalties for waste misuse.

In general, recommendations for harmonizing the state of waste management can be summarized as follows:

- harmonization of legislation in accordance with EU legislation;
- expanding the responsibility of producers;
- development of a national waste reduction strategy;
- increasing the importance of environmental education among the population;
- development of enterprises that will choose secondary resources as raw materials;
- economic support of enterprises that help reduce waste;
- creation of conditions for rational waste management (development of enterprises for processing, waste incineration, reception, etc.).

## **References**

1. Vojcixovs`ka A., Kravchenko O., Melen`-Zabramna O., Pan`kevy`ch O. (2019), Krashhi Yevropejs`ki prakty`ky` upravlinnya vidxodamy`L`viv: Kompaniya Manuskry`pt 2. Incinerators. Available at: <https://www.the-village.com.ua/village/city/eco/291097> 3. The first Ukrainian brand audit. Available at:<https://www.the-village.com.ua/village/city/eco/289737-brand-audit-> 4. About

modification of the Law "About waste" Available at: [http://search.ligazakon.ua/l\\_doc2.nsf/link1/GH53\\_E00A.html](http://search.ligazakon.ua/l_doc2.nsf/link1/GH53_E00A.html)

УДК 595.44:502.72(477.72)

## **NEW DATA ON THE SPIDER FAUNA (ARANEAE) OF THE NATIONAL NATURE PARK “KAMYANSKA SICH”**

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**Анотація. Іосипчук А.М. Нові відомості про фауну павуків (Araneae) національного природного парку «Кам'янська Січ».**

Проведення інвентаризації фауни та дослідження розповсюдження видів є однією з основних задач для проведення моніторингу, розробки плану управління та подальшої оцінки ефективності заходів з охорони. Саме тому, нами було проведено дослідження фауни павуків нещодавно створеного Національного природного парку «Кам'янська Січ». За їх результатами у червні-липні 2020 року, інвентаризаційні списки фауни парку було доповнено 6 видами павуків: *Aelurillus m-nigrum* Kulczyński, 1891, *Alopecosa taeniorpus* (Kulczyński, 1895) *Attulus inopinabilis* (Logunov, 1992), *Gnaphosa ukrainica* Ovtsharenko, Platnick & Song, 1992, *Tetragnatha nigrita* Lendl, 1886 та *Titanoeca schineri* L. Koch, 1872. Нами був досліджений розподіл павуків за наступними біотопами: Т1.4.а Справжні різnotравно-типчаково-ковилові та типчаково-ковилові степи степової зони; Ч4.3 Нітрофільні остепнені біотопи високих чагарників та С3.1 Будинки. Видове багатство павуків у різних біотопах суттєво відрізнялося: серед зафіксованих у 2020 році з 31 виду павуків 23 видів перебувають у середовищі існування Т1.4.а, 11 видів у Ч4.3, 1 вид у С3.1. Наразі фауна парку налічує 91 вид павуків із 21 родини. За загальним видовим різноманіттям павуків парку домінує родина Gnaphosidae (21%). Підтверджено найзахіднішу відому межу географічного ареалу *Micaria bosmansi* Kovblyuk & Nadolny, 2008. Для Півдня України вперше зазначається *Attulus inopinabilis*, зокрема, для території Херсонської області. Fauna павуків НПП «Кам'янська Січ» представлена більшістю видами Південної України. Статистична обробка даних не проводилась через тривалу експозицію за екстремально підвищених температур кінця червня, яка могла вплинути на достовірність отриманих показників. Довгостроковий моніторинг території парку дозволить розширити інвентаризаційні списки фауни, дослідити їх розподіл за середовищами існування.

**Ключові слова:** заповідні території, інвентаризація фауни, Національний природний парк «Кам'янська Січ», павуки, Південь України.

**Abstract. Iosypchuk A.M. New data on the spider fauna (Araneae) of the National Nature Park “Kamyanska Sich”.**

Fauna inventory and investigation of species habitat distribution is one of the main objectives of monitoring, management plan development and further assessment of the conservation effectiveness of protected areas. We investigated the spider fauna of the newly created National Nature Park ‘Kamyanska Sich’ in the Kherson Region of Ukraine. Based on the studies conducted in June and July 2020, the inventory lists of the park's fauna were supplemented by six spider species: *Aelurillus m-nigrum* Kulczyński, 1891, *Alopecosa taeniopus* (Kulczyński, 1895), *Attulus inopinabilis* (Logunov, 1992), *Gnaphosa ukrainica* Ovtsharenko, Platnick & Song, 1992, *Tetragnatha nigrita* Lendl 1886, and *Titanoeca schineri* L. Koch, 1872. We studied spider distribution in the following habitats: T1.4.a True forb-fescue-feather grass and fescue-feather grass steppes of the steppe zone; Ч4.3 Nitrophilous meso-xeric high steppe shrubs, and C3.1 Buildings. A total of 31 spider species was registered. The species richness in various habitats in 2020 ranged as follows: 23 species were found in the habitat T1.4.a, 11 species in Ч4.3, and one species in C3.1. Currently, the spider fauna of the park includes 91 species of 21 families. The family Gnaphosidae dominates in the park’s spider fauna (21% of total species). In general, the araneofauna of Kamyanska Sich National Park is represented by species typical of Southern Ukraine. Some of rare species were registered in its territory. *Micaria bosmansi* Kovblyuk & Nadolny, 2008 has the westernmost known boundary of its geographical range. *Attulus inopinabilis* is recorded for the first time from the south of Ukraine, in particular, from Kherson Region. Statistical data processing was not performed due to prolonged exposure to extremely high temperatures in late June, which could affect the reliability of the obtained indicators. Long-term monitoring of the park territory will allow to enlarge the inventory lists of its fauna and to clarify species distribution within the habitats.

**Keywords:** fauna inventory, National Nature Park “Kamyanska Sich”, protected areas, South Ukraine, spiders.

**General formulation of research and its topicality.** Spiders (Araneae) are obligate predators that prey on a large number of insect species and are therefore part of most terrestrial food chains. They are presented, in particular, as regulators of the number of some pest insect species [5]. Quantitative calculations of invertebrates in various phytocenoses indicate that spiders constitute a significant part of biomass, almost not inferior to insects [1]. Moreover, spiders are very sensitive to changes in

living conditions, so they are widely used as bioindicators [3]. The study of regional fauna and species ecological specificity features prominently in the priority areas of zoological research. A separate item considers the study of the fauna of protected areas. National Nature Park (NNP) ‘Kamyanska Sich’ was established in 2019 by the Decree of the President of Ukraine №140 / 2019 of April 11, 2019. Preliminary studies of invertebrates, namely spiders, in this area were conducted in 2019 [4]. Information on other targeted studies of the park's araneofauna is not known.

**Setting of the problem and the aim of the article.** Fauna and flora inventory is crucial for the development of a management plan and further evaluation of the effectiveness of conservation measures, especially if it is conducted in the early stages of the area protection. Therefore, our study was carried out in the NNP ‘Kamyanska Sich’ that was created for the conservation of typical landscapes of southern Ukraine. Since this park has been recently established, studies of the animal species composition, including invertebrates, are only fragmentary. Consequently, further research on the spider fauna of the park is relevant.

As for the methodological framework of our research, Qualitative and quantitative methods of field zoological research were used to study spider species composition and abundance. The material was collected from June 15 to July 3, 2020 in the park's protected area of Ternuvat and Marguriv section, in the economic zone, and the zone of stationary recreation. We used hand collecting (dismantling debris from branches, searching under bark, stones and lumps of earth, digging holes, etc.), sweep-netting (60 sweeps with entomological net) and pitfall trapping [2]. Formalin of low concentration (1 – 2%) served as a fixative. Plastic cups of 200 ml were used as traps; they were set up in a line of nine traps at a distance of 10 m from each other [6].

Spiders were fixed in 70% ethylene glycol. The material was determined under the binocular microscope MBS-2 with the use of following identification guides: ‘Identification key of the spiders of the European part of the USSR’ (Tyshchenko V.P., 1971) [13], ‘Spiders (Arachnida, Aranei) of Siberia and the Far East of Russia’ (Marusik Yu.M., Kovblyuk N.M., 2011) [6], ‘The spiders of Great Britain and

Ireland' (Roberts M.J., 1993) [11] and a modern online resource (Spiders of Europe..., 2021) [12]. Statistical data processing was not performed, as prolonged exposure to very arid conditions caused by extreme temperature rise in late June could affect the reliability of the obtained indicators.

The NNP 'Kamyanska Sich' is located in the Beryslav District of the Kherson Region and includes a terrace of the Dnieper River between the villages of Chervonyi Mayak and Kachkarivka adjacent to the ravine and terrace of the plain, part of the Kakhovka Reservoir of the Dnieper River, and flooded gullies. The total park's area is 12261.14 ha of state-owned land [10], including 6013.241 ha (49.04%) of land with withdrawal. The territory of the NNP is a unique for the Right Bank massif of virgin Pontic fescue-feather grass steppes and it is completely covered by the Lower Dnieper regional eco-corridor, which is the Lower Dnieper section of the meridional Dnieper eco-corridor of the National Eco-network of Ukraine [7].

We use the classification of biotopes provided in the National Catalog of Habitats of Ukraine [8], which combines classifications according to EUNIS, Annex I of the Habitats Directive, Resolution 4 of the Bern Convention and UkrBiotop. The study of spider fauna in 2020 was conducted in three habitats:

T1.4.a True forb-fescue-feather grass and fescue-feather grass steppes of the steppe zone. The main type of steppes in the steppe zone, common on plateaus and slopes of various landforms - gullies, ravines, valleys, etc. Sometimes limestone outcrops may appear on the soil surface.

Ч4.3 Nitrophilous meso-xeric high steppe shrubs. The plants typical of this habitat grow at the gully bottoms, in the gorges and on the slopes of rocky hills, where the soil and air humidity is higher than in surrounding steppe habitats.

C3.1 Buildings. In the NNP 'Kamyanska Sich', they are represented by houses and homesteads of the village of Radenske.

**Discussion and Results.** Based on the field research in 2020, 31 spider species of 12 families were recorded from the NNP "Kamyamska Sicjh": 23 species in the habitat T1.4.a, 11 species in Ч4.3, and one species in C3.1 (Table 1). Of these, six species were found for the first time in the park: *Aelurillus m-nigrum* Kulczyński,

1891, *Alopecosa taeniopus* (Kulczyński, 1895) *Attulus inopinabilis* (Logunov, 1992), *Gnaphosa ukrainica* Ovtsharenko, Platnick & Song, 1992, *Tetragnatha nigrita* Lendl and 1886 *Titanoeca schineri* L. Koch, 1872.

In terms of species diversity of the studied habitats, the family Gnaphosidae was the most species-rich in 2020 (10 species, 32.26% of the local fauna); Salticidae (7 species, 22.58%) and Thomisidae (3 species, 9.68%) followed it. Compared to 2019, the dominant families have not changed [4]. In 2019, the family Gnaphosidae (19 species, 20.88%) also dominated in the park's araneofauna.

*Table 1*

**Spider species distribution in various biotopes of the NNP ‘Kamyanska Sich’.**

**June and July 2020**

T1.4.a: 1 – high sloping riverbank dominated by forbs, 2 – medium-height riverbank dominated by forbs, 3 – high riverbank dominated by *Galatella* sp. 4 – mesic forb steppe on the high sloping riverbank, 5 – bunchgrass steppe on the upper interfluves; 6 – limestone outcrop on the medium-height sloping ravine; 4.3: 7 – shrub thickets on the medium-height riverbank; 8 – shrubs in the gully bottom; C3.1: 9 – woody fence near the house. Nomenclature follows World Spider Catalog (2021) [14].

Families/species	Biotopes								
	T1.4.a.						4.3.		C3.1
	1	2	3	4	5	6	7	8	9
Araneidae Clerck, 1757									
<i>Larinoides suspicax</i> (O. Pickard-Cambridge, 1876)					+				
<i>Neoscona adianta</i> (Walckenaer, 1802)	+	+	+						
Dysderidae C. L. Koch, 1837									
<i>Harpactea rubicunda</i> (C. L. Koch, 1838)			+	+			+		
Gnaphosidae Pocock, 1898									
<i>Aphantaulax trifasciata</i> (O. Pickard-Cambridge, 1872)			+						
<i>Berlandina cinerea</i> (Menge, 1872)	+								
<i>Civizelotes gracilis</i> (Canestrini, 1868)							+		
<i>Drassodes lapidosus</i> (Walckenaer, 1802)		+							

Families/species	Biotopes								
	T1.4.a.						Ψ4.3.	C3.1	
	1	2	3	4	5	6	7	8	9
<i>Drassyllus praeficus</i> (L. Koch, 1866)							+		
<i>Gnaphosa opaca</i> Herman, 1879							+		
<i>Gnaphosa taurica</i> Thorell, 1875							+		
<i>Gnaphosa ukrainica</i> Ovtsharenko, Platnick & Song, 1992	+								
<i>Haplodrassus dalmatensis</i> (L. Koch, 1866)	+								
<i>Micaria bosmansi</i> Kovblyuk & Nadolny, 2008	+					+	+		
Lycosidae Sundevall, 1833									
<i>Alopecosa kovblyuki</i> Nadolny & Ponomarev, 2012							+		
<i>Alopecosa taeniopus</i> (Kulczyński, 1895)						+			
Oxyopidae Thorell, 1870									
<i>Oxyopes lineatus</i> Latreille, 1806					+				
Salticidae Blackwall, 1841									
<i>Aelurillus m-nigrum</i> Kulczyński, 1891			+						
<i>Asianellus festivus</i> (C. L. Koch, 1834)							+		
<i>Attulus inopinabilis</i> (Logunov, 1992)						+			
<i>Euophrys frontalis</i> (Walckenaer, 1802)	+								
<i>Heliophanus flavipes</i> (Hahn, 1832)				+					
<i>Heliophanus lineiventris</i> Simon, 1868							+		
<i>Salticus scenicus</i> (Clerck, 1757)							+		
Tetragnathidae Menge, 1866									
<i>Tetragnatha nigrita</i> Lendl, 1886								+	
Theridiidae Sundevall, 1833									
<i>Parasteatoda lunata</i> (Clerck, 1757)									+
Thomisidae Sundevall, 1833									
<i>Runcinia grammica</i> (C. L. Koch, 1837)	+	+	+	+		+			
<i>Thomisus onustus</i> Walckenaer, 1805	+		+						

Families/species	Biotopes								
	T1.4.a.						Ψ4.3.	C3.1	
	1	2	3	4	5	6	7	8	9
<i>Xysticus kochi</i> Thorell, 1872				+					
Titanoecidae Lehtinen, 1967									
<i>Titanoeca schineri</i> L. Koch, 1872,	+	+					+		
Uloboridae Thorell, 1869									
<i>Uloborus walckenaerius</i> Latreille, 1806	+	+	+			+			
Zodariidae Thorell, 1881									
<i>Zodarion thoni</i> Nosek, 1905		+					+		
<b>Total species = 31</b>									

In the previous year, *Runcinia grammica* prevailed in all grassy habitats, while in 2020, it was substituted by *Neoscona adianta* at the four of six plots of true steppes with both dry and wet microclimatic conditions. Due to a partial change in the study plots of the same habitat, *Runcinia grammica* dominated only at the plot with limestone outcrops and on the high riverbank dominated by *Galatella* sp.

Our research confirmed the westernmost known boundary of *Micaria bosmansi* geographical range in the Lower Dnieper region. This rare European species has previously been found in the Crimea, eastern Ukraine and Southern European Russia, *Attulus inopinabilis* has been recorded for the first time from the South of Ukraine, in particular, from the Kherson Region [12, 9].

**Conclusions.** The fauna of the National Nature Park ‘Kamyanska Sich’ includes 91 spider species of 21 families. The arachnological research in June and July 2020 resulted in supplementing the inventory lists of the park's fauna with six spider species. The majority of species is concentrated in the steppe habitats. The spider fauna of the NNP ‘Kamyanska Sich’ represents well the araneofauna of Southern Ukraine. Long-term monitoring of the park biodiversity will enlarge the faunal inventory lists and specify species habitat distribution.

## References

1. Azheganova N.S. Kratkij opredelitel' paukov lesnoj i lesostepnoj zony SSSR [Brief determinant

to spiders of the forest and forest-steppe zone of the USSR]. Leningrad : Nauka, 1968. 150 p. (in Russian) 2. Biolohichne riznomanittia Ukrayny. Dnipropetrovska oblast. Pavuky (Aranei) : monogr. [Biological diversity of Ukraine. Dnipropetrovsk Oblast. Spiders] / O.V. Prokopenko ta in.; za zag. red. prof. O.Je. Pahomova. D. : Vyd-vo Dnipropetr. nac. un-tu, 2010. 340 p. (in Ukrainian). 3. Changes in arthropod diversity along a land use driven gradient of shrub cover in savanna rangelands: identification of suitable indicators. *Biodiversity and Conservation* / Blaum N. at al. 2009. № 18 (5), 1187-1199. 4. Iosypchuk A. First data on the spider fauna (Araneae) of the National Nature Park ‘Kamianska Sich’ (South Ukraine). «*Biology: from a molecule up to the biosphere*»: proceedings of the 14th International young scientists’ conference. November 27th – 29th 2019, Kharkiv, Ukraine. Kharkiv : Publisher V. N. Karazin KhNU, 2019. 169–171. 5. Ivanov A. V. Pauki, ih stroyenie, obraz zhizni i znachenije dlja cheloveka [Spiders, their structure, way of life and significance for humans]. Leningrad : Izd-vo Leningradskogo un-ta, 1965. 304 p. (in Russian). 6. Marusik Ju.M., Kovbljuk N.M. Pauki Sibiri i Dal'nego Vostoka Rossii [Spiders of Siberia and the Far East of Russia]. Moskva : Tovarishchestvo nauchnyh izdanij KMK, 2011. 344 p. (in Russian). 7. Moysiyenko, I.I. (2017). Sozofity proektovanoho natsionalnoho pryrodnoho parku “Kamyanska Sich” [Sozophytes of the projected National Nature Park “Kamyanska Sich”]. *Nature protection in the steppe zone of Ukraine (to the 90th anniversary of the creation of the Nadmorsky reserves)*: Proceedings of the All -Ukrainian Scientific and Practical Conference, v. Urzuf, 14-15 March, 2017. № 1. 271-280. (in Ukrainian). 8. Natsionalnyi kataloh biotopiv Ukrayny [National Catalog of Habitats of Ukraine] / Za red. A.A. Kuzemko ta in. Kyiv : FOP Klymenko Ju.Ja., 2018. 442 p. (in Ukrainian). 9. Polchaninova, N., Prokopenko E. Catalogue of the spiders (Arachnida, Aranei) of Left-Bank Ukraine. *Arthropoda Selecta. Supplement No.2*. Moscow: KMK Scientific Press, 2013. 268 p. 10. Pro stvorennia natsionalnoho pryrodnoho parku «Kamyanska Sich» [Creation of the National Nature Park ‘Kamyanska Sich’]: Ukaz Prezydenta Ukrai'ny vid 11 kvitnjia 2019 roku №140/2019. Available at: <https://www.president.gov.ua/documents/1402019-26530> (in Ukrainian). 11. Roberts J. M. The Spiders of Great Britain and Ireland, Compact Edition. Colchester: Harley Books, 1993. 229 p. 12. Spiders of Europe. Version 10.2020. / Nentwig W. et al. Available at: [https://www.araneae.nmbe.ch\\_13](https://www.araneae.nmbe.ch_13). Tyshchenko V.P. Opredelitel' paukov evropejskoj chasti SSSR [Identification Key of the Spiders of the European Part of the USSR]. Leningrad : Nauka, 1971. 281 p. (in Russian). 14. World Spider Catalog (2021). World Spider Catalog. Version 22.0. Natural History Museum Bern, Available at: <http://wsc.nmbe.ch>

## **CLINICAL ASPECTS OF STUDIING CENTRAL NERVOUS SYSTEM EMBRYOGENESIS**

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**Анотація. Краснопольська К.О., Суслова С.О. Клінічні аспекти вивчення ембріогенезу центральної нервової системи.**

У статті розглянуто основні етапи ембріогенезу головного та спинного мозку. Розглянуто вади розвитку центральної нервової системі, які виникають на різних етапах ембріогенезу. Визначено значення та клінічні аспекти вивчення внутрішньоутробного розвитку спинного та головного мозку. Розглянуті основні методи пренатальної діагностики вад розвитку центральної нервової системи. Визначено роль пренатальної діагностики в лікуванні вад розвитку центральної нервової системи. Визначено головну мету проведення пренатальної діагностики вад розвитку центральної нервової системи.

**Ключові слова:** эмбриогенез центральной нервной системы, пренатальная диагностика, пороки развития.

**Abstract. Krasnopol'ska K.A., Suslova S.A. Clinical aspects of studiing central nervous system embryogenesis.**

The main stages of embryogenesis of the cerebrum and the spine were studied in the article. The malformations of the central nervous system, which occur at different stages of embryogenesis, were considered. The significance and clinical aspects of the study of intrauterine cerebrum and spine developments were determined. The main methods of the prenatal diagnostic of the malformations of the central nervous system were considered. The role of the prenatal diagnostic in the malformations treatment was determined. The main goal of the prenatal diagnostic of the malformations of the central nervous system was determined.

**Keywords:** central nervous system's embryogenesis, prenatal diagnostic, malformations.

**General formulation of research and its topicality.** Despite the level of development of medicine, congenital malformations of the central nervous system account for about 25% of all congenital malformations in children, and the mortality in such cases in infancy or prenatal period is 30%. The study of the most important

stages of intrauterine development of the central nervous system and pathologies that are associated with them can save a large number of children's lives.

**Setting of the problem and the aim of the article.** The nervous system provides internal coordination and continuous cooperation of different parts and organs within the body, which allow it to manifest itself as a living, integral system in its relationship with the external environment. In many countries, timely prenatal diagnosis, prevention and prognosis of congenital malformations of the central nervous system is a priority. In this article, we will discuss the main stages of the embryogenesis of the central nervous system and the pathology that occurs during these periods through the analysis of scientific articles from MEDLINE, life science journals, and online books (<https://www.ncbi.nlm.nih.gov/>).

**Discussion and Results.** At the beginning of the third week of development, the ectodermal layer becomes thicker and forms the neural plate. Then the process of forming a neural tube from a neural plate, that is called neurulation takes place: the neural plate is lengthening and its lateral edges elevate to form neural folds, and the depressed midregion forms the neural groove. Gradually, the neural folds close in in the midline where they fuse. Fusion begins in the cervical region and spreads cranially and caudally, forming the neural tube. The open ends of the neural tube form the cranial and caudal neuropores. The cranial neuropore closes on the 25th day of embryogenesis, and the caudal neuropore closes approximately 3 days later.

At an early stage of its development, the neural tube consists of one layer of cylindrical cells, which are then intensively multiplied by mitosis and their number increases; as a result, the wall of the neural tube thickens. At this stage of development, three layers can be distinguished in it: the inner layer (later an ependymal lining will form from it), the middle layer (the gray matter of the brain, the cellular elements of this layer differentiate in two directions: some of them turn into neurons, the other part - into glial cells) and the outer layer (white matter of the brain).

The cephalic end of the neural tube forms three primary brain vesicles: forebrain, midbrain and hindbrain. Two ocular vesicles protrude from the dorsolateral

walls of the anterior cerebral vesicle. On the 6th week of development forebrain forms the telencephalon and diencephalon, the midbrain remains and the hindbrain forms the myelencephalon and metencephalon. As a result of the uneven development of the cerebral vesicles, the cerebral tube begins to bend (at the level of the midbrain – the parietal deflection, in the region of the hindbrain – the pontine and at the transition of the accessory brain to the spinal cord – the occipital deflection). The parietal and occipital deflections are turned outward, and the pontine – inward. From the undifferentiated posterior part of the neural tube a spinal cord and a spinal canal are developed.

The terminal brain, in which 2 hemispheres are formed, grows the most. At the 3rd month of development, a lateral fossa forms on the surface of each hemisphere, and from the 5th month, sulci are formed. In the diencephalon thalamus is laid, and protrusions appear, which give rise to the epithalamus and hypothalamus. Adhesions are formed in the forebrain connecting its right and left halves.

Myelination of fibers in the central nervous system begins at the 4th month of development and occurs in a specific sequence. The general pattern is the earlier myelination of phylogenetically ancient formations and later maturation of phylogenetically new structures. Differentiation and maturation of nerve nuclei and pathways occurs in the spinal cord in the direction from the upper segments to the lower, and in the brain – from its posterior to the anterior parts. In the spinal cord and brain stem, the motor pathways are myelinated earlier and later the sensitive ones. By the time of birth, the process of myelination in the central nervous system is largely over. In the cerebral hemispheres, the afferent systems are myelinated first, and then the efferent ones. This process begins in the last months of intrauterine development and continues after birth.

Now we will consider those stages of ontogenesis with which various malformations of the brain may be associated:

1. dorsal induction (3-4 weeks – the formation of a neural tube, cells of the meninges of the brain, caudal sections of the neural tube), if the process of dorsal induction is disturbed, the main defects are anencephaly, encephalocele, Arnold-

Chiari malformation;

2. ventral induction (5-10th weeks – the formation of the anterior parts of the brain and facial structure), in case of violation of ventral induction, among the main defects of the central nervous system, holoprosencephaly, septooptic dysplasia, lobar aplasia, agenesis of the transparent septum are distinguished;

3. neuronal and glial proliferation (2-5 months – proliferation of neurons and glia in the periventricular areas), in violation of neuronal proliferation, the main defects are microlisencephaly, hemimegalencephaly, phakomatoses, megalencephaly, etc.;

4. neuronal migration (3-5 months – displacement of cells to the periphery and the formation of the cortex and subcortical structures, as well as the formation of layers of the cerebellar cortex), when the process of neuronal migration is disturbed, the main defects are lisencephaly, heterotopia, agenesis of the corpus callosum, etc.;

5. organization and myelination (from the 6th month before birth and the postnatal period - the formation of the layers of the cortex, the development of axons, dendrites, synapses), in violation of the organization and myelination, the main defects are polymicrogyria, schizencephaly, microdysgenesis. [5, p.36]

In the first half of pregnancy, the processes of formation of brain structures and migration of neurons predominate, and in the second half – the onset of processes of myelination of nerve fibers. Malformations occurring in the early stages of ontogenesis are characterized by significant severity and usually lead to death, for example, in the case of anencephaly.

Currently, the main methods of prenatal diagnostics are ultrasound, determination of the level of alpha-fetoprotein, chorionic gonadotropin, 17-hydroxyprogesterone, plasma protein associated with pregnancy in the mother's blood serum, amniocentesis, biopsy of chorionic villi, obtaining blood and fetal skin [5, p.48]. For the timely diagnosis of congenital malformations of the fetus, all pregnant women undergo an ultrasound examination at least 3 times during pregnancy: at 10-12, 20-22 and 30-32 weeks.

Prenatal examination of the fetal central nervous system should include an

assessment of the shape of the fetal head, the bones of the cranial vault, the cavity of the transparent septum, the optic tubercles and pedicles of the brain, the lateral and III ventricles, the structures of the posterior cranial fossa, in particular, the cerebellum and cisterna magna, corpus callosum, spine and possible defects neural tube.

Termination of pregnancy is not a priority for prenatal diagnosis. An important task is the timely diagnosis of those malformations that can be corrected, combining the efforts of obstetricians, neonatologists, pediatric neurologists, pediatricians and other specialists to ensure the birth of a child and provide him with specialized care. [5, p.49]

**Conclusion.** Improvement diagnosis of CNS malformations should be directed not only to establish the fact of their existence, but also to optimize further tactics of pregnancy with a solution about its interruption in case of unfavorable clinical and prognostic assessment and availability of objective medical indications for this with a decrease in the frequency of heavy malformations to a minimum in the population. Monitoring and evaluation of congenital anomalies of the central nervous system allows to analyze the effectiveness of prenatal diagnosis, to establish the main level of prevalence this congenital pathology among newborns and identify possible risk factors for its occurrence.

## References

1. Avramenko T.V. Sostoyaniye predostavleniya perinatal'noy meditsinskoy pomoshchi v Ukraine //Neonatologiya, khirurgiya i perinatal'naya meditsina [State of provision of perinatal medical care in Ukraine // Neonatology, surgery and perinatal medicine] . - T. II, №1(3).-2012.-P.6-10.
2. Alvarez R.M., Garcia-Diaz L., Marquez J., Fajardo M. et al. Hemimegalencephaly: prenatal diagnosis and outcome //Fetal Diagn. Ther. – 2011.- Vol. 30 (3).- P. 234-238.
3. Barashnev YU.I., Bakharev V.A. Embriofetopatii. Diagnostika i profilaktika anomaliy TSNS i skeletal [Embryopathology. Diagnostics and prevention of CNS and skeletal anomalies] .-M.: Триада-Х. – 2010. - 480 p.
4. Tomas V. Sadler. Medychna embriolohiya za Lanhmanom. [Medical embryology according to Langman.] – L'viv: «Nautilus»
5. Shevchenko A.A. «Vrozhdennyye poroki razvitiya tsentral'noy nervnoy sistemy (TSNS): kliniko-neurologicheskiye aspekty i problemy prenatal'noy diagnostiki GU» [Congenital malformations of the central nervous system (CNS): clinical and neurological aspects and problems of prenatal diagnosis of GU] – «Institute of Pediatrics, Obstetrics and Gynecology of the National Academy of Medical Sciences of Ukraine», Kiev, 2014 - 20 p.

## **NATURAL DISASTERS IN KHARKIV (XVII-XIX CENTURIES)**

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### **Анотація. Майорова І.Р. Стихійні лиха в Харкові (XVII-XIX ст.).**

У статті досліджено стихійні лиха в Харкові у XVII-XIX ст. Сутність проблеми полягає в досліджені стихійних лих в Харкові протягом зазначеного вище періоду. Робота складається з трьох частин, які містять інформацію стосовно природно-географічних умов Харкова, характеристиці природних лих та реакціях/методах боротьби міслян. Зазначені головні причини стихійних лих. Проаналізовано методи боротьби міслян, ситуативні реакції репрезентантів міського простору на стихійні лиха. У роботі досліджено важливість динаміки та характеру боротьби міських жителів з природними лихами протягом зазначеного періоду. Акцентовано увагу на зростанні зацікавленості міського населення проблемами довкілля. Результати дослідження доводять, що протягом тривалого часу методи боротьби були обмежені інструкціями, численними декретами (стосовно протипожежної безпеки в місті) та неорганізованими діями під час стихійних лих.

**Ключові слова:** історія довкілля, міський простір, стихійні лиха, урбаністичні студії.

**Abstract. Maiorova I.R. Natural disasters in Kharkiv (XVII-XIX centuries).**

The paper investigates natural disasters in Kharkiv in the XVII-XIX centuries. The essence of the problem is about research of natural disasters in Kharkiv indicated above period. The work consists of three parts, which contain information on the natural and geographical conditions of Kharkiv, the characteristics of natural disasters, and the reactions/methods of struggle of citizens. The main reasons of natural disasters are dedicated. Methods of the struggle of citizens, situational reactions of representatives of urban space to natural disasters are analyzed. The importance of the dynamics and nature of the struggle of urban residents against natural disasters during this period is investigated. Emphasis is placed on the growing interest of the urban population in environmental issues. Results of the research prove that for a long time the methods of struggle were limited to instructions and numerous decrees (for example, regarding fire safety within the city) and unorganized actions during natural disasters.

**Key words:** environmental history, natural disasters, urban space, urban studies.

**General formulation of research and its topicality.** The historical relevance of the topic of research is determined primarily by the development of urban studies in the world, and, consequently, increased attention to the genesis and development of urban centers these days. Despite the increased scientific interest in Environmental History, several questions are still out of focus and requires more detailed consideration. The essence of the problem is about research of natural disasters in Kharkiv during the XVIII-XIX centuries, particularly on the pages of the periodical press ("Youzhny Kray" and "Kharkovskiye Vesti").

**Setting of the problem and the aim of the article.** The proposed study is an attempt to highlight the most significant aspects of natural disasters in both Kharkiv and Kharkiv region. Also, in this paper, we will try to characterize not only the phenomena provoked by natural and climatic conditions but also human negligence or carelessness. In brief, the purpose of the article is a comprehensive analysis of natural disasters, determining the main methods of struggle and reactions of citizens. The object of research is the natural disasters in Kharkiv during the XVIII-XIX centuries. The subject of the study is the most important aspects identified with climatic conditions and geographical location, natural disasters, and, ultimately, "dwellers' feedback". The tasks are to characterize the natural, climatic, and geographical position of the city in the historical context, to highlight natural disasters and methods of combating them in the complex. Materials used are periodic press, namely "Youzhny Kray" and "Kharkovskiye Vesti" newspapers, "Descriptions of the Kharkiv governorate of the end of the XVIII century", epistolary of famous public figures, etc.

**Research outcomes.** It is well known that Kharkiv region is located in the northeast of Ukraine on the border of forest-steppe and steppe physical-geographical zones and occupies the south-western outskirts of the Middle Russian Upland. We can note the high level of compactness of these territorial outlines. The relief of this area is a wavy plain with a slight slope in the south-western (to the Dnieper basin) and the south-eastern (to the Don basin) directions.

The climate of Kharkiv and the Kharkiv region, in general, is formed due to the

interaction of three main climate-forming factors - the influx of solar radiation, atmospheric circulation, and the nature of the underlying surface. The territory of the city is characterized as belonging to the forest-steppe zone of temperate climate.

Regarding fluctuations in average annual temperatures, we note that small and medium deviations from the norm are observed quite often, moreover, clearly within the norm, the air temperature is usually not fixed. Temperature fluctuations are observed in any direction and at any time of the year.

Thus, our analysis based on the above factual material allows us to state that the territory of Kharkiv is in a rather favorable physical and climatic realities (no comparative consideration should be made with the "fire history" of Queensland, or, for example, with regular earthquakes in Iceland). Undoubtedly, the favorable configuration, a powerful array of natural resources (from fertile soils to natural gas deposits) have become crucial in the process of settlement and development of these areas.

It should be mentioned that most natural phenomena in the city of Kharkiv belong to a fairly massive and complex category, which is usually called "meteorologically dangerous phenomena." Thus, the complex category of "meteorologically dangerous phenomena" is quite widely represented in the study area. But, first things first, we are going to take a closer look at "fire history" of Kharkiv.

In a comprehensive work on the history of the city of Kharkiv, D.I. Bagaliy and D.P. Miller emphasize that this city center has de facto suffered from fires since its foundation [1, p.167]. Of course, the configuration of the city, which determines the natural and climatic conditions, only contributed to this. Thus, researchers mention that the fire of 1733, one of the greatest natural disasters in Kharkiv, which, according to rough estimates of historians, destroyed almost 300 yards within the city.

It is worthy of special mention that dust gusts and general air pollution are rather an obvious problem for the city of Kharkiv, as well as many other cities in Ukraine. However, this natural phenomenon was also quite clearly identified in

personal correspondence by V. G. Belinsky: "What kind of dust in Kharkiv! Horror!" [2, p. 287].

Significantly, the epistolary source is dated June 15: during this period, as a rule, in the steppe and forest-steppe areas, a high-temperature background and various types of droughts (both soil and atmospheric) are recorded. Concerning natural disasters caused by animals, in particular insects, it should be noted the damage to crops in large areas during the mass reproduction of locusts.

To sum up, despite the general favorable location of the studied city center, still insufficient moisture, insufficient vegetation (as noted, forests were destroyed by the inhabitants of Sloboda Ukraine), the human factor (carelessness in handling fires in smithies, for example) and a number other factors were provoked by natural phenomena, which in some places the city administration could not cope with in time. In the context of considering the reaction of citizens to natural disasters, we will consider only those phenomena that were partly caused by the human component and could be prevented for compliance with safety rules. First of all, since the founding of Kharkiv, the main basis of the administration's concern for urban development have been decrees on fire safety and, in fact, safety against the spread of infectious diseases. The great fires of 1733 and 1756 are an argument in favor of the ineffectiveness of those security rules that were issued first by the Moscow voivode and later by the regimental administration [1, p. 164].

The main causes of fires in the city of Kharkiv in the period under study: carelessness, situational emotions, the location of production centers (workshops of blacksmiths, tar within the city). As a rule, the latter reason provoked the most powerful fires, due to which the city administration tried to speed up the process of "relocating" potentially dangerous workshops away from the city center. In part, when the "red rooster" did not cause any damage to a Kharkiv dweller, his attitude to the disaster was indifferent.

The basic aspects related to the improvement of Kharkiv administrating should be considered. "Medical Administration" played an important role in improving the sanitary condition of the city [1, p.178]. This organizational structure monitored the

city's landscaping: the streets were clean, the bodies of dead cats and dogs were cleaned regularly, and fairs and auctions were monitored (special attention was usually paid to the unsanitary condition of meat outlets). The city administration has also occasionally focused on air pollution: it has proposed plans to relocate soap and other factories almost outside the city limits, due to the deteriorating health of urban residents in areas where harmful enterprises were located.

Thus, there is a certain dynamism in the methods of struggle, transformation in the minds of urban residents. This is a rather long process, that requires intense inner work, but the actualization of attention to the "urban space" de facto from the middle of the XVIII century is indicative.

**Conclusions.** Our analysis based on the above factual and source material allows us to state that despite the favorable and compact configuration, array of natural resources, generally attractive picture of climatic conditions, the city of Kharkiv has not escaped natural disasters. City dwellers sporadically encountered not only meteorological hazards but also disasters, the causes of which were ignoring numerous instructions, non-compliance with regulations, including fire safety. We can state that for a long time the methods of control were limited to instructions and numerous decrees (for example, regarding fire safety within the city) and, finally, unorganized actions during natural disasters. However, it is significant that there is a certain dynamism in the methods of struggle, in particular attempts, partly quite successful, to organize a fire brigade in the city. It can be concluded that there is a gradual increase in public interest in environmental issues, unsanitary condition of streets and squares in Kharkiv during the period. This indicates a transformation in the minds of urban dwellers, which is a signal of the gradual onset of the modern era.

## References

1. Bagaley D.I. and Miller D.P. (1912). Istorya goroda Harkova za 250 let ego sushestvovaniya (s 1655 po 1905 g.) [The history of the city of Kharkov for 250 years of its existence (from 1655 to 1905).] Available at: <http://resource.history.org.ua/item/10836>
2. Belinsky V.G. (1958). Polnoe sobranie sochineniy [Complete collection of works.] Available at: <http://russian-literature.org/author/Belinsky>
3. Nash R. (1988). The right of nature. A history of environmental ethics. Available at: [https://www.goodreads.com/book/show/340507.The Rights of Nature](https://www.goodreads.com/book/show/340507.The_Rights_of_Nature)

4. Marsh G.P. (1869). Man and Nature, or Physical Geography as Modified by Human Action. Available at: <https://quod.lib.umich.edu/cgi/t/text/text-idx?c=moa;idno=AJA7231>

УДК 94:[323.282:616-051](47+57)"193/195"

## **MEDICINE AS A WEAPON IN THE USSR: HISTORICAL ASPECTS OF COURT PROCEEDINGS AGAINST DOCTORS**

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**Анотація. Пацация М.М. Медицина у якості зброї у СРСР: історичні аспекти проваджень над лікарями.**

У даній статті наведено найбільш розповсюджені історичні приклади фальсифікації проявів використання медиків у якості зброї, неналежним чином, у СРСР. Було розглянуто Третій Московський процес, який висвітлює включно й діяння медиків, які нібито спричинили смерть пацієнтів, а також «Справу лікарів», яка мала на меті викрити антирадянську діяльність деяких лікарів-євреїв. Мета таких фальсифікацій, як було виявлено, полягає, ймовірно, в усуненні політичних опонентів, зміцненні свого авторитету та керуванні думками населення із використанням ЗМІ. Важливо зазначити, що наведені провадження спричиняли неабиякий резонанс, таким чином не виключаючи можливість маніпулювання ставленням громадян до окремих верств населення та представників народів. Головною метою цієї статті є формування уявлення читачів про існування неналежного використання науки у часи СРСР. Це мусить спричинити появу інтересу до аналізу схожих аспектів зловживання вже у сучасності. Останнє так само може підштовхнути суспільство до формування спеціалізованих органів контролю та перегляду гуманності деяких проявів використання медиків суто заради досягнення чиєїсь мети.

**Ключові слова:** Історія медицини, СРСР, фальсифікації, Московський процес, Справа лікарів, Міністерство Державної Безпеки.

**Abstract. Patsatsyia M.M. Medicine as a weapon in the USSR: historical aspects of court proceedings against doctors.**

This article presents the most common historical examples of falsification of the usage of doctors as a weapon, improperly, in the USSR. The Trial of the Twenty-One was considered, which covered the actions of doctors who allegedly caused the deaths of patients, as well as the Doctors'

plot, which aimed to expose the anti-Soviet activities of some Jewish doctors. The purpose of such falsifications, it was found, is probably to eliminate political opponents, strengthen of own authority and control the opinions of the population through the use of the mass media. It is important to note that these proceedings caused a great resonance, thus not excluding the possibility of manipulating the attitude of citizens to certain segments of the population and peoples. The main purpose of this article is to form readers' ideas about the existence of improper use of science in Soviet times. This should lead to an interest in analyzing similar aspects of abuse today. The latter also may push society to form specialized bodies to control and review the humanity of some manifestations of the use of doctors purely for the sake of achieving someone's goal.

**Key words:** History of medicine, USSR, falsifications, Moscow trial, Doctors' plot, Ministry for State Security.

**General formulation of research and its topicality.** It is known that the three main functions of medicine have always been to preserve, restore and improve health. But some cases in the history of medicine show us examples of the use of this science for opposite purposes, namely for the deliberate and intentional harm to health. Uncovering the problem of abuse of science and manipulating the facts of such abuse in order to achieve their own goal in the past, as well as understanding the urgency of solving such a problem are now crucial steps to create a humane and progressive society. It should be noted that the formation of various organizations, the purpose of which will be to ensure control over the rule of law and justice in the medical field, will be a significant impetus in this process. Thus, the unusualness and poor coverage of this aspect of the medical profession makes the problem of using medicine for negative purposes an important and relevant topic.

**Setting of the problem and the aim of the article.** "Of all the sciences, without a doubt, medicine is the noblest". This statement of Hippocrates aptly describes the science, the main purpose of which is to help all who need it. But, unfortunately, even it can be used not for its intended purpose, but on the contrary — to cause harm. The problem of medical abuse is one of the most pressing, although at the same time it attracts little attention. Although this article deals only with the USSR, we should not forget about other cases of slander and abuse of the profession

and draw parallels, understanding that each historical case brings only a greater understanding of the importance of humanity and honesty. The aim of this article is to reveal the details of two proceedings that took place during the Soviet era, to identify, based on previous research, the truth about falsifications of medical malpractice, and to form a perception of past medical abuse and warnings against such acts in the future.

The **object** of the study are individual proceedings that took place in the USSR.

The study is based on historical and historiographical **sources**. To achieve this goal, general scientific and scientific-historical methods and approaches were used, namely: system approach, analytical method, comparative method, etc.

**Discussion and Results.** It is possible that the first attempts by wealthy and powerful people to use medics as a means of combating the enemy (external or internal) date back to ancient times. This could be facilitated by a deep knowledge of the properties of nature and the body, a weak understanding of the essence of treatment methods, as well as the power that a doctor has always had over his patient.

Nevertheless, the more elucidated sources of evidence of the use of physicians as a means of killing enemies date back to modern times. However, even in this case, the evidence of the sources is not unambiguous. The course of the study reveals that the validity of accusations of doctors of abuse of medical knowledge by the authorities are not *a priori* correct and need further study.

In the days of the Union of Soviet Socialist Republics, there were cases of defamation involving manipulations of medical error, which were presented in the form of the use of medicine to harm the authorities. In the 20th century, “killer-doctors” have repeatedly appeared in courts in the Soviet Union. As early as 1938, at the Third Moscow Trial or the trial of the anti-Soviet “right-wing Trotskyist bloc,” three well-known doctors in the country were convicted and executed for deliberately harming Soviet high-ranking officials and cultural figures, including Vyacheslav Menzhinsky, head of the United State Political Administration, writer Alexei Gorky, his son Maxim Peshkov, and Chairman of the Council of People’s Commissars Valerian Kuybyshev [4, p. 378-384].

Dmitry Pletnyov, one of the convicted doctors, said that "...The whole indictment against me is a falsification... I am ready to shout to the whole world about my innocence..." [1]. In addition, in one of his letters to Prosecutor Vyshinsky, he wrote: "When I did not give in, the investigator said literally the following: if the top management believes that you are guilty, then even if you are one hundred percent right, you will still be guilty..." [1]. He was tortured and still forced to confess to his involvement in Gorky's murder. During the last word of the meeting, he stated that he hoped to save his life because he did not know about the actions of the bloc, he stated that all his actions would not have happened if not for the meeting with Yagoda, former People's Commissar for Internal Affairs and further threats from him [4, p. 371-377].

During the interrogation, Lev Levin spoke [4, p. 229-240] about plans for the planned depletion of organisms as the first step towards murder. For example, Maxim Peshkov was weakened due to excessive alcohol consumption and deliberate elimination of drugs that would help his heart. Menzhinsky was given the system of lysates, which led to the deterioration of the patient's condition, and together with heart medication caused a new attack of angina pectoris. "Heart stimulants" were continuously used against Kuybyshev, [4, p. 229-240] and he was not forbidden to walk or work after the operation caused by sore throat, although this should have been done — he died of angina pectoris attack. Alexei Gorky was allowed to walk and work a lot, as well as to sit by the fire, despite the fact that the heat worsened his condition. This weakened him. He was advised to return to Moscow. There in his apartment he fell ill with the flu. Deliberately improper treatment later led to his death.

Ignaty Kazakov, director of the Institute of Metabolic and Endocrine Disorders of the People's Commissariat of Health, Lev Levin, a doctor-therapist, a consultant to the Kremlin's medical and sanitary department, Dmitry Pletnyov, a doctor-therapist, were charged with murder on the instructions of Genrikh Yagoda, Commissioner of Internal Affairs and People's Commissar for Communications in the past [4, p. 378-384].

Although resonant, this is not the only case of proceedings against doctors in the USSR. The high-profile “Doctors’ plot” of the 1950s allegedly exposed the conspiracy of Soviet medics against the ruling apparatus, as well as numerous attempts to assassinate many officials through deliberate misconduct. Perhaps it was the country’s leaders’ thirst for the elimination of their opponents and the struggle against “cosmopolitanism”, which re-launched the government’s anti-Semitic policies, that prompted high-ranking officials to initiate the first detentions. Yakov Etinger, head of the Moscow Medical Institute, was the first to be prosecuted on January 18, 1950, on charges of active nationalism. And that was just the beginning. M. Ryumin, investigator, sends a letter to Stalin, in which he mentions the Minister of State Security of the USSR Viktor Abakumov as a man who deliberately hid the active work of Etinger. This led to changes in the leadership of the ministry. Perhaps the elimination of political opponents was one of the reasons for drawing attention to it. Returning directly to the medical component of the case, it is important to mention the contribution of the 1948 situation with Lidia Timashuk, a cardiologist who aimed to prove that Andrei Zhdanov, one of the Soviet high-ranking officials, had been misdiagnosed and died as a result. Later it became clear that Karpay, a colleague of Timashuk, had entered into a discussion with her about the diagnosis. She, unlike Timashuk, believed that the ECG did not show any signs of myocardial infarction. In one of Timashuk’s letters it was stated: “...A. A. Zhdanov’s treatment and regimen were carried out incorrectly, as myocardial infarction requires strict bed regime for several months, in fact, he was allowed to walk — walk in the park 2 times a day, go to the movies and other physical activities. Wrongly, without any legal basis, Professor Egorov removed me from the Kremlin hospital to the branch of the clinic, as if to strengthen the work there...” [2, p. 54].

No less interesting is the letter of Ignatiev, one of the new representatives of the MGB, to Stalin dated April 2, 1952: “He is accused of carrying out terrorist activities. From 1930 she kept in touch with the especially dangerous state criminal Etinger Y. G., she knew about some of his hostile manifestations. The medical examination carried out in the case determined that Karpay had incorrectly

deciphered A. A. Zhdanov's electrocardiograms, and he had not been diagnosed with myocardial infarction, as a result of which A. A. Zhdanov's treatment regimen was violated" [2, p. 54].

Despite the fact that Timashuk's statement against professors of medical and sanitary management was written, it was not considered immediately — only in 1953 Timashuk was invited to tell about this situation in more detail to the Ministry of State Security, and in January she was awarded the Order of Lenin "for help provided to the Government in the case of exposing killer-doctors" [5]. As a result of the proceedings, it was announced that most of the "murderers in white coats" had been recruited by the international Jewish nationalist organization Joint, and their actions were linked to Zionism. These were doctors Vovsi, Vinogradov, Kogan, Egorov, Ettinger, Mayorov, Greenstein, Feldman, Shereshevsky and others [3].

"Physical measures" were used during interrogations. The whole accusation was based on the fact that the doctors were recruited by foreign states, and in fact, in relation to one of the new charges against Professor Vovsi, he replied: "You made me an agent of two intelligence services, do not attribute at least German — my father and brother's family were tortured by the Nazis in Dvinsk" [2, p. 56]. Echoes of this case also affected Kharkiv. Many Jewish doctors were also detained because of the case of Dr. Kogan-Yasny. Prosecution and harassment of doctors eventually ceased after Stalin's death. The case turned out to be fabricated with the aim of massacring Jewish nationalists, many of whom were among doctors. Lavrentiy Beria initiated the rehabilitation of the defendants, the population received information that the USSR State Security Committee was directly involved in supporting the fabrication of proceedings, which had a pronounced anti-Semitic character [2, p. 58]. All were released and returned to their jobs. It was announced that the data were obtained using invalid methods. Among other consequences of this proceeding is that the case led to the removal of the USSR Minister of State Security, Viktor Abakumov, who was accused of treason, Zionist conspiracy, and obstruction of the investigation of the "doctors' case" because he did not recognize the fairness of the proceedings. Other high-ranking officials from the MGB were removed, [2, p. 58] and the Presidium of

the Supreme Soviet of the USSR revoked the decree according to which Lidia Timashuk was awarded the Order of Lenin.

**Conclusions.** According to the results of the research, it was found that in both of these proceedings there was falsification by the authorities, which was probably aimed at achieving their own goals and strengthening their authority. A number of people were arrested and executed.

The history of medicine shows many examples of the use of doctors for negative purposes. But many of these cases are actually distortions of information. These were mainly politically motivated decisions aimed at eliminating their opponents. But despite the existence of genuine cases of intentional harm, detailed research into cases of abuse of medical services by influential structures may refute some baseless allegations in the historical memory of society and enhance the credibility and reputation of the medical profession, which has been tainted by events. the leading role of performers was played by doctors.

## References

1. Dmitriev Y. (1988). Dmitry Pletnyov: «Ja gotov krichat na ves mir o svoej nevinovnosti...» Tragicheskaja stranica iz zhizni vidnogo dejatelja otechestvennoj mediciny [Dmitry Pletnyov: "I am ready to shout to the whole world about my innocence ..." A tragic page from the life of a prominent figure in Russian medicine]. Trud : Gazeta. – 1988. – 5 iyunja. – Trud: Newspaper. – 1988. – June 5.
2. Nikitin N. V. and Mukhin K. Y. (2010). Delo vrachej: nachalo i konec [The Doctors' plot: Beginning and End]. Russkij zhurnal detskoj nevrologii. 2010. No. 2. – Russian Journal of Child Neurology. 2010. No. 2. 3. Podlye shpiony i ubijcy pod maskoj professorov-vrachey [Vile spies and killers under the mask of professor-doctors]. Pravda : Gazeta. – 1953. – 13 janvarja. – Pravda : Newspaper. – 1953. – June 13. 4. Sudebnyj otchjot po delu antisovetskogo "pravo-trockistskogo bloka" [Judicial report in the case of the anti-Soviet "bloc of Rightists and Trotskyites"]. Juridicheskoe izdatelstvo NKJu SSSR. Moskva. 1938 – Legal publishing house of the NKY USSR. Moscow. 1938. Available at: <http://istmat.info>. 5. Ukaz o nagrazhdenii Lidii Timashuk ordenom [Decree on awarding Lidia Timashuk with the order]. Available at: <http://togdazine.ru>.

## FEATURES AND ADVANTAGES OF THE URBAN ENVIRONMENT GIS-MODELING BASED ON LIDAR INFORMATION

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**Анотація. Серьогін Д.С. Особливості та переваги ГІС-моделювання міського середовища на основі лідарної інформації.**

В статті розглядається ГІС-моделювання міського середовища на підставі лідарної інформації. Розглянуті особливості та переваги тривимірного моделювання міського середовища в порівнянні з двовимірними картами. Тривимірне моделювання міста може виконуватися на підставі обробки лідарних даних, що є найбільш ефективним способом та має ряд переваг. Згідно автору, такими перевагами є висока точність геопросторових даних, отримання даних в конкретній області інтересів та можливість автоматичної класифікації об'єктів земної поверхні. Повідомляється, що тривимірне моделювання має відповідати ряду умов для більш коректного відображення об'ємних об'єктів, які встановлюються набором методів, таких як: побудова точкової тривимірної математичної моделі сцени та її об'єктів, аналіз поверхні тривимірних моделей, створення сцен, освітлення сцен і текстурування. Лідарна зйомка надає найбільш точну інформацію про земну поверхню. Особлива увага приділяється використанню тривимірного моделювання для вирішення ряду наукових та прикладних задач дослідження урбогеосистем, спрямованих на підвищення якості життя населення, оптимізацію містобудування та визначення динаміки архітектурних змін в забудовах конкретного міста. В підсумку, використання лідарних даних для тривимірного моделювання міста дозволяє значно покращити якість та інформативність візуалізації міського середовища.

**Ключові слова:** лідар, тривимірне моделювання, ГІС, лідарна зйомка, урбогеосистема, міське середовище.

**Abstract. Serohin D.S. Features and advantages of the urban environment GIS-modeling based on lidar information.**

The article deals with GIS modeling of the urban environment on the basis of LiDAR information. Features and advantages of the urban environment 3D modeling in comparison with 2d-maps is accounted for. It is reported that 3D city modeling can be performed based LiDAR data

processing, the use of which is the most efficient way and has several advantages. According to the author, such advantages are high accuracy of geospatial data, obtaining data in a specific area of interest and the ability to automatically classify objects on the earth's surface. It is reported that 3D modeling must meet a number of conditions for a more correct display of volumetric objects, which are established by a set of methods, such as: construction of a point 3D mathematical model of the scene and its objects, analyzing the surface of 3D models, rendering scenes, lighting scenes and texturing. It is argued that LiDAR survey provides the most accurate and clear information about the earth's surface. Particular attention is paid to the use of 3D modeling for solving a number of scientific and applied issues of urban ecosystem research aimed at improving the quality of life of the population, optimizing urban planning and determining the dynamics of architectural changes in the buildings of a particular city. Finally, it is concluded that the use of LiDAR data for 3D modeling of the city can significantly improve the quality and informativeness of the urban environment visualization.

**Keyterms:** LiDAR, 3D modeling, GIS, LiDAR survey, urban ecosystem, urban environment.

**General formulation of research and its topicality.** The classical representation of the urban environment in the form of flat (2D) maps does not always allow reflecting the specifics of the spatial distribution of individual objects in relation to their immediate neighborhood, highlighting the architecture of buildings and other city infrastructure. Three-dimensional (3D) modeling allows you to consider the reproduced object in real relation to the environment and make an adequate decision. From a systemic point of view, 3D modeling reveals the consistency of the urban environment and creates a more adequate model of it.

The most suitable tool for 3D modeling of the urban environment are modern geographic information systems (GIS), which are closely related to many trends in human technological development: the latest tools for collecting and processing geospatial data, improving data visualization, integration in the web environment and support on mobile devices.

One of the directions for improving 3D modeling in GIS is the use of lidar data (remote laser scanning). The lidar survey technology is cost-effective and provides the collection of extremely accurate data on the outlines of the earth's surface and

objects on it are in the form of a point cloud, forms a 3D picture of the terrain.

**Setting of the problem and the aim of the article.** The aim of this work is to reveal the features and advantages of using lidar data and 3D modeling to analyze the urban geosystem properties of the city. In this paper, a modern methodological approach is considered, which consists in using lidar data for 3D modeling of the urban environment. The technological aspects of collecting and processing lidar data are also discussed in detail. Visualization of the results of lidar data processing makes it possible to more effectively study urbanization processes and analyze urban geosystem properties. The use of lidar survey technology and tools for processing its output data in aggregate can provide grounds for the practical implementation of the Smart City concept.

**Discussion and Results.** Modern 3D geoinformation modeling is a separate subject segment of 3D modeling. It creates new information resources used in management and in many subject areas. 3D modeling must meet a number of conditions for a more correct display of volumetric objects, it is established by a set of methods and tools. The latter include [1]:

- the construction of a point 3D mathematical model of the scene and its objects;
- the analysis of the 3D objects surface;
- creating scenes – schematic arrangement of objects relative to each other;
- the scenes lightning – installation and adjustment of light sources;
- texturing – assigning textures to surfaces of 3D models, which in a certain way reflect the properties of the material – color, smoothness, transparency.

The most important characteristic of a 3D model should be an ultra-high accuracy of displaying real objects of the earth's surface. This characteristic can be provided by data collected during lidar surveying of the earth's surface. Lidar survey data are datasets containing point cloud that can be processed, visualized, analyzed, and shared in a GIS environment.

Lidar surveying is performed using the LiDAR (Light Detection and Ranging) device – an active optical sensor that releases laser beams onto the earth's surface

while the vehicle is moving along special survey routes. The laser reflection from the surface of objects is received and analyzed by a sensor device. The receivers record the exact time elapsed from the moment the laser pulse was emitted by the system until the moment it returned, in order to calculate the distance between the sensor and the object [5]. Together with information on internal and external positioning (GPS and INS), these distances are transformed into 3D points which reflect and simulate the surface of laser pulses reflection.

The point data is further processed after collection, taking into account the range of laser operating time, scan angle, GPS coordinates, internal positioning information (INS), which allows obtaining accurate x, y, z coordinates.

Point cloud may be defined as processed spatially organized laser survey data. The point cloud is a set of 3D high-altitude points with x, y, z values, as well as additional attributes. The point cloud data represent the heights of the ground, buildings, forest cover, overpasses, and other objects that the laser beam collides with. In addition to positional values x, y, z, the system records additional information: intensity, number of reflected signals, point classification, true color of the fixed point (in RGB format), GPS time, scanning angle and scanning direction [4].

The construction of models based on lidar information takes into account a number of conditions indicated above. First, the point cloud itself constitutes a 3D mathematical model of a certain spacious scene, with the x, y, z values set. Secondly, the point cloud is the result of scanning the real area, and all objects that belong to it, therefore, the default modeling will take into account the surface of objects and their position relative to each other. Point cloud model texturing can be achieved by combining lidar surveying with another remote sensing method – aerial photography, as a result of which point clouds can be assigned an RGB attribute.

The lidar survey technique has become dominant both locally and regionally in the last two decades, due to the significant availability of various scanning hardware and the availability of software for processing derived data in the form of a point cloud [2, p.3].

Scanning lidar tools in machine vision systems form a 2D or 3D picture of the surrounding space, and are successfully corrected with the capabilities of GIS platforms to provide 3D visualization in the form of a 3D scene. Lidar data is also a fairly unique subject for geoprocessing. For example, only using it is it possible to generate very accurate digital elevation models (DEM) in the form, as a rule, of ultra-high resolution grid matrices, through special software. However, the most popular area of lidar data processing is 3D modeling of key elements of the city – buildings.

Obviously, 3D city models as a representation of the 3D geometry of the urban environment can be obtained from a variety of sources, but lidar data are considered to be the most preferable for a number of reasons [2, p.7]:

1. High accuracy of geospatial data collected by lidar surveys. Point cloud is capable of reflecting the discrete features of the location of real natural landscapes or urban objects in great detail.

2. Lidar data are collected only in a certain area of interest (AOI) in a quite fast and cost-effective way. Thus, a sufficiently accurate geospatial monitoring of the required area can be carried out. This makes it possible to identify changes in the development of a city from sets of lidar data collected at different times.

3. The lidar survey technology provides the collection of data related to the objects of the Earth of three categories: topographic surface, two vegetation belts (upper and lower), and artificial buildings and structures.

Thus, the key advantage of lidar imaging technology may lie in the long term, which allows the construction of 3D models of cities over large areas in a very short period of time.

The possibilities of 3D modeling of the urban environment based on the processing of lidar data are advisable to be used in studies of urban geosystems. In particular, in the subject area of urban ecosystem analysis and the definition of the morphology or dynamics of architectural changes in the buildings of a certain city, it is very important to obtain visual results to determine the patterns of spatial distribution of various architectural forms and urban infrastructure. Also, the technology can hardly be overestimated for solving a number of applied issues of

urban geosystem research aimed at improving the quality of life of the population, optimizing urban planning, urban monitoring, and the like. Examples of such questions might be:

- solving problems of telecommunication and wireless network (calculation of line of sight, optimal distribution of transmitters);
- planning of response and prevention of emergency situations;
- airborne noise pollution simulation;
- planning of municipal infrastructure.

Within the framework of the urban geosystems studying, 3D modeling allows considering the infrastructural objects of the city in real dependence with the environment, while such modeling allows to adequately describe the real area, and the relative position of individual objects. On the basis of city 3D models, it is much easier to distinguish its urban geosystem properties and to identify non-obvious features that are not displayed in any way on conventional topographic maps

Lidar data can be used to analyze certain urban geosystem features in its original form – in the form of a point cloud with a standard set of attributes (at least there are many applications that allow pure visualization of point cloud). However, for a more effective use of such data, careful processing by means of GIS is required, which is based on complex computational algorithms for the analysis and processing of points, and high-quality visualization of individual selected 3D models for various objects of the earth's surface, in particular buildings [3, p.5].

One of the important advantages of lidar data modeling by GIS is the georeferencing of the latter in a specific coordinate system. The coordinate system is set to LAS files during their initial processing.

Having a properly assigned geographic projection for point cloud allows you to render 3D models on surfaces, such as global coverage maps (OpenStreetMaps, ESRI Imagery, and others). However, such visualization requires special software that will provide an environment for displaying 3D models on a virtual map or globe, taking into account spatial coordinate information. There are at least two examples of such software: Google Earth and Cesium Viewer. Google Earth is a Google project

that provides the ability to visualize 3D models in KML format on a digital globe covered with aerial photography of the earth's surface. Cesium Viewer is a web application implemented using the Cesium JavaScript library, which allows displaying three-dimensional models of various formats of electronic maps of third-party resources.

The results of 3D modeling of lidar information can be stored in the .OBJ format, which, in turn, is available for viewing and editing by many 3D editors that provide many tools for direct processing of 3D models, without taking into account geographic information (fig. 1.). Therefore, in case of incorrect automatic modeling of lidar information objects, they can always be edited manually.



Fig. 1. Results of 3D modeling of lidar information using the ELiT web application

**Conclusions.** Thus, the use of GIS modeling based on the processing of lidar information is an extremely effective way of representing the urban environment and provides a number of opportunities for the analysis of urban geosystem properties. Lidar data allows high-precision 3D modeling of the built-up area, from which information is generated about the size, architecture of buildings, as well as their relationship with the environment. The collection, processing of lidar data with subsequent visualization is a highly complex process that requires more detailed study for its automation and use in the urban environment studies.

## References

1. Isaev G. N. Modelirovanie informaczionnykh resursov: teoriya i reshenie zadach: uchebnoe posobie / M . : Alpha-M: INFRA-M, 2010 – 224 (in Russian) 2. Kostrikov, S.V. Urban remote sensing with LiDAR for the Smart City concept implementation. Visnyk of V.N. Karazin Kharkiv National University, series "Geology. Geography. Ecology". 2019, 50, 101-124. <https://doi.org/10.26565/2410-7360-2019-50-08> 3. Kostrikov, S.V.; Bubnov, D.Y.; Pudlo, R.A. Urban environment 3D studies by automated feature extraction from LiDAR point clouds. Visnyk of V.N. Karazin Kharkiv National University, series "Geology. Geography. Ecology". 2020, 52, pp. 156-181. <https://doi.org/10.26565/2410-7360-2020-52-12> 4. Lidar: range-resolved optical remote sensing of the atmosphere series, Springer series in optical sciences, vol. 102 / C. Weitkamp (Ed.). – New York: Springer, 2005. – 460 p. 5. Wang R. 3D building modeling using images and LiDAR: a review [Text]/ R. Wang //International Journal of Image and Data Fusion. – 2013. – Vol.4. – №4. – P.273-292.

УДК 613.955

## **PHYSICAL DEVELOPMENT OF PUPILS IN AGE ASPECT**

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**Анотація. Шевцова М.Ю. Фізичний розвиток учнів у віковому аспекті.**

Рівень фізичного розвитку є одним з показників здоров'я дитини або підлітка, але при проведенні профілактичних оглядів школярів рівень фізичного розвитку та його гармонійність не визначається і в основних показниках здоров'я населення не враховуються. При цьому 75% хвороб у дорослих є наслідком умов життя у дитячі та молоді роки. У роботі проведена об'єктивна оцінка фізичного розвитку учнів ліцею №107 м. Харків з урахуванням факторів регіонально-географічного розміщення, динаміки змін антропометричних показників, які визначають акселерацію населення. У даній статті надано оцінку рівня фізичного розвитку за антропометричними та соматоскопічними показниками. Проведено порівняльний аналіз коливань антропометричних показників у дітей з різних регіонів України та інших країн. Просліджено динаміку фізичного розвитку дітей з 1959 по 2017 рік. Встановлено, що у більшості досліджуваних дітей гармонійний фізичний розвиток. Дисгармонійність у переважної більшості обстежуваних встановлена за рахунок вузької грудної клітки та низької маси тіла відносно інших показників антропометрії. Виявлена

відсутність негативного впливу зовнішніх факторів на антропометричні характеристики дітей. Динаміка змін зросту та ваги учнів ліцею лежать на кривих, що відповідають процесу акселерації населення. Діти, що мешкають у містах, мають високі середні показники зросту, порівняно з дітьми сільської місцевості та районах із суровими умовами. Дослідження показало, що зміна індексу маси тіла між роками не перевищує 5% вже протягом 60 років.

**Ключові слова:** акселерація, антропометричні показники, індекс маси тіла, фізичний розвиток, соматоскопічні показники.

**Abstract. Shevtsova M.Y. Physical development of pupils in age aspect.**

The level of physical development is one of the indicators of a child or a teenager's health, nevertheless during preventive examinations of schoolchildren the level of physical development and its harmonicity are not determined and not considered in the main indicators of public health. However, 75% of diseases in adulthood are caused by living conditions in childhood and young years. The paper carries out an objective assessment of the students' physical development of Lyceum № 107 in Kharkiv, taking into account factors of regional and geographical location, the dynamics of changes in anthropometric indicators that determine the population acceleration. The article assesses the level of physical development by anthropometric and somatoscopic indicators. A comparative analysis of anthropometric indicator fluctuations among children from different regions of Ukraine and other countries is made. The dynamics of children's physical development from 1959 to 2017 is traced. It was found that most of the children in the study had harmonic physical development. The overwhelming majority of the studied students were found to be disharmonious due to their narrow thorax and low weight relative to other anthropometric indices. Absence of negative influence of external factors on anthropometric characteristics of children is observed. Dynamics of changes in height and weight of the lyceum students lie on the curves that meet the process of population acceleration. The children living in urban areas were determined to have high average height rates, compared to children in rural areas and areas with harsh living conditions. The investigation shows that the body mass index change between years does not exceed 5% for 60 years.

**Keywords:** acceleration, anthropometric indicators, body mass index, physical development, somatoscopic indicators.

**General formulation of research and its topicality.** The analysis of the scientific literature showed that a sufficient number of works had been devoted to the issues of children's physical development, which identified social factors that affect it [4, p. 132] and considered the phenomenon of its acceleration [7, p. 175]. Certain

studies on pupil physical development were conducted in Kharkov, Ukraine [3, p. 86-89]. However, the issue of identifying the most affecting factors on its development and objective assessment of its harmonicity are still not performed, despite periodic surveys of individual anthropometric indicators [3, 1]. There are almost no group assessments of children's physical development. It is impossible to make an objective assessment of physical development without taking into account regional and geographic factors and the dynamics of anthropometric indicators that determine population acceleration.

**Setting of the problem and the aim of the article.** The actuality of this work is the objective necessity of regular research on the physical development of children.

**Objective:** to assess the state of physical development of children of different age groups. **Tasks:** to study physical development of students and to define its level by anthropometric and somatoscopic indicators; to compare anthropometric indicator fluctuations among children from different regions of Ukraine and other countries; to observe the dynamics of children's physical development from 1959 to 2017. **The theoretical and practical value** of the results gives an opportunity to apply the obtained data for forming practical recommendations to improve the health of the young generation. **Object-matter:** physical development of boys and girls of different age groups. **Subject-matter:** anthropometric and somatoscopic indicators of students' physical development. **Methodology:** theoretical search; anthropometric methods; somatoscopic methods; methods of mathematical statistics. **Material:** experimental data of the study that was conducted in the Lyceum № 107 (Kharkiv, Ukraine) among 203 students (94 boys and 109 girls). The analyzed students were grouped according to their age: 11, 13, 16 years old. **Research Outlook:** further we can compare the data with new studies, thus correcting factors affecting the health of young people. **Scientific novelty:** changes in the body mass index over the last 60 years are concidered.

**Discussion and Results.** The physical development of middle and high school age children in each age group was found to be distributed according to the parameters of the normal distribution curve: for the majority (63.4%) it is average, for

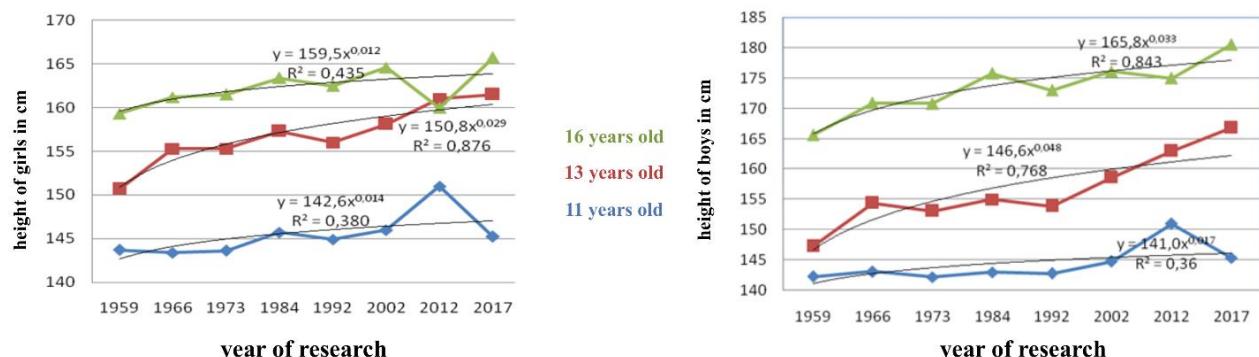
21.4% above average, 15% – high and 0.2% – below average. It has been revealed that the hyposthenic type of constitution, which is caused by a narrow thorax coverage and low weight relative to their height, is typical for the majority of the studied schoolchildren. Among boys of 11 years old it was at 60%, 13 years old – 82%, 16 years old – 72%; among girls of 11 years old 59% had this type of constitution, 13 y. o. - 73%, 16 y. o. – 68%.

The next task of the study is to compare the physical development of lyceum children with the similar indicators obtained by researchers in other regions of Ukraine and worldwide [1-3, 5, 6, 8, 9]. Selected regions differ in their climate and geographical characteristics as well as their living conditions (rural and urban areas).

There were no differences in height rates among children aged 11. It should be noted that children living in urban areas have high average height rates compared to rural children and those living in harsh environments. The average thorax coverage (TC) of boys and girls in the lyceum, compared to their height, is low and it is lower than TC children from other regions.

The body weight of pupils-boys is higher compared to the weight of children from other regions of Ukraine and Europe. At the same time, children in the United States have the highest body weights. Also, it should be noted that children in harsh environments (Karelia) have low body masses. Girls of 11 and 13 years old from different regions have some imbalances in their weight, probably caused by hormonal changes typical for this age. However, at the end of the puberty period, 16-year-old girls have body mass indicators that are within the age norm.

To analyze the impact of acceleration processes, lifestyle and habits of modern children, we compared the physical development results in our study with the



*Figure 1. Dynamics of Kharkiv children height in different years*

previous ones, which presented similar anthropometric data of Kharkiv students in different years [3, 9]. The dynamics of children's height from 1959 to 2017 shows a general trend of boys' and girls' average height increasing among Kharkiv children all of the ages: 11, 13, 16 years old (figure 1).

It should be noted that the step function describing this height has an almost linear trend, which is proved by the value of approximation reliability  $R^2=0,75-0,85$ . At statement of other approximating functions values of factor  $R^2$  were less than represented functions on the graph. The great disparity in physical development indicators with a low coefficient of variation among 11-year-olds is due to the teenage period, which leads to different rates among children in this age group (fig.1)

All age boys have an increase in the average body weight, while girls have a much lower increase rate in it, and for the 16-year-old girls group, the average weight

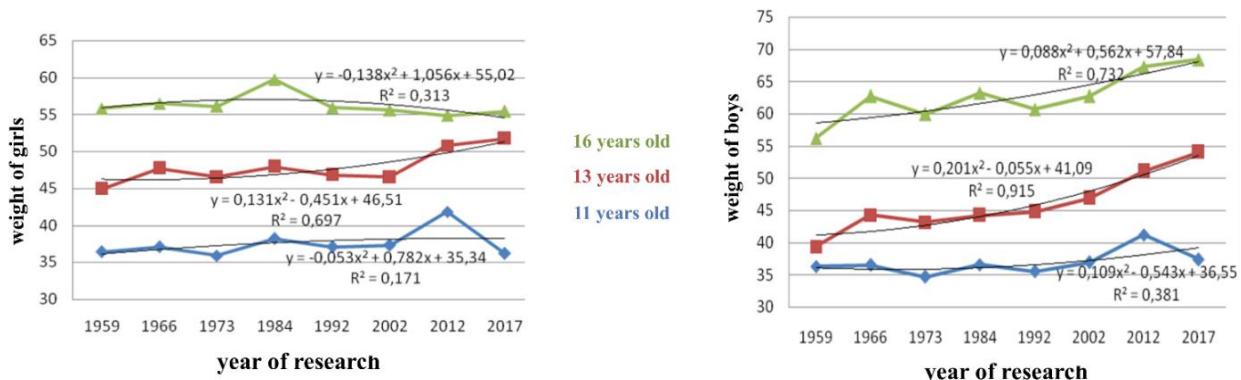


Figure 2. Dynamics of Kharkiv children weight in different years

practically does not change during 58 years (figure 2).

Body Mass Index (BMI) for boys and girls in different years. The analysis of the BMI histogram shows that the BMI value, up to and including 2002, was always higher for girls than for boys, moreover, it was higher for all age groups (figure 3).

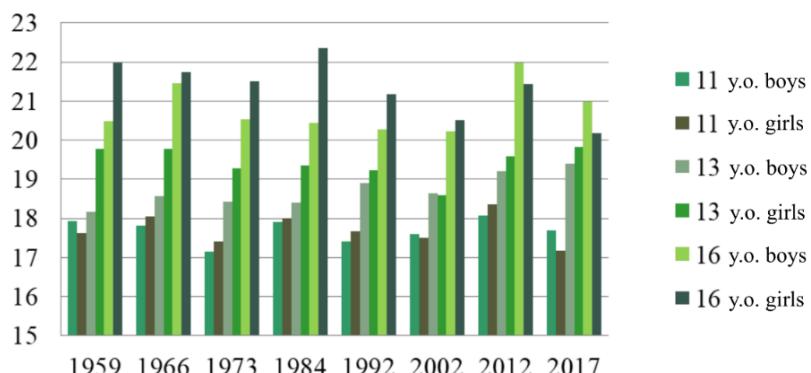


Figure 3. Dynamics of children's body mass index (BMI), kg/m<sup>2</sup>

However, in recent years (2012, 2016) girls' BMI is less than boys' by almost 4%. In the same time, difference in this index between years does not exceed 5%. The average BMI for all years was  $17,7 \pm 0,49$  kg / m<sup>2</sup> for 11-year-old boys and  $17,72 \pm 0,63$  kg / m<sup>2</sup> for 11-year-old girls, which is similar to the little underweight. For 13-year-old boys and girls, as well as 16-year-old boys and girls BMI corresponds to the age norm.

The investigation of the paper resulted in some **conclusions**. It has been found that the physical development of the majority of middle and high school age children is medium and it depends on the parameters of the normal distribution curve in each sex and age group. It has been revealed that the hyposthenic type of constitution is typical for the majority of observed schoolchildren: for 11-year-old boys it was 60%, 13-year-old - 82%, 16-year-old - 72%; for 11-year-old girls - 59%, 13-year-old - 73%, 16-year-old - 68%. The children living in urban areas were determined to have high average height rates, compared to children in rural areas and areas with harsh living conditions. The children in the United States have the highest weight indicator, while children in harsh environments (Karelia) have the lowest one. Lyceum pupils, compared to children in other regions, have high height, low weight, and normal body mass index. It has been shown that the dynamics of changes in height and weight of lyceum students lie on the same curves as the results of previous studies from 1959 to 2017. The changes in the body mass index can be traced only depending on the age groups of pupils. The changes of BMI between years do not exceed 5% for 60 years.

## References

1. Anthropometric Reference Data for Children and Adults: United States, 2011–2014. Data from the National Health and Nutrition Examination Survey [Text] // – August, 2016. – Series 3, Number 39–46 p. 2.
2. Bogomolova E.S. (2012) Fizicheskoe razvitiye sovremennoy kh shkolnikov Nizhnego Novgoroda (Physical development of today's schoolchildren in Nizhny Novgorod) [text]/ E.S.Bogomolova, Yu.G. Kuzmichev, T.V.Badeeva, M.V.Ashina, S.Yu. Kosyuga, A.S.Kiseleva// Medyczinskij al'manakh. – №3(22). – p.193-198. (in Russian)
3. Danylenko H.M. (2002). Dynamika fizychnogo rozvityku shkolariv mista Kharkova [Dynamics of physical development of Kharkiv schoolchildren] / H.M. Danylenko, O.A. Besedina, S.A.Pashkevych// Visn. Khark. nats.

un-tu. – №546, p. 86-89. (in Ukrainian) 4. Karsaevskaya T.V. (1970) Soczial'naya i biologicheskaya obuslovленность изменений в физическом развитии человека [Social and biological conditioning of changes in human physical development] T.V. Karsaevskaya. – L.: Mediczina, p. 132 (in Russian) 5. Kostiuk Yu.S. (2013) Kharakterystyka fizychnoho rozvytku uchnev 5-9 klasiv (10-14 rokiv) silskykh malokomplektnykh shkil [Characteristics of physical development of students in 5th-9th grades (10-14 years old) of rural incomplete schools] [Electronic resource]/ Kostiuk Yu.S.// – p. 3. Available at: <http://visnyk.chnpu.edu.ua>. 6. Masyuk V.S. (2006) Fizicheskoe razvitiye detej i podrostkov respubliki Kareliya [Physical development of children and adolescents in Karelia] [text]/ V.S. Masyuk, I.M. Shabalina// E`kologiya cheloveka. – №2. – p. 28-33. (in Russian) 7. Nikityuk B.A. (1990) Akseleraciya fizicheskogo razvitiya detej i eyo posledstviya [Acceleration of children's physical development and its consequences] /B.A. Nikityuk, K.A. Savchenko. – Alma-Ata: Kazakhstan, p. 175 (in Russian) 8. Platonova A.G. (2013) Izmeneniya v fizicheskom razvitiyi kievskikh shkol`nikov za desyatiletij period (1996-2008 gg.) [Changes in physical development of Kyiv schoolchildren over a ten-year period] [text]/ Platonova A.G. // Gigiena i sanitariya. – № 2. – p. 69-73 (in Russian) 9. Senatorova H.S. (2012) Fizychnyi rozvytok i antropometrychni parametry pidlitkiv Kharkivskoho rehionu [Physical development and anthropometric parameters of teenagers in Kharkov region] [Electronic resource] / H.S. Senatorova, T.V. Chaichenko, O.L. Onikiienko, I.O. Sanina, V.M. Tsymbal// – p. 10. Available at: <http://repo.knmu.edu.ua/bitstream.pdf> 10. Velychko V.I. (2011) Fizychnyi rozvytok ditei shkilnoho viku Pivdnia Ukrayny [Physical development of schoolchildren in southern Ukraine] / V.I. Velychko, I.L. Babii// Zdorov`e rebenka. – №3(30). – p. 4. Available at: [http://www.mif-ua.com/archive/article\\_print/21921](http://www.mif-ua.com/archive/article_print/21921)

УДК 611.1.013

## **CLINICAL ASPECTS OF STUDYING CARDIOVASCULAR SYSTEM EMBRYOGENESIS**

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**Анотація. Тесленко А.О., Приходько Є.А. Клінічні аспекти вивчення  
ембріогенезу серцево-судинної системи.**

У статі розглянуто основні етапи ембріогенезу серцево-судинної системи. Визначено  
значення та клінічні аспекти вивчення внутрішньоутробного розвитку судин та серця.

**Ключові слова:** кардіогенез, серцево-судинні захворювання, вроджені вади серця

**Abstract. Teslenko A.O., Pryhodko E.A. Clinical aspects of studying cardiovascular system embryogenesis.**

The main stages of embryogenesis of the cardiovascular system were studied. The significance and clinical aspects of the study of intrauterine vascular and heart development were determined.

**Keywords:** cardiogenesis, cardiovascular diseases, congenital heart defects

**General formulation of research and its topicality.** Embryogenesis is a subject of embryology, organ development science. As an example, we used cardiogenesis and related it to the pathology of the cardiovascular system. High-quality prenatal diagnosis depends on understanding the stages of cardiogenesis. This allows us to provide timely treatment and save more children's lives.

**Setting of the problem and the aim of the article.** Cardiovascular disease (CVD) is the leading cause of death worldwide. The number of people dying of CVD is increasing rapidly every year. According to statistics from the World Health Organization (WHO), 17.3 million people died of CVD in 2008. This represents 30% of all deaths in the world. Among the causes of infant mortality, congenital heart disease (CVD) ranks third after central nervous system and musculoskeletal disorders. The birth rate of children with congenital heart defects (CHD) ranges from 0.7 to 1.7%, and this number is increasing.

**Object-matter.** Embryogenesis of the cardiovascular system (CVS).

**Subject-matter.** Basic stages of CVS embryogenesis, tetralogy of Fallot (TOF).

The **objective** of the research is to study the main stages of the CVS embryogenesis, to determine the importance and clinical aspects of the study of the intrauterine development of blood vessels and heart and to statistically analyze the possibility of treating CVS on the example of surgical treatment of TOF.

**Tasks:** 1) to analyze the recommendations; 2) to study the main stages of CVS embryogenesis; 2) to apply the obtained knowledge in the clinical aspect on the example of the results of the special treatment of CHD (TOF); 3) to identify problems

associated with the study of the development of CVS in the fetus and the main characteristics of CHD.

**Materials and methods.** The main stages of CVS embryogenesis were studied by analyzing scientific articles in medical journals and e-mail resources. The importance and clinical aspects of studying CVS embryogenesis were taken on the clinical basis of the Department of General and Emergency Surgery of the V. T. Zaitsev Institute of General and Emergency Surgery of the National Academy of Sciences of Ukraine.

**Research outcomes.** The embryo heart development starts at the 2nd-3rd week of fetal development. At first, the heart looks like two paired tubes located in the neck of the embryo. During the isolation of the embryo from the extra-embryonic parts, the paired tubes are connected and moved into the chest cavity.

Thus, the two ends appear – the arterial trunk and the venous sinus. The primary common ventricle is located in the middle, next to the arterial trunk, and the primary common atrium is closer to the venous sinus. Between them there is a narrow atrioventricular channel and a septum [4 p.34-43., 8 p. 189-200.].

The sickle-shaped fold starts to develop from the posterior upper atrium by the end of the 3rd week of fetal development. During the down and forward growth it reaches the common atrioventricular orifice and is closed by valves, but there is still a primary orifice at the bottom of the primary atrial septum. CHD, which is characterized by an atrial septal defect such as Ostium primum, is believed to be the result of delayed septal development at this stage of embryogenesis. Starting from the 5th week of the intrauterine development, the primary opening is gradually covered by a secondary atrial septum.

As a result, by the 6th week of pregnancy the heart becomes four-chamber with atrioventricular valves and the arterial trunk is divided into the aorta and pulmonary artery [4 p.65-67, 8 p.201-231].

According to literary sources, CHD is formed during fetal development from the 3rd to 7th week of embryogenesis.

The causes of CHD are chromosomal abnormalities (5%), single gene

mutations (2–3%), environmental factors (alcoholism, infection, drugs, X-rays), polygenic multifactor inheritance, metabolic disorders (diabetes mellitus, phenylketonuria) [10,p.56].

One of the most common CHD is tetralogy of Fallot. TOF is characterized by a deficit of the right ventricular output part and the displacement of the conical septum forward and left. The displacement of the septum causes stenosis of the right ventricle output part with the development of fibrous ring of the lung stem, its valve system and, very often, the trunk of the pulmonary artery.

The pathology is found in 12–14% of all CHD.

According to R. Anderson et al., the cause of the pathology is the rotation of the arterial cone counterclockwise. As a result of this process, the aortic valve remains in the embryonic position and is located to the right of the pulmonary valve. This position of the aorta looks as if it is on the inter ventricular septum. This is why the defect is caused by two factors: the anatomical position of the aorta above the interventricular septum and the rotation of the arterial cone counterclockwise. It also causes a displacement of the pulmonary artery, which may lead to its elongation. Rotation of the arterial cone prevents the aorta from joining the septum, which leads to septal defect [4].

According to R. Van Praag et al., the main reason is the lack of normal expansion of the funnel-shaped part of the right ventricle. This contributes to the abnormal displacement of the supraventricular crest forward and to the left. There is space above the inter ventricular septum and the septum of the muscular cone remains open, which leads to a defect of the septum. Aortic dextraposition is a secondary anomaly. It occurs as a result of dilation of the aorta, increased blood flow and the overhang of its muscular part of the inter ventricular septum [9,p.28-41].

Hans Bankle's hypothesis is that the abnormal development of the right ventricle leads to infusion hypoplasia and cone hypertrophy [2,p.65].

The TOF pathology complex consists of a septal defect with aortic dextraposition and various measures of right ventricular stenosis. The fibrous rings of the aortic and mitral valve are interconnected and therefore right ventricular and atrial

hypertrophy is observed. The size of the left ventricle is mostly normal, sometimes a slight reduction of the cavity is observed.

While all anatomical CHD changes are common in the fetus, right ventricular hypertrophy is not [7,p.531].

According to statistics, 34 patients were operated at the Zaitsev Institute for the period from 2014 to 2018. 100% of them had radical CHD correction. 32 operations were successful. At present, each of the patients needs a repeated operation. The terms of surgical intervention were from 3 to 11 months. Prenatally, CHD was diagnosed in 40% of patients in this group.

The study of the development of embryonic CVS and the work on the application of knowledge in the clinical aspect, using the results of the special treatment of CHD (TOF) as an example, revealed problems concerning the tactics of treatment of CHD. Need to be studied:

- 1) algorithm of actions to prepare a patient with CHD for surgery;
- 2) the types of laboratory tests that CHD patients perform when planning operations;
- 3) the method of surgical treatment;
- 4) surgical instruments used in CHD operations for newborns and infants;
- 5) possibility of vascular prosthetics in the presence of obstructive defects.

**Conclusion.** The causes of CVS pathology are based on knowledge of normal embryogenesis. There are real possibilities of prenatal diagnostics of many CHDs. Knowledge of normal CVS embryogenesis should be used in the study of pathological conditions, which allows timely diagnosis and use of the correct therapeutic tactics.

## References

1. Anderson R. H., Wilkinson J. L., Arnold R., Lumbkiewicz K. Morphogenesis of bulboventricular malformations. 1. Consideration of embriogenesis in the normal heart. // Brit. Heart J. — 1974. — Vol. 36. — P. 242. 2. Bankle G. Congenital heart defects. - M.: Medicine, 1980. 3. Buchneva O.V. /Morphological studies of the aorta in patients with acute aortic syndromes -2019.-P.37-39 4. Sadler, Thomas V. Medical English for Langman. - L.: Nautilus, 2001 .-- 550 p.
5. Kozlov V.O., Shatorna V.F., Mashtalir M.A., Normal cardiogenesis and the influence of some

- teratogenic factors on the heart -2006-P.7-15 6. Leontyuk A.S.,Fundamentals of age histology / Leontyuk A.S., Sluka B.A.; Vysh.shk., 2000.- P.416 7. Lev M., Rimoldi H. J. A., Rowlatt U. F. The quantitative anatomy of cyanotic tetralogy of Fallot // Circulation. — 1964. — Vol. 31. — P. 531. 8. Moore K, Persaud T. V. N., Torchia M. Before We Are Born. — Esevier, 2016. — P. 189—224. 9. Van Praag R., Corwin R. D., Dahlquist E. H., Fredom R. M., Mattioli L., Nebesar R. A. Tetralogy of Fallot with severe left ventricular outflow trackt, obstruction due to anomalous attachment of the mitral valve to the ventricular septum // Am J. Cardiol. — 1970. — Vol. 26. — P. 93. 10. Zatikyan E.P Cardiology of the fetus and newborn. - M.: Info-Media, 1996.

УДК 544.351.2

## **FORECASTING OF CRIOPROTACTIVE AND ANTIFREEZE PROPERTIES FOR AQUEOUS/ORGANIC MIXTURE**

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**Анотація. Волканова А.О. Прогнозування кліопротекторних та антифризних властивостей для водно/органічної суміші.**

Дана стаття стосується вивчення сольватохромних ефектів у чистих та бінарних розчинниках. Також представлена інформація про придатність функціональних кривих  $E_T = f$  (мольна частка) бінарних сумішей для вивчення кріопротекторних властивостей.

Загальновідомо, що сольватохромні зонди, наприклад бетаїновий барвник Райхардта, використовуються для вивчення полярності розчинника. Особлива увага приділяється сольватохромним ефектам у чистих розчинниках, були зібрані та оброблені дані про акцепторні числа. Графіки  $E_T = f$  (AN) вказують на лінійну кореляцію. Цей факт безпосередньо пов'язаний з наявністю єдиного центру сольватації в барвнику Райхардта. Залежність  $E_T(30)$  від відносної діелектричної проникності вказує на те, що сольватація аprotонних та протолітичних розчинників відбувається за різними механізмами.

Для вивчення переважної сольватації у бінарних сумішах застосовується барвник 4-[[[2,4-динітрофеніл)метилен]іміно-2,6-дифеніл]фенол (*Ind 2*), оскільки він має два центри сольватації: фенолятий атом кисню, а так само як і бетаїнів барвник Райхардта, і дві нітрогрупи. Завдяки тому, що молекули води мають високу діелектричну проникність і малий розмір молекул, вода здатна сольватувати барвник особливим чином – за

нітрофрагментом молекули у збудженному стані. Про це також свідчать відхилення значення  $E_T$  даного розчинника від загальних залежностей відносної діелектричної проникності та акцепторного числа.

Для того, щоб довести гіпотезу, було продемонстровано залежність  $E_T$  від складу водно-органічної суміші. На цих залежностях спостерігається екстремальна поведінка: при певній граничній концентрації води спостерігається різке зниження значення  $E_T$  до значення  $E_T$  для чистої води.

Повідомляється, що утворення кристалічної фази льоду принципово неможливе до цього критичного значення. Більше того, автори підкреслюють, що факт неможливості замерзання дозволяє використовувати ці суміші як кріопротектори та антифризи.

Для підтвердження припущення були представлені та проаналізовані дані діаграми синтезу для шести водно/органічних систем.

**Ключові слова:** акцепторне число, бінарна суміш, відносна діелектрична проникність, діаграма плавлення, параметр полярності розчинника, сольватохромія

**Abstract. Volkanova A. O. Forecasting of crioprotective and antifreeze properties for aqueous/organic mixture.**

The given article refers to the study of solvatochromic effects in pure and binary solvents. Also, the information about the applicability of the functional curves  $E_T = f(\text{mole fraction})$  for the binary mixture to study of cryoprotective properties is presented.

It is well known that solvatochromic probes, for example Reichardt betaine dye, are used to study the solvent polarity. Particular attention is given to solvatochromic effects in pure solvents, data on acceptor numbers were collected and processed. The plots  $E_T = f(AN)$  show a linear correlation. This fact is directly related to the presence of a single solvation center in the Reichardt dye. The dependence of  $E_T(30)$  on the relative permittivity indicates that the solvation of aprotic and protolic solvents proceeds with different mechanisms.

To study preferential solvation in binary mixtures, the dye 4 - [(2,4-dinitrophenyl)methylene] imino-2,6-diphenyl phenol (**Ind 2**) has been applied, because it has two solvation centers: a phenolate oxygen atom, as well as Reichardt betaine dye, and two nitro groups. Due to the fact that water molecules have a high dielectric constant and a small molecule size, water is able to solvate the dye in a special way – by a nitro fragment in an excited state. This is also evidenced by the deviations of the  $E_T$  value of a given solvent from the general dependences for the relative permittivity and acceptor number.

In order to prove the hypothesis, it has been shown the dependence of  $E_T$  on the composition of the aqueous/organic mixture. Extreme behavior is observed on these dependences: at a certain limiting water concentration, there is a sharp decrease in the  $E_T$  value to the values for pure water.

It is reported that the formation of a crystalline phase of ice is fundamentally impossible before this critical value. Moreover, the authors have emphasized that the fact of freezing impossibility makes it possible to use these mixtures as cryoprotectants and antifreezes.

To confirm the assumption, fusion diagram data for six aqueous/organic systems have been presented and analyzed.

**Key words:** acceptor number, binary mixture, fusion diagram, parameter of solvent polarity, relative permittivity, solvatochromism

## **1 Solvatochromic effects in pure solvents**

An important problem facing physical chemistry is solvent effects or so-called solvent polarity. In consistency with the simplest theoretical approaches, the solvent is considered as a structureless medium, which is characterized with the physicochemical parameters such as the relative permittivity and the dipole moment [13, p. 2345]. The relative permittivity takes into account strictly electrostatic interactions between solvent molecules [7, p. 3672]. The dipole moment is directly related to the structure of the solvent molecules and determines the interaction of polar molecules [16, p. 254].

It soon became clear that these parameters had been limited and had not described the whole process of solution formation. It is necessary to describe the solvation ability, considering the solvent polarity and taking into account all possible intermolecular specific and nonspecific interactions. The lack of theoretical approaches to calculating or predicting solvent effects led to the introduction of the empirical polarity parameter  $E_T$ . This parameter is based on the measurement of absorption spectra in the UV/vis range of 2,6-diphenyl-4-(2,4,6-triphenylpyridinium-1-yl) phenol – Reichardt betaine dye (**Ind 1**) [8, p. 10429]. According to the electron density distribution in the ground and excited states of deprotonated **Ind 1**, the electron density is concentrated on the phenolate oxygen in the ground state and on the quinoid structure in the excited state [8, p. 10439]. Obviously, the solvatochromic effects are caused by the interaction of the solvent with these moieties of the molecule: with the phenolate oxygen atom in polar solvents and with the quinoid structure in non-polar solvents. However, the latter is unlikely due to steric

hindrances associated with the presence of phenyl radicals and low interaction energy of the solvent/**Ind 1** in this state [15, p. 328].

This statement is confirmed by the linear correlation between  $E_T$  (30) and an acceptor number (*AN*) for 58 pure solvents (Fig. 1) [6, p. 664]. The existence of such a dependence indicates that **Ind 1** has one chromophore group, namely the phenolate oxygen atom. In addition, it has been shown that there exists a close to parabolic dependence of  $E_T$  as a function of the relative permittivity (Fig. 2) [5, p. 89].

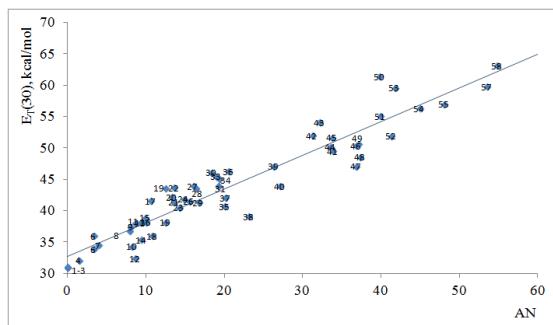


Fig. 1 Correlation of  $E_T(30)$  and *AN* for **Ind 1**

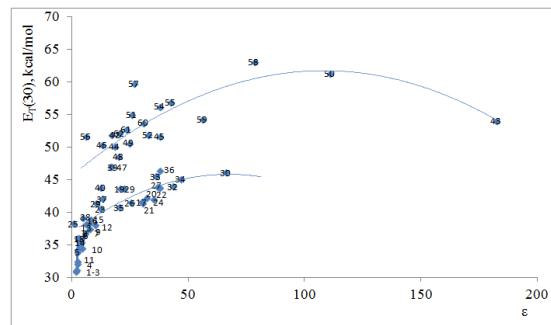


Fig. 2 Correlation of  $E_T(30)$  and  $\epsilon$  for **Ind 1**

According to figure 2, the dependences of  $E_T$  on the relative permitivitty are described with different curves. It indicates that the nature of intermolecular interactions of the corresponding solvents with dye molecules is different: aprotic solvents solvate dye due to nonspecific ion-dipole interactions, while protic solvents interact through H-bonds.

Undoubtedly, **Ind 1** is one of the best solvatochromic probes for measuring the solvent polarity, but it has some drawbacks. The main is the impossibility to evaluate  $E_T$  for acidic solvents and, moreover, **Ind 1** is not suitable for measuring the preferential solvation of binary mixtures [8, p. 10453].

Therefore, the distinct field of chemistry is dedicated to the synthesis and modification of solvatochromic compounds capable of solving these challenges. One of such experiments led to the synthesis of the dye 4-[[2,4-dinitrophenyl) methylene] imino-2,6-diphenyl] phenol (**Ind 2**) [9, p. 10671]

Investigation of this dye demonstrates that its solvatochromic effects ( $\Delta\lambda = 334$  nm) are commensurate with the solvatochromic effects of **Ind 1** ( $\Delta\lambda = 213$  nm). This has been indicated by the dependence of  $E_T$  on the acceptor number (Fig. 3). As in

the case of **Ind 1**, the dependence is linear (Fig. 4), but water, formamide (**FA**) and N-methylformamide (**N-MFA**) deviate from the linear correlation. Such phenomenon is obviously associated with the solvation of dye molecules by the corresponding solvents not on the phenolate oxygen, but on the nitro moiety of the molecule. The fact that the nitro moiety in an excited state is the interacting fragment is evidenced by the electron density distribution [9, p.10670].

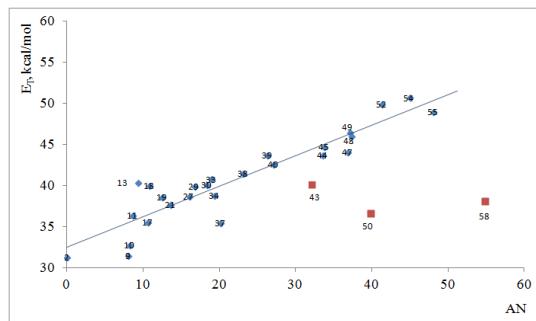


Fig. 3 Correlation of  $E_T$  and AN for **Ind 2**

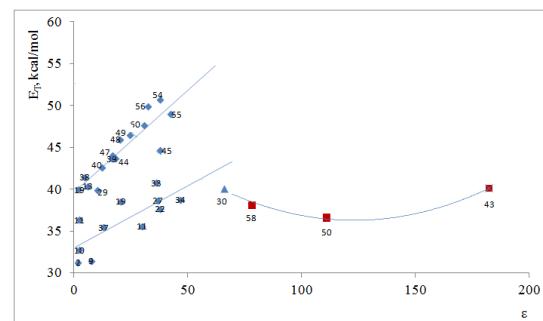


Fig. 4 Correlation of  $E_T$  and  $\epsilon$  for **Ind 2**

Another evidence of the specific solvation of **Ind 2** in comparison with **Ind 1** is shown in Fig. 4 – the dependence of  $E_T$  on the relative permittivity. Similarly to the corresponding plot for **Ind 1**, parabolic dependences for aprotic and protic solvents are different. However, the mechanism of dye solvation alters in the range of glycerol (**Gly**), ethylene glycol (**EG**) and its low molecular weight oligomers, as evidenced by a sharp reduction of  $E_T$  value – at low  $\epsilon$ , the phenolate oxygen is solvated, at high  $\epsilon$  – a nitro groups.

Thus, the structural features of the dye allow us to make an assumption about its applicability in the study of preferential solvation in binary mixtures.

## 2 Cryoprotectants

All vital processes take place in the aquatic environment. A crucial challenge facing cryobiology is the protection of living cells from freezing damage. It is well-known that water expands while freezing, but despite this, cells are destroyed not due to the expansion of ice. The reason is that water freezes as an individual substance, excluding all the rest of the cell contents during cryopreservation. It means that instead of being a solvent for all components of intra- and intercellular fluid, water gathers itself into crystals and pushes out everything else.

Thus, there are two mechanisms of damage to living cells: either due to a change in the shape of cells (as a rule, destruction of cell membranes), or osmotic effects arising from the concentration of substances in unfrozen water, the so-called "solution effect". In order to solve these problems, cryoprotectants are applied [2, p. 423-425].

Cryoprotectants are defined as chemicals that lower the freezing point of intracellular and intercellular fluid, and at the same time prevent the formation of a crystalline phase of pure water, i.e. ice. Effective cryoprotectants do not form hydrates, are non-toxic at any of their concentrations, and almost always form strong H-bonds with water molecules. These substances include dimethyl sulfoxide (**DMSO**), **Gly**, **EG**, propylene glycol (**PG**), low molecular weight **EG** oligomers, etc.

In the case these substances or their solutions are used in technology and industry, they are defined as antifreezes [1, p. 80]. The statement that antifreezes do not freeze only up to a certain temperature is the main difference between antifreezes and biological cryoprotectants. Cooled deeply, antifreezes can form a crystalline ice phase. Therefore, any biological cryoprotectant can be antifreeze, and the opposite statement is not true.

### **3 Solvatochromic effects in binary mixtures**

Binary mixtures are used in various fields of physical and organic chemistry. In the case of pure solvents, results are more or less clear, but the study of binary mixtures is much more complex – nonlinear behavior is observed. It is associated either with the formation of stable intermolecular associates, or with preferential solvation, i.e. the case if the composition of the solvation shell of the dye differs from the bulk composition [10, p. 28487].

In order to investigate preferential solvation, the dependence of the  $E_T$  value on the concentration has been studied. The dependences of  $E_T(30)$  on the mole fraction for **Ind 1** have no singular points, although they are nonlinear [11, p. 2214]. The  $E_T(30)$  value of the organic component mildly increases to the  $E_T(30)$  value for pure water.

A completely different situation is observed for **Ind 2**. In case of

aqueous/organic mixtures, if water is added, a mild increase in the polarity parameter of the mixture is observed, the value of which is higher than the values of pure components. Apparently, the phenomenon is caused due to the formation of a 1:1 heteromolecular complex. Thus, the polarity of the free functional groups is higher than the polarity of the mixture components. At the certain mixture concentration, sharp reduction of  $E_T$  value to the polarity parameter of pure water is present [9, p. 10674].

#### 4 Results and discussion

Analyzing  $E_T$  dependences on the mixtures composition for *Ind 2*, it can be concluded that there is a certain range of compositions in which the dye molecules are solvated exclusively by water molecules in all studied systems. In the range of compositions from a pure organic component to a concentration at which a sharp  $E_T$  reduction occurs, dye molecules are most likely to be solvated by a 1:1 heteromolecular associate. This assumption is made because  $E_T$  values at these concentrations are higher than the values for both pure water and pure organic component. The heteromolecular associate solvation is possible only if the free OH-group of the water molecule exhibits a higher acceptor ability, due to the pull of electron density to the oxygen.

According to this statement, the crystalline phase formation during cooling in this concentration range is unlikely. Thus, the position of the sharp reduction corresponds to the safest mixture composition used as a cryoprotectant.

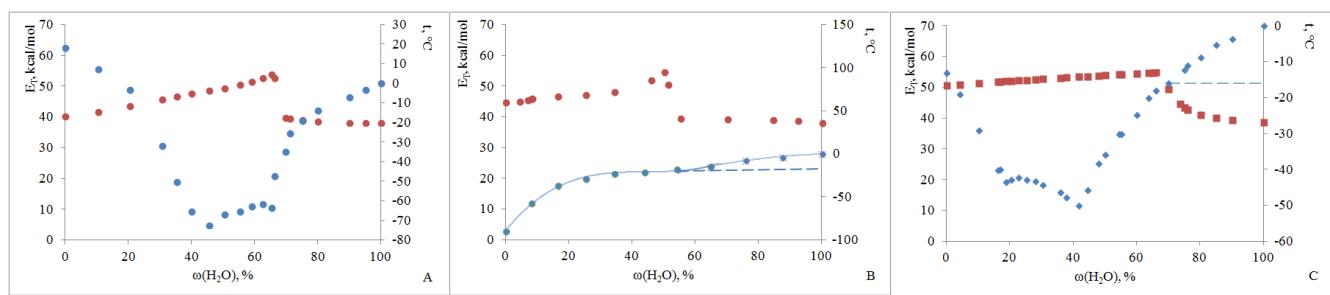


Fig. 5 Comparison of correlation  $E_T$  and mixture concentration with fusion diagram for: A. water/DMSO[12, p. 1316], B. water/*i*-*PrOH*, C. water/*EG*

In order to confirm the assumption, mixtures fusion diagrams, used as cryoprotectants and/or antifreezes have been collected and processed (Fig. 5, 6).

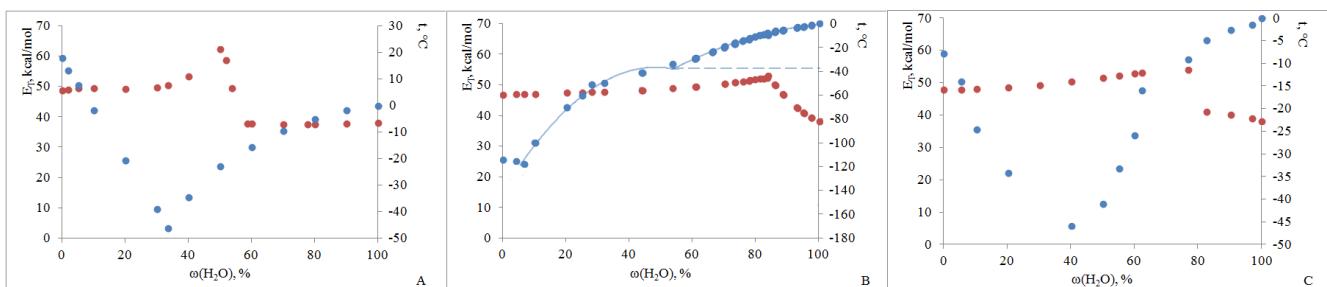


Fig. 6 Comparison of correlation between  $E_T$  and mixture concentration with fusion diagram for: A. water/**Gly**, B. water/**EtOH**, C. water/**DEG**

## CONCLUSIONS

To study the polarity of binary mixtures, **Ind 2** has been used. The mild increase in  $E_T$  value is observed with the addition of water as well as on similar dependences for **Ind 1**. However, a sharp decrease in the  $E_T$  value to the value of pure water exists at a certain concentration.

Up to the critical composition, **Ind 2** is solvated by a 1:1 heteromolecular associate. According to this statement, the crystalline phase of ice cannot form during cooling on this range.

Comparison of the collected data makes it clear that the sharp reduction on the  $E_T$  dependences on the mixture concentration coincides with the eutectic composition for the water/ **DMSO** mixture. The reduction corresponds to the composition of the incongruently melting substance for the water / **i-PrOH** and water/**EG** systems. However, no such coincidences have been found for the water/**Gly**, water/**DEG** and water/**EtOH** mixtures.

Based on the first three dependences (Fig. 5-7), it has been concluded that the study of the binary mixtures polarity in the whole range of concentrations allows determining the safest content of cryoprotectant. Cryoprotectants can be used only as antifreezes at lower organic component concentration and only up to a certain temperature.

## References

1. Antifreezes and deicing liquids (1978) *Kirk-Othmer encyclopedia of chemical technology*, 3<sup>rd</sup> ed; V. 3, 79-95.
2. Best B. P. (2015) Cryoprotectant toxicity: facts, issues and questions *Rejuvenation Research*, 18(5), 422-436.
3. Catalan J., Reichardt Ch., De Paz L. G. (2010) On the molecular

structure and UV/vis spectroscopic properties of the solvatochromic and thermochromic Pyridinium-N-Phenolate betain dye B30 *J.Phys. Chem.*, 114, 6226-6234. 4. Etienne Th., Michaux C., Monari A. [et.al.] (2014) Theoretical computation of Betain B30 solvatochromism using a polarizable continuum model. *Dyes and pigments*, 100, 24-31. 5. Evans L. T. (1988) A simple solubility theory combining solubility parameter and Lewis acid-base concepts. PhD. Thesis, Rochester Institute of Technology. 6. Gutman V. (1976) Empirical parameters for donor and acceptor properties of solvent. *Electrochimica Acta*, 21, 661-670. 7. Inoue M., Urano K. (1975) Formula for static anisotropic dielectric-constants *Journal of chemical physics*, 63(8), 3672-3673. 8. Machado V.G., Stock R.I., Reichardt C. Pyridinium N-Phenolate Betaine Dyes *Chemical Reviews* 2014, 114, 10429–10475. 9. Nandi L., Facin F., Marini V. [et.al.] (2012) Nitro-Substituted 4-[(Phenylmethylene)imino]-phenolates: Solvatochromism and Their Use as Solvatochromic Switches and as Probes for the Investigation of Preferential Solvation in Solvent Mixtures *The Journal of Organic Chemistry*, 77, 10668-10679. 10. Pazin W. M., Almeida A. K. A., Dias J. M. M. [et.al.] (2020) Thermal and solvatochromic effects on the emission properties of a thienil-based dansyl derivative *RSC Adv.*, 10(48), 28484-28491. 11. Pires P. A. R., Seoud O. A. El., Machado V. G. [et.al.] Understanding solvation: comparison of Reichardt's solvatochromic probe and related molecular "Core" structures *J. Chem. Eng. Data* 2019, 64(5), 2213-2220. 12. Rasmussen D. H., MacKenzie A. P. (1968) Phase diagram for the system water-dimethylsulphoxide *Nature*, 220, 1315-1317. 13. Reihardt Cr. (1994) Solvatochromic dyes as solvent indicators *Chemical Reviews*, 94, 2319–2358. 14. Shoji Yu., Kinoshita D., Furumi S. (2020) Straight-chain alkanediol derivatives leading to glassy cholesteric liquid crystals with visible reflection *Liq. Cryst.*, 1-13. 15. Stock R. I., Sandri Cr., Rezende M. C. [et.al.] (2018) Solvatochromic behavior of substituted 4-(nitrostyryl)phenolate dyes in pure solvents mixture composed of water and alcohols *J. Mol. Liq.*, 264, 327-336. 16. Vilkov L. V., Pentin Ju. A. (1987) Fizicheskie metody issledovanija v himii. Strukturnye metody i opticheskaja spetroskopija: Ucheb. dlja him. spec. vuzov M.: Vyssh. shk. – 367 s.

УДК 599.4(477.54)

## ACOUSTIC MONITORING OF BATS IN KHARKIV

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**Анотація. Язык Є.О. Акустичний моніторинг кажанів у Харкові.**

У даній статті досліджено фауну рукокрилих міста Харкова за допомогою

акустичного ультразвукового моніторинга. Метод ультразвукової ідентифікації також дозволяє визначити призначення сигналу – пошук і захоплення здобичі, уникнення перешкод в темряві і комунікації між особинами. Відповідно до частоти, форми та інших характеристик звуків, можна ідентифікувати види кажанів, які були записані. Ехолокаційні сигнали перетворювалися за допомогою бетдетектора і записувалися на диктофон для подальшої розшифровки сонограм. Обробка даних, отриманих за допомогою даного методу, дозволила уточнити перелік видів кажанів в урбосередовищі, визначити загальне співвідношення зареєстрованих видів. Під час досліджень рукоокрилих акустичним методом на території Харківського Національного Університету було зареєстровано 3 види особин: *Nyctalus noctula*, *Eptesicus serotinus* та *Pipistrellus pygmaeus*. Були отримані результати обліку кажанів за допомогою ультразвукового детектора та проведений аналіз даних, згідно з яким була складена діаграма. Додатково був проведений порівняльний аналіз акустичного моніторингу відносно інших років. У 2017 році найбільш численним видом виявилася руда вечірниця (*N. noctula*) (81%). Аналогічний результат був отриманий за статистичними даними акустичного моніторингу, зібраними у 2010-2014 роках, коли проводився експеримент. У зв'язку із завершенням періоду міграції у вересні активність рукоокрилих пішла на спад, у порівнянні з серпнем. В ході спостереження були зареєстровані соціальні звуки лілика пізнього.

**Ключові слова:** акустичний ультразвуковий моніторинг, населення кажанів, рукоокрилі, урбосередовище, Харківська область

**Abstract. Yatsyk Y.O. Acoustic monitoring of bats in Kharkiv.**

This paper investigates the fauna of bats of Kharkiv by the means of acoustic ultrasonic monitoring. All bats are using ultrasonic signals for orientation in the space, which is a good basis for biomonitoring their spreading. By looking at the frequency, shape and other characteristics of calls, it's possible to identify the species of bat that was recorded. Echolocation signals were converted using a bat-detector and recorded on a dictaphone for further interpretation of sonograms. Processing of data, obtained using this method, allowed to clarify the list of species of bats in the urban environment, to determine the overall ratio of registered species. During the research of bats by acoustic method, on the territory of Kharkiv National University had been registered 3 species of individuals: *Nyctalus noctula*, *Eptesicus serotinus* and *Pipistrellus pygmaeus*. The results of bat accounting with an ultrasonic detector were obtained and data analysis was performed, according to which a diagram was made. Additionally, a comparative analysis of acoustic monitoring compared to other years was conducted. In 2017, the most numerous species was the *N. noctula* (81%). A similar result was obtained according to the statistics of acoustic monitoring collected in 2010-2014, when the experiment was conducted. Due to the end of the migration period in September, the

activity of bats decreased, compared to August. During the observation, the social sounds of the *Eptesicus serotinus* were recorded.

**Keywords:** acoustic ultrasonic monitoring, bats, bat population, species composition, urban environment

**General formulation of research and its topicality.** The study of bats (Chiroptera), the second most numerous species of mammals [7, p. 312], significantly complicated by lifestyle and mobility of its members [2, p. 526]. As a result, the popularity of the ultrasonic acoustic detectors is growing. The study of animal sound signals is very often used for species identification. The method of ultrasonic identification also allows to determine the purpose of the signal, i.e. search and capture of the prey, avoidance of obstacles in the dark and communication between individuals [3, p. 155]. All bats are using ultrasonic signals for orientation in the space, which is a good basis for biomonitoring their spreading [6, p. 197]. Due to its high informativeness, the ultrasonic acoustic monitoring method is increasingly used to identify statistical patterns in the distribution of bats and analysis of the preferences in the choice of habitats [4, p. 53]. It is very important that this method does not cause stress in the studied animals.

Acoustic monitoring provides a basis for making the right decisions on nature management and environmental protection. The study of natural changes is currently relevant in connection with the expansion of urban areas and urbanization of the environment. This paper considers how the anthropogenic impact on the natural habitat of bats changes their species diversity and ratio. Compared to the natural habitat, bats face a number of threats in cities: overheating and lack of fodder base in summer, anthropogenic traps throughout the year. The relevance of this topic is confirmed by the fact that bats are a very vulnerable group that needs protection, as these representatives of the fauna are listed in the Red Book of Ukraine [1, p. 464]. The material presented in this paper complements the picture of the elderly population of bats in the center of Kharkiv, and also gives an understanding of the changes in the life of urban bats.

**Setting of the problem and the aim of the article.** Bats are threatened and

declining because of urbanization, but certain bat species have been more able to adapt to urban environments. So, **the objective** of the paper is to investigate the species diversity of bats that seasonally migrate to the city of Kharkiv.

**The object** of the paper are the bat populations that live in summer in the center of Kharkiv, **the subject** – recordings of bat sounds in the urban environment, their species composition.

According to the objective of the study, the following **tasks** were set:

- 1) To keep records of bats with the help of an ultrasonic detector in the city center of Kharkiv;
- 2) to trace the dynamics of changes in the acoustic composition of bats in this area, comparing with the summer periods of other years;
- 3) to investigate with the help of acoustic monitoring how exactly urbanization affects the life of bats.

**The practical value.** Bats are important indicators of biodiversity, and tracking their population trends is critical to assessing the impact of global ecosystem change. Also, they are a vulnerable group, so the given data can be used to plan the measures to preserve their numbers. The article has been provided by following **materials and methods**: descriptive method, acoustic monitoring (recording of bat sounds with the PetterssonD240X Ultrasound Detector), analysis by the programs (Bat Sound and Bat Explorer), comparative and statistical methods. The PetterssonD240X Ultrasound Detector time-expansion detector was used to record the echolocation signals of bats. This detector allows to record echolocation signals and then, using software to display these sounds in the form of spectrograms. All recorded bat signals are transferred to the memory card of the ZOOM H2 Handy Recorder because the detector itself has a small amount of memory.

Records of bats were conducted from July to September 2017. Recordings were made after sunset, about 8 o'clock in the evening, about 2 times a month (in the end of July and the beginning of August, which is considered to be migratory period). The place of recording are the main buildings of Kharkiv National University. The ancient buildings of KhNU and Gosprom are considered a unique "hot spot" of

concentration of migrating bats, which defines it as a place for regular acoustic monitoring of bats. The recording lasted exactly one hour. It should be noted that the recording time was divided into 12 five-minute fragments in order to facilitate the analysis, as well as make it more accurate. Data analysis was performed in the BatSound program. The following parameters of the converted echolocation signal were taken into account for determination: peak frequency (kHz), minimum and maximum frequencies (kHz), pulse duration (msec), pulse interval duration (msec), and signal shape. A series of sound pulses of the same frequency recorded in one time period was taken as a sequence of one individual. Data on all bats were entered into the electronic database MSExcel2007. Data analysis and charting were performed using the Excel Query Designer.

**Research outcomes.** For the purpose of acoustic monitoring of bats, 5 recordings were made, each lasting one hour, with intervals of five minutes. In total, the number of recorded sequences was counted (1859 records). During the research of bats by acoustic method, on the territory of Kharkiv National University, had been registered 3 species of individuals: *Nyctalus noctula*, *Eptesicus serotinus* and *Pipistrellus pygmaeus*. The results of bat accounting with an ultrasonic detector were obtained and data analysis was performed, according to which a diagram was made. Additionally, a comparative analysis of acoustic monitoring compared to other years was conducted.

According to the statistical results of 2014-2015, the *Nyctalus noctula* was the absolute dominant of the sample, its share of all bats was about 70.5%. The share of *Eptesicus serotinus* was about 15%, *Pipistrellus pygmaeus* – 11%, other species were less than 9%. In 2017, the most numerous species was the *N. noctula* (81%). A similar result was obtained according to the statistics of acoustic monitoring collected in 2010-2014, when the experiment was conducted. In addition, the number of migrating bats in the city from the third decade of July is progressively increasing, reaching a maximum in the second or third decade of August, then decreases in September during the transition to wintering. Using the acoustic method in 2017, the following results were obtained: in August and September, three species of bats were

identified, the dominant among which, as in 2010-2015 was the *Nyctalus noctula*, but there is a tendency to increase the percentage of *Eptesicus serotinus* in the obtained sample. Due to the end of the migration period in September, the activity of bats decreased, compared to August. During the observation, the social sounds of the *Eptesicus serotinus* were recorded. 10-15 sequences were detected in mid-August. bats of this species use the territory of KhNU, only as an "intermediate" repository. It is important to note that the *Nyctalus noctula* and *Eptesicus serotinus* are migratory-sedentary species. The smallest share of the received sequences is necessary for sound signals of *Pipistrellus pygmaeus*. It can be assumed that this result is due to the lower competitiveness of this species and the fact that *Pipistrellus pygmaeus* is an exclusively migratory species. The second part of the observation was aimed to conducting an experiment, which was to investigate the activity of bats in the urban environment. For this purpose, a bat of the *Eptesicus serotinus* species was selected, in which the right wing was amputated. During August, signals were recorded, after sunset ten times for one hour. No social sounds were detected, but the bat gave signals called distress calls [5, p. 1005]. These signals have the ability to attract the attention of other bats, that is demonstrated by the analysis of the received records. According to the analysis, the activity of the *Nyctalus noctula* was detected.

**Conclusions.** We can come to the following conclusions: ultrasound recordings of bats with the help of an ultrasonic detector have been performed, 1859 sequences of 3 species have been obtained (*Nyctalus noctula*, *Eptesicus serotinus* and *Pipistrellus pygmaeus*). In the result of the analysis it has been found that the *Nyctalus noctula* remains unchanged in number, but comparing the results of studies, it is important to note that the ratio of *Eptesicus serotinus* comparing to previous years has increased. It has been established that the *Nyctalus noctula* appears in the city in August, although studies in June 2014-2015 show that individuals of this species can stay in the city during the summer from June. Acoustic studies in 2017 showed that *Nyctalus noctula* bats could reproduce in an urban environment, as evidenced by the presence of social sounds.

It is shown that indeed due to the environmental changes of the last decade,

some species of bats remain in cities for the winter and for further residence. Urbanization of bats leads to more negative consequences, namely it does not affect biodiversity indicators, which are higher in cities, but affects the number of bat populations, the duration of the period of forage activity and, their reproduction.

## References

1. Akimova, I.A. (2009). Chervona knyha Ukrayiny. Tvarynyi svit [The Red Book Of Ukraine. The Animal World]. K.: Globalconsulting, 2009. – 464 p.
2. Flaquer, C., Torre, I., Arrizabalaga, A. (2007). Comparison of sampling methods for inventory of bat communities. Journal of Mammalogy, 88(2). – 2007. – P. 526-533.
3. Jones, G., Vaughan, N., Parsons, S. (2000). Acoustic identification of bats from directly sampled and time expanded recordings of vocalizations. Acta Chiropterologica, 2.2000.pp. 155-170.
4. Pauza, D. H., Pauziene N. (1998) Bats of Lithuania: distribution, status and protection. Mammal Review, 28. - 1998.pp. 53-67.
5. Russ, J. ., Jones, G., Mackie, I. ., & Racey, P. . (2004). Interspecific responses to distress calls in bats (Chiroptera: Vespertilionidae): a function for convergence in call design Animal Behaviour, 67(6), – P. 1005–1014.
6. Russo, D., Jones, G. (2003). Use of foraging habitats by bats in a Mediterranean area determined by acoustic surveys: conservation implications. Ecography, 26.2003. - pp. 197-209.
7. Simmons, N.B., Wilson, D. E. (2005). Order Chiroptera. Mammal Species of the World: A Taxonomic and Geographic Reference. Baltimore, MD: Johns Hopkins University Press, – 2005. – P. 312–529.

УДК 614.2:004.9

## TELEMEDICINE

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### **Анотація. Захарова А.О., Білопольська М.І. Телемедицина.**

У даній статті розглянуте сучасне напрямлення медицини, завдяки якому використання комунікаційних технологій міжнародної мережі медичними фахівцями надає можливість оцінити стан здоров'я пацієнта, встановити правильний діагноз і надати відповідні рекомендації в режимі реального часу. Умови для розвитку телемедицини – наукові, технічні, економічні й соціальні – існують в усіх розвинутих країнах. За останні 25 років у багатьох регіонах Європи, Америки і Азії впроваджені потужні цифрові мережі і нові засоби телекомунікації. В Україні на державному рівні ця сфера почала стрімко розвиватись

з 2017 року, після впровадження реформи охорони здоров'я. Тож телемедицина стала своєрідною відповідлю на вимоги сьогодення, коли для порятунку життя пацієнта важлива кожна хвилина. Ця система допомагає виграти такий дорогоцінний час, стерти дістанції між містами і надати якісну медичну допомогу тим, хто її потребує. В процесі дослідження наукової літератури та аналізу статистичних даних були зроблені висновки щодо подальшого розвитку телемедицини в Україні враховуючи сучасну епідемічну ситуацію.

**Ключові слова:** медична галузь, телемедицина, комунікація, онлайн консультація

**Abstract. Zakharova A.O., Belopolska M.I. Telemedicine.**

This article discusses a modern area of medicine, through which the use of communication technologies of the international network of medical professionals provides an opportunity to assess the health of the patient, establish a correct diagnosis and provide appropriate recommendations in real time. Conditions for the development of telemedicine – scientific, technical, economic and social – exist in all developed countries. Over the past 25 years, many regions of Europe, America and Asia have introduced powerful digital networks and new methods of telecommunications. In Ukraine, at the state level, this area began to develop in 2017, after the implementation of health care reform. Therefore, telemedicine has become a kind of response to the demands of today, when every minute is important to save a patient's life. This system helps to save such precious time, blur the boundaries between cities and provide quality medical care to those who need it. In the process of researching the scientific literature and analyzing statistical data, conclusions were made on the further development of telemedicine in Ukraine, taking into account the current epidemic situation.

**Key words:** medical branch, telemedicine, communication, online consultation

**General formulation of research and its topicality.** Nowadays, telemedicine is becoming an important field in the exchange of professional experience, in the field of medical service, distance learning, advanced training of health workers without leaving the activity at the main place of work. International experience shows that one of the best and most promising ways to increase the level of health care, expand opportunities for access and quality of medical services to the population, especially for those groups living in rural areas, is the introduction of telemedicine.

**Setting of the problem and the aim of the article.** In general, telemedicine is a complex of actions, technologies and measures used in the provision of medical care using remote communications, when the distance factor is critical. Telemedicine services include remote medical consultations, control of physiological parameters of

the patient's body, diagnostic and therapeutic manipulations, exchange of patient examination results, other medical services, as well as medical video conferences, video seminars, video lectures in the form of electronic messaging using telecommunications. Telemedicine services that can provide communication between the patient and the doctor are gaining popularity because they allow access to professional medical support at a distance [5]. Areas of application of telemedicine are extensive – monitoring the patient's condition during the period of rehabilitation at home, assistance to the population living away from medical institutions and the ability to contact a doctor in emergencies.

Telemedicine, in its primary form, can also be considered a doctor's consultation by phone. For example, when a person does not feel well, but all the reception windows are busy, or human just needs a minute consultation that does not require a visit. Also, its simple option is communication in messengers between a doctor and a patient, which is gaining popularity these days. In addition to the phone or messenger, the patient will be able to contact the doctor and discuss those issues that are of concern using the video conferencing service [4]. Another type of use of telemedicine – doctors, within the framework of telemedicine consultations, can get together and discuss different medical cases among themselves, exchanging experience. It has been popular around the world for many years.

Despite the general enthusiasm for telemedicine, the world has not decided yet what exactly is meant by this term. Its use is so wide that it allows everyone who works in this direction to put something of their own in the concept of "telemedicine". For example, Wikipedia defines telemedicine as "the provision of health care services in an environment where distance is critical, by health care professionals who use information and communication technologies to exchange relevant information for the diagnosis, treatment and prevention of disease and injury, research and evaluation, and also for the continuing education of health workers to improve the health of the population and the development of local communities". In other words, according to this definition, telemedicine is a branch of medicine that can be applied wherever information and communication technologies are available.

According to the World Health Organization (WHO), telemedicine is a method of providing health care services where distance is a critical factor.

But, if someone ask an ordinary citizen what "telemedicine" is, then, most likely, an image a la "Skype communication" will appear in his head, where on the one hand, he is, and on the other – the doctor he communicates with. And he will not mistaken. Indeed, in most countries of the world this telemedicine format is probably the most widespread. In the past few years, employers in Europe and the United States have even begun to provide telemedicine coverage for their employees. For companies, this is several times cheaper than providing them with full health insurance.

**Research outcomes.** In Ukraine, a completely different, albeit less well-known, direction is now more relevant – telemedicine consultations in the "doctor-doctor" format. Telemedicine consultations in the "doctor-doctor" format are used when, due to various circumstances, a family doctor needs to consult a narrow specialist in the interests of the patient, or it is necessary to convene a consultation, but it takes a long time to get to these doctors physically [1]. Telemedicine consultations in this case are divided into two types: synchronous (real-time consultations) and asynchronous (delayed teleconsultations).

The system of medical care should be based on national, standardized, legally, economically, clinically and ethically reasonable use of computer, electronic information and telecommunication technologies to unite all medical and preventive institutions of Ukraine of different forms of ownership and implementation state policy in health care. At the state level in Ukraine, telemedicine was widely discussed in 2017 with the introduction of health care reform. At the same time, they began to prepare the legislative framework for this and, in less than 9 months, the primary-level medical institutions underwent massive computerization. This is important for the development of telemedicine, since it has become possible to process telemedicine data. At the beginning of 2019, the Ministry of Health of Ukraine announced the beginning of the introduction of telemedicine technologies in a test mode in five regions: Kharkiv, Dnipro, Kirovograd, Poltava and Rivne.

The main goal of the reform of the medical sector in Ukraine is improving the health of the population by ensuring equal and fair access of all citizens to medical services of appropriate quality. One of the priorities of telemedicine development is the improvement of the regulatory framework, which are both extremely important for the effective and high-quality further development of the entire health care system of Ukraine and its proper reform. Legislation in the field of telemedicine and e-health, harmonized with legal norms, needs to be developed and approved by the European Union and WHO methodological documents, normative evidence-based scientific and methodological documents, standards and protocols, national system of electronic medical records, distance learning system, electronic document management, information systems of medical preventive institutions, educational and research establishments, information pharmaceutical systems, protection digital information systems. By providing telemedicine services, personal, medical secrecy provided by the legislation of Ukraine, as well as the confidentiality of personal data must be preserved. The Ukrainian politicians have not only realized the importance of modern medicine, but have also begun to embody this understanding in key policy documents. The presidential reform program until 2020 and the draft Coalition Agreement of the pro-Ukrainian majority in parliament call the reform of the health care system and, in particular, the development of telemedicine among the priorities.

The development of telemedicine is extremely necessary for our country, especially considering the modern doctrine of local conflicts. In military medicine, telemedicine technologies are able to simplify the work of doctors, perform effective management during the evacuation stages, systematize and standardize the quality of medical care. Given the complexity and long-term treatment of gunshot wounds, this makes it possible to keep under constant and long-term control the treatment process of each victim. Significant work on the introduction of telemedicine in Ukraine has been carried out in the last year since the adoption of a joint program of Ukraine and NATO.

Thanks to the use of modern communication technologies, an international network of medical professionals will be able to assess the patient's health, make a

correct diagnosis and provide appropriate recommendations in real time. Telemedicine has become a kind of response to today's demands, when every minute is important to save a patient's life [3]. This system helps to save such precious time, blur the boundaries between cities and provide quality medical care to those who need it so much.

Conditions for the development of telemedicine – scientific, technical, economic and social – exist in all developed countries. Over the past 30 years, many regions of Europe, America and Asia have introduced powerful digital networks and new methods of telecommunications. Hardware and software have become faster, more powerful, cheaper and easier to use. Today, there are more than 300 specialized centers in these countries. Remote counseling, scheduling, supporting of preventive and curative procedures - this is not the whole list of medical services [2].

A large amount of telemedicine research in the United States is conducted with the financial support of the government. Telemedicine projects in the United States are funded from both the US Department of Health and Human Services and the Department of Defense.

**Conclusions.** Today, telemedicine is becoming an effective way to provide timely medical care. Thanks to the use of this technology, physicians around the world have the opportunity to use a global information database and share invaluable experience with colleagues in different parts of the world. These opportunities contribute to the development of medicine. The use of modern telemedicine systems is one of the most promising ways to reform the Ukrainian health care system, which allows increase the efficiency of funds allocated for medical monitoring in a relatively short time and with limited funding, improving the quality of treatment, reducing risk of diseases, increasing life expectancy, etc. [6]. Now our country is moving according to the scenario when people simultaneously increase the volume somewhere, and somewhere the quality (quality – the number of different directions of using telemedicine). The government is also trying to attract as many doctors as possible to telemedicine, to interest local authorities in such projects. Indeed, given the speed of development of new technologies, the possibilities of telemedicine may

become almost limitless very soon.

## References

1. All-Ukrainian medical newspaper "Your Health" (<http://www.vz.kiev.ua/ru/>). 2. DTEK website (<http://www.dtek.com>). 3. Left Bank website (<http://ukr.lb.ua>). 4. Lviv portal (<http://portal.lviv.ua>). 5. Medical portal on health EuroMD (<https://euromd.com.ua>). 6. Ukrainian Association for Computer Medicine (<http://uacm.kharkov.ua/>)

УДК 618.11-006-031.82-06:[618.177+616.379]:616.34-008.9:579.61

## THE CORRELATION BETWEEN GUT MICROBIOTA AND PCOS

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**Анотація. Золотарьова Е.О., Кріпак К.М. Взаємозв'язок мікробіоти кишківника та СПКЯ.**

Синдром полікістозних яєчників (СПКЯ) є одним з найбільш поширених та складно виліковних станів жінки, що, на сьогоднішній день, не піддається лікуванню за єдиним протоколом. СПКЯ- полісимптомне ендокринологічне захворювання, котре проявляється одночасно гіперандrogenією, а також олігоовуляцією (рідка овуляція) чи ановуляцією (відсутність овуляції), що призводить до безпліддя. Додатково СПКЯ супроводжується порушеннями з боку підшлункової залози- інсульнорезистентністю, у результаті якої набувається діабет другого типу. Зараз проводяться ряд досліджень, які направлені на діагностику та продуктивне лікування синдрому, так як питання досить актуальне та потребує негайного вирішення. І ми презентуємо одне з них, котре у майбутньому має обов'язково знайти собі застосування і принести користь у ході діагностики та лікування. Це дослідження доказує взаємозв'язок мікробіоти кишківника і СПКЯ, та як можна вплинути на подальше лікування, знаючи ці особливості.

**Ключові слова:** Синдром полікістозних яєчників, мікробіота кишківника, гіперандrogenія, метаболічний синдром, овуляція, інсульнорезистентність

**Abstract. Zolotareva E.O., Kripak K.M. The correlation between gut microbiota and PCOS.**

Polycystic ovary syndrome (PCOS) is one of the most common and difficult in treatment women which, for the time being, cannot be treated according to a single protocol. PCOS is a polysymptomatic endocrinological disease which is manifested by hyperandrogenism as well as

oligoovulation (liquid ovulation) or anovulation (lack of ovulation), which leads to infertility. In addition, PCOS is accompanied by disorders of the pancreas, which causes type 2 diabetes. A number of studies are currently underway to diagnose and treat the syndrome productively, as the issue is quite relevant and needs to be solved immediately. And we present one of them, which in the future should be applied and useful in the course of diagnosis and treatment. This study demonstrates the correlation between gut microbiota and PCOS and how further treatment can be influenced by knowing these features.

**Key words:** Polycystic ovary syndrome, gut microbiota, hyperandrogenism, metabolic syndrome, ovulation, insulin resistance

### **General formulation of research and its topicality**

Polycystic ovary syndrome (PCOS) is a metabolic syndrome (MS) and endocrine with a complex etiology, and its pathogenesis is uncertain yet.[5] In recent years, we can observe that the correlation between metabolic disease and gut microbiota (GM) has become a hot topic in researches, leading to a number of new ideas about the pathological mechanisms and etiology of PCOS.[5] The investigations show that GM can cause hyperandrogenism, insulin resistance, metabolic syndrome (obesity, diabetes) and chronic inflammation and may contribute to the growth of PCOS by influencing energy absorption, the pathways of short chain fatty acids (SCFA), choline, lipopolysaccharides and bile acids, the brain–gut axis intestinal permeability and intestinal permeability.[5]

Several metabolic disorders have been linked to PCOS, including insulin resistance (IR), obesity and diabetes.[5] About 50% of PCOS patients present with varying degrees of IR, which in turn serves as a link to other endocrine disorders.[5] For the time being, a new treatment of PCOS and consensus on the diagnosis has emerged, and the idea that metabolic abnormalities and other complications of PCOS should be included in the diagnosis and treatment of PCOS has been emphasized by several reproductive endocrine well-known institutions, such as the American Endocrine Society, the National Institutes of Health (NIH), the European Endocrine Society and others.[5]

The diagnosis, treatment and research scope of PCOS has gone beyond

reproduction-related fields and now also involves cardiovascular disease, metabolic disease, tumors and other aspects.[5] The relevance of our topic lies in the fact that this disease is widespread among girls of different ages and does not have one plan of prescribed correct guaranteed treatment.

### **Setting of the problem and the aim of the article**

In this article we are going to provide a relevant information about correlation between gut microbiota and PCOS in order to define useful ways of treatment. The main problems of this disease are the difficulty of identifying the reason and the selection of the appropriate correct individual therapy. Polycystic ovary syndrome is the result of a combination of genetic, health and lifestyle factors, some of which have not been identified. From our perspective, it is always necessary to control and examine changes to metabolic states during studing PCOS. Current researches demonstrate that GM disorders are connected with appearance and evolution of metabolic diseases. [5] Over the past two decades, several researches have informed a correlation between GM and metabolic syndrom. [5]

### **Discussion and Results**

Now, we will observe the pathway machanisms of GM towards to PCOS.

GM degrades carbohydrates into simple sugars and then ferments them into hydrogen, CO 2, CH 4, and short chain fatty acids (SCFAs) to ensure energy to the host. [5] Obese people receive most part of energy from meal and in this way they exacerbate obesity symptoms, making a closed circle. This phenomenon is associated with a disordered GM.[5] More than half of PCOS patients were overweight or obese. It was requested that GM may have a particular effect on obesity and energy metabolism within the context of PCOS. [5]

Here we present the short-chain fatty acid (SCFA) metabolism pathway. Gut microbiota decompose organic materials to produce three major types of SCFAs, including acetate, butyrate and propionate.[5] Den Besten found that SCFAs can activate peroxisome proliferator-activated receptor gamma in liver and muscle, thereby regulating glucose uptake and fatty acid oxidation.[5] GM can also affect insulin sensitivity through inflammatory responses mediated by branched-chain

amino acids (BCAAs) and SCFAs.[5] Zheng found in three prospective cohort investigations that the more BCAAs people ingested, the more likely they were to develop type 2 diabetes.[5]

ASH not only inhibits the secretion of GnRH and of sex hormones but also blocks the transformation of sex hormones. The lower the level of ASH, the higher the androgen level. High androgen levels in turn can aggravate the abnormal GM, creating a vicious cycle. [5] Therefore, we draw the conclusion that GM affects the occurrence and development of PCOS through the SCFA pathway.

The choline pathway will be covered here. PCOS patients do not only suffer from diabetes and obesity, but instead of these they also have a high danger of heart disease. Researches have shown that gut microbiota may contribute to the occurrence and development of cardiovascular disease through the choline pathway.[5] Choline is an essential nutrient that is naturally present in some foods and available as a dietary supplement. It is a component of cell membranes and essentially involved in lipid metabolism.[5] PCOS patients often present with hyperlipidemia and IR, which can damage vascular endothelial function and induce thrombosis. These metabolic abnormalities increase the risk of CHD.[5]

Now we want to consider possible treatment options. Currently, the etiology of PCOS has not been determined, that making it complicated to eliminate the disease. Treatment approaches include anti-androgen therapy, insulin sensitizer therapy, or ovulation induction therapy to relieve clinical symptoms, improve fertility, maintain health, and improve patients' quality of life. Nevertheless, actual plans of therapy have many different kinds of shortcomings and necessary to continue to identify the causes of the disease and find a correct way to treat the disease.[5]

Lifestyle interventions will go a long way in treating this syndrome. This approach focuses on behavior, exercise, diet, psychology and other channels, all of which can affect the activity of the GM and thus regulate the metabolism of the host. Dietary changes can rapidly change the relative abundance and species in GM, something that has been confirmed in patients with MS.[3] Nowadays, such research has been carried out along to examine the effects of dietary composition on women

with PCOS.[3] According to Moran and his colleagues' research women who received high protein diet for 12 weeks did not differ from women on a low protein diet, although their postprandial glucose response was reduced.[4] Other scientists, such as Crystal C. Douglas, Barbara A. Gower carried out a number of studies and found that eukaloric diets that are either enriched in monounsaturated fatty acids (MUFA; 17% energy) or are low in carbohydrates (Low CHO; 43% energy) may reduce circulating insulin concentration by compared to a standard diet.[1] Decreasing insulin concentration following a diet low in CHO and MUFA will lower free T levels, decrease insulin-induced androgen synthesis, and improve the lipid profile.[1] As it is considered that elevated insulin levels contribute to endocrine disruption in PCOS, it may be expected that lowering insulin levels will ultimately lead to an improved endocrine profile.[1] This information may allow clinicians to change treatment regimens to ensure adherence to the diet.

A recent meta-analysis revealed that exercise can improve the levels of follicle-stimulating hormone, sex hormone-binding globulin, total testosterone and androgen in PCOS patients.[5] We hypothesize that exercise changes the GM in PCOS patients and thus results in an improvement of metabolic disorders in hosts. Physicians should therefore encourage PCOS patients to do aerobic exercises at 60–80% of maximum heart rate for more than 30 min at least 4 times per week.[5] Studies have shown that cognitive behavioral therapy (CBT) can improve the psychological fatigue of patients with PCOS.[5] Given the bidirectional signaling pathway of the brain–gut axis, we speculated that an improvement in emotional brain activity could affect GM and intestinal homeostasis. Also, patients should do physiotherapy (internasal electrophoresis of vitamin B1, ultraviolet irradiation of blood etc.); it is aimed to normalization of the hormonal interaction. Metformin is used to normalize the carbohydrate and fat metabolism. [2, p. 87]

Mainly hormones are indicated for the treatment as well. To stimulate the ovulation Clomiphene or Clostylbegit are prescribed as well as products containing ‘pure’ FSH or in combination with LH (Menopur, Humegon, Metrodin).[2, p. 87]

For the treatment and prevention of the endometrial hyperplastic processes they

use synthetic progestins according to a standart scheme (6-8 cycles). [2, p. 87]

For the treatment of hirsutism Cyproterone acetate, Verospiron, Metronidazol are taken according to the standard scheme. [2, p. 88] If the hyperprolactinemia is diagnosed, they prescribe Bromcriptin, Metergolin, Parlodel. [2, p. 88] The complex of the treatment is added with glucocorticoids (Prdnisolone, Dexamethasone) for the patients with the adrenal form. [2, p. 88]

Fecal microbiota transplantation as a treatment. Fecal microbiota transplantation (FMT) is a method whereby microorganisms from the feces of healthy donors are introduced into the small intestine of patients through a nasogastric tube or a nasointestinal tube to directly and rapidly change the composition of the new host's GM and treat disease.[5] FMT has been proposed as a treatment option for Clostridium difficile infections (CDI), and its effectiveness to treat CDI was reported to be more than 90%, with few adverse reactions reported. FMT can also be used to treat inflammatory bowel disease, chronic constipation and some non-gastrointestinal diseases.[5] Vrieze et al. transplanted the GM of healthy donors into patients with metabolic syndrome, and found that after 6 weeks, the insulin sensitivity of the recipients had increased.[5]

## **Conclusions**

At the end of our article, we would like to summarize all of the above and make conclusions. A study that proves the link between microbiota and PCOS has been carried out and the results have been published relatively recently. It is not right to change the tactics of treating women immediately on its basis. A number of additional studies are required, but this is already a step towards solving this issue with more effective and efficient methods.

Changes in lifestyle and nutrition, as confirmed by the presented studies, make a significant contribution and it will definitely improve the clinical picture and condition of the woman. It is necessary to use drugs aimed at changing the amount of GM, on which the insulin level will depend, as well as a number of other groups of drugs. Also, physical activity, taking probiotics or prebiotics has a positive effect on the result. Such a new method as faecal microbiota transplantation is a rarely used

method and we hope that its refinement and study as a treatment option will also find application in this area in a short time.

Thus, all the information presented by us is undoubtedly useful and relevant for scientists and medical practitioners.

## **References**

1. Crystal C. Douglas, Barbara A. Gower, Betty E. Darnell, Fernando Ovalle, Robert A. Oster, Ricardo Azziz (2006). Role of diet in the treatment of polycystic ovary syndrome. *Fertil Steril*. Available at: <http://www.ncbi.nlm.nih.gov>
2. Gryshchenko V.I., Shcherbina M.O. (2014). *Obstetrics and Gynecology*. Kyiv: AUS Medicine Publ.
3. Sidika Kasim-Karakas SE, Almario RU, Gregory L, Wong R, Todd H, Lasley BL (2004). Metabolic and endocrine effects of a polyunsaturated fatty acid-rich diet in polycystic ovary syndrome. Available at: <http://pubmed.ncbi.nlm.nih.gov>
4. Moran LJ, Noakes M, Clifton PM, Tomlinson L, Norman RJ (2003). Dietary composition in restoring reproductive and metabolic physiology in overweight women with polycystic ovary syndrome. Available at: <http://pubmed.ncbi.nlm.nih.gov>
5. Xiaoxuan Zhao, Yuepeng Jiang, Hongyan Xi, Lu Chen, and Xiaoling Feng (2020). Exploration of the Relationship Between Gut Microbiota and Polycystic Ovary Syndrome (PCOS). *Geburtshilfe Frauenheilkd*. Available at: <http://www.ncbi.nlm.nih.gov>

**SECTION III**  
**TECHNICAL SCIENCES**

УДК 004.03:656.22

**USE CASE OF COMPUTER SYSTEMS IN JAPANESE RAILWAY  
INDUSTRY**

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**Анотація. Андреєв М.В. Приклад використання комп'ютерних систем в японській залізничній галузі.**

Відповідно до назви статті, стаття описує невидиму частину вдосконалення залізничної системи в Японії – різні комп'ютерні системи. У статті обговорюється, як комп'ютери допомагають гарантувати безпеку людям та яка їх роль у збільшенні пунктуальності японських поїздів. У статті акцентується комп'ютерні системи лише поїздів Сінкансен. У тексті надається інформація про те, де використовуються різні комп'ютерні системи, які компанії Japan Railways Group їх використовують та як ці системи працюють між собою. Також згадується історія розвитку комп'ютерних систем, а саме систем COMTRAC(Computer Aided Traffic Control System), COSMOS(Computerized Safety, Maintenance and Operation Systems of Shinkansen), CYGNUS(Computer system for signal control and useful maintenance of Hokkaido Shinkansen), SIRIUS (Super Intelligent Resource and Innovated Utility for Shinkansen Management), роль Європи та Сполучених Штатів Америки у розробці систем. Детально говориться про структуру кожної із згаданих систем. Велика увага приділяється пристроям та підсистемам, які формують загальну підтримку від планування експлуатації поїзда до фактичної щоденної експлуатації, що використовуються в цих системах. Стаття дає уявлення про те, як здійснюється обмін інформацією між поїздом та командною кімнатою, як контролюється швидкість, які дані отримуються з поїзда, як люди взаємодіють із комп'ютерними системами та як центри управління контролюють хід кожного поїзда та здійснюють комплексне управління. Питання різних непередбачених ситуацій, таких як аварія, несправність обладнання, землетруси, затримки, також висвітлюються в цій статті. Ця стаття являє інтерес для розробників та інженерів, демонструючи не дуже відому область використання комп'ютерних технологій, особливо в

нашій країні. В підсумку обговорюється мета комп'ютерних систем та результат їх роботи.

**Ключові слова:** Сінкансен, COMTRAC, COSMOS, CYGNUS, SIRIUS

**Abstract. Andreiev M.V. Use case of computer systems in Japanese railway industry.**

As the title implies the article describes the invisible part of improving railway system in Japan – different computer systems. The article discusses how computers help ensure safety, what the role of it is in increasing the punctuality of Japanese trains. The article specifically refers only to computer systems of Shinkansen trains. The text gives information on where different computer systems are used, what companies of Japan Railways Group companies use them and how these systems work with each other. History of development of these computer systems, namely COMTRAC (Computer Aided Traffic Control System), COSMOS (Computerized Safety, Maintenance and Operation Systems of Shinkansen), CYGNUS(Computer system for signal control and useful maintenance of Hokkaido Shinkansen), SIRIUS (Super Intelligent Resource and Innovated Utility for Shinkansen Management), also will be mentioned: what the role of Europe and the United States of America in development of systems is, which system was the first one, etc. It is spoken in detail about the structure of each mentioned system. Much attention is given to devices and to the subsystems, that form a total support from train operation planning to actual daily operation, that are used in these systems. The article provides an insight into how information is shared between train and command room, how speed is controlled, what data are extracted from train, the way people interact with computer systems and how control centers monitor the progress of each train and perform integrated management. The issue of different unforeseen situations, like crash, failure of equipment, earthquakes, delays, are also covered in this article. The article is of interest to developers and engineers, demonstrating not so known field of adaptation of computer technologies, especially in our country. In conclusion, the goal of computer systems is discussed, what result of their work is.

**Keywords:**COMTRAC, COSMOS, CYGNUS, Shinkansen, SIRIUS

### **General formulation of research and its topicality**

Overview of up-to-date computer technologies of Japanese Railways (JR). The topic of railways is well developed in Japan, so there is a lot of research on this topic. Various innovations, developments and their analysis are regularly covered in “Hitachi Review” and “Japanese Railway Engineering” technical journals. The safety and quality of railway transport are always relevant. The uninterrupted operation of transport is very important. The experience of the Japanese railways

would be very useful for our country.

### **Setting of the problem and the aim of the article**

These days, computers are used in every sphere of human live. The sphere of railways is not an exception. The aim of this article is a demonstration of how computers can be used in railway industry using Japan as an example.

### **Discussion and Results**

In Japan after 1953, the movement to improve the performance of trains began with the introduction of new technologies from Europe and the United States and the technological development of domestic manufacturers. In 1950, S. Oda, a member of JNR insisted in the report of his business trip to USA that telecommunication is the most important technology for the modernization of railway business, and the critical factors are the automation and electronic technology. Dr. E Hosaka, a member of Railway Technical Research Institute (RTRI) of JNR, on returning from his study at MIT, also told his colleagues at the institute that information processing and automation engineering are important subjects from now on, and the R&Ds to apply computer technologies to freight and passenger transport, and train traffic control started [1, p. 2].

When the Tokaido Shinkansen opened on October 1, 1964, Centralized Traffic Control (CTC) system was used to manage the operations of the Shinkansen. In the report of Railway Communications committee commissioned by JNR, the concept of “Computer-aided train traffic control system based on CTC” was proposed in 1958. This device displays the direction, position, train number, signal display, speed, and various alarms / turnouts of all trains operating within the jurisdiction on the display panel, installed in the general command room. Dispatcher was supposed to always grasp the driving situation by looking at this display panel, and manually operate the turnout and give immediate instructions by using interlocking. However, increased number of trains would increase burden on dispatchers. Considering increasing transport demands and even more diversified running patterns of trains due to the extension of Shinkansen lines, just increasing the number of dispatchers was insufficient to avoid serious problems and situation in train operation. To solve these

problems, it was required to introduce a computer system into the train control and traffic management.

In 1960's the Japanese National Railways at that time, along with Hitachi company, having a track record of jointly developing MARS, a computer system for reservation and ticketing, started collaborating. The world's first PTC (Programmed Traffic Control), the Shinkansen operation management system COMTRAC, was developed in 1970, and after trial operation, introduced in 1972 when the Sanyo Shinkansen opened. Trains' progress can be constantly monitored with screens showing where each train is. This system helps to ensure that there are no collisions, as CTC can clearly see where all trains are, what speed they are going at, and where they are going to. After that, COMTRAC was reorganized with the extension of routes and the development of computer technology.

COMTRAC is required to be highly reliable and responsive in real time, because it has to control high-speed Shinkansen operation, and it also needs to have an excellent man-machine interface which enables the dispatchers to communicate efficiently with the computer and to perform appropriate judgments and actions.

COMTRAC system consists of different subsystems:

**Course control system.** Also called PRC (Programmed Route Control) system. Based on the schedule of all the trains of the day, the railroad switches of all the lines of the Tokaido and Sanyo Shinkansen are automatically controlled via CTC, and the trains are accurately directed to enterstation tracks. In addition, in case abnormality such as delay occurs, a warning is issued, and after the operation arrangement system (speed restriction, change of sidetracks train waiting, suspension of operation and special train operation) is automatically calculated, the manual operation by dispatcher is supported. The PRC system consists of the following devices: CTC device, PRC device, ATC (Automatic Train Control) device. [10]

ATC system automatically controls the speed by powering and braking to follow the target speed of operation. The target speed is set by taking account of the ATC restriction, on-schedule running, and energy-efficient operation. The basic action of the system is as follows. Firstly, it accelerates up to the speed just below the

ATC restriction. Secondly, it keeps the train at the maximum permissible speed with extreme accuracy. Thirdly, it stops accelerating at the point allowing on-schedule operation to the destination. The accurate operation at the maximum permissible speed reduces the loss of running time. [7, p. 86]

**Information processing system.** Also called EDP (Electronic Data Processing) system. It mainly performs information processing, such as operation and the maintenance schedule of trains, the operation schemes of train cars/vehicles, information transmission to the crew basestation and the vehicle base, and the control of broadcasting for passengers. The EDP system consists of the following devices:

TID (Traffic Information Display) – a device for providing information such as a train position and delay of a train on a railway. Device displays the train number, the location on the line, the time of delay, etc.

SMIS (Shinkansen Management Information System) – system that integrates the management of vehicles, railways, electric power, and signal equipment.

**Operation display system.** Also called MAP (Man-Machine Advanced Processor) system. The position of trains, the opening direction of the railroad switches, which are sent from the CTC or the PRC, as well as the meteorological data such as wind speed, rainfall and snowfall amounts, which are sent from the monitoring device along the railway line, are displayed on the operation display board. It is also connected to UrEDAS (Urgent Earthquake Detection and Alarm System), and gives an alarm signal when an earthquake occurs, and stops all trains immediately. [10]

Also ARIS (Advanced Rolling Stock Information Management System) can be mentioned. ATC data, driving parts, air conditioning equipment, vehicle body tilting devices, etc., are recorded during driving, and ARIS is responsible for providing analysis of it to give information about its condition, if there is a need for repair. Inspection and repair information is stored in the database. From the database this information is available for SMIS and COMTRAC [3, p. 6-7].

The development know-how of COMTRAC succeeded the development of a variety of train operation management systems such as COSMOS, SIRIUS and

ATOS that fit the characteristics of railway operators and railway lines. Computerized Safety, Maintenance and Operation Systems of Shinkansen (COSMOS) comprehensively developed Shinkansen system - COMTRAC, which was introduced into the functioning of to the Tohoku Shinkansen and the Joetsu Shinkansen from the start of their operation. Kyushu Shinkansen command system (SIRIUS - Super Intelligent Resource and Innovated Utility for Shinkansen Management), which combined system that considered the coordination of both the Shinkansen and the regular railway lines using the same track at the platform. [10]

The East Japan Railway Company has Shinkansen lines operating about 800 trains per day, dispatching nearly 250 drivers and 350 crew per day to make the trains operational. To keep the operation plan and management of Shinkansen in order, there is the system named COSMOS. In 1995, due to out-of-date computer systems of COMTRAC, COSMOS was developed.

COSMOS has seven sub-systems –the TPS (Transportation plan system) (train planning, rolling stock operation and use plannings, crew allocation planning, transmission of transportation plans, sales information, statistics), the OCS (Operation control system) (operation control, station route control, diagram management, passenger guidance), the Yard management system (work planning in depots, route control in depots), the Maintenance work control system (maintenance work planning, maintenance work management, routing configuration for maintenance cars), the Rolling stock control system (equipment management, failure management, history management), the Centralized monitoring system (preventive disaster information, facility monitoring) and the Electric power control system (substation control, facility monitoring). In COSMOS, these seven sub-systems are cooperating elaborately. In 1995 when the system was first developed, there were eight subsystems including a facility management system, which was then merged into the system for the conventional lines [6, p. 3].

TPS includes two scheduling systems for drivers and crew. The first one is a function to perform planning and management of the driver and crew scheduling several months in advance. Another function, as driver and crew scheduling is

planned beforehand, reschedules when the train is delayed. This function is called “Rescheduling for driver and crew”.

In the OCS, the forecast train scheduling data is made with the system so far. This data is a calculation of the scheduled departure and arrival times at each train station and the forecasted arrival and departure times according to actual events. The forecast train scheduling data, called “FTS”, periodically displays the information once a minute in this system. When the train is delayed, this system calculates the delay time of the departure and arrival at each station [4, p. 228].

SIRIUS has been in operation from the time of partial opening of the Kyushu Shinkansen Kagoshima route in 2004. It enabled connection control with the conventional lines and was responsible for interaction with Sanyo Shinkansen since it opened completely in 2011. Thus its main feature is smooth cooperation with other systems. SIRIUS consists of the following subsystems that form a total support from trainoperation planning to actual daily operation: TPS, OCS, Work management system, Monitoring system[9].

Work management system controls use of electric power by the Shinkansen trains and by wayside equipment. It also prepares and manages plans for performing rolling stock inspections and other daily maintenance work.

Monitoring system supplies information, such as rainfall,wind speed, seismic data, and rail temperatures, for preventing disasters along the line. This subsystem also monitors position and status information from in-service rolling stock.

The OCS consists of an information management system, traffic management system (PRC), and train radio system, with the information management and traffic management systems being responsible for exchanging data with COMTRAC. This system implements daily train operation of all lines based on the train timetables received from the TPS. PRC determines train positions based on the information of line occupation, train number and signals received from the on-site interlocking devices[2, p. 332].

Information management system working with the OCS,sends the timetable change to each station and crew office in real time so as to ensure immediate response

to that change[8, p. 126].

The Hokkaido Shinkansen system (Computer system for signal control and useful maintenance of Hokkaido Shinkansen CYGNUS) development started in 2016. Hokkaido Shinkansen is connected to the Shinkansen synthesis system (COSMOS) of the company, for connection with Tohoku Shinkansen. Given the difficulty of using COSMOS to manage schedules for conventional freight trains with very different operating practices, a decision was made for the JRHokkaido jurisdiction to develop a new integrated Shinkansen system (CYGNUS) for the Hokkaido Shinkansen line that is separate from COSMOS, and that can perform integrated management of both the Shinkansen and the conventional trains that run on shared track.

The CYGNUS traffic management system manages train operations in the JR Hokkaido jurisdiction over the course of a day. Display of information about the status of operations along the entire length of the Hokkaido Shinkansen line, automatic route setting, and scheduling are all performed on the traffic management hub. The CYGNUS traffic management system also has functions for engineering works management.

COSMOS manages the Hokkaido Shinkansen schedules along the entire length of the Shinkansen line between Tokyo and Shin-Hakodate-Hokuto, while CYGNUS manages the schedules for the Shinkansen and conventional lines between Shin-Aomori and Shin-Hakodate Hokuto that are under the jurisdiction of JR-Hokkaido. The CYGNUS traffic management system has a centralized configuration and manages both Shinkansen and conventional train traffic on lines under JR-Hokkaido jurisdiction [5, p. 30].

## **Conclusions**

Nowadays, different computer systems are used in different parts of Japan. SIRIUS (Super Intelligent Resource and Innovated Utility for Shinkansen Management) is maintained by JR Kyushu company on the Kyushu Shinkansen. COSMOS (Computerized Safety, Maintenance and Operation Systems of Shinkansen) is operating by JR Tokai and JR West on Tohoku Shinkansen, Joetsu

Shinkansen, Hokuriku Shinkansen, Yamagata Shinkansen, Akita Shinkansen. COMTRAC (Computer Aided Traffic Control) is used by JR East and JR West companies on Tokaido and Sanyo Shinkansen. JR Hokkaido applies CYGNUS (Computer system for signal control and useful maintenance of Hokkaido Shinkansen) on Hokkaido Shinkansen.

They are highly reliable real-time control systems, including the real-time automatic control of signalers and the assistance of rescheduling through the forecast of train diagrams, support the high-speed, high-density, accurate, and stable transportation of shinkansen trains.

## References

1. Akita, K., and Hasegawa, Y. (2015).History of COMTRAC – Development of Innovative Traffic Control System for Shinkansen, 8
2. Harada, M., Mori, H., Osonoi, H., Ohira, T., Koike, T., and Iwama, N. (2012). Shinkansen Traffic Management System for Mutual Direct Operation of Sanyo Shinkansen and Kyushu Shinkansen.*Hitachi Review Vol. 61, 351, 331-335*
3. Okabe, H., Suzuki, M., and Hokari, H. (2013). Improvement of Advanced Rolling Stock Information Management System.*Japanese Railway Engineering No. 180, 22, 6-9*
4. Shimizu, H., Tanabe, H., Honda, S. and Yasura, K. (2006).The new Shinkansen rescheduling system for drivers and crew.*Computers in Railways X, 985, 227-234*
5. Sugai, T., Tanabe, H., Tamura, S., Tsuchiya, Y., Isogai, M., Ohta, K., Yamami, T., and Sato, M. (2016). Traffic Management Systems for Expanding Shinkansen Network with Trouble-free Operation of Mutual Direct Trains. *Hitachi Review Vol. 65, 486, 26-33*
6. Suzuki, H. (2014). Advanced Operation Arrangement Support System of the Shinkansen Integrated System “COSMOS”. *Japanese Railway Engineering No. 183, 22, 2-5*
7. Yasui, Y. (2006).Automatic train operation system for the high speed Shinkansen train.*Computers in Railways X, 985, 441-446*
8. Yoshino, Y. (2010). Linkage of a conventional line dispatch system with the Shinkansen dispatch system. *Computers in Railways XII, 987, 121-131*
9. Shinkansen Traffic Management Systems. Available at:  
[https://www.hitachi.com/products/it/control\\_sys/railway\\_solution/safety\\_transport/shinkansen.html](https://www.hitachi.com/products/it/control_sys/railway_solution/safety_transport/shinkansen.html)
10. Shinkansen operation management system (in Japanese). Available at:  
<https://ja.wikipedia.org/wiki/新幹線運行管理システム>

# INVESTIGATION OF WAYS TO OPTIMIZE BUNCHES OF CHARGED PARTICLES THAT ARE FORMED DURING WAKEFIELD ACCELERATION IN HIGH-DENSITY PLASMA

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**Анотація.** Останнім часом масштаби енергій, що розглядаються вченими у їхніх дослідженнях, значно зросли. Крім того, вимоги до прискорених згустків стали більш жорсткими - вони повинні бути в значною мірою сфокусованими, а також, моноенергетичними. Пошук шляхів зменшення просторових розмірів та розподілу енергії згустків електронів – не проста, але важлива й нагальна проблема. У цьому листі розглядаються лише самоінжектовані згустки. Вони утворюються в результаті процесів збудження кільватерного поля лазерним імпульсом у плазмі та подальшого прискорення електронів. Формуючи лазерні імпульси, а саме змінюючи їх інтенсивність, довжину та амплітуду, ми отримуємо умови формування самоузгодженого і рівномірного для всього самоінжектованого згустку електричного поля прискорення.

Автори досліджують поле в області самоінжектованих згустків, а також величину радіальної сили, що діє на них. Крім того, оцінюється розмір згустків та розподіл імпульсів (енергії) їхніх частинок. Порівнюються два випадки: випадок із профільованими та однаковими самоінжектованим згустками. Це вигідний спосіб отримання самоінжектованих згустків з невеликим просторовим та енергетичним розкидом. Дослідження було виконано з використанням 2D (з урахуванням радіальної залежності) чисельного моделювання. У дослідженні кільватерне поле збуджується високоінтенсивними лазерними імпульсами з середньою інтенсивністю  $W = 2 \cdot 10^{18} W / cm^2$ . Для дослідження щільність плазми вибрана такою, що дорівнює  $1.8 \cdot 10^{22} cm^{-3}$ . Довжина хвилі лазерного випромінювання дорівнює декільком нанометрам. Ці параметри були обрані відповідно до пропозиції професора Т. Таджими щодо прискорення лазером в металі. У той же час автори стверджують, що розглянута задача є масштабовою за певних умов.

**Ключові слова:** кільватерне поле, плазма, самоінжектований, лазер, прискорення, фокусування

**Abstract.** Recently, the scale of energies considered by scientists in their research has

increased significantly. In addition, the requirements for accelerated bunches have become more stringent - they must be largely focused as well as monoenergetic. The search for ways to reduce the spatial dimensions and energy spread of electron bunches is not a simple, but important and urgent problem. In this letter only self-injected bunches are considered. They are formed as a result of the processes of excitation of a wakefield by a laser pulse in plasma and the subsequent electrons acceleration. By shaping laser pulses and namely by varying their intensity, length and amplitude, we obtain conditions of forming a self-consistent and uniform for the entire self-injected bunch accelerating electric field. The authors investigate the field in the region of self-injected bunches, as well as the magnitude of the radial force that acts on them. In addition, the size of the bunches and their spread in momenta (energy) are estimated. Two cases are compared: the case of shaped and identical self-injected laser pulses. This is a direct way of obtaining self-injected bunches with a small spatial and energy spread. The study was carried out using 2D (also considering radial dependence) numerical modeling. In the study under consideration, the wakefield is excited by high-intensity laser pulses with  $a_0 \ll 2$ , which corresponds approximately to the intensity  $W = 2 \cdot 10^{18} W/cm^2$ . For the study, the plasma density is chosen to be equal to  $1.8 \cdot 10^{22} cm^{-3}$ . The wavelength of the laser radiation equals several nanometers. These parameters were chosen in accordance with professor T. Tajima's proposal on wake acceleration in metal. At the same time, the authors state that the problem is scalable under certain conditions.

**Key words:** wakefield, plasma, self-injected, laser, acceleration, focusing

### **General formulation of research and its topicality**

In short, the issue of wake acceleration is always relevant. Standard methods for producing high-energy particles are outdated. Even using a laser, the maximum that can be obtained in them is the acceleration of several hundred megavolts up to gigavolts per meter in the dielectric and metal structures (for example, the works of R. J. England, A. D. Kanareykin, J. Breuer and many others).

There is a fair number of theoretical researches and experiments on laser acceleration. In particular, in [1, pp. 1-5] it was obtained that acceleration rate exceeds 40 GV per meter when using a laser. Simultaneously in another experiment [2, pp. 741-744] an electron bunch excites wakefield and provides acceleration rate for subsequent bunch more than 80 GV per meter.

The usage of laser wakefield acceleration makes it possible to increase the

acceleration rate by several times in comparison with dielectric accelerators [3, pp. 2-4] case and by hundreds of times in comparison with the maximal rate of one hundred megavolts per meter in metallic structures.

One of the most important tasks is to ensure the focus of the bunches. Wakefield focusing were discussed in [4, pp. 159-163].

In this article focusing of self-injected bunches and the region of zero radial wake force will be studied.

Authors study the self-consistent fields of self-injected bunches. The dynamics of self-injected bunches is studied in detail in several sources [6, pp. 422-425].

In [5, pp. 73-76] the wakefield excitation by sequence of electron bunches was investigated. Previous and current researches, as well as experiments have shown the feasibility of laser wake acceleration [8, pp. 97-99]. In particular, Professor T. Tajima suggested using an X-ray laser pulse to excite a wakefield. A laser with a wavelength of several nanometers is also used in this study. General analysis of laser-plasma acceleration is presented in [7, pp. 267-270].

According to Tajima's proposal, the authors considered plasma with a density equal to the density of metal [7, pp. 267-270].

Thus, the proposed study is relevant, since it combines several ways to increase the efficiency of acceleration and focusing of electron bunches.

### **Setting of the problem and the aim of the article**

This article is devoted to the study of the dynamics of laser pulses in plasma. The aim of the letter is to study self-injected bunches (object of the study), their configurations, parameters and fields (subject of the study) to ensure the highest rate of acceleration of charged particles in plasma. In particular, wakefield excited in plasma is used for bunches production. The results obtained are compared with the case of the absence of laser pulse shaping. More precisely, in this letter the authors propose to consider the process of the formation of self-injected bunches when the wakefield is excited by a chain of shaped laser pulses in plasma whose density is approximately equal to the density of the metal. The authors state that such a configuration makes it possible to achieve a minimal (not exceeding several percent)

deviation of bunch particles energy from their average energy. Moreover, the size of the self-injected bunches is such that it is several times smaller than the size of the wake bubble. At the same time the accelerating field gradients were obtained reaching values of hundreds of gigavolts per meter.

Shaped bunches and basic principles of shaping were studied in [9, pp. 81-99].

The relevance of the work is due to the need to improve the existing charged particle accelerators. The letter looks at promising technologies (high-intensity X-Rays lasers, for example) in a scalable task. Therefore, this work is promising from the point of view of further analysis and continuation of research.

## **Discussion and Results**

For simulation the UMKA code was used which is specially developed for calculating the dynamics of lasers propagation in plasma [10, p. 37]. The code is two-dimensional (the third dimension is uniform) and allows investigating the velocities and fields of particles in three directions. The relativistic case is considered. The process is considered in Cartesian coordinates. The modeling area is rectangular. Its size is 300 units along the  $x$ -axis and 50 units along the  $y$ -axis. The unit of length corresponds to the wavelength of the laser  $\lambda$ . One should keep in mind that normalized physical quantities are given in the text of the article. The following boundary conditions were used: along the  $y$  axis, the boundary conditions are periodic for particles and fields. The plasma is open along the  $x$  axis.  $a = eE / (m_e c \omega_0)$  – is the amplitude of the laser pulse at the initial time of the simulation.  $E$  - is the laser pulse amplitude in CGS units.  $t_0 = 2\pi / \omega_0$  is the normalized unit of time. The momentum values in figures are the values of the gamma factor in the expression:  $P = m_e c \gamma$ , where  $m_e$  is electron mass,  $c$  is speed of light.

The simulation timestep is  $\tau = 0.05$ .  $\omega_0$  is defined from  $n_0 = m_e \omega_0^2 / (16\pi^3 e^2)$ .

In short, the simulation picture is as follows. A laser pulse with  $s$  polarization penetrates through one of the boundaries of the modeling region and propagates in

the plasma along the  $x$  axis. The plasma density is mainly considered equal to  $n_0 = 1.8 \cdot 10^{22} \text{ cm}^{-3}$ . The laser pulses are Gaussian distributed. Also, the laser impulses are shaped according to the such scheme: [1<sup>st</sup> pulse]: radius(1), length(8), amplitude(1); [2<sup>nd</sup> pulse]: radius(2), length(4), amplitude(1.732). Numbers mean laser wavelength and laser amplitude. Several data were obtained from previous researches [11, pp. 39-42].

The simulation results indicate that the use of pulses shaping makes it possible to achieve the so-called “plateau”. It means a uniform longitudinal field and, at the same time, a zero-radial force. A consequence of this effect is a small spread in the electron energies of self-injected bunches. The simulation results show the best pattern at the time point that corresponds to 140 laser periods from the beginning of simulation. In this article, two cases were considered. One case is the shaped laser pulses mentioned above. The other case is three identical laser pulses, with parameters corresponding to the parameters of the second shaped pulse. Fig. 1 and 2 show the distribution of the plasma electron density  $n_e(x, y)$  as well as the accelerating field for a sequence of shaped laser pulses. Darker tones indicate a higher density of plasma electrons and vice versa. Fig. 2 (a) and Fig. 2 (b) show that in the region of self-injected bunches the accelerating field  $E_x(\xi)$ ,  $\xi = x - V_g t$  is constant. For a self-injected bunch after the first laser pulse, it can be seen that practically the entire bunch is in a constant longitudinal accelerating field. Then, if the bunch is not deformed and the plateau is observed at the moment of self-injection, the plateau can be located on  $E_x(x)$  at any point where the bunch is accelerated. It looks like the plateau is «moving with the bunch». In our case in the area of location of point (very short) self-injected and accelerated electron bunch, micro-plateau on  $E_x(x)$  is realized (see Fig. 1, 2). We are considering the simulation results at a certain point in time. In Fig. 3 one can see everything is the same as in Fig. 1, 2 but for the case of equal pulses. This is another part of research that shows shaping absence effect. First of all, the self-injected bunch after the first laser pulse becomes indistinguishable. The density of electrons in the region of this bunch is too low (Fig.

2 (a)). In addition, it can be clearly seen from Fig. 2 (b) that the self-injected bunch after the second laser pulse is almost completely in an inhomogeneous field, with the exception of a small part at the beginning of the bunch. The transverse and longitudinal dimensions of the self-injected bunches are 7 times smaller than the transverse and longitudinal dimensions of the wake bubble in the case of equal pulses (Fig. 3). In the case of shaped pulses, such a ratio of the sizes of self-injected bunches and wake bubbles is observed: for the first self-injected bunch width/length ratio is 17 for width and 10 for length. For the second bunch this ratio is 6 for width and 7 for length. Thus, it can be concluded that shaping is advantageous for the formation of a "plateau" of the accelerating electric field for bunches like the bunch after the first laser pulse.

Shaping allows the self-injected bunches to be more focused. In Fig. 4 (a), 4 (b) one can see the dependence of the radial focusing (defocusing) force from the transverse coordinate. It can be seen from the figures that for both cases of shaped and identical pulses the radial force is  $F_r(r) \approx 0$  at the area of self-injected bunches. For all these figures, the  $x$  coordinate is chosen to correspond to the middle of the bunches. This shows that the scattering of bunches in the radial direction in both cases is minimal. However, the Fig. 1 (a), 1 (b) and Fig. 3 (a), 3(b) indicate that focusing is better in the case of shaped pulses.

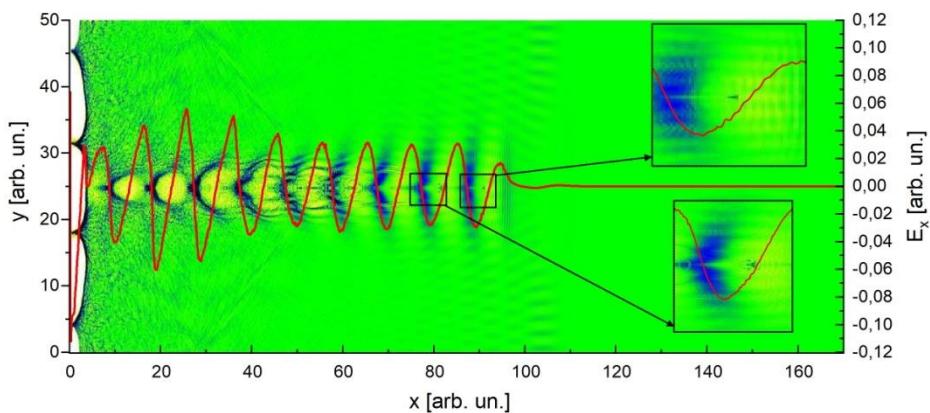


Fig. 1. Plasma density distribution and longitudinal wakefield  $E_x$  (strong line) graph when wakefield excited by the sequence of shaped laser pulses. Common view.

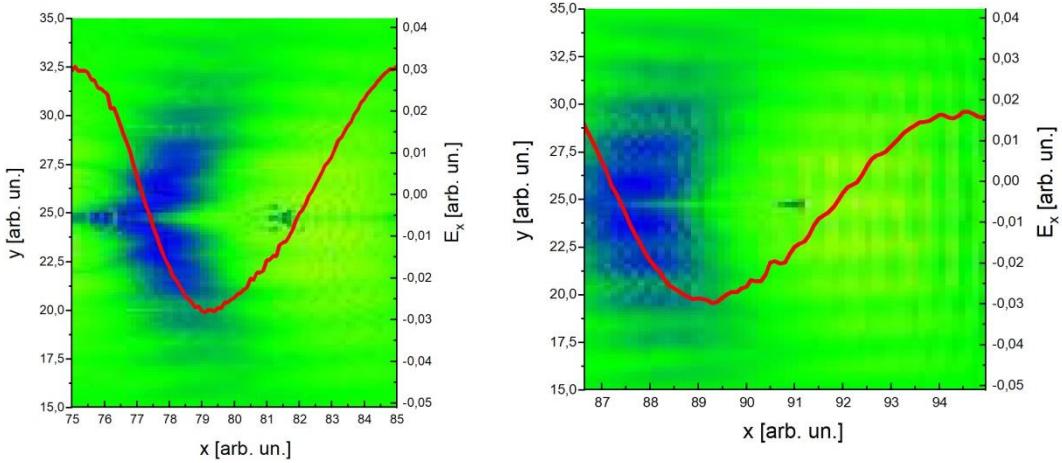
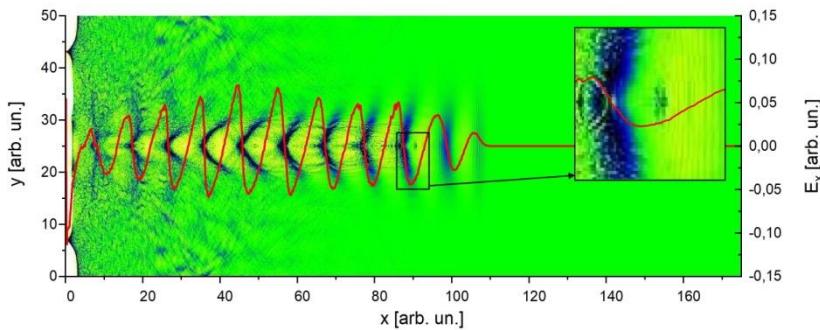


Fig. 2. Plasma density distribution and longitudinal wakefield  $E_x$  (strong line) for shaped lasers. Left (a) picture is the 2<sup>nd</sup> pulse and right (b) picture is the 1<sup>st</sup> pulse. The bunch obviously has a smaller radius. Fig. 5 (a), 5 (b) show the distribution of the momentum longitudinal component depending on the coordinates. It can be determined that in the case of identical laser pulses, the electron energy of self-injected bunches seems higher than energy in the case of shaped pulses. In the case of shaped lasers, the electron energy reaches (average) 12 MeV and in the case of identical laser pulses, the energy averages about 40 MeV.

We shall consider the first bunches (bunches after the first laser pulse in both cases) because of first bunches better focusing. In the case of equal laser pulses the bunch is strongly defocused along the radius, and the energy spread reaches 50%. In the equal pulses case, self-injected bunch is focused, and the energy spread is less than 10%. Moreover, in both cases, the magnitude of the accelerating field reaches 500 GV / m and more.



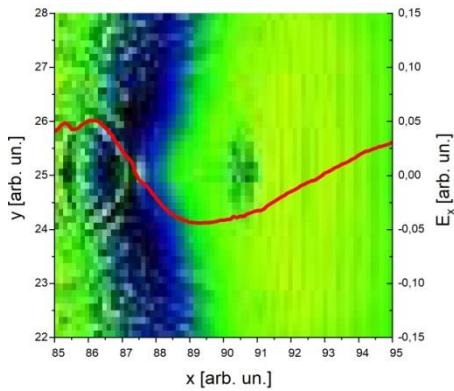


Fig. 3. Plasma density distribution and longitudinal wakefield  $E_x$  (strong line) for equal pulses. Left (a) is the common view. Right (b) is detailed view of 2<sup>nd</sup> bunch

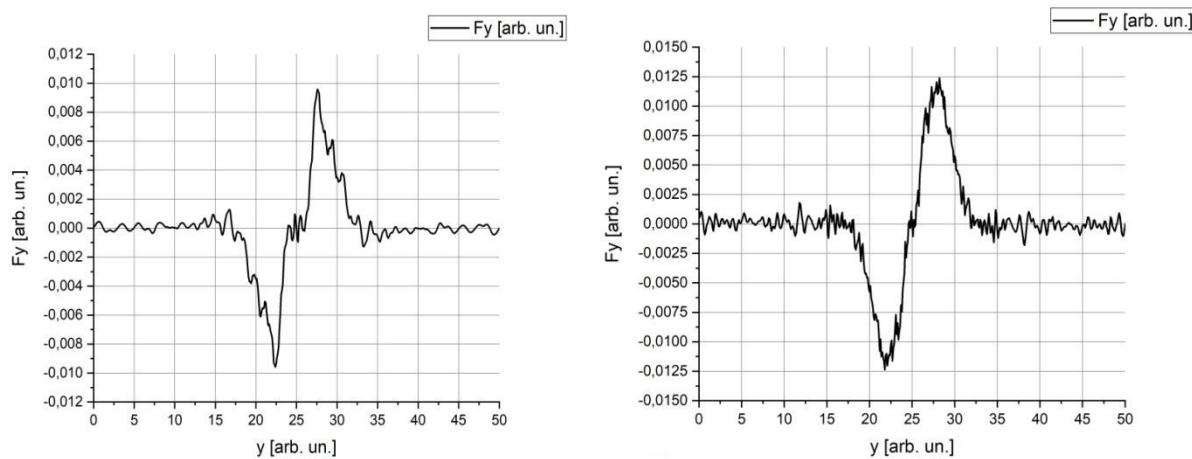
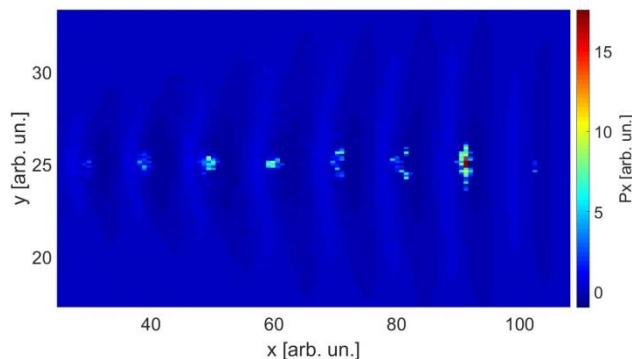


Fig. 4.  $F_y$  – transverse focusing force acting on self-injected bunches in the case of shaped laser pulses. Left (a) related to the first bunch, right (b) related to the 2<sup>nd</sup> self-injected bunch.



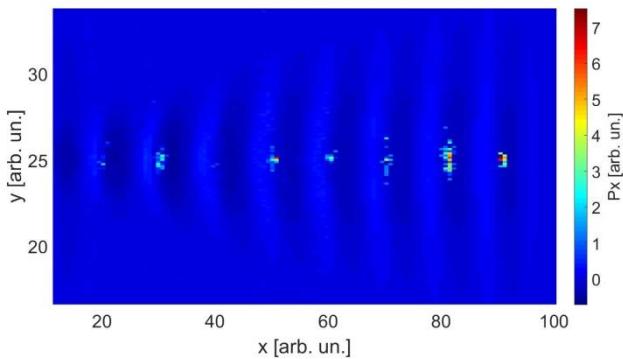


Fig. 5. Density plot of  $p_x$  that illustrate energy scattering. The  $x$ ,  $y$  and also  $p_x$  are space dimensions and momentum in arb. units. Left figure (a) related to the case of equal laser pulses. Right figure (b) related to the case of shaped laser pulses.

## Conclusions

The dynamics of laser pulses in two cases was investigated: in one case, lasers are shaped by intensity, length, and radius; in another case all three pulses of the sequence are the same. It was shown that the chosen parameters make it possible in both cases to achieve results at which the transverse and longitudinal dimensions of self-injected bunches are several times smaller than the corresponding dimensions of wake bubbles. Nevertheless, results of the shaped pulses investigation are more suitable for bunches focusing. The conditions were found to provide the better spatial and energy configuration of the accelerating fields.

## Acknowledgements

This work is supported by National Research Fund of Ukraine «Support for research of leading and young scientists» grant «Transport of electron/positron bunches at high-gradient acceleration by electromagnetic fields excited in dielectric structures or plasma by a high power electron bunches and an intense laser pulse» 193/02.2020.

## References

1. Leemans W. P., Gonsalves A. J., Mao H.-S. et al (2014). Multi-GeV Electron Beams from Capillary-Discharge-Guided Subpetawatt Laser Pulses in the Self-Trapping Regime. *Phys. Rev. Lett.*, 113.
2. Blumenfeld I., Clayton C. E., Decker F.-J. et al (2007). Energy doubling of 42 GeV electrons in a metre-scale plasma wakefield accelerator. *Nature, L.*, 445.
3. Thompson M. C., Badakov H., Cook A. M. et al (2008). Breakdown Limits on Gigavolt-per-Meter Electron-Beam-Driven Wakefields in Dielectric Structures. *Phys. Rev. Lett.*, 100.
4. Lotov K. V., Maslov V. I.,

Onishchenko I. N. et al (2012). Homogeneous Focusing of Electron Bunch Sequence by Plasma Wakefield. *Problems of Atomic Science & Technology*, 3. 5. Lotov K. V., Maslov V. I., Onishchenko I. N., Yarovaya I. P. (2013). Mechanisms of Synchronization of Relativistic Electron Bunches at Wakefield Excitation in Plasma. *Problems of Atomic Science & Technology*, 4. 6. Maslov V. I., Svystun O. M., Onishchenko I. N. et al (2016). Dynamics of Electron Bunches at the Laser-Plasma Interaction in the Bubble Regime. *Nuclear Instruments and Methods in Physics Research A*, 829. 7. Tajima T., Dawson J. M. (1979). Laser Electron Accelerator. *Phys. Rev. L.*, 43. 8. Fainberg Ya. B., Ayzatsky N. I., Balakirev V. A., Berezin A. K. et al (1997). Study of excitation of wakefields in plasma by bunches of relativistic electrons. *Problems of Atomic Science & Technology*, 4. 9. Katsouleas T., Wilks S., Chen P., Dawson T. J. M., Su J. J. (1987). Beam Loading In Plasma Accelerators. *Particle Accelerators*, 22. 10. Dudnikova G. I. et al (2005). Parallel algorithms for numerical simulation of propagation of an electromagnetic radiation in plasma. *Comp. Techn.*, 10 (1), 37. 11. Maslov V. I., Bondar D. S., Grigorenko V., Levchuk I. P., Onishchenko I. N. (2019). Control of Characteristics of Self-injected and Accelerated Electron Bunch Inplasma by Laser Pulse Shaping on Radius, Intensity and Shape. *PAST*, 6.

УДК: 004.032.26

## NEURAL NETWORKS

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### **Анотація. Бугай М.А. Нейронні мережі.**

У цій статті розглядаються основи проектування нейронних мереж. Розглянуто біологічну основу нейронних мереж та її спрощення для програмної реалізації. У статті розглянуто історію розробки нейронних мереж, будову природного та штучного нейронів, схематично зображені їх елементи. Визначено функції аксонів та дендритів. Дано визначення синапсису. Детально розглянуто алгоритм обробки вхідних сигналів із використанням вагових коефіцієнтів. Розглянуто різні функції активації нейронів та побудовані їхні графіки. Представлено спосіб знаходження вагових коефіцієнтів.

**Ключові слова:** штучні нейронні мережі, персепtron, вагові коефіцієнти, функція активації

### **Abstract. Buhai M.A. Neural networks.**

The article deals with designing neural networks. The biological basis of neural networks has been examined, as well as, its simplification for the program realization. The history of neural

networks development has been reviewed. The structure of biological and artificial neurons is presented and depicted schematically. The functions of axons and dendrites is defined. The definition of the synapses is given. The algorithm of input signals processing by using synaptic transmission efficiency is examined in detail. Different activation functions are considered and their graphs are built. The method of obtaining the weights of synaptic transmission efficiency is offered.

**Keywords:** artificial neural networks, perceptron, synaptic transmission efficiency, activation function

### **General formulation of research and its topicality**

Artificial neural networks are a rough model of brain, which can be created by using electronic devices. As a result, we obtain very complex nonlinear system, which is able to perform parallel computing.

Neural networks help to optimize calculations and make them much faster. They also work in the fields where the classical algorithms do not work. For example, neural networks are used for computer vision, voice recognition, nonlinear calculations, etc[2,p. 1].

### **Setting of the problem and the aim of the article**

**Subject-matter:** artificial neural networks as way of solving tasks.

**Object-matter:** getting acquainted with the development of artificial neural networks and the prospects of their usage.

**Methods:** description and analysis.

**Materials:** the leading experts' publications in the field of programming and mathematical analysis.

## **Discussion and Results**

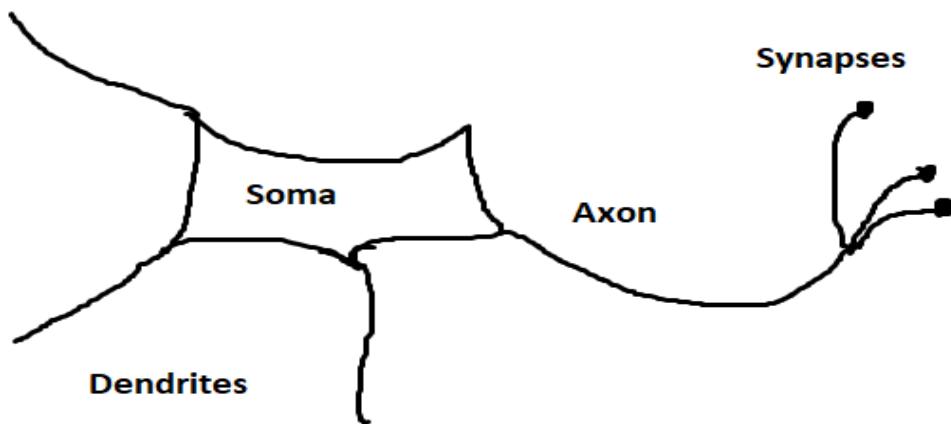
First attempts to make artificial neural network were made at the end of the 1950s. The most famous model of the simplest artificial neural networks is the perceptron which was developed by Frank Rosenblatt. Unfortunately, the disadvantage of this model is that it cannot be used for all purposes. Therefore, from 1969 until the early 1980s artificial neural networks lost their popularity.

Nevertheless, researches were still being carried out during those years.

The breakthrough occurred in the 1980s, when the researches proposing solution to the perceptron's problem were published [4,p. 6].

However, to develop a neural network it is necessary to understand the human brain's work. It is a complex system, based on neurons – cells that can send and receive electrochemical signals from each other. The simplified model of the neuron is presented in the Fig. 1. There are dendrites, which receive information, and axon, which sends it. The body of the neuron is named soma. The particular connection between axons and dendrites is named synapses [1,p 3-4].

The transfer of electrochemical pulses can be characterized by synaptic transmission efficiency, or coefficient  $w$ . If  $w$  is more than 0, synapses is named excitatory. Otherwise it is named inhibitory. The sum of pulses from dendrites activates cell, and it impacts axon of the next cell. But sometimes cell does not activate even if the sum is bigger than a certain number.



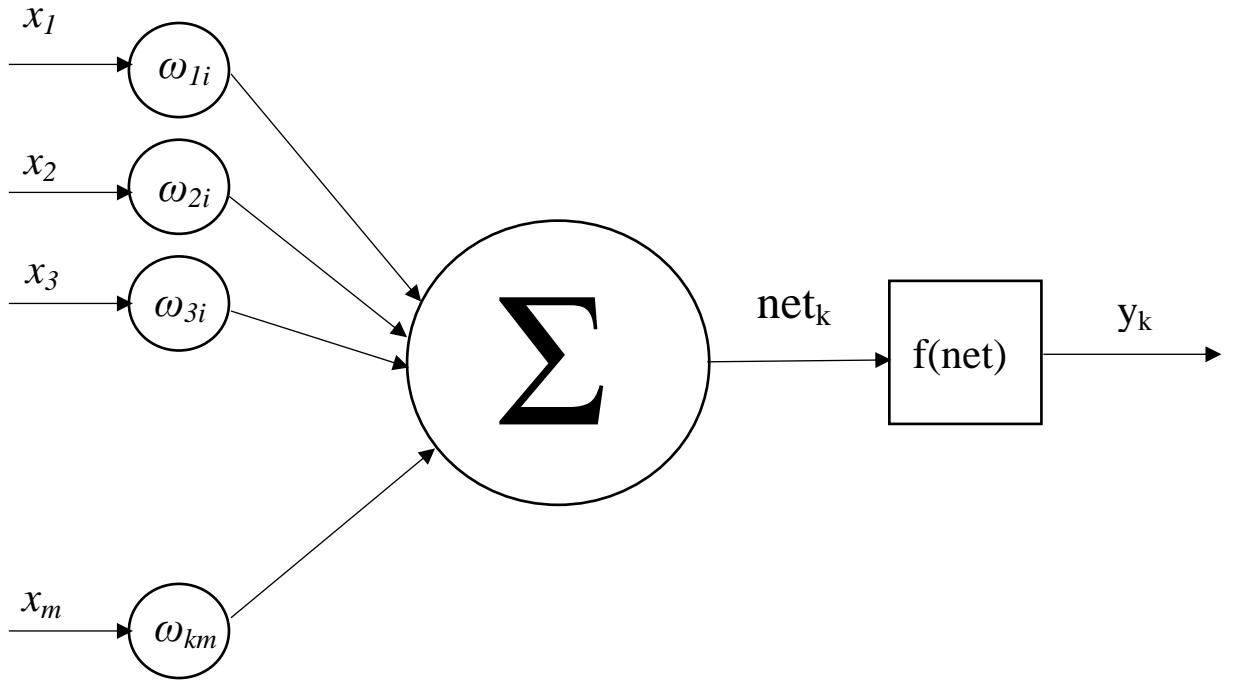
*Fig.1. Biological neuron*

An artificial neuron is a simplified model of biological neuron. Fig. 2 shows a model of an artificial neuron.

Every artificial neuron has its own inputs (there can be a lot of them), a body and one output, just like a biological neuron [3,p. 6-7].

Every input signal  $x_j$  is multiplied to weight  $w_{kj}$  of  $j$  input. Then all weighted inputs are summed up by using function  $net$ :

$$net_k = \sum_j^m w_{kj} x_j \#(1)$$



*Fig.2. Artificial neuron*

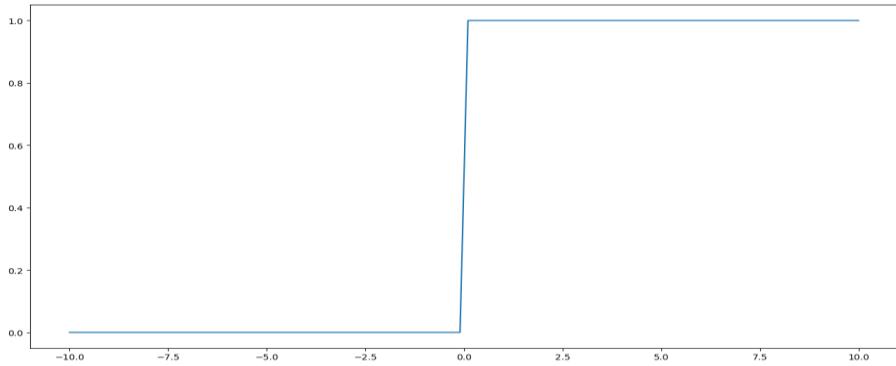
After that,  $net_k$  is converted into an activation value by using activation function to calculate the output  $y_k$  [1,p. 4]:

$$y_k = f(net_k) \#(2)$$

The optimal activation function has not been discovered yet, but it is possible to use some of them.

1. The threshold function is determined by the equation (3):

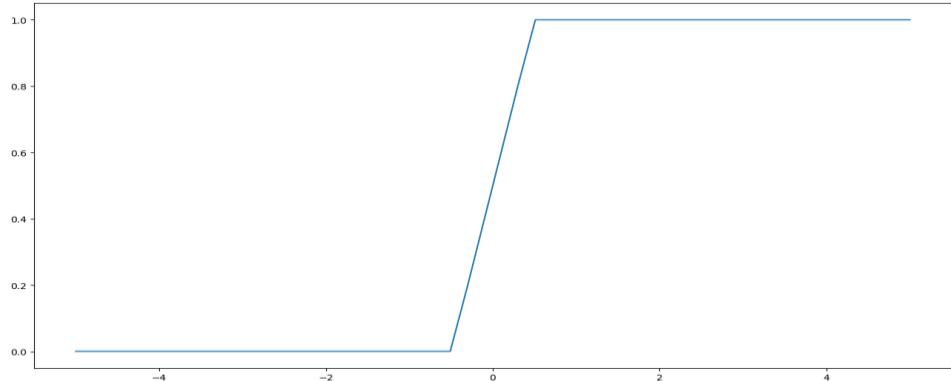
$$f(net) = \begin{cases} 1, & net \geq 0 \\ 0, & net < 0 \end{cases} \#(3)$$



*Fig.3. Piecewise function*

2. The piecewise-linear function is shown by the equation (4):

$$f(\text{net}) = \begin{cases} 1, \text{net} \geq \frac{1}{2} \\ \text{net}, -\frac{1}{2} < \text{net} < \frac{1}{2} \#(4) \\ 0, \text{net} \leq -\frac{1}{2} \end{cases}$$

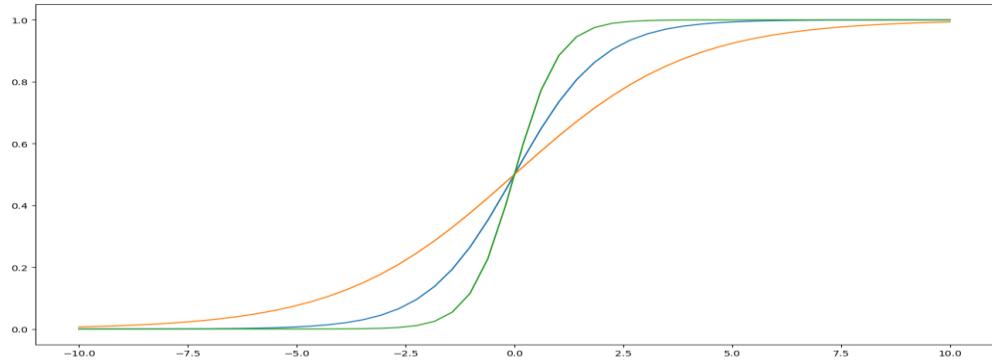


*Fig.4. Piecewise-linear function*

3. A sigmoid function is represented by the equation (5):

$$f(\text{net}) = \frac{1}{1 + e^{-\alpha \text{net}}} \#(5)$$

where  $\alpha$  is a slope parameter of the sigmoid function [2,p 13-14].



*Fig.5. Sigmoid function*

The purpose of system training is to find the weights  $w_{ki}$ . The training law is chosen for every specific situation.

### Conclusions

The principles of creation and performance of neural networks on the example of the perceptron have been examined in the article. Different activation functions have been considered and their graphics have been built.

It can be concluded that neural networks may be used in such areas as auto piloting, face recognition, and artificial intelligence. The possibility of solving the problems which cannot be solved by classical algorithms is a significant advantage of neural networks.

### References

1. Anderson Dave, McNeill George (1992). *Artificial neural networks technology*. New York: Kaman Sciences Corporation.
2. Simon Haykin (1999). *Neural networks – A comprehensive foundation, Second edition*. Prentice-Hall inc.
3. Veelenturf Leo P. J. (1995). *Analysis and applications of artificial neural networks*. Prentice-Hall inc.

УДК 539.123/.124:539.1.074

## MUON LIFETIME MEASUREMENTS FROM THE COSMIC RAYS

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**Анотація. Бурлаєнко О.В., Лобасенко А.В. Вимірювання життя мюона за допомогою космічних променів.**

Метою цього експерименту був вимір середнього часу життя мюонів, отриманих з космічних променів. За допомогою сцинтилятора на основі органічної рідини спостерігався процес розпаду мюонів і вимірювався енергетичний спектр як для електронів, так і для мюонів. За експериментальними даними отриманий середній час життя мюонів становить  $\tau_\mu = 2.139 \pm 0.023^{+0.144}_{-0.068} [\mu\text{s}]$ . Цей результат відповідає наступному значенню константи зв'язку Фермі  $G_F = (1.18 \pm 0.06) \times 10^{-5} \text{GeV}^{-2}$ . У підсумку ми знайшли значення  $\tau_{capture}$  для органічної рідини з ємності сцинтилятора, хімічний склад якої в експерименті був невідомий.

**Ключові слова:** мюон, середній час життя, експеримент, космічні промені, рідкий сцинтилятор

**Abstract. Burlayenko O., Lobasenko A. Muon lifetime measurements from the cosmic rays.**

The aim of this research was to measure the cosmic ray (CR) muons mean lifetime. Using organic liquid scintillator, muon disintegration process was observed, and energy spectrum was measured both for electrons and muons. From our experimental data, obtained muon mean lifetime is  $\tau_\mu = 2.139 \pm 0.023^{+0.144}_{-0.068} [\mu\text{s}]$ . This result leads to the next value of Fermi coupling constant  $G_F = (1.18 \pm 0.06) \times 10^{-5} [\text{GeV}^{-2}]$ . Finally, we estimated the value of  $\tau_{capture}$  for used tank of organic liquid scintillator whose chemical composition was not known in the experiment.

**Key words:** muon, mean lifetime, measurement, cosmic rays, liquid scintillator

**1. General formulation of research and its topicality.** Muons  $\mu^\pm$ , discovered by C. Anderson and S.H. Neddermeyer [4, p.9] in 1937, during examining CR are among the six elementary particles that belongs to the lepton-flavour. In essence, they are similar to the electron, but possess much greater mass. On Earth, most naturally occurring muons are created by CR - particles (mostly protons) from somewhere in the galaxy which have been accelerated to extremely high energy by still unknown mechanisms. When a CR proton collides with atomic nuclei in the earth's upper atmosphere (about 15 km above sea level), nuclear reactions appear. This, in turn, initiate a hadronic shower - a cascade of particles (mostly pions  $\pi^{\pm,0}$ ) that may result in further nuclear reactions. Charged pions that do not undergo further nuclear reactions extremely quickly decay into so-called “secondary muons” and muon

neutrinos ( $\nu_\mu$ ) or antineutrinos ( $\bar{\nu}_\mu$ ).

The fact that CR travel at relativistic speeds makes it possible for the “secondary muons” continue in about the same direction as the original CR particles even till the sea level due to time dilation. At sea level their flux is  $1 \text{ cm}^{-2}\text{s}^{-1}$  on a horizontal surface and their average energy is  $4 \text{ GeV}$ . However, muons are unstable particles:

$$\mu^\pm \rightarrow e^\pm + \nu_e(\bar{\nu}_e) + \bar{\nu}_\mu(\nu_\mu), \quad (1)$$

where the  $\mu^\pm$  decay process is shown by the Feynman diagram in Fig. 1 a.

As one can notice, muon undergoes a three-body decay. As a result of this process, the kinetic energy of emitted  $e^+$  or  $e^-$  is not fixed but takes a broad range of values with a maximum of  $m_\mu/2 \approx 53 \text{ MeV}$  in the rest frame of the muon.

*Scientific Motivation:* The muon decay is a purely leptonic process, which can be explained by the V-A theory of weak interaction associated with W-boson exchange and can be confirmed with high precision by both experimental and theoretical researches. From the theoretical standpoint, considering the limit of momenta, which is small compared with  $M_W$ , the muon decay mode follows from the Fermi theory, i.e. a four-fermion contact interaction as seen in Fig. 1 b. Herewith, the decay amplitude is simply proportional to the square of Fermi's coupling constant ( $G_F$ ).

The most precise measurement of the Fermi's coupling constant  $G_F$  comes from the direct measurement of the muon lifetime  $\tau_\mu$ . The latter entity is related to the former one by the following expression:

$$\frac{1}{\tau_{\mu^+}} = \frac{G_F^2 m_\mu^5}{192 \pi^3} (1 + \Delta q), \quad (2)$$

where  $\Delta q$  encapsulates the higher order QED and QCD corrections. In particular, together with  $\alpha$  (fine structure constant) and  $M_Z$  (mass of the Z boson), the constant  $G_F$  defines the gauge coupling of the electroweak sector of the Standard Model (SM).

*Decay of Positive / Negative Muons:* It should be mentioned that once created, the muon decay is a completely random event, i.e. it does not depend on its previous history. The probability  $dP$  of decay in the next infinitesimal time interval  $dt$  is independent of how long it has lived since creation and is given by  $dP = \Gamma dt$ , where the decay rate  $\Gamma$  is the inverse of the muon lifetime:

$$\Gamma = 1/\tau_\mu.$$

This decay process implies that the probability of a muon decay in the interval from  $t$  to  $t + dt$  (given that the muon exists at  $t = 0$ ) follows the exponential probability density function:

$$dP_e(t) = \Gamma e^{-\Gamma t} dt.$$

Here,  $t$  represents the time of a particular decay when it occurs and will be called as a *decay time*.

Positive muons have always the same lifetime regardless whether the muons are in matter or in vacuum. However, the lifetime of negative muons in matter is different from their lifetime in vacuum because the negative muons interact with the nuclei of atoms. Negative muons are slowed down in matter and form "muonic atoms". The muonic atom is an atom where an electron is replaced by a negative muon. Thus, the lifetime of negative muons is determined by two competing processes: decay and nuclear capture. The lifetime of negative muons in free decay is denoted as  $\tau_{decay}^-$ , and the lifetime of negative muons in nuclear capture is denoted as  $\tau_{capture}^-$ . The total lifetime of negative muons [3, p.5] in a muonic atom is  $\tau_{total}^-$  expressed as:

$$\frac{1}{\tau_{matter}^-} = \frac{1}{\tau_{decay}^-} + \frac{1}{\tau_{capture}^-}. \quad (3)$$

If we seek to determine the lifetime of muons in vacuum, this is a source of systematic error that tends to decrease the measured value relative to the true value.

**2. Setting of the problem and the aim of the article.** When a charged particle passes through matter, it can lose energy and be deflected from its incident direction. For charged heavy particles, such as muons, these effects are primarily due to inelastic collisions with atomic electrons of the material. The amount of energy transferred during every collision is small, but in dense media the interaction cross section can be large and if many collisions occur per path length, the cumulative effect can lead to substantial energy loss.

A quantum-mechanical description of how this energy loss relates to its relevant quantities is analytically expressed by the Bethe-Bloch's formula. Commonly used approximation for CR muons at the see level of  $dE/dx$  is  $2 \text{ MeV}/(\text{g/cm}^2)$ . Thus, for a tank ( $20 \times 20 \times 40 \text{ cm}^3$ ) with liquid scintillator, that we use in the experimental setup, muon will deposit energy  $\approx 40 \text{ MeV}$  as a result a spectrum with a maximum of around  $40 \text{ MeV}$  is expected. According to its surface, we are going to register  $\sim 800$  events per minute and only  $\approx 0.3\%$  of these muons will decay inside the tank.

The schematic of the experiment accompanied by typical oscilloscope is shown in Fig. 2. One of the resulting signals will allow us to study the energy of the detected particles and the second one will be used to study the lifetime of muons.

When secondary muons in our experiment pass through a tank of organic liquid scintillator, they deposit kinetic energy by ionization. Some of the light produced is detected by the photomultiplier tube (PMT). Most muons have an energy near  $1 \text{ GeV}$  and travel completely through the detector. However, if a low-energy muon is

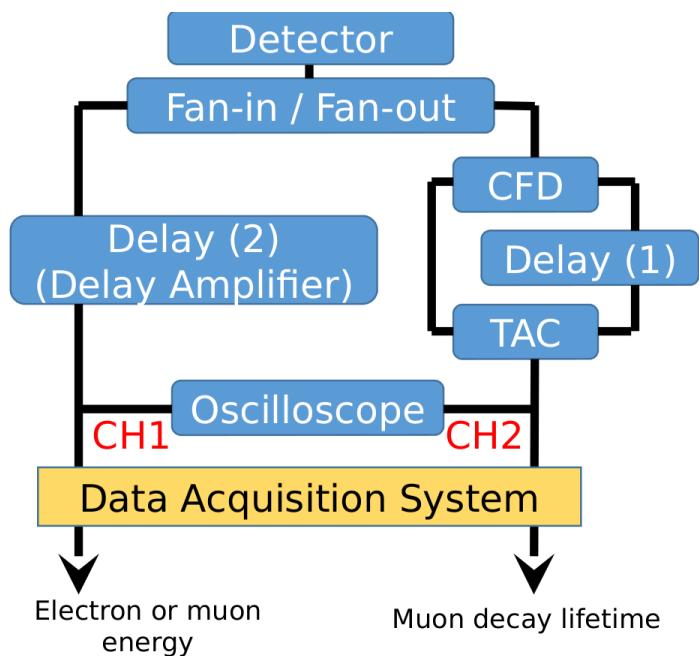


Figure 2: The scheme of the assembled setup (the signals goes from top to bottom)

stopped within the detector, it decays. The neutrino interaction cross sections are too small to interact with the scintillator, but the electron deposits enough energy to generate a second light pulse. The time difference between the pulses is considered as the muon lifetime. A histogram of these time differences for many decaying muons resembles an exponential distribution from which the mean lifetime can be determined.

The time difference between the muon and electron pulses was observed using the Time - Amplitude Converter (TAC), which emit an analog pulse with a height corresponding to the length of the time difference between the signal received in its Start input and a signal received in its Stop input, provided that this time is less than a  $20 \mu\text{s}$  time window. To measure the lifetime of muons, we send twice the same signal in the TAC, but the one sent to the Start input is delayed by a  $\Delta t_d = 200 \text{ ns}$  by the module Delay (1). Thus, when a muon is detected, the corresponding electrical signal will first be sent to the Stop input (no response) and then to the Start input. If the muon decays after a time of  $\Delta t < 20 \mu\text{s}$ , the emitted electron in turn sends a signal to the Stop input and the disintegration time obtained is then recovered via the acquisition card.

In order to get rid of significant background noise (ambient beta and gamma rays) - can be used a Constant Fraction Discriminator (CFD) which filter out pulses from the input that are lower than the chosen threshold on the CFD. We then only keep the peak around  $25 \times 10^3$  ADC channels. The shape of the spectrum and the flux obtained in this way are compatible with those of the muons, which tells us that we are observing them in fact. All the observed signals were collected and processed by "FASTER" - digital modular Data Acquisition System. The acquisition of a spectrum with only the detector and an amplifier, is shown in Fig.3.

The TAC output voltage pulse is recorded by FASTER in number of bins that should be calibrated in value of time. In order to calibrate the time scale, we connected the START and STOP outputs to the TAC in place of the outputs of the logic gates. The stop signal should go through the gate/delay module just like the real signal. Thus, one can obtain a time calibration line using the relationship between the channel, Ch, and the time, t ( $\mu$ s), which is well expressed with a linear equation  $t = p_0 \cdot Ch + p_1$ . Here  $p_0$  and  $p_1$  are parameters which need to be determined from the fit. In the present research, this equation is

$$t = 3.617 \cdot 10^{-4} \times Ch - 8.432 \cdot 10^{-2} [\mu\text{s}]. \quad (4)$$

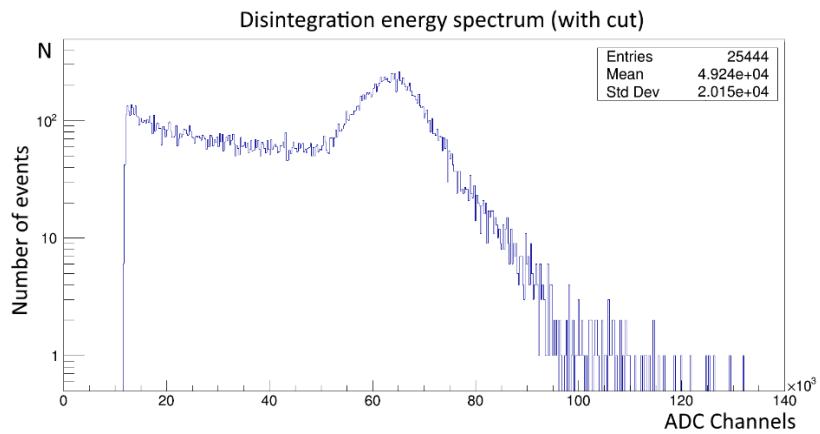
To obtain the energy of a particle (electron or muon), a time coincidence between the signal at the output of the TAC and delayed signal from the detector should be established. This coincidence was achieved by digital triggering, when the two signals coincide within the same time window defined on the FASTER. Finally, an output signal whose amplitude is proportional to the energy of the detected particle could be obtained.

### 3. Results.

**3.1. Data Analysis for Muon Lifetime.** The data were collected during a total of  $\approx 90$  hours and 27 385 decay events were recorded to reduce the statistical uncertainty of the measurement.

The measured distribution of the muon lifetime is, then, a combination of exponential decay and constant background, i.e. can be presented in the form:

$$N(t) = N_0 e^{-t/\tau_\mu} + B, \quad (5)$$



*Figure 3: Energy spectrum (in ADC channels) for all the events inside the scintillator. Low-energy noise was extracted from the spectrum by a CFD module.*

where  $N(t)$  is the number of counts in the bin corresponding to a certain time,  $\tau_\mu$  is the mean muon lifetime,  $N_0$  is a normalisation parameter and  $B$  is the number of background events per time bin (which are actually random coincidences). This gives us a lifetime  $\tau_\mu = 2.139 \pm 0.022 \mu\text{s}$  with a background noise  $B = 5.671 \pm 0.598$  and normalization parameter  $N_0 = 1126.15 \pm 14.327$  which is shown in Fig. 4,

which represents the fit where the data analysis was performed using ROOT software toolkit. In this section, the results are presented with their statistical uncertainties only. Systematic uncertainties will be discussed in Sec.4.

**3.2. Energy spectrum of electrons and muons.** From the acquisition setup (see Fig.2) the energy spectrum (in ADC channels) for muons that decay, and correspondent electrons were produced. As described in Sec.2, the time coincidence of the logic gate at the output of the TAC with the signals corresponding to the muons can be established by means of a Delay and is directly observable at the oscilloscope. For electrons, the resulting spectrum cut-off is compatible with the 53 MeV cut-off of the theoretical electron spectrum, which suggests that it is indeed their spectrum [1, p.2]. In this case, an important source of systematical uncertainty is a small size of the detector and due to this reason, some electrons can escape. The behavior of energy spectra for both electrons and muons were as expected.

**4. Conclusions.** *Systematic uncertainties over the average lifetime of muons:* So far, the results have been presented with their statistical errors only. This section will present how the systematic uncertainties were estimated.

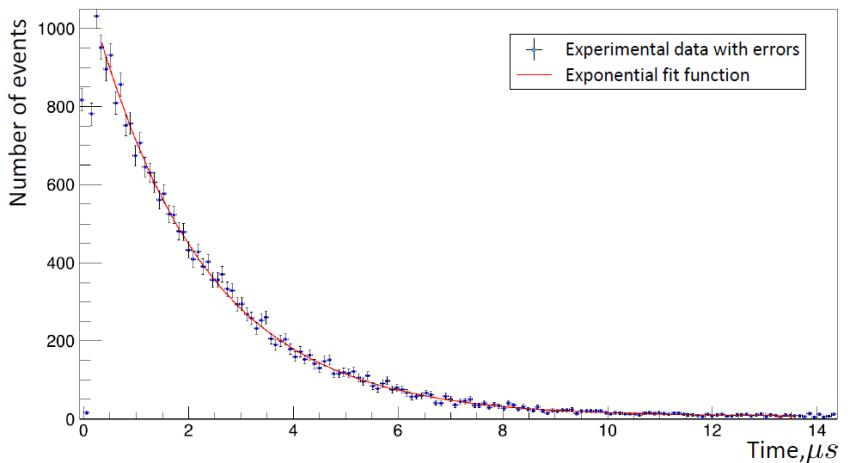


Figure 4: The amount of muon decays in a correspondence to muon lifetime.

Let us identify main sources of uncertainties for the measurement of  $\tau_\mu$ :

1. Using the calibration line (4) we propagate uncertainty which is  $\sigma_t = 0.0616$ . It was obtained applying the error propagation formula.
2. Uncertainty due to the chosen ranges of the fit is  $\sigma_{range} = 0.028$ , which was found by variation of the fit function ranges.
3. Uncertainty that propagate CFD (from the manual) is  $\sigma_{CFD} = 0.005 \mu s$ .

Thus, by summing the systematic uncertainties quadratically, we obtained the result:

$$\tau_\mu = 2.139 \pm 0.023 \text{ (stat)} \pm 0.068 \text{ (syst)}, \quad (6)$$

which agrees with results presented by [5, p.342].

It should be noted that this result has an uncertainty due to the effect of  $\mu^-$  capture by atoms. Unfortunately, because of the fact that the chemical composition of used scintillator was not known we could not use the value for  $\tau_{capture}$  in our fit in order to assume how negative muon capture affects on our measurement of muon lifetime.

However, this effect could be estimated using the result of experiments for precise determination of positive muon lifetime [2, p.10]. We made a new adjustment of the distribution of Fig. 4 with a function of the shape:

$$N'(t) = N_0 [A e^{-t/\tau_{\mu^+}} + e^{-t/\tau_{\mu^-}}] + B. \quad (7)$$

Here, we impose  $A = 1.275$  ratio between the negative and positive muons fluxes at the sea level and  $\tau_{\mu^+} = 2.197 \mu s$  is a lifetime of positive muon [5. p.212]. Thus, the only remaining free parameters are the normalization constant  $N_0$ , lifetime of negative muon in matter  $\tau_{\mu^-}^{matter}$  and the background  $B$ . These parameters are:  $N_0 = 495 \pm 6.453$ ,  $\tau_{\mu^-}^{matter} = 2.069 \pm 0.052$ ,  $B = 5.611 \pm 0.576$ .

Estimating statistical and systematical uncertainties introduced above  $\tau_{\mu^-}^{matter} = 2.069 \pm 0.052 \pm 0.08$ . Using this result one can find the difference between  $\tau_\mu$  and  $\tau_{\mu^-}^{matter}$  which is  $\sigma_{\tau_{\mu^-}} = 0.119 \pm 0.069$ . Obtained difference is actually a seeking error for the effect of negative muon capture in matter. Assuming that the value of  $\tau_\mu$  belongs to the interval  $[\tau_{\mu^-}^{matter}; \tau_{\mu}^{vacuum}]$  it is clear that uncertainty from the negative muon capture tends to decrease the measured value and

does not tend to increase it. So, we can define the confidence interval around  $\tau_\mu$ , where for upper limit we should take into account  $\sigma_{\tau_\mu^-}$  and for lower limit - not.

Thus, the final result we obtained is:

$$\tau_\mu = 2.139 \pm 0.023 \text{ (stat)} {}^{+0.144}_{-0.068} \text{ (syst).} \quad (8)$$

This fit can also be applied with  $\tau_{\mu^+}$  as a free parameter but in this case we will not see any difference between the lifetimes of  $\mu^-$  and  $\mu^+$  due to the lack of data and accuracy. In addition, there is an uncertainty which was not settled: the  $\mu^+/\mu^-$  flux ratio was not measured at the lab, so its value could be inaccurate.

However, obtained result give an estimation about the value of  $\tau_{capture} = 35.512 \pm 1.63 \text{ } [\mu\text{s}]$  for used tank of organic liquid scintillator whose chemical composition is not known.

*Fermi coupling constant from the muon lifetime:* From the obtained lifetime we can derive the value for Fermi coupling

$$\frac{G_F}{(\hbar c)^3} = \sqrt{\frac{\hbar}{\tau_\mu} \cdot \frac{192\pi^3}{(m_\mu c^2)^5}} = (1.18 \pm 0.06) \times 10^{-5} \text{ [GeV}^{-2}\text{].} \quad (9)$$

This value is in a good agreement with data provided by Particle Data Group [5, p.212].

## References

1. Ehrlich R.D. et al., Phys. Rev. Lett. 16, 540 (1966).
2. Gafarov A. et al. [MuLancollab.], Nucl. Phys. B - Proceedings Supplements vol. 225-227, 232 (04.2012).
3. Lim B. and Ruben D., "Investigation of Combined Positive and Negative Muon Decay in a Scintillator", (2005).
4. Neddermeyer S.H., and Anderson C.D., "Note on the Nature of Cosmic Ray Particles", Phys. Rev. 51, 884 (1937).
5. Patrignani C. et al. (Particle Data Group), Chin. Phys. C, 40, 100001 (2016).

УДК 623.741

## DRONES AS A PERSPECTIVE IN THE NEAR FUTURE

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**Анотація. Черкаський О.О. Дрони як перспектива в близькому майбутньому.**

З часів появи дрони були переосмислені науковцями як потенційно необхідні роботизовані машини, які не тільки значно полегшать життя, але і зможуть замінити людину в майбутньому. Фізика займається дронами як радіокерованими апаратами для виконання різних завдань. Метою цієї статті є вивчення пристрою управління невеликими літаючими машинами і їх впливу на життя звичайного народу. Стаття дає можливість переглянути ставлення до роботів в цілому, щоб стати більш освідченими в робототехнічних розробках. У статті також йдеться про результати дослідження, оцінювався потенціал дронів, їх ефективність для економіки країни та зовнішні фактори впливу на людину.

**Ключові слова:** літаючий апарат, потужність двигуна, октокоптер, лопаті

**Abstract. Cherkaskyi O.O. Drones as a perspective in the near future.**

Since the appearance of drones they have been regarded by scientists as potentially needed robotic machines which will not only greatly facilitate life, but also will be able to replace a human in the future. Physics deals with drones as a radio-directed apparatus to perform various tasks. The aim of this article is to investigate the control devices of small flying machines and their influence on the life of ordinary people. The article gives the opportunity to review attitudes to robots in general and to become more competent in robotic developments. The article also presents some results of the drone research, the potential of these flying machines, their efficiency for the national economy and external factors of influence on humans.

**Key worlds:** aerial vehicle, engine power, copter, oktokopter, blades

### **Setting of the problem and the aim of the article**

### **General formulation of research and its topicality:**

Drones evolve and improve every year. They already occupy leading places in human life and living in general. Soon they will become elements of a large system and help people in all spheres saving our precious time.

Subject: Radio-located machines.

Object: Drones

Tasks of this paper: Consider the principle of drone operation, its history and use in various spheres.

### **History of drones**

The word “drone” simply refers to any aerial vehicle that is unmanned.[3] By this definition, the earliest unmanned aerial vehicle in the history of drones was seen in 1839, when Austrian soldiers attacked the city of Venice with unmanned balloons

filled with explosives.

## **Physical processes**

To date, drones have already begun to "conquer the world". Progress does not stand still and scientists make inventions every day to make everyday life easier there or otherwise. The use of radio-directed devices is very wide from the sphere of horticulture and cultivation of crops to the military industry and food delivery. Among them there are military industry, food delivery and gardening [1].

Traditionally a drone consists of several components, namely a control charge, a metal or plastic body and engines. An interesting fact is that different numbers of engines are needed for different tasks. In general the blades that are fastened with each individual engine turn the torque into a force of thrust by means of its structure. Consequently, in order to transport larger cargoes, it is necessary to increase the number of blades or their size, which will lead to the need to increase the engine power and at the same time increase the volume of the body. The variety of these devices is impressive to date because, of course, it is not possible to apply them as previously said, the scope of the use of drones is indispensable. Drones are often called copters (from the English rotorcraft) which is actually a complete reflection of it. Because according to the principle of its work, it is a reduced copy of it. According to the number of rotors drones are called differently. From the number of rotor copter called differently. Thus, a copter with 4 rotors will be called a quadcopter, and the one with 7 rotors - octocopter.

The quadcopter is designed in such a way that the blades are used in pairs in different directions, which creates a lift force, which gives the robot the opportunity to rise into the air. Alternately changing the direction of movement and slowing down the movement of individual propellers, you can change the direction of movement of the device.

Almost all drones are controlled by a remote control based on the principle of radio communication. Sending a radio signal is processed in a board which gives the command to the drone to rotate one or another propeller. Each propeller has a separate rotor to provide a separate control to everything.

To enable the quadrocopter to rise into the air, it is necessary to make all the blades work perfectly smoothly and rotate at the same constant speed. When the thrust force is balanced with the force of gravity, the copter will hang in the air and remain motionless. With the increase in the speed of rotations, the copter will rise higher and with its decrease, it will get lower.

### **Areas of use of drones**

The first and probably the most important field in robotics development is medical applications of drones. Medical drones perform the function of transporting donated blood to the places where it is needed. Now this method is most commonly used in African countries where the incidents of malaria reach a peak and require urgent human blood transfusion [1]. Robotic drones are also able to find a person in a GPS tracker and provide emergency care right on the spot, waiting for the arrival of doctors. No doubt, the huge advantage of drones in this field is that they can fly high, which means having a great overview.

The second use of the machines which is also of great interest is the introduction of air delivery systems. Some countries such as the United States, Germany and China are known to have started using drones for mail delivery within the shortest time covering the whole territory of the country.

In addition the field of air taxi is being developed at the moment, which will soon replace conventional gasoline engine cars and will greatly facilitate the movement, as there is much more free space in the air.

The use of copters in gardening is worth mentioning too. Sometimes they are used to spray poisons in agriculture. In addition, most of these apparatuses work on electricity which does not pollute the external environment. They are also completely friendly to living organisms. Using drones farmers will get a good opportunity to grow more in future, which will have a positive impact on consumers [5].

Space can be considered to be one more field where drones can be made use of although it has not been studied properly yet. The problem is that it is necessary to take into account much more parameters behind the earth, and therefore the drones must be significantly improved [2].

Today with the help of drones we have images of Mars and Saturn. In the short run humanity expects soil samplings from Mars to be delivered by another group of drones sent in 2009. This will give an incredible impetus to the colonization of other planets. Renowned businessman-innovator Elon Musk launches unmanned rockets into space to put into orbit Starlink "satellites. The satellite service is planned to be performed by means of radio-directed drones in future.

### **Problems of drones**

However drones are not perfect devices, they have certain problems. There are three major shortcomings of these flying machines. Firstly, the control of drones, as mentioned above, will take place at the expense of GPS communication. Today's realities do not make it possible to cover satellite connections all over the planet. That is why drones can "get lost" in places far away from human controllers.[4]

The second equally important problem is the low battery capacity. This prevents a person from using the machine promptly at any given time. Currently, the process of improving compactness and long duration of batteries is underway. But at this point, scientists fail to decrease the mass of batteries.

The cheap drones often have an uncalibrated compass that's why, they often fly in the opposite direction. Once mounted, the compass can be customized, but it is time consuming. Consequently, the orientation in the space has yet to be finalized.

Governments of different countries refuse to use drones because they are cheap enough and almost everyone can afford to buy them. Therefore, the number of flying vehicles has rapidly increased so that they interfere with the movement of aircraft. A law prohibiting the use of high-flying drones has been adopted in many countries. Only the people who receive permission from the government officials can use them as well as military personnel to perform military tasks.

### **Conclusion**

Consequently, drones currently occupy a high level in the development of modern society. Due to their advantages, the drone market is flooded and now they help people in solving various problems. Drones are a mobile and easy-to-operate robot available to everyone. The design of the device is not too complicated, so we

can upgrade and improve aircraft at home. Drones have already taken their place in space exploration, earth and underwater spaces.

## References

1. B.Kennedy (2015). 5 issues drones will have to navigate Available at: <https://www.cbsnews.com/media/5-issues-drones-will-have-to-navigate/#:~:text=5%20issues%20drones%20will%20have%20to%20navigate%201,drone%20quickly%20went%20viral.%20...%20More%20items...%20>
2. B. S. McGrath (2015). Drones in Spase. Available at: [Drones in Space | TIME For Kids](#)
3. J.Sifton (2012). A Brief History of Drones. Available at: [A Brief History of Drones | The Nation](#)
4. S.Morrow (2019). Beware of the drone! Privacy and security issues with drones. Available at: [Beware of the drone! Privacy and security issues with drones - Infosec Resources \(infosecinstitute.com\)](#)
5. R.Iyengar (2020). This company is using drones to replant forests devastated by wildfires. Available at: [This company is using drones to replant forests devastated by wildfires - CNN](#)
6. D.Woods (2017). What can drones do for your business. Available at: [10 Killer Use Cases: What Drones-as-a-Service Can Do For Your Business \(forbes.com\)](#)

УДК 330.341.1:004.75

## BLOCKCHAIN: A PARAGON OF TECHNOLOGICAL BREAKTHROUGHS

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### **Анотація. Чистяков А. Д. Блокчейн: зразок технологічних проривів.**

Блокчейн – новаторська технологія, спочатку запропонована в статті “Bitcoin: A Peer-to-Peer Electronic Cash System”, написаній загадковим Сатоші Накамото в 2009 році. Біткойн спочатку мав стати повністю розподіленою електронною системою готівки, яка б працювала без фінансової установи в її основі. Незважаючи на те, що Сатоші Накамото розробив, беззаперечно, геніальний і чудовий винахід, він, мабуть, не мав найменшого уявлення про шлях, яким рухатиметься ця технологія. Десятки IT-компаній, які інтегрують блокчейн зі своїм робочим процесом, тисячі блокчейн стартапів та мільярди доларів, вкладені в галузь, роблять блокчейн не просто “Розподіленою електронною системою готівки”, а цілком новим напрямком у сучасних інформаційних технологіях.

**Ключові слова:** блокчейн, блок, транзакція, доказ роботи, доказ ставки, невизначеність.

**Abstract. Chistyakov A.D. Blockchain: a paragon of technological breakthroughs.**

Blockchain is a groundbreaking technology, originally proposed in “Bitcoin: A Peer-to-Peer Electronic Cash System” paper, written by mysterious Satoshi Nakamoto in 2009. Bitcoin was initially intended to become a fully peer-to-peer electronic cash system that would operate without an underlying financial institution. Although Satoshi Nakamoto has pioneered indisputably ingenious and remarkable invention, they, perhaps, did not have the foggiest idea of the route the technology takes. Tens of IT companies that integrate blockchain with their workflow, thousands of blockchain startups, and billions of dollars invested into the industry make blockchain not just a “Peer-to-Peer Electronic Cash System”, but a whole new direction in modern information technologies.

**Keywords:** Blockchain, block, transaction, proof of work, proof of stake, uncertainty.

## **General formulation of research and its topicality**

The article investigates blockchain technology through a compilation of various subjects: history, blockchain methodology, the core blockchain implementation ideas together with the math under the hood, and the discussion about how the application of a blockchain may ease our existence.

## **Setting of the problem and the aim of the article**

**The main purpose** of the article is to shed light on the topic of blockchain technology, to acquaint a reader with the most fundamental principles and institutes of this rapidly developing industry, and to prove that a seemingly insignificant math masterpiece is an inevitable future of ours.

The article concentrates on the following questions: What is a blockchain?; How does it function?; What are the benefits of a blockchain?; Are we on the verge of the future?

## **Main body**

Humanity has always been passionate to discover new aspects of life and technology, regardless of their intricacy. We have always been encouraged to enhance our lives, to take control of the unknown, and to develop elaborate tools that would help sort out the ever-growing issues. However, despite being that curious, uncertainty has always been an obstacle on our way to success.

"As humans we find ways to lower uncertainty about one another so that we

can exchange value." - Bettina Warburg.

We have come up with an infinite number of means to lower our uncertainty. At first, we started gathering into tribes to trust and know each other personally. When the size of a tribe reached the critical point, where the members could not memorize each other, our anxious brain introduced a God – the one that explained the origin of the inexplicable, e.g. a thunder, a volcanic eruption, or an earthquake. If one worshiped the same God as another one did, they would become trustful. The concept continued with the formation of the term “Government”. Following the interests of the “Government”, people began to believe and confide the once from the same “Country” of residence. Then the 20th century came along with countless breakthroughs in computer science and technology, bringing to life the Internet and such companies as Google, Microsoft, Amazon, Apple, etc. – the companies that we still trust and rely on. Nevertheless, our uncertainty has not decreased, and with constantly escalating fraud, we need an ultimate weapon to subdue our incertitude – the blockchain.

## **Blockchain**

A blockchain is an elaborate, trustful, and decentralized system without underlying third-party authority verifying the workflow. A blockchain is completely autonomous due to the considered algorithms running in its core.

The primary component of the blockchain is a transaction. Where a transaction is nothing but a record that consists of a sender's public key, a receiver's public key, and a transmitting message. Every user of a blockchain disposes of their own public and private key. Those are especially generated to hold particular mathematical properties. The public key is known to every other party on the blockchain, whilst the private key is kept secret. After the sender has constructed the message, the special 256-bit signature (that is acquired from the private key and the message) is appended to the body of the transaction. The idea behind is to be able to check who exactly has signed the transaction via the sender's public key (it is possible due to the keys' properties). This 256-bit signature-verification algorithm ensures that nobody else is capable of creating transactions except the intended owner of the transaction.

Nevertheless, there is a tiny flaw in the concept – one is still able to copy transactions, without the need to forge the signature (which is almost impossible due to the 256-bit length). In order to prevent the misuse of blockchain, each transaction is given an ordinal number, which eliminates the chances of it being copied.

Transactions are assembled into blocks. Each block may consist of an arbitrary number of transactions. For instance, Bitcoin blockchain allows maximum of 2400 transactions per block, whilst Ethereum blockchain, up to 200. The constructed blocks then have to be proved and added to the “Distributed Database”.

There are two main approaches to the approval process:

- 1) Proof of work
- 2) Proof of stake

In the “proof of work” approach, the special-purpose processing unit (a miner) is challenged with a task to generate a particular number so that computing a cryptographic SHA-256 hash function of the block and that number, gives  $N$  leading zeros in the output, where  $N$  is automatically set by a blockchain system to balance the rate of blocks generation.

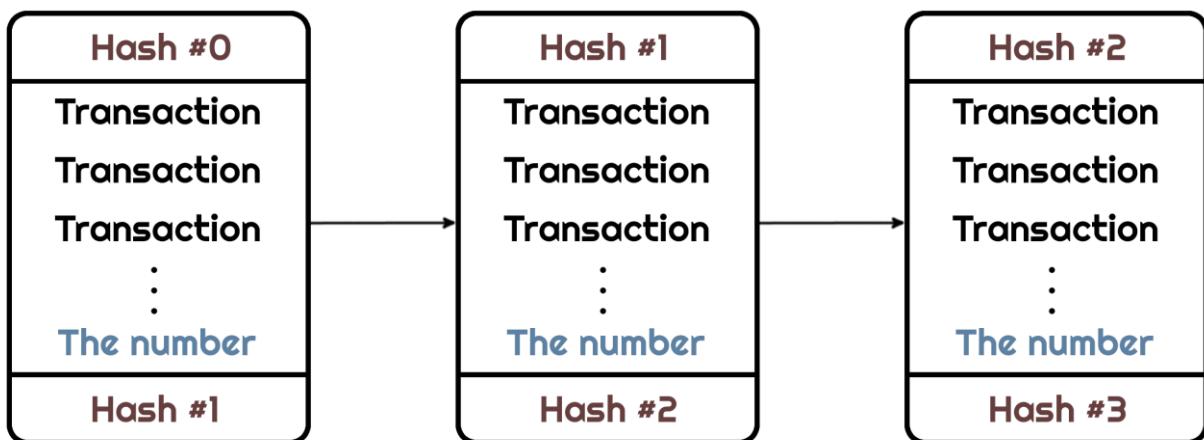


For instance,  $N=30$ . The probability of generating a number is  $2^{30} \sim 1,000,000,000$ . So a miner has to loop through a billion numbers to achieve the desired result. The key point of “proof of work” is that computing such hash is a highly demanding problem that needs tremendous computing power – the hacker has miserable, if any, chances of winning the computation race.

Undertaking the “proof of stake” approach, there are no miners that consume

megawatts of energy involved. The validation (approval) of a block becomes a blockchain's node responsibility. Instead of computational power, the user is forced to deposit a substantial monetary amount on the blockchain to become a validator. The blockchain then randomly picks a validator based on several factors: the total value of the account, their activity, the age of the deposit, etc. The chosen validator is then signs (computes a hash of) a block and broadcasts it to the other validators. The key point of "proof of stake" is that a user has to be extremely wealthy to influence a blockchain flow. And once again, the hacker, usually not as affluent, has minuscule chances of penetrating the block's approval.

However, a blockchain protocol described so far is more like a block-set, not a block-chain. What makes a set a chain, is that every proceeding block is linked with the preceding one, resulting in drastic changes in the hash function output. The consequence of the linkage makes it impossible to interchange, interconnect, or delete blocks from the existing blockchain, making it immutable.



Nevertheless, a blockchain has to be stored somewhere – it does not float in the midair, of course. It can not be installed on a centralized server of any authority, because that would yield uncertainty and mistrust among the users. Moreover, a hacker or an authority itself could potentially break into the blockchain's workflow and change its behavior, or even worse – switch it off. The solution is to entirely decentralize a blockchain's database, so every desirous person could become a host, therefore supporting a blockchain. The technology used to implement the idea is

called “Distributed ledger technology”.

When a block is approved on a blockchain, it is broadcasted to the connected distributed ledgers and added to their database. These ledgers should only “trust” the longest block-chain, because a hacker still has chances, yet miserable, of winning a block-approval lottery and broadcasting malicious transactions. Due to the probability distribution principle, if a hacker has negligible computational power (or deposit), the malicious blocks will not emerge that often.

The last, but not the least topic that needs to be mentioned, is a block reward. When a block gets approved, a special transaction is appended to a block’s body, stating that an approver has obtained a reward. The reward itself is usually coins that a blockchain embodies: Bitcoin, Ethereum, EOS, etc.

Summarizing, blockchain technology is a fully decentralized, trustful, self-supported, autonomous, and versatile tool that, if applied properly, will annihilate our uncertainty.

### Application

Blockchain, being secure, public, and reliable, has numerous applications in various industries, that may carry a great improvement in their transparency and usage.

### Supply chain

Supply chains usually consist of a number of intermediaries, that form a complex route for a product to reach its customer. The complexity and lack of traceability makes supply chain a perfect use case for blockchain. A blockchain infrastructure may lower the cost-savings and raise the transparency of such a network. The immutability of blockchain will make it impossible to counterfeit important delivery data, e.g. delivery cost, product quantity, or delivery time, and having a fully transparent supply chain will lead to the unforgeable delivery status of high-value goods, that is updated on the fly.

### Cryptocurrency

The very first association with blockchain that comes to many minds is indeed Bitcoin and the volatility of the cryptocurrencies market. Despite being volatile and

highly news-influential, the market still has to mature and grow a lot. The main ideas behind cryptocurrency are the ability to send and trade money across the world instantly, not paying enormous fees (talking of big funds), and the confidence that nothing fails in the middle of a process.

### Health care

One of the most vital industry that is expected to be altered by blockchain is health care. Patients' health records, their medical history, and a list of dispensed remedies should be immutable throughout a life. The blockchain technology fits right in to become a backbone of this fateful and fragile business.

### Art

Struggling from permanent forgeries and thefts, the art industry may thrive when it merges with blockchain technology. Nobody could duplicate or fabricate the original masterpiece due to blockchain constraints, leading to a new era of digital art and trustworthiness.

### Conclusion

The blockchain industry, although still being in its infant state, is a paragon of technological breakthroughs we have already encountered in the 21<sup>st</sup> century. Being refined in the core and polyhedral outwardly, blockchain has myriad applications that all may change the way we live and perceive technology. Behold, the future is incoming.

### References

1. 3Blue1Brown (2017). No kak na samom dele rabotaet bitkojn? [But how does bitcoin actually work?]. Available at:<https://youtu.be/bBC-nXj3Ng4>
2. Bettina Warburg (2016). Kak blokchejn radikal'no izmenit ekonomiku [How the blockchain will radically transform the economy]. Available at: <https://youtu.be/RplnSVTzvnU>
3. Everett Muzzy (2020). CHto takoe dokazatel'stvo stavki? [What Is Proof of Stake?]. Available at: <https://consensys.net/blog/blockchain-explained/what-is-proof-of-stake/>
4. Kacee Johnson (2020). 3 glavnyh scenariya ispol'zovaniya blokchejna v 2020 godu [Top 3 Blockchain Use Cases of 2020]. Available at: <https://www.cpa.com/blog/top-3-blockchain-use-cases-2020>
5. Satoshi Nakamoto (2009). Bitkojn: odnorangovaya sistema elektronnyh deneg [Bitcoin: A Peer-to-Peer Electronic Cash System]. Bitcoin.org (in English)
6. Wikipedia (2020). Dokazatel'stvo raboty [Proof of work]. Available at: [https://en.wikipedia.org/wiki/Proof\\_of\\_work](https://en.wikipedia.org/wiki/Proof_of_work)
7. Wikipedia (2020). Dokazatel'stvo stavki [Proof of

stake]. Available at: [https://en.wikipedia.org/wiki/Proof\\_of\\_stake](https://en.wikipedia.org/wiki/Proof_of_stake) 8. Wikipedia (2020). Raspredelennyj reestr [Distributed ledger]. Available at: [https://en.wikipedia.org/wiki/Distributed\\_ledger](https://en.wikipedia.org/wiki/Distributed_ledger) 9. Wikipedia (2020). Kriptovalyuta [Cryptocurrency]. Available at: <https://en.wikipedia.org/wiki/Cryptocurrency>

УДК 004.4

## **RENDERING OF THREE-DIMENSIONAL OBJECTS**

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### **Анотація. Дудник С.Г. Візуалізація тривимірних об'єктів.**

У статті описано результати імплементації двох технік візуалізації. Ця стаття надасть велику допомогу початківцям у комп’ютерній графіці. Сценою рендеринга було обрано кубик Рубика через те, що це усім відома тривимірна гра, у якій небагато об’єктів та є рухомі компоненти без фізичної симуляції. Таким чином можна виконувати усі обчислення на CPU без використання інструкцій SIMD. Це дозволяє використовувати стандартну графічну платформу мови програмування Java, названу Swing. Java є високо ефективною мовою програмування, та має різноманітні методи оптимізації, та значно більш портативна, ніж інші швидкі мови, тому є підходящим вибором для цього дослідження. JavaFX теж могла би бути використана, але вона потребує встановлення SDK, тому менш портативна. Swing не підтримує тривимірну графіку, але це не є проблемою, бо ціллю дослідження є реалізація строщених версій переведу тривимірного простору у двовимірну площину самостійно. Було реалізовано дві версії переведу у двовимірну графіку. Перша робить перспективну проекцію без використання буферу глибини (z-буферу), у зв’язку з простотою нашої сцени відсутність буферу глибини майже не впливає на результат, якщо використати сортування полігонів як альтернативу. Друга реалізована версія рендерингу використовує трасування променів, але у процесі вивчення було встановлено, що це надто повільно через обмежень продуктивності CPU, тому промені не відбиваються, та відсутні тверді тіні, віддзеркалення, розсіювання світла інші складні світлові ефекти. Через цю ж проблему, підтримується тільки одне джерело світла. Велика увага приділяється продуктивності рендерингу. Продуктивність значно залежна від розділення, але збільшення зображення не було обговорено у статті. Обробка після переведу у 2D зазвичай має малий вплив на продуктивність, тому їй не приділено уваги.

**Ключові слова:**рендеринг; тривимірність; проекція; трасування променів; кубик Рубика.

**Abstract. Dudnyk S.G. Rendering of three-dimensional objects.**

This article describes the results of implementing two rendering technics. The article is of great help to beginners in computer graphics. The rendering scene is Rubik's cube because it is a well-known three-dimensional game that has a few objects and moving components without physics simulation. Thereby it is possible to do all calculations on aCPU without the usage of SIMD instructions. That allows using the default graphics library of the Java programming language called Swing. Java is a highly efficient programming language and has various optimization methods, and much more portable than other fast languages, so it is an appropriate choice for this research. JavaFX could also be used, but it requires SDK installation and thus is less portable. Swing has no three-dimensional graphics support, but it is not a problem because the focus of the research is to implement simplified transitions from three-dimensional space to two-dimensional plane ourselves. Two kinds of rendering were implemented. The first one is perspective projection without the depth buffer (z-buffer). Due to the simplicity of our scene, the absence of the depth buffer has almost no effect on the results if sorting of polygons is used as an alternative. The second kind of implemented rendering is ray tracing, but in the process of researching, it was found that it is very slow because of the CPU performance limitations, so rays do not reflect, and there are no hard shadows, reflections, light scattering, and other complex light effects. Only one light source is supported because of the same issue. Much attention is given to rendering performance. The performance highly depends on the resolution, but image upscaling was not discussed in the article. Post-processing usually has a low impact on performance, so no attention is given to it.

**Key words:** rendering; three-dimensionality; projecting; ray tracing; Rubik's cube.

**General formulation of research and its topicality.**Three-dimensional rendering is necessitated in many domains. The most obvious usage is 3D gaming and animated movies, but with the advancement of technology, it became to look much more realistically, and nowadays, the same technologies are used in the film industry for live-action movies (CGI and VFX). Moreover, it is used in almost any field of science or art. All of this brings a lot of attention to the problem. There are many recent studies about using artificial intelligence to make 3D rendering faster and more realistic. Nvidia RTX was a huge announcement in 2018 [4]. It made ray tracing possible to do in real-time for personal computers.

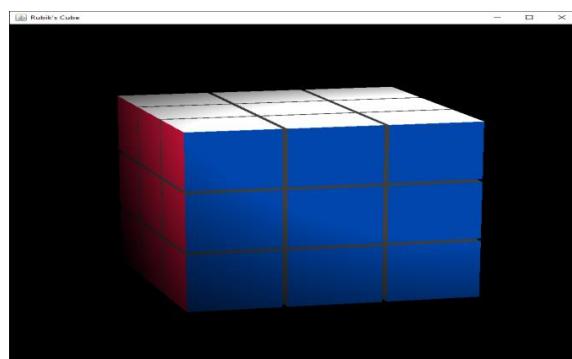
**Setting of the problem and the aim of the article.** Ray tracing [7] takes much more mathematical calculations than perspective projection [6]. The aim is to compare rendering techniques and check if it is possible to do real-time tracing on a CPU, at least on a primitive scene.

**Discussion and results.** The classic version of Rubik's cube was chosen. Its dimensions are  $3 \times 3$ . Basic controls were implemented.

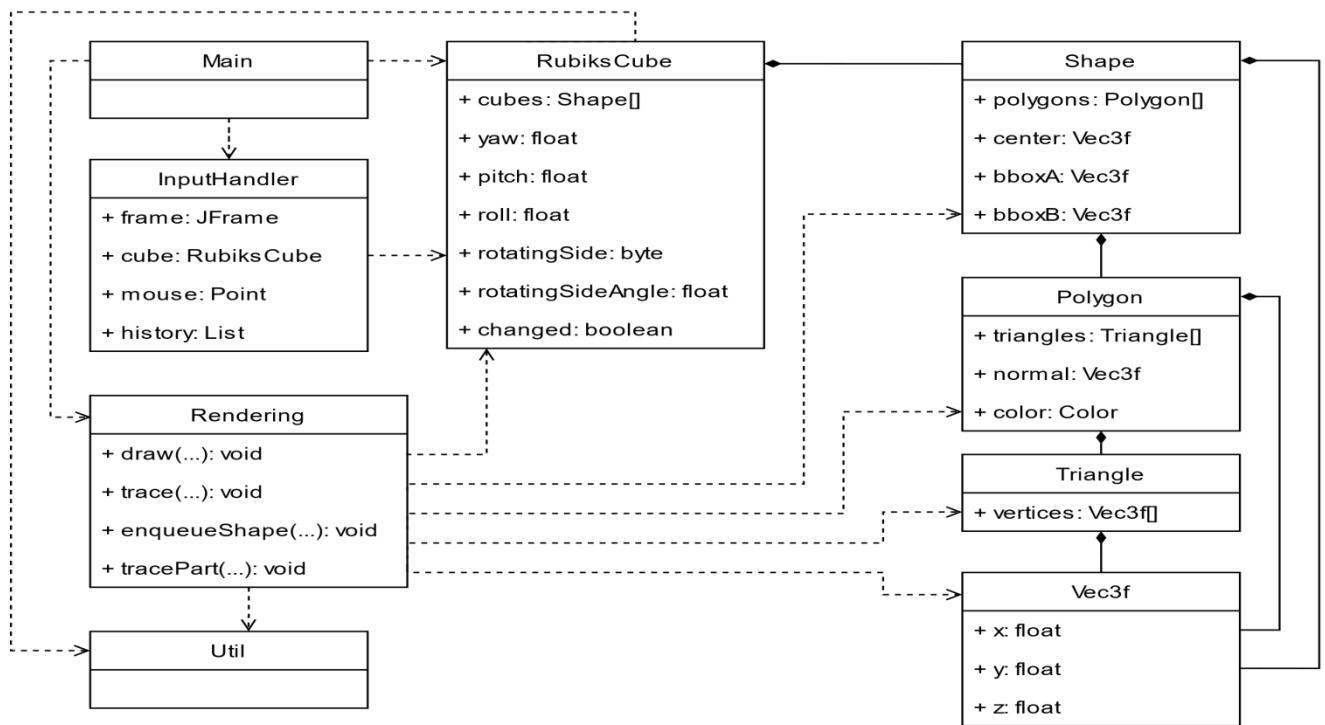
Available actions:

- Rotate the cube or edges;
- View the history of rotations;
- Undo last rotation;
- Shuffle the cube;
- Reset the cube;
- Switch the rendering mode;
- Switch the autorotation.

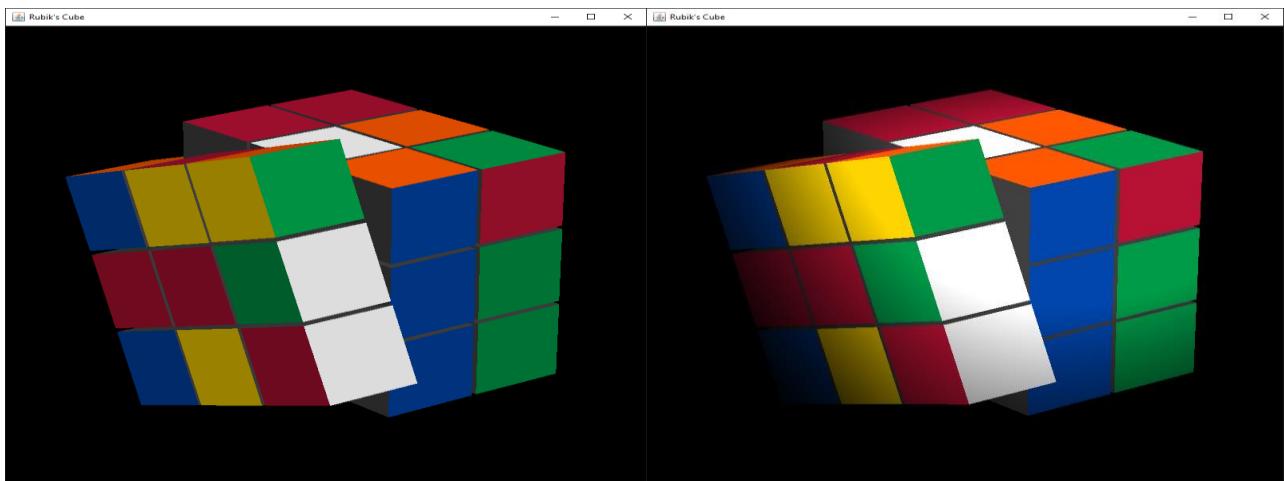
The window is minimalistic and shows only the cube.



The program structure is based on MVC (Model-view-controller) [3]. Input handling and rendering are in separate classes that are combined by the main class. Input handler applies corresponding changes to the model. Renderer only renders. The main class creates the window and controls the max frame rate. The architecture is shown on the UML diagram.



Classes `Vec3f`, `Triangle`, `Polygon`, and `Shape` contain linear algebra operations and math structures. `RubiksCube` class is responsible for the cube's properties. Class `Util` contains various utility and linear algebra functions. Such structure makes rendering independent of other functionality, which simplifies the development, testing, and sharing of the results. The difference between the rendering methods is drastic, despite CPU limitations that strongly lowered potential ray tracing quality. However, various techniques can be used to make the projection look more realistic [1], [11], but they do not apply to more complex scenes. Final implementations can be seen on the following images, the first one is the projection, and the second one is ray tracing.



Due to the specificity of the project, most of the program logic testing was done through the GUI. Almost any error in a formula will be clearly visible on the screen. Thus, the window was implemented in the first stage of development. After, the orthogonal projection of one cube was created to check the core functionality. Next, it was replaced with the perspective projection with colors and basic controls. After inspecting the code, it was optimized and decomposed to increase its maintainability. Next, the Rubik's cube was added, but because of the absence of the depth buffer [2], there was no method of handling collisions of polygon projections, and, as a result, rendering artifacts were present. To remove the artifacts was chosen an alternative to the depth buffer, sorting of the polygons. The sorting is insufficient for complex scenes, but it is enough for the Rubik's cube. Using the depth buffer requires custom 2D rendering methods that are beyond the scope of this research. After checking the correctness of rendering, the rotation of edges was added: firstly, animation, after actual rotation. This was tested and adjusted before adding hard shadows. The level of a shadow depends on the scalar products of normals and vectors to the light source. The execution speed was high, so ray tracing was the next step. Ray tracing with primitive shadows immediately increased the rendering time by several orders of magnitude because it did  $2 \times 6 \times 26 = 312$  checks for ray-triangle intersection [9] for each ray. It was clear that new features cannot be added, and further steps were focused on optimization. Ray tracing can be easily split between the cores of the CPU, so the pool of threads was used to speed up the rendering by several times. Finally, minimum bounding boxes [8] were added as another important optimization and greatly decreased the number of checks of the ray intersection. Nonvisual features were tested with various sets of input data and special values. The performance was tested by measuring the time needed to render a frame.

**Conclusions.** Ray tracing proved to be even slower than expected. The author of the article hoped that path tracing [5] could be used in real-time for such a simple scene, but due to CPU limitations, only ray tracing can be run with acceptable FPS. So, many light effects were not implemented. The final version of ray tracing is very limited: a ray goes from the camera to the surface, and the light level is calculated

based on the distance to the light source. Ray tracing potentially can be much more realistic. Presumably, specialized optimizations can be applied to increase the performance, but the research is about real-time rendering in the general case. Another way of optimization is SIMD (single instruction, multiple data) [10], but this is almost like using a GPU. Java does not suit for heavy mathematical calculations and lacks the support of many hardware features. A different programming language can be used to continue the research. C++ supports SIMD and most GPU frameworks, so the results can be compared with the GPU rendering.

## References

1. Ambient occlusion. Available at: [https://en.wikipedia.org/wiki/Ambient\\_occlusion](https://en.wikipedia.org/wiki/Ambient_occlusion)
2. Depth buffer. Available at: <https://en.wikipedia.org/wiki/Z-buffering>
3. Model–view–controller. Available at: <https://en.wikipedia.org/wiki/Model–view–controller>
4. Nvidia RTX. Available at: [https://en.wikipedia.org/wiki/Nvidia\\_RTX](https://en.wikipedia.org/wiki/Nvidia_RTX)
5. Path tracing. Available at: [https://en.wikipedia.org/wiki/Path\\_tracing](https://en.wikipedia.org/wiki/Path_tracing)
6. Perspective projection. Available at: [https://en.wikipedia.org/wiki/3D\\_projection#Perspective\\_projection](https://en.wikipedia.org/wiki/3D_projection#Perspective_projection)
7. Ray tracing. Available at: [https://en.wikipedia.org/wiki/Ray\\_tracing\\_\(graphics\)](https://en.wikipedia.org/wiki/Ray_tracing_(graphics))
8. Ray-box intersection algorithm. Available at: <https://developer.arm.com/documentation/100140/0402/Advanced-graphics-techniques/Implementing-reflections-with-a-local-cubemap/Ray-box-intersection-algorithm>
9. Ray-triangle intersection algorithm. Available at: [https://en.wikipedia.org/wiki/Möller–Trumbore\\_intersection\\_algorithm](https://en.wikipedia.org/wiki/Möller–Trumbore_intersection_algorithm)
10. SIMD. Available at: <https://en.wikipedia.org/wiki/SIMD>
11. Shadow mapping. Available at: [https://en.wikipedia.org/wiki/Shadow\\_mapping](https://en.wikipedia.org/wiki/Shadow_mapping)

УДК 004.62

## THE LEMPEL-ZIV-WELCH (LZW) ALGORITHM AS A MAJOR LOSSLESS DATA COMPRESSION ALGORITHM

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**Анотація. Дъяконов С.О. Алгоритм Lempel-Ziv-Welch (LZW) як основний алгоритм стиснення даних без втрат.**

У даній статті розглянуто алгоритм стиснення даних без втрат LZW, який для

зменшення розміру даних використовує концепцію словника. Він був опублікований у 1984 році як покращена версія алгоритму LZ78. Хоча LZW і є застарілим у порівнянні із сучасними алгоритмами, проте він має ряд важливих переваг над іншими алгоритмами, які розглянуті у цій статті далі. Також у ній приведено практичну оцінку його складності, розглянуто його недоліки, приведено порівняння з деякими іншими сучасними алгоритмами. Усі результати були отримані шляхом практичного застосування алгоритму та занесені до відповідної таблиці. Для реалізації алгоритму були використані структурна мова програмування С та об'єктно-орієнтована мова програмування Java. Використання отриманих результатів дозволить визначити роль алгоритму LZW серед інших алгоритмів стиснення даних.

**Ключові слова:** алгоритм LZW, основні алгоритми стиснення даних, порівняння алгоритмів стиснення даних, принцип роботи, стиснення даних без втрат

**Abstract. Dyakonov S.O. The Lempel-Ziv-Welch (LZW) algorithm as a major lossless data compression algorithm.**

In this article the algorithm of lossless data compression, which is called the LZW algorithm, was considered. It was published in 1984 as improved version of the LZ78 algorithm. While the LZW algorithm is outdated in comparison with other modern algorithms, it has important advantages over them, which are considered in the article. Furthermore, the paper reveals the practical mark of its complexity, considers its disadvantages, and shows its comparison with some modern algorithms. All results were achieved due to practical using of the algorithm and put in the appropriate table. Structured programming language C and object-oriented programming language Java were used for implementation. Results give an opportunity to place the LZW algorithm among other data compression algorithms.

**Key words:** comparison of data compression algorithms, lossless data compression, major data compression algorithms, operation principle, the LZW algorithm

General formulation of research and its topicality. Understanding of operation principle of major data compression algorithms gives an opportunity to continue research in the domain, what is important nowadays, develop new algorithms and modify available algorithms. Furthermore, it will help to determine limits in programs with its practical implementation and use them more effectively.

Setting of the problem and the aim of the article. To compose an objective picture about the LZW's place among other data compression algorithms. For

achieving this aim it is necessary to analyze the algorithm and its operation principle, test it with different input data, their formats and capacities, determine the algorithm's advantages and disadvantages, estimate complexity of its work and implementation and determine the most optimal type of data for the LZW algorithm.

### **Discussion and Results.**

Since the concept of 'information' has appeared, it is necessary to have an ability to transfer and compress it. Nowadays, the necessity is highly demanded because capacity of data increases rapidly. It leads to problems of optimal data storage and transfer. Data compression can solve the problem.

Data compression is a process of encoding using fewer bits than the original representation. It is useful for processing of big data, its storage and transfer. The main problem of this domain is non-existence of a perfect algorithm, which could compress data effectively, quickly and lossless. The question is what to choose: speed or quality? The problem is partly solved with uniting several simple algorithms in a single complex algorithm. Because of that more or less optimal results can be achieved. Reducing of binary sequence length allows to reduce data capacity. Let's consider text coding.

One of the best solving of this problem is replacing codes of symbols that have high frequency with shorter one. For example, if letters 'P' and 'E' meet 3 times in the message 'PETER PIPER' then original size of the message is  $11*8=88$  bits (11 symbols including space, 8 bits for every symbol). Now we replace codes of letters 'P' and 'E' with 1 and 0 accordingly, namely we use a bit for a letter (instead of 8). Then the message takes  $6*1+4*8=38$  bits (6 letters coded with a bit and 4 usual letters coded with 8 bits). That means the message size is reduced more then by half now. To decode the string properly information about the code replacement should be saved in computer's memory. So, this info should be added to the output file. It can increase its capacity. When a computer gets the message, bits will be replaced with appropriate symbols automatically and we will have the decoded message.

### **Data compression algorithms.**

There is a plenty of lossless data compression algorithms, and they have

different operation principles. The group of algorithms with a sliding window consists of LZ77, DEFLATE, LZS, LZMA and others. Dictionary conception includes LZ78, LZW, LZWL etc. Also there is a group that uses symbols prediction based on beforehand analysis. It unites PPM, bzip2 and PAQ algorithms [7]. Each group has advantages and disadvantages, and different algorithms solve existent problems in different appropriate ways. It proves that there is no perfect algorithm for data compression, and the choice between them should be done depending on purposes. That is why it is necessary to know operation principle of basic algorithms as the LZW algorithm, which is considered in the paper, and also its practical applying, pros and cons.

The LZW algorithm is a modified version of the LZ78 algorithm, and it has adaptive features of the Lempel-Ziv algorithm and achieves similar correlation of compression in normal commercial computer applications. It is famous with its logic simplicity that causes program implementation low cost. Also it has good speed characteristics[1].

### **Implementation of compression.**

The work of the algorithm is based on using of a dictionary (table) that is building when it executes. The dictionary has sequences of symbols and its codes. Usually, such codes consist of 12 bits. The table has prefix feature, namely for every string its prefix also is in that table: if the string  $pK$  ( $p$  – string,  $K$  – single character) is in the dictionary then there is the string  $p$  too. First, all single characters are added. Second, next operations are executed:

*Step: Read next input character  $K$*

*If no such  $K$  (input exhausted):  $code(p) \Rightarrow output; EXIT$*

*If  $pK$  exists in string table:  $pK = p$ ; repeat Step.*

*Else  $pK$  not in string table:  $code(p) \Rightarrow output$ ,  $pK$  — string table,  $K = p$ , repeat Step.*

A string table for the example in Figure 1. The string table is initialized with 3 code values for the 3 characters. Code values are assigned in sequence to new strings [6].

Figure 1. A compression example.

<b>Input</b>	<i>a</i>	<i>b</i>	<i>a</i>	<i>B</i>	<i>c</i>	<i>b</i>	<i>a</i>	<i>c</i>	<i>a</i>	<i>b</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	<i>a</i>	
<b>Output</b>	1	2	4		3	5		8			1	10		11		
<b>New string</b>	4		6			8					10			12		
		5			7			9			11					

The input data, being read from left to right, is examined starting with the first character *a*. Since no matching string longer than *a* exists in the table, the code 1 is output for this string and the extended string *ab* is put in the table under code 4. Then *b* is used to start the next string. Since its extension *ba* is not in the table, it is put there under code 5, the code for *b* is output, and *a* starts the next string. This process continues straightforwardly.

Table 1. A string table for the example in Figure 1.

<b>String</b>	<b>Code</b>	<b>Alternate string</b>
<i>a</i>	1	1
<i>b</i>	2	2
<i>c</i>	3	3
<i>ab</i>	4	1 <i>b</i>
<i>ba</i>	5	2 <i>a</i>
<i>abc</i>	6	4 <i>c</i>
<i>cb</i>	7	3 <i>b</i>
<i>bab</i>	8	5 <i>b</i>
<i>baba</i>	9	8 <i>a</i>
<i>aa</i>	10	1 <i>a</i>
<i>aaa</i>	11	10 <i>a</i>
<i>aaaa</i>	12	11 <i>a</i>

## **Advantages and disadvantages.**

The undeniable advantage of the LZW algorithm is absence of necessity to save the previous process. Moreover, it is not necessary even to save the previous table for decoding: the algorithm creates and fills equal table gradually using step by step decoding. For reconstruction of original message a recursive function is used. Other advantages are:

- relatively high speed;
- absence of necessity to save the table;
- ability to use hashing;
- simplicity of implementation and understanding;
- absence of beforehand analysis (for symbol prediction);
- effective work, especially coding English texts [3].

But in some cases its advantages may turn into disadvantages. Thus, it is hard to optimize the algorithm without beforehand analysis, and its effectiveness for some data can deteriorate so much that compressed file takes even more space then the original one; limited size of a dictionary needs clearing when it is full for working with big files. Furthermore, the part of the dictionary must be saved anyway. Another disadvantage is generation of symbols in the reverse order (the problem is solved using stack LIFO). The LZW algorithm is greedy algorithm. It means the algorithm chooses optimal way of solving a problem on each step, but it doesn't mean the global optimum will be reached.

## **Complexity of the algorithm.**

Complexity is an important characteristic of every algorithm. It depends on input data, dictionary size and frequency of appearing of new strings [2]. After some tests with different input data next results have been achieved: if the file's size is under 1585 Kb (usual book in .TXT format), then the algorithm makes 2-3 iterations on each step. Of course, it is an average value. Then, the complexity is  $O(3*N)=O(N)$  [3]. But actually (in general case) the algorithm's complexity is related to Kolmogorov (descriptive) complexity [4].

Table 2. Comparison with some other algorithms [5].

	<b>Size (bytes)</b>	<b>LZW</b>	<b>LZW</b>	<b>HUFF MAN</b>	<b>HUFF MAN</b>	<b>LZH</b>	<b>LZH</b>
<b>1.doc</b>	1 216 502	570 513	46,9 %	359 113	30 %	337 749	27,8 %
<b>2.doc</b>	659 456	165 288	25 %	157 580	23,9 %	120 529	18,3 %
<b>3.txt</b>	39 715	18 936	48 %	24 769	62 %	19 183	48 %
<b>4.txt</b>	3977	2571	64,6 %	2567	65 %	2865	72 %
<b>5.bmp</b>	2 137 730	416 950	19,5 %	610 085	29 %	407 932	19 %
<b>7.tif</b>	775 036	366 622	47 %	468 322	60 %	318 365	41 %
<b>9.gif</b>	18 519	25 425	137 %	18 780	102 %	22 107	119 %

**Conclusions.** So, listed advantages were confirmed in practical way. It can be stated from the table that the LZW algorithm has good characteristics of compression and is good for both text data and images. The best compression can be achieved during processing of English texts. It would be great to compare it with modern algorithms such as PAQ or PPM and find out a possibility of their association to get a more optimal algorithm. The algorithm's complexity proves that the LZW has high speed. It is caused with its simplicity. Of course, there are modern algorithms, which use combination of simple algorithms (e.g. LZW+Huffman=LZH), with higher speed.

Having been published long time ago the LZW algorithm attracted great interest from specialists in compression domain, so it leaded to developing a plenty of programs with different algorithm's variations. It is used in such formats as GIF, TIFF, PDG, PostScript, early versions of ZIP and other special applications. Also it is partly used in modern versions of ZIP and ARJ.

So, the LZW algorithm occupies an important place in compression domain in

its original version and in combinations (modifications) with other complex algorithms. Understanding of its operational principle is required for improving of this domain in IT.

## References

1. Arseniy Seroka @JagaJaga. Algory`tmy` LZW, LZ77 ta LZ78. [LZW, LZ77 and LZ78 algorithms]. Available at: <https://habr.com/ru/post/132683/>.
2. Gor`kov Aleksej @agorkov. Ocinka skladnosti algory`tmiv. [Complexity of an algorithm]. Available at: <https://habr.com/ru/post/104219/>.
3. Gumbo. Big O complexities of algorithms LZW and Huffman. Available at: <https://stackoverflow.com/a/6189930>.
4. Kolmogorov complexity. Available at: [https://en.wikipedia.org/wiki/Kolmogorov\\_complexity](https://en.wikipedia.org/wiki/Kolmogorov_complexity).
5. Mohammed Al-laham1 & Ibrahiem M. M. El Emry. Comparative study between various algorithms of data compression techniques. Available at: [https://www.researchgate.net/publication/44261387\\_Comparative\\_Study\\_between\\_Various\\_Algorithms\\_of\\_Data\\_Compression\\_Techniques](https://www.researchgate.net/publication/44261387_Comparative_Study_between_Various_Algorithms_of_Data_Compression_Techniques).
6. Terry A. Welch. A technique for high-performance data compression. Available at: [https://www2.cs.duke.edu/courses/spring03/cps296.5/papers/welch\\_1984\\_technique\\_for.pdf](https://www2.cs.duke.edu/courses/spring03/cps296.5/papers/welch_1984_technique_for.pdf).
7. Vyacheslav Golovanov @SLY\_G. Algory`tmy` sty`snnenna dany`x bez vtrat, chasty`na 2 [Lossless data compression algorithms, part II]. Available at: <https://habr.com/ru/post/235553/>.

УДК 004.43`42:004.424

## USING PROGRAM INTERFACE TO INTERGRATE ASSEMLER AND C LANGUAGES WITH PYTHON

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**Анотація. Колмогоров Д. Використання програмного інтерфейсу для інтеграції мов Assembler та С з Python.**

Основна мета статті — ознайомити читачів з бібліотекою PyXAsm, яка інтегрує мову Асемблера з мовою програмування Python. У статті розглянуто основні принципи використання описаної бібліотеки для студентів технічних факультетів. На початку статті автор описує різницю між двома основними компіляторами для мови С — Visual Studio Compiler та gcc від проєкту GNN. У наступному параграфі йдеться про поняття класів Register і Type у PyXAsm. Приведено декілька прикладів того, як правильно використовувати ці класи з точки зору правил написання коду. Далі автор переходить до проблеми використання класу Variable. Він використовується для маніпулювання типами С та

значеннями змінних у вставках збірки. У цьому параграфі є опис можливих помилок. Як висновок, автор намагається пояснити, як використовувати Function - основний клас PyXAsm, який створює програмний код C, компілює .c файли у поширені бібліотеки та використовує .so файли у Python. Крім того, деякі помилки, такі як `asm.ArgumentValueError`, були описані в останньому параграфі.

**Ключові слова:** Python, мова асемблера, мова C, монтажні вставки.

**Abstract. Kolmogorov D. Using program interface to intergrate Assembler and C languages with Python.**

The main purpose of the article is to acquaint readers with PyXAsm library, which integrates Assembler language with Python programming language. The paper reviews the basic principles of using described library for students of technique faculties. At the beginning of the article the author discusses difference between two main compilers for C language — Visual Studio Compiler and gcc from GNN project. The following paragraph deals with concepts of Register and Type in PyXAsm. There are some examples, how to use these classes correctly from the point of view of clean code. Next the author goes on to the problem of using Variable class. It is used to manipulate with C types and values of variables in assembly insertions. There is description of possible errors in this paragraph. In conclusion the author tries to explain how to use Function — main class of PyXAsm, which builds source, compiles .c files to shared libraries and uses .so files in Python. Also, some errors like `asm.ArgumentValueError` were described in the final paragraph.

**Keywords:** Python, Assembler language, C language, assembly insertions.

## **General formulation of research and its topicality**

At the current in the vast majority of cases of getting to know assembly language in higher educational institutions of Ukraine is regarded as using assembly inserts in program code of C or C++ languages. In doing so, different compilers have different syntax to use these inlays. As for example, compiler Visual Studio for C++ has following syntax:

```
int add(int a, int b)
{
    int res;
    asm(mov eax, a; mov ebx, b;
        add eax, ebx; mov res, eax;);

    return res;
}
```

Compiler g++ from the GNN project when implements the same function has the following syntax:

```
int add(int a, int b)
{
    int res;
    asm("mov eax, %1;" "mov ebx, %2;" 
        "add eax, ebx;" "mov %2, ebx;" 
        : "=r" (res): "r" (a), "r" (b));
    return res;
}
```

In addition, we have to compile the original file via command:

```
g++ -o main.exe main.cpp -masm=intel
```

Flag `-o` indicates on that the next command-line argument is name of compiled executable file. Instruction `-masm=intel` indicates on that Intel syntax is used for assembly insertions (by default AT&T syntax is used).

In author's opinion, such difference in the syntax and in the process of compilation is an occasion to realize a general program interface, which won't depend on compiler (more precisely PI will use it implicit).

### **Setting of the problem and the aim of the article**

For this attempt the solution was taken to develop library called PyXAsm, which uses external compiler to create shared libraries (files with .so extension).

With source of PyXAsm library you can acquaint by this [link](#).

Library was created for Python programming language since:

- Python is widely spread among developers and still becomes more viral
- Python has cleared syntax, which can reduce development time

There is the responsibility to call C or C++ functions, using standard libraries' module called `ctypes` and compiled *shared libraries*

### **Using PyXAsm**

To install PyXAsm library you need to download libraries' source by this [link](#). Then in directory, where the program's code was saved, run `setup.py` using command:  
`python3 -r setup.py`

## Registers

To use register, you need to import by its name from `asm.register`.

```
from asm.register import eax, ebx
```

In inner realization all registers are of type `Register`. Instances of this class are used in instructions, which are described below.

## Instructions

To use instruction you need to import it by its name from `asm.instructions`. For example to import `mov`, `jmp` and `cpuid` instructions, you need to execute following code snippet:

```
from asm.instructions import mov, jmp, cpuid
```

In inner realization instructions without parameters (for example, `cpuid`) are instances of `InstructionWithoutParameters` class, instructions with one parameter (for example, `jmp`) are instances of `InstructionWithOneParameter` class and instructions with two arguments are instances of `InstructionWithTwoParameters` class. All these classes are inherited from `BaseInstruction` class, which is an abstract class.

To pass arguments to instruction enough use `()` operator (this operator uses `__call__` magic method).

```
from asm.instructions import mov  
from asm.register import eax  
2_to_eax = mov(eax, 2)
```

The results of calling instructions are instances of `InstructionInstance` class.

## Types

Types in PyXAsm are overbuilding on types from `ctypes` (for example `c_int`) and used in definition of variables (`Variable` class is described below). To use it you need to import types from `asm.types`:

```
from asm.types import int_c, short_c
```

In inner realization all types are instances of `Type` class.

There is responsibility to create arrays using `Array` class. To use it you also need to import from `asm.types`:

```
from asm.types import Array
```

While initialization two arguments are passed:

- `ctype` (implicit) – an instance of `Type` or `Array` class from `asm.types`
- `size` (optional) – a size of array. The value of `size` argument should be an instance of `int` class and also should be greater than zero

For example, to create two dimensional array with numbers of type short with size (10, 5), you need execute following code snippet:

```
from asm.types import short_c, Array
short_2d_arr:Array = Array(Array(short_c), 10)
```

## Variables

`Variable` class is used to define variables, which used in PyXAsm functions (`Variable` class is described below). To use it, you need to import it from `asm`:

```
from asm import Variable
```

While initializations two arguments are passed:

- `ctype` (implicit) – an instance of `Type` or `Array` class from `asm.types`
- `value` (optional) – a default value for variable. It is an instance of different classes in order to type of variable

For example, to create variable of type `char` with value '`a`', you need to execute following code snippet:

```
from asm import Variable
from asm.types import char_c
v:Variable = Variable(char_c, value='a')
```

Unexpected type of variable's value, wrong type of `ctypes` argument and other errors will `asm.ArgumentTypeError` and `asm.ArgumentValueError` raise exceptions.

## Labels

Labels in **PyXAsm** are realized using `Label` class. To use it you need to import this class from `asm`. `Label` class initializes with one argument - iterable object with elements of type `InstructionIsinstance` that is, with elements that are the results of calling instructions from `asm.instructions`.

To create label that adds values of variables called '`a`' and '`b`', use following code snippet:

```
from asm.instructions import mov, add
from asm import Variable, Label
```

```

from asm.registers import eax, ebx
from asm.types import int_c
a, b = Variable(int_c), Variable(int_c)
add_label = Label([mov(eax, a), mov(ebx, b), add(eax, ebx)])

```

## Functions

Function class is the main class of PyXasm. It is initialized using several arguments:

- source (required) - iterable object with elements of type Instruction Isintance
- input\_vars(optional) - iterable object with elements of type Variable
- local\_vars(optional) - iterable object with elements of type Variable
- output\_vars(optional) - iterable object with elements of type Variable
- labels(optional) - iterable object with elements of type Label

To use it you need to import Function class from asm. For example, to create function, that calculates Pier Arrow of two numbers, use following code snippet:

```

from asm.instructions import mov, logic_or, logic_not
from asm.types import short_c
from asm import Variable, Function
from asm.registers import ax, bx
a, b, result = Variable(short_c), Variable(short_c), Variable(short_c)
pier_arrow:Function = Function([mov(ax, a), mov(bx, b),
                                logic_or(ax, bx), logic_not(ax),
                                mov(result, ax)],
                               input_vars=[a,b],
                               output_vars=[result])

```

To call `pier_arrow` function, use () operator:

```
>>> pier_arrow(1, 1)
```

```
0
```

Number of arguments in () should be equal to number of input variables. Function class validates values of each argument, and if the type of the corresponding variable does not support the value of the argument, `ArgumentTypeError` will be raised.

Also, input variable can not have a default value, so variable defined as

`a = Variable(short_c, value=3)` can not be input variable in function.

## Conclusion

This article overviews using of program interface that integrates Assembler language with Python. This program interface realized in PyXasm library, developed by Dmitriy Kolmogorov. In this paper were described all basic concepts of this library such as types, registers, instructions, variables and functions. This PI will help students to use Assembler language in their works.

## References

1. Luciano Romalho (2016). *Fluent Python (O'relly)*.
2. Mark Lutz (2013). *Learning Python, 5th Edition (O'relly)*
3. Link: PyXasm GitHub repository

УДК 615.817:616.12-7

## CARDIAC PACEMAKERS AS LIFE SAVING DEVICES

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### **Анотація. Ходачок Є.С. Кардіостимулятори як рятувальні засоби.**

У статті розглядається сучасний метод лікування хвороб серцево-судинної системи за допомогою кардіостимулятора. Вже понад семидесяти років розвивається дана технологія, а застосування цього пристрою врятувало та збільшило тривалість життя багатьох мільйонів людей. Кардіостимуляція визначається як методика регулювання серцевого ритму за допомогою впливу електричними імпульсами на серце. Підкреслено, що новітні кардіостимулятори ефективно контролюють роботу серця і стабілізують кардіоцикл при найменших відхиленнях показників. Були описані процедура імплантації, режими роботи, моніторинг за пристроєм. А також, певна увага приділялась новаціям у цій технології. Різновиди кардіостимуляторів також наведені у статті. На основі проаналізованої інформації можна зробити висновок, що використання кардіостимуляторів є важливим у сучасній кардіохірургії.

**Ключові слова:** віддалений контроль, імплантация, кардіостимулятор, режими роботи, стимуляція

**Abstract. Khodachok Y.S. Cardiac pacemakers as life saving devices.**

The article deals with a current technique of treating diseases of cardio-vascular system by means of pacemakers. The given approach has been developed for more than seventy years and this device application has saved lives of millions of people and increased life expectancy. Pacemaking is defined as a technique of heart rhythm regulation by means of controlling cardio-vascular system with electrical impulses. The novel pacemakers are demonstrated to be effective in controlling heart work and stabilizing the cardiocycle at the lowest deviations of parameters. The implantation procedure, operating modes, device monitoring have been described. Particular attention is given to innovations of this technology. Pacemaker types are also demonstrated in the article. On the basis of the information analyzed the conclusion can be made that applying pacemakers is essential in modern cardiac surgery.

**Key words:** implantation, pace mode, pacemaker, remote monitoring, stimulation

**General formulation of research and its topicality.** Cardiovascular diseases occupy the first positions in the list of death causes. These causes include bradycardia, complete heart block, heart failure, cardiomyopathy. With the invention of such technology as artificial pacemaking the risk of developing a myocardial infarction or sudden cardiac arrest in a patient has been reduced significantly.

**Object-matter:** heart disease treatment.

**Subject-matter:** cardiac pacemakers.

**Introduction.** Nowadays doctors and scientists are greatly concerned about the dramatic growth of cardio-vascular diseases which affect both elderly and young people. To deal with this problem researchers design various pacemakers. Such developments become more and more reliable with the appearance of up-to-date technologies. Modern pacemakers enable patients to lead a normal lifestyle monitoring the patient's state, finding problems and stabilizing the heart rhythm. The essence of this technology is to support the heart rhythm by means of electrical impulses which stimulate or suppress the ventrical activity.

**Discussion and Results.** The first external pacemaker was invented and tested in the early 1930s by Albert Hyman. It was quite a large device that sent impulses to the heart through electrodes located in the intercostal space of a person. In the early 50s, pacemakers began to be powered by a built-in battery and were portable.

However, they were not located inside the person. The first fully implantable pacemaker appeared in 1958. It was created by Rune Elmquist. These pacemakers were short-lived: 1 or 2 years. In the next 50 years, the concept has not changed and it was expected to create an artificial stimulation of the heart muscle. The shape, size, materials of the device changed with the time. The wireless pacemakers have emerged that fit directly into the heart chambers. Currently, developments are underway to create battery-free stimulators that will work by heart impulses [1, p. 189-190].

There are several kinds of pacemakers: the ones for temporary treatment (e. g. following myocardial infarction) and permanent, single-chamber and two-chamber, wired and wireless pacemakers.

The most common pacemaker consists of a shell and conductive elements. The housing contains the battery and the necessary electronics. The conducting cable consists of two components: the cathode and the anode, which are separated by an insulating material. An impulse that stimulates the work of the heart muscle appears between these two electrodes. The cable is attached directly to the myocardium of the heart. Firstly, the electrodes can have a helix at the tip of the wire by means of which it penetrates into the muscle. Secondly, there are electrodes which possess tines to attach the wire to the myocardium. Operating a pacemaker it is necessary to know which impulse to send. Modern pacemakers are able to analyze the work of the heart and, if necessary, support it with their action. This approach extended the life of the pacemaker [1, p. 190-193].

During the operation, the patient is under local anesthesia. An incision is made about 5 centimeters under the collarbone, and a pocket is formed into which the pacemaker will be inserted. The operation is performed under the control of fluoroscopy. The subclavian vein puncture is made and electrodes are placed. The main parameters of the electrodes are checked on the computer, then they are fixed in the atrium and ventricle of the heart. The electrodes are connected to a stimulator, which is located in an earlier formed pocket under the fascia of the pectoralis major muscle. After installing the device, the wound is sutured. The stimulator is switched

on and its main operating parameters are checked and programmed on a special device - a programmer. The next day after implantation the position of the device and electrodes is checked using an X-ray, and pneumothorax should be excluded [3, p.2-3].

The work of a pacemaker depends on the activity of the heart. The electrical impulse generated by the heart is received and analyzed by this device. The mode of operation of the pacemaker is adjusted depending on the results. Each mode is encrypted (e. g. VVIP, AAIR). The first letter indicates the chamber to be stimulated (A - atrium, V - ventricle, D - both chambers, 0 - none); the second one is detection of spontaneous heart activity (A - atrium, V - ventricle, D - both chambers, 0 - none); the third mode is the response to the received signal (I – inhibition, T – trigger, D - both, 0 - none); the fourth is the frequency-adaptive function (R - frequency adaptation, 0 - none); the fifth indicates the presence of antitachycardic stimulation in the pacemaker system (P - antitachycardic stimulation; S - defibrillation; D - both; 0 - none). DDD-mode is one of the most common modes, because it can easily be switched to any other mode, e.g. VVI, VAT, AAI [1, p. 193-195].

After the pacemaker implantation, the characteristics of the device and the cardiac activity are regularly monitored. Nowadays remote monitoring is one of the main methods. There are several techniques to provide it.

1. Remote interrogation (RI) is a planned procedure. The patient applies a special device to the pacemaker, and this device reads all the necessary data and transmits it via a cellular connection to the server and then to the clinic.
2. Radiofrequency RM does not require a patient's intervention. Typically, a home monitoring system is installed closely to the patient's bed. With this technology, data collection can be performed on a daily basis. This method is able to identify any rejections in the indicators and warn the patient and the clinic about this. This is the main advantage of the radiofrequency RM over other methods, which are obviously made use of less frequently [2, p. 227].

The presence of wires and the device itself in the subcutaneous pocket increases the chances of bacteria growth and infection of the body. In order to avoid

this, the pacemakers implanted directly into the heart have been invented. These pacemakers are much smaller than the conventional ones. Devices for single-chamber pacing are currently available, and pacemakers for two-chamber pacing are still under development. In addition, the main disadvantage of all pacemakers is their battery, the presence of which leads to periodic replacement of the device. Now developments are underway to create batteryless pacemakers that will convert cardiac and pulmonary motion into electrical energy [2, p. 229-233].

**Conclusions.** Pacemakers are known to have established as an up-to-date technology which can greatly improve patients' lives. But the presence of a pacemaker also imposes certain restrictions on the patient's life. Taking into consideration the importance of these devices, nowadays an extensive work is being carried out by researchers to make them better.

## References

1. Siva K. Mulpuru, MD, Malini Madhavan, MBBS, Christopher J. McLeod, MBCHB, PHD, Yong-Mei Cha, MD, Paul A. Friedman, MD (2017). Cardiac Pacemakers: Function, Troubleshooting, and Management. Available at: <http://dx.doi.org/10.1016/j.jacc.2016.10.061>
2. Siva K. Mulpuru, MD, Malini Madhavan, MBBS, Christopher J. McLeod, MBCHB, PHD, Yong-Mei Cha, MD, Paul A. Friedman, MD (2017). Advances and Future Directions in Cardiac Pacemakers. Available at: <http://dx.doi.org/10.1016/j.jacc.2016.10.064>
3. Tsakiridis K, Kotsakou M, Kioumis I, Lazaridis G, Pitsiou G, Lampaki S, Papaiwannou A, Karavergou A, Katsikogiannis N, Karapantzos I, Karapantzou C, Baka S, Mpoukouinas I, Karavasilis V, Rapti A, Trakada G, Zissimopoulos A, Zarogoulidis K, Zarogoulidis P. (2015). Pacemaker insertion. Available at: <http://dx.doi.org/10.3978/j.issn.2305-5839.2015.02.06>

УДК 617.7:606

## BIONIC EYE

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**Анотація. Ковальова А.М. Біонічне око.**

Пропонується вирішення питання сліпоти за допомогою біонічного ока. Сліпота може бути результатом захворюванням на вікову дегенерацію жовтої плями та на пігментний ретиніт, що призводить до погіршення або втрати зору. Це захворювання відноситься до спадкової групи дегенеративних захворювань ока. Наведено аналіз деяких розробок систем біонічного зору та принципу їх роботи. Біонічне око, на відміну від протезу ока, дозволяє покращити зір без втручання безпосередньо в око людини. Протезування очей відбувається з метою заміни фізичної структури та зовнішнього вигляду очей через необхідність видалення існуючого ока з причини захворювання, травми. Приведено приклади розробок біонічного ока, які призначенні для виконання функцій зору. Показано, що саме ці розробки мають велику перспективу у майбутньому. Проаналізовано переваги та недоліки існуючих взірців біонічного ока.

**Ключові слова:** вікова дегенерація жовтої плями, око біонічне, сітківка, вади зору

**Abstract. Kovalyova A.M. Bionic eye.**

It is proposed to solve the problem of blindness with the help of the bionic eye. Blindness can be the result of age-related macular degeneration and Retinitis Pigmentosa, which leads to deterioration or loss of vision. This disease belongs to the hereditary group of degenerative eye diseases. The article analyzes some developments of this bionic vision system and the principle of their work. The bionic eye, unlike the eye prosthesis, allows to improve vision without interfering directly with the human eye. Eye prosthetics is done to replace the physical structure and appearance of the eyes due to the need to remove the existing eye because of a disease or an injury. Examples of bionic eye developments designed to perform visual functions are given. It is shown that these developments have great prospects in the future. The advantages and disadvantages of existing samples of the bionic eye are analyzed.

**Key words:** age-related macular degeneration, bionic eye, retina, visual impairment

**General formulation of research and its topicality.** The human eye is a sense organ capable of receiving images from the outside world, which are then transmitted to the brain. The eye is a complex optical system. The main task of this system is to transmit the correct image to the optic nerve. The human eye has the greatest significance of all the senses, providing not only new information but also human orientation in the world. Approximately 90% of information from the outside world comes through the eyes. Many aspects of our lives need a clear vision.

**Setting of the problem and the aim of the article.** According to unofficial

data, at least 2.2 billion people worldwide have visual impairments or blindness. These defects prevent patients from having full-fledged activity and enjoying their life in general. Therefore, the creation of new technical means to improve or restore vision is an urgent task of specialists in the field of medical instrumentation.

**Discussion and Results.** An eye disease is any disease or disorder that affects a human eye and causes vision loss. Vision loss exists in a continuous range from almost normal vision to complete blindness. Scientists have developed a bionic eye as a solution for those people who have lost their eyesight and for patients with poor vision. The people with poor vision associated with age-related macular degeneration or inherited retinal degenerations are most likely to benefit from a bionic eye.[1]

Age-related macular degeneration (ARMD). Basically, this disease occurs in elderly people. There are two types of ARMD: dry macular degeneration and wet macular degeneration. The difference is the presence of abnormal blood vessels in the second type of ARMD. ARMD is characterized by impairment of acute and central vision. Central vision is responsible for the clarity of seeing objects. ARMD affects the central part of the retina, which allows a person to see tiny details. Inherited retinal degenerations (IRDs). This is a group of progressive diseases, the influence of which leads to progressive photoreceptor cell death and the associated vision loss [2].

A bionic eye is an artificial vision system surgically implanted into a human eye in order to convert the light flux into impulses that the brain can process for a person with a damaged retina. It is a bionic prosthesis that allows a blind person to see again. The retina is a thin light-sensitive layer of nerve tissue located on the inner side of the back of the eyeball. The main function of the retina is to transform the image received from the external environment into neural impulses that are transmitted to the image processing center located in the occipital lobe of the brain.

The bionic eye as a device of artificial vision consists of a transmitter, a camera mounted on glasses, and a microchip surgically placed behind the retina consisting of a set of electrodes.

The principle of operation of the bionic eye (Fig. 1) is as follows:

1. The camera captures the image and sends information to the microprocessor;

2. The microprocessor converts data to an electronic signal and transmits it to the receiver;
3. The receiver sends signals through a tiny cable to an electrode panel implanted by doctors on the back wall of an eye (retina);
4. The retinal implant emits pulses which travel through the optic nerve to the brain;
5. The brain perceives patterns of light and dark which correspond to the electrodes stimulated on the retina implant [5].

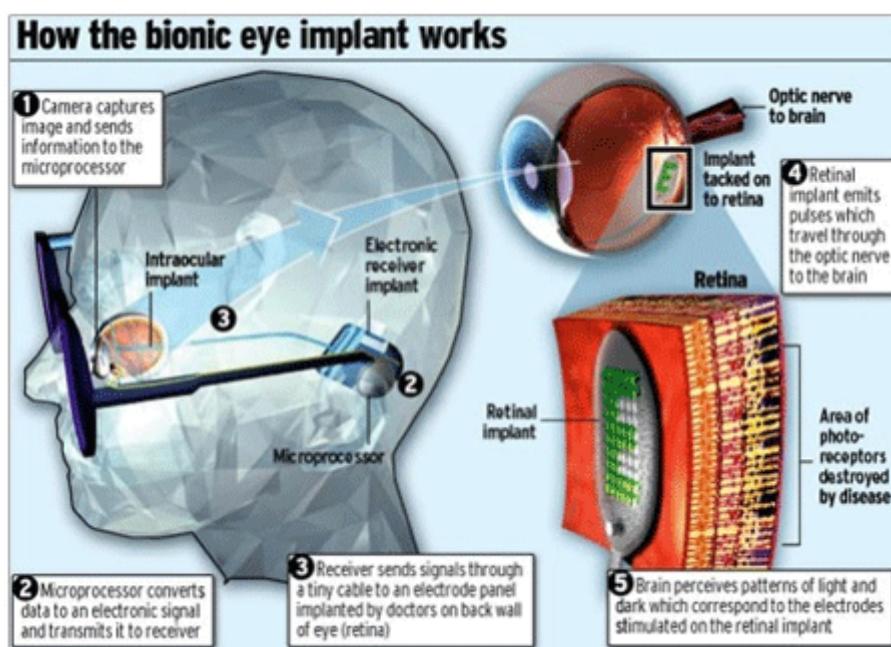


Figure1. The principle of the bionic eye operation

Many different bionic electronic implants can currently be found, but bionic eye and the term itself were developed by Daniel Palanker, an employee at Stanford University and his research group "Biomedical Physics and Ophthalmic Technologies".

Depending on the type of a prosthesis we can specify the following ones: epiretinal (on the retina); subretinal (behind the retina); suprachoroidal (above the choroid); intrascleral; located on the optic nerve; implanted in the brain.

The international team led by Prof. FAN Zhiyong and Dr. GU Leilei from Hong Kong University and Technology (HKUST) have designed the Electrochemical Eye (EC-EYE) which is the world's first 3D artificial eye with a bionic hemispherical retinal structure [6].

The EC-EYE structure includes a lens, ionic liquid (vitreous), a photosensitive array (retina), a wire (optic nerve).

It turns out that both external and internal EC-EYE is similar to the human eye. EC-Eye has certain advantages over other developments.

Firstly, a hemispherical retina is an array of light-sensitive nanowires. The spherical structure of the human retina reduces the propagation area of the photon flux that has passed through the lens resulting in sharpening the focus. The retina has a density of nanosensitive points which is much higher than that of the human retina providing clearer images. Secondly, due to the faster response to light and darkness of the artificial retina, biometric eyes are superior to other designs of a bionic eye prosthesis and the human eye.

Forecasts for the future. In the future, this eye will be able to distinguish infrared radiation in the darkness. Simply put, a person will be able to see in the darkness. It is also not the only feature that will be available soon.

The Australian Monash university have designed Gennaris 'Bionic Eye'[4].

The Gennaris bionic vision system is comprised of custom-designed headgear with a camera and wireless transmitter, a vision processor unit and software, and a set of  $9 \times 9$ mm tiles that are implanted into the brain.

The first advantage of this development is that the new technology allows people with damaged optic nerves to see.

The second advantage is that it is the first device designed to correct a person's blindness which does not need an eye replacement procedure. The technology is aimed at restoring vision and even transmitting music directly to the human brain.

It should be noted that the Australian Monash University uses a self-produced brain implant in the bionic eye system.

In the future, the device will be able to provide not only the treatment of blindness, but also the solution of complex brain problems, such as Pakirson's disease.

But even now Gennaris is competing with Neuralink.

Second Sight Medical Products group has developed Orion Visual Cortical Prosthesis System [3]. This is a neural implant which restores partial vision to the blind bypassing the eye and optic nerve. The signal is transmitted directly from a video camera to the electrodes implanted in the visual cortex of the brain.

The group is going to

- improve image fidelity by creating arrays with thousands of electrodes ;
- provide face- and object- recognition ;
- develop distance filtering;
- create thermal imaging.

In the above, we have highlighted the benefits of each development. However, despite all the advantages of the latest technology the bionic eye users are not able to see as well as the people with good eyesight .

The main disadvantages of the bionic eye can be specified as:

- 1) poor image quality;
- 2) most developments are not available for the patients who were born blind ;
- 3) a long period of adaptation to the device as the installation process requires an overnight stay in the hospital followed by a fairly long recovery period before the unit is turned on;
- 4) lack of color vision;
- 5) possibility of retinal damage due to the heat generated by the implant;
- 6) high prices of the device.

These flaws are found in many bionic eye designs. The previously mentioned companies have already paid attention to these problems, but the solution only remains in plans for the future so far.

**Conclusions.** The blind people have been offered a hope and it is a bionic eye. Despite a number of shortcomings, the bionic eye is a unique development. Many

companies have already made big strides in this area. The previous developments are currently being improved. For example, Gennaris users will soon be able to communicate telepathically with each other. We believe that people with bad eyesight will not be called "the disabled", but "superheroes" in the near future.

## References

1. Daniel M. Albert, David M. Gamm, Edward S. Perkins .Encyclopedia Britannica. Eye disease. Available at:<https://www.britannica.com/science/eye-disease>
2. Daniel M. Albert, David M. Gamm, Edward S. Perkins. Encyclopedia Britannica .Eye disease-Retinal detachment. Inherited retinal degenerations and age-related macular degeneration. Available at:<https://www.britannica.com/science/eye-disease/Retinal-detachment#ref65005>
3. Andrew Tarantola (2019). Available at: <https://www.engadget.com/2019-08-09-second-sight-orion-bionic-eyes-predator-vision.html>
4. Isaiah Alonzo (2020). Tech Times. Available at: <https://www.techtimes.com/articles/252646/20200917/gennaris-bionic-eye-surpasses-neuralink-worlds-first-brain-implant-human.html>
5. Sourav Sharma (2014). An introduction to 'Bionic Eye'. Available at: <https://sharmasourav.wordpress.com/2014/10/03/an-introduction-to-bionic-eye/>
6. Hongrui Jiang (2020) .Nature. Artificial eye boosted by hemispherical retina. Available at: <https://www.nature.com/articles/d41586-020-01420-7>

УДК 004.7

## THE SAFETY OF USING BLOCKCHAIN TECHNOLOGY IN REAL LIFE

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**Анотація. Кротов Р.А. Безпека використання технології блокчейну в реальному житті.**

Дана стаття присвячена аналізу технології блокчейн, а також підтвердженню безпеки її використання у наші дні. Відповідно до назви, у статті описуються блокчейн, якій захищено за допомогою різноманітних механізмів. Стаття надає читачу інформацію о застосуванні шифрування, яке дозволяє змінювати ланцюжки блоків, які належать користувачу. Згадується, що у технологію блокчейн від самого початку закладена безпека на рівні бази даних. Детально говориться про технологію блокчейн, завдяки якій біткоін став першою цифровою валютою, яка вирішує проблему подвійних витрат без використання будь-якого авторитетного органу або центрального сервера. Слід підкреслити, що технологія блокчейн є основною структурою більшості криптовалютних систем і запобігає дублюванню або

знищення такого роду цифрових грошей. Велика увага приділяється і тому, що сучасні технології використовуються не тільки в банківській сфері, а й у багатьох галузях життєдіяльності. Зроблено висновок, що дана технологія добре себе зарекомендувала в сферах, де потрібно обробляти велику кількість даних, також дана технологія дозволяє не турбуватися про збереження своїх персональних даних, так як всередині технології реалізована сучасна система захисту, яку практично неможливо зламати.

**Ключові слова:** безпека, блокчайн, блокчайн-ланцюг, шифрування

**Abstract. Krotov R.A. The safety of using blockchain technology in real life.**

This article is devoted to the analysis of blockchain technology, as well as the confirmation of the security of its use today. As the title implies, the article describes blockchains that are secured using various mechanisms. The article provides the reader with information about the use of encryption, which makes it possible to change the blockchains that the user owns. A mention should be made that security at the database level was originally incorporated into the blockchain technology. It is spoken in detail about the blockchain technology, thanks to which Bitcoin became the first digital currency that solves the problem of double spending without the use of any authoritative body or central server. It should be stressed that blockchain technology is the main structure of most cryptocurrency systems and prevents duplication or destruction of this kind of digital money. Much attention is given to the fact that modern technologies are used not only in the banking sector, but in many sectors of life. In conclusion, this technology has proven itself well in areas where you need to process a large amount of data, and this technology also allows you not to worry about saving your personal data, since a modern security system is implemented inside the technology, which is almost impossible to hack.

**Key words:** blockchain, blockchaintchain, encryption, security

**General formulation of research and its topicality.** In our information age, data security has become one of the most important challenges. It seems that our entire life is being tracked through databases, and our sensitive information is more vulnerable than ever. Therefore, information security is extremely relevant today. Hacking has become a serious and widespread problem in cyberspace, and organizations around the world are engaged in an arms race to eliminate existing weaknesses in their networks and harden them against future cyber-attacks. It is to combat the growing cyber threat that a new weapon has been created – blockchain technology.

If we talk about the use of blockchain, many have only one association with the financial sector. In fact, blockchain can be used not only there. Now this technology is widely spread in the field of medicine, energy, real estate. The use of blockchain can guarantee the safety and integrity of data on the Internet of Things (IoT), as well as provide a reliable security system. Blockchain technology also successfully interacts with the gaming market and is now rapidly developing and gaining more and more popularity.

**Setting of the problem and the aim of the article.** Blockchain is a distributed database that stores data about completed transactions, which are recorded in a specific order and form an invariable sequence of related blocks. These digital “blocks” are then linked cryptographically and chronologically into a “chain” using complex mathematical algorithms. Each block is related to the previous one and contains a set of records. New blocks are always added strictly to the end of the chain. The encryption process known as hashing is performed by many different computers on the same network. If, as a result of their calculations, they all get the same result, then the block is assigned a unique digital signature (signature). As soon as the register is updated and a new block is formed, it can no longer be changed. Thus, it cannot be faked. You can only add new entries to it. It is important to take into account that the registry is updated on all computers in the network at the same time.

Security in blockchain technology is ensured through a decentralized time-stamping server and peer-to-peer network connections. As a result, a database is formed, which is managed autonomously, without a single center. This makes blockchains very convenient for event logging (eg, medical records) and data operations, identity management, and source authentication.

Blockchain technology has built-in error resilience. This bodes well for blockchain technology that continues to evolve. As revolutionary as it sounds, blockchain really is a mechanism that provides the highest degree of accounting and identification. There will be no more missed transactions, human or machine errors, or even changes made without the consent of the parties involved. Most importantly,

blockchain helps ensure the legitimacy of a transaction by recording it not only in the main ledger, but in a distributed system of ledgers linked through a secure verification mechanism [4, p.138].

**Discussion and Results.** It is precisely in the absence of intermediaries that the main advantage of the blockchain over conventional banking transactions lies. It is known that now all transactions with documents, money or other data must go through intermediaries. Government authorities, banks or notaries constantly monitor the authenticity of the transactions. There is no central authority here, so transactions are verified by all participants in the system. This greatly simplifies the procedure and eliminates intermediaries.

The network program code is available to anyone who wants to access it, but the user's identity and other personal information is not disclosed. Block creators see only the necessary data for a specific operation. The blockchain is decentralized, there is no one common command center, breaking into which, it will turn out to destroy all data about the transaction and its participants or replace them.

For example, if a transaction was carried out in which 100 people participated, then this blockchain chain will remain working and available for viewing even if 99 computers of other participants are damaged. Indeed, in fact, each link of the blockchain chain is a kind of full backup of the data of all transactions of all other participants to this link. Hacking one of these computers will not in any way affect the safety of data on the rest (as well as on changing them).

*Spheres of application of technology in real life.* Unchanged and verified data, transparency of legal relations, speed and convenience of service - all these reasons became the reason for big business to pay attention to this promising technology. As predicted by J'son& Partners Consulting, the first candidates for blockchain implementation are the financial sector, telecom, transport, industry and the agro-industrial complex. By the way, banks understand all the prospects of blockchain and are actively starting to use it. There are first test transactions [3, p.117].

Despite the fact that interest in blockchain technology is more related to the field of finance, the scope of application of distributed ledger technology is not

limited to it. Along with banks, players in other non-financial markets have also taken notice of the technology and are looking for ways to capitalize on the opportunities it provides. Let us look at some examples of practical applications of blockchain technology that exist outside the financial services industry.

1. *Blockchain in medicine.* Medicine is one of the areas where data storage and processing is one of the key factors. The health, and even the life of the patient, may depend on how quickly doctors receive the results of the examination or the medical history. Blockchain technologies allow entering all the data into the patient's card, and if necessary, even doctors from another city or country can get access to them (for example, if the patient was forced to go to a medical facility during a vacation or a business trip). With the use of blockchain, specialists from other countries can be admitted to the internal resource without any fear, having previously limited access to the framework of what is necessary.

2. *Energetics.* The founders of “Energy Blockchain Labs” argue that the company is the only enterprise in the world dedicated to the full value added cycle of the energy industry. Founded in 2016 by three seasoned energy, finance and information technology professionals, the lab is working on groundbreaking solutions, including collaborative projects with other companies to develop a range of blockchain-based energy Internet technologies and solve generational challenges. and energy consumption, trade, management and others.

3. *Real estate.* “UBITQUITY” offers real estate, mortgage and reviewing companies its own blockchain-platform for keeping records of property and associated property rights. The platform is positioned as a parallel alternative to the legacy paper-based transaction management system, allowing you to speed up the process of legal due diligence of real estate, increase transaction transparency and trust through full decentralization.

“Silvertown” helps housing associations and large property management companies monitor the physical health of properties using smart home technology. The information received from smart beacons and sensors is transmitted and stored on the blockchain, which ensures the integrity of data and privacy of renters.

4. *Internet of Things*. “Chronicled” is a San Francisco-based company that launched a promising IoT blockchain-platform in August aimed at improving the consumer experience. As part of the project, the Ethereum-blockchain stores the identity of physical items such as consumer goods and collectibles. This allows the creation of secure and compatible with many other systems digital identifiers, which opens opportunities for new mechanisms of interaction with the consumer based on tracking his proximity to the object.

5. *Video games*. Blockchain has found its fans even in the video game industry.

“Etheria” is a virtual world where players try to take possession of the cells of the playing field, mining them for blocks, and build something on them. All data describing the world and its state, as well as all the actions of players, are stored in the decentralized Ethereum-blockchain.

“First Blood” is a platform that allows esports players to challenge each other in different gaming disciplines, fans to place bets or judge games, as well as organize tournaments and receive rewards from any such activity. First Blood operates on the Ethereum-blockchain with its own 1ST token, actively using smart contracts to process results and oracles as a source of information on match results.

**Conclusions** .Blockchain is a technology that has a chance to overturn the sphere of government regulation, the sphere of the state as a whole, finance – every single sphere. It is in this statement that the main result of studying blockchain technology lies. It is possible that the moment has now come when the blockchain is being rolled out on public roads and being introduced into the most important sectors of life. New projects on the blockchain will be based on its main advantages – openness, security, security. That is why the blockchain will be a good help for any services where users could worry about possible fraud or data safety. This article explored the various applications and uses of this technology outside of banking.

Also, blockchain technologies can be used in tourism, education, the automotive industry, public transport, industrial production, agriculture, etc. All this confirms once again that Blockchain technology has grandiose prospects and can be

implemented in almost any field of activity.

## References

1. Artem Genkin, Aleksej Miheev, *Blokchejn. Kak jeto rabotaet I chto zhdet nas zavtra*, Al'pina Publisher, 2018, p. 592.
2. Don Tapskott, Aleks Tapskott. *Blokchejn-revoljucija. Kak tehnologija, stojashchaja za bitkojnom, menjaet den'gi, biznes i mir*, Jeksmo, 2017, p. 448.
3. Melani Svon. *Blokchejn. Shema novojj ekonomiki*, Olimp-Biznes, 2017, p. 240.
4. Nataniel' Popper. *Cifrovoe zoloto. Neverojatnaja istorija bitkojna, ili O tom, kak idealisty i biznesmeny izobretajut den'gi zanovo*, Vil'jams, 2016, p. 386.
5. Uil'jamMogajar. *Blokchejn dlja biznesa*, Jeksmo, 2017, p. 349.

УДК 533.9.01

## PROPERTIES OF DUSTY PLASMA WITH NEGATIVE IONS IN AFTERGLOW REGIM

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**Анотація. Крупка А.А. Властивості запиленої плазми з негативними іонами в режимі післясвічення.**

В роботі досліджено густини електронів, позитивних та негативних іонів, їх потоки та швидкості в залежності від часу та просторової координати у режимі розпаду плазми для рівних температур іонів  $T_i$  та електронів  $T_e$ . За базову модель розряду взято модель плазми з негативними іонами, яку представлено у роботі [1]. Було проведено теоретичне та числове дослідження заряду порошинок та сил, що діють на порошинку у плазмі, що є в режимі розпаду, в залежності від радіусу порошинок, температур заряджених частинок, густин електронів та іонів, розмірів камери та інших параметрів розряду.

**Ключові слова:** запорошена плазма, режим розпаду, негативні іони

**Abstract. Krupka A.A. Properties of dusty plasma with negative ions in afterglow regim.**

The spatiotemporal evolution of charged species densities, wall fluxes and velocities during the afterglow with equal ion  $T_i$  and electron  $T_e$  temperatures of an electronegative discharge has been investigated. The model of plasma with negative ions presented in [1] has been taken as a basic plasma model. The theoretical and numerical analyzes of the dust charge and the forces acting on a dust particle in the afterglow plasma, which are depending on the radius of the dust particle,

the temperatures of charged species, the electron and ion densities, the size of the chamber and other discharge parameters, have been carried out.

**Key words:** dusty plasma, afterglow, negative ions

Let us consider a non-stationary dusty plasma layer consisting of electrons with density  $n_e$ , positive ions with density  $p$ , negative ions with density  $n$ , negatively charged dust particles with radius  $a_d$  and charge  $Z_d$ . Plasma is considered quasineutral, i.e.  $n_e + n = p$ . It is assumed that there are spherical dust grains in the plasma, the density of which is much lower than the densities of electrons and ions. It is assumed that the ion mean free path is less than the size of the plasma, and the plasma parameters depend on the  $x$ -coordinate and the fluxes of charged particles  $\Gamma_k = -D_k \partial n_k / \partial x \pm \mu_k n_k E$ , where  $D_k$  and  $\mu_k$  are the  $k$ -species diffusion coefficient and mobility, respectively, tied by the Einstein relation  $k D_k = T_k \mu_k$ , where  $T_k$  is the  $k$ -species temperature. The self-consistent electrostatic field can be found from the condition of zero net current  $j = e(\Gamma_p - \Gamma_n - \Gamma_e) = 0$  [1] and is given by

$$E = \frac{D_p \nabla p - D_n \nabla n - D_e \nabla n_e}{\mu_p p + \mu_n n + \mu_e n_e} \quad (1)$$

Equation (1) should be supplemented by equations of balance for negative ions and electrons:

$$\frac{\partial n}{\partial t} - \mu_n \frac{\partial}{\partial x} \left( T_i \frac{dn}{dx} + En \right) = \nu_{att} n_e - \gamma_d n - \beta_{ii} np \quad (2)$$

$$\frac{\partial n_e}{\partial t} - \mu_e \frac{\partial}{\partial x} \left( T_e \frac{dn_e}{dx} + En_e \right) = (Z_{ioniz} - \nu_{att}) n_e + \gamma_d n \quad (3)$$

where  $\beta_{ii}$  is the ion-ion recombination rate coefficient,

$Z_{ioniz}, \nu_{att}, \gamma_d$  – are the ionization, attachment, and detachment frequencies, respectively. These frequencies and diffusion coefficients were taken from [2].

Substituting expression (1) in equations (2) and (3), we obtain:

$$\frac{\partial n}{\partial t} - \frac{\partial}{\partial x} \left( \mu_i T_i \frac{dn}{dx} - un \right) = \nu_{att} n_e - \gamma_d n - \beta_{ii} np \quad (4)$$

$$\frac{\partial n_e}{\partial t} - \frac{\partial}{\partial x} \left[ D_{eff} \frac{dn_e}{dx} \right] = (Z_{ioniz} - \nu_{att}) n_e + \gamma_d n \quad (5)$$

$$n_e = p - n$$

$$\text{where } u \equiv \frac{\mu_i T_e}{n_e + \frac{\mu_i}{\mu_e(p+n)}} \frac{dn_e}{dx} \text{ and } D_{eff} = \frac{\mu_i T_e(p+n)}{n_e + \mu_i/\mu_e(p+n)} + \mu_i T_i.$$

For simplicity we have considered the case of equal ion mobilities and diffusion coefficients  $\mu_p = \mu_n \equiv \mu_i$ ,  $D_p = D_n \equiv D_i \equiv \mu_i T_i$ . In an electron-dominated plasma  $n_e \mu_e \gg \mu_i(p + n)$ , and  $D_{eff} \approx \mu_i T_e(p + n)/n_e + \mu_i T_i$ . In an ion-ion plasma  $n_e \mu_e \ll \mu_i(p + n)$ , and  $D_{eff} \approx \mu_e T_e$ . Boundary conditions for (4), (5) were: symmetry at the plasma center, and zero negative ion and electron densities (in reality, a very small value for density) at the wall. This peculiar boundary condition corresponds to the absence of negative ion generation at the wall.

We therefore investigate the afterglow evolution assuming equal ion and electron temperatures, and  $v_{att}, \gamma_d, \beta_{ii} p < D_i/\Lambda^2, D_{eff}/\Lambda^2$ , where  $\Lambda = 2L/\pi$ ,  $x = 0$  and  $x = L$  correspond to the center and boundary of the plasma layer. After a short period in the afterglow, all three density profiles are similar [3]:

$$\frac{n}{n_0} = \frac{p}{p_0} = \frac{n_e}{n_{e0}} = f\left(\frac{x}{\Lambda}\right) = \cos\left(\frac{x}{\Lambda}\right) \quad (6)$$

where index 0 corresponds to the densities of the particles in the center of the plasma layer. Using these expressions, from equations (4) and (5) we obtain the following expressions for particle fluxes:

$$\begin{aligned} \Gamma_p(x, t) &= -\frac{D_i p_0}{\Lambda} \left(1 + \frac{1}{1+F}\right) f'\left(\frac{x}{\Lambda}\right) \\ \Gamma_n(x, t) &= -\frac{D_i n_0}{\Lambda} \frac{F}{1+F} f'\left(\frac{x}{\Lambda}\right) \\ \Gamma_e(x, t) &= -\frac{D_i n_{e0}}{\Lambda} \left(1 + \frac{p+n}{n_e(1+F)}\right) f'\left(\frac{x}{\Lambda}\right) \end{aligned} \quad (7)$$

where  $F = \mu_i(p + n)/(\mu_e n_e)$ .

Expressions (7) determine the drift velocities of positive  $u_p(x)$  and negative  $u_n(x)$  ions in the field  $E$ :

$$u_p(x) = \frac{\Gamma_p(x)}{p(x)} \quad (8)$$

$$u_n(x) = \frac{\Gamma_n(x)}{n(x)} \quad (9)$$

The evolution of electron density can be found analytically

$$\frac{\mu_i}{\mu_e} \ln \left( \frac{n_e(0)}{n_e(t)} \right) + \frac{1}{2} \ln \left( \frac{n_e(0) + n(0)}{n_e(t) + n(0)} \right) = t/\tau_d \quad (10)$$

where  $\tau_d \equiv \Lambda^2/D_i$ . Equation (10) describes two different regimes in the afterglow, before and after a critical time  $t_{cr}$ ,

$$t_{cr} = \frac{\tau_d}{2} \ln \left( \frac{p_0}{n_0} \right) \quad (11)$$

For  $t < t_{cr}$ , the second term on the left-hand side of (10) dominates and the solution is simply  $n_e(t) + n(0) = [n_e(0) + n(0)] \exp(-2t/\tau_d)$ , corresponding to ambipolar decay of positive ions. For  $t > t_{cr}$  the first term on the left-hand side of (10) becomes important, and (10) describes free electron diffusion, with  $n_e \sim \exp(-D_e t / \Lambda^2)$ . Note that all electrons have practically escaped within a finite time period  $t_{cr}$ , as observed in [4] and discussed in [5]. After all electrons have practically escaped, negative ions start to come out by free diffusion, and  $n \sim \exp[-(t - t_{cr})/\tau_d]$  for  $t > t_{cr}$ .

In a low-temperature discharge a dust grain experiences several forces. Here we will concentrate on the positive- and negative-ion drag and electric forces, which are the most important under the conditions given. The electric force acting on an isolated dust grain in the plasma is given by

$$F_e = e Z_d E \quad (12)$$

where  $Z_d$  is the dust charge.

The drag force on an isolated dust grain can be represented by a sum of the “orbital” and “collection” forces [6].

The momentum-transfer cross section for ion collection is

$$\sigma_\alpha^c(v) = \pi b_{coll}^2 \quad (13)$$

where  $b_{coll} = a_d (1 \pm 2b_{\pi/2}/a_d)^{1/2}$ ,  $a_d$  is the dust radius, and  $b_{\pi/2} = e^2 |Z_d| / m_\alpha v^2$ . Here «+» for positive ions, and «-» for negative ions. For  $b_{\pi/2} > a_d/2$  for negative ions  $b_{coll} = 0$ .

The orbital momentum-transfer cross section can be expressed as [6, 7]:

$$\sigma_\alpha^o(v) = 2\pi b_\pi^2 \ln \left( \frac{\lambda_d^2 + b_\pi^2}{b_{coll}^2 + b_\pi^2} \right)^{\frac{2}{2}} \quad (14)$$

where  $\lambda_d$  is the Debye length. For the electronegative plasma the Debye length:

$$\lambda_d = \left[ 4\pi e^2 \left( \frac{n_e}{T} + \frac{n}{T} + \frac{p}{2E_p} \right) \right]^{-0.5} \quad (15)$$

where  $E_p = m_i v_p^2 / 2$  and  $v_p = \sqrt{u_p^2 + 8T/m_i\pi}$ .

The positive- and negative-ion drag forces:

$$F_{drp} = pm_i v_p [\sigma_p^o(v_p) + \sigma_p^c(v_p)] u_p \quad (16)$$

$$F_{drn} = nm_i v_n [\sigma_n^o(v_n) + \sigma_n^c(v_n)] u_n \quad (17)$$

where  $v_n = \sqrt{u_n^2 + 8T/m_i\pi}$ .

In order to make use of the cross sections in our calculations, we need to find the dust-grain charge.

The dust charge is found by balancing the plasma currents on the dust grain

$$I_p + I_e + I_n = 0, \quad (16)$$

where  $I_\alpha$  is the local current of particle  $\alpha$  onto the dust grain. The ion current is given by:

$$I_p = \pi a_d^2 e p v_p \left( 1 + \frac{2e^2 |Z_d|}{a_d m_i v_p^2} \right) \quad (17)$$

The approximate electron and negative-ion grain currents are given by:

$$I_e = -\pi a_d^2 e n_e \sqrt{\frac{8T}{\pi m_e}} \exp \left( \frac{-e^2 |Z_d|}{a_d T} \right) \quad (18)$$

$$I_n = -\pi a_d^2 e n_n \exp \left( \frac{-e^2 |Z_d|}{a_d T} \right) \quad (19)$$

The obtained expressions and results are a good basis for further work on this scientific problem and can be used for accurate calculation of the forces acting on the dust grains during the decay of dusty plasma with negative ions. Written calculation

algorithms in Python can be useful in the future work to calculate the parameters of the plasma in the afterglow regime, and under other external conditions.

## References

1. Kaganovich, I. D., Ramamurthi, B. N., Economou, D. J. (2001). Spatiotemporal dynamics of charged species in the afterglow of plasmas containing negative ions. Phys. Rev. E. V. 64. 2.
- Lieberman M. A., Lichtenberg A. J. (2005). Principles of plasma discharges and materials processing. New York: John Wiley & Sons. P. 565.
3. Koniukov M. V. (1958). Concentration of negative ions in the plasma of a positive column. Zh. Eksp. Teor. Fiz. V. 34, P. 908.
4. Puckett, L. J., Kregel, M. D., Teague, M. W. (1971). Phys. Rev. V. 4, P. 1659.
5. Gutsev, S. A., Kudryavtsev, A. A., Romanenko, V. A. (1995). Tech. Phys. V. 40, P. 1131.
6. Bouchoule A. (ed). Dusty Plasmas: Physics, Chemistry, and Technological Impacts in Plasma Processing. (1999). New York: Wiley.
7. Perrin, J., Molinas-Mata, P., Belenguer, P. (1994). J. Phys. D. V. 27, P. 2499

УДК 004.43

## WHAT IS PROGRAMMING: AVAILABLE EXPLANATION AND ADVICE TO BEGINNERS

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**Анотація. Кринична А.О. Що таке програмування: доступне пояснення та поради початківцям.**

У даній статті розглядається принцип роботи з даними в коді на основі JavaScript. Стаття стосується сучасні технології, які містять коди. Стаття містить інформацію про програмування для початківців. Детально говориться про JavaScript, яка є динамічним, об'єктивно-орієнтованим прототипом мови програмування, яка найбільше підходить для новачків. Текст дає цінну інформацію про використання мови JavaScript, яка допомагає оволодіти навичками в написання сценаріїв вебсторінок для надання їм інтерактивності та сценаріїв в прикладних програмах, створення односторінкових та прогресивних вебзастосунків, програмування на боці сервера, стаціонарних застосунків та мобільних застосунків. Велика увага приділяється вибору мови програмування, яку треба обирати та розумітися в ній. Стаття дає докладний аналіз про те, як саме розробляти програми, починаючи з найпростіших і закінчуючи найскладнішими алгоритмами.

Ця стаття надасть велику допомогу для початківців, які зацікавлені у вивчені мов програмування.

У результаті стаття дає цінну інформацію про те, з чого почати і що потрібно мати для роботи з даною мовою програмування, які труднощі виникають на початку роботи, та головне, як самому перевірити на правильність власний код.

**Ключові слова:** інтерактивність, вебсторінка, мова програмування, програмування, редактор коду, системи програмування

**Abstract. Krynychna A.O. What is programming: available explanation and advice to beginners.**

This article discusses the principle of working with data in code based on JavaScript. The article deals with modern technologies that contain codes. The article contains information about programming for beginners. It is spoken in detail about JavaScript, which is a dynamic, object-oriented prototype of a programming language that is best suited for beginners. The text gives valuable information on the use of JavaScript, which helps to master the skills of writing web page scripts to make them interactive and scripts in applications, creating one-page and progressive web applications, server-side programming, stationary applications and mobile relationships. Much attention is given to the choice of programming language, which must be chosen and understood in it. It gives a detailed analysis of how to develop programs, starting with the simplest and ending with the most complex algorithms. This article is of great help to beginners who are interested in learning programming languages. As a result, the article gives the reader valuable information about where to start and what you need to have to work with this programming language, what difficulties arise at the beginning, and most importantly, how to check your own code.

**Key words:** interactivity, web page, programming language, programming, code editor, programming systems

General formulation of research and its topicality. The research topic is relevant because today it is impossible to imagine our lives without computer technology. Current programming is multifaceted and is used in such important areas as construction, business and economics, medicine, biology and physics. A large percentage of manual labor in industry has been replaced by machine and robotic labor, which is controlled by software that provides a significant increase in speed, accuracy and efficiency of production. Such a rich variety of applications is provided by a solid selection of programming languages, each of which has its pros and cons.

Programming is an integral part of modern life. Let's try to understand this area. And again, here come to the aid of programmer skills, namely - the ability to think critically and analyze this information.

On the Internet a lot of already written programs can be seen that are easy to rewrite, but it must be told a little understanding of this area so that some people can write at least one program.

There are a lot of articles about programming that reveal a lot of secrets, give advice and explain this or that topic. Unfortunately there are not many articles just for beginners. The further inquiries in this article can be useful.

### **Setting of the problem and the aim of the article**

The problem is how to present information to a beginner, the most important information is submitted here to be understood. The following issues are considered first in this article. They are: what set of tools you need to work, programming languages, introduction to JavaScript-based programming, working with data in the code.

### **Discussion and Results**

Some set of tools you need to work. The tools of a typical programmer often consist of the following things: A computer; an Internet connection (first of all it is necessary for search of all unexplored and unknown in any of known search services); a code editor (or IDE - a set of software used by programmers to develop software) that will help organize everything you create; compiler or interpreter. This is a program that reads your code and tries to find errors in it. It then collects your code into a single package and sends it to your computer for execution; headphones. You may be distracted by outside noise, and headphones are one easy way to protect yourself from noise. You can use free software to get started with the code. These are Atom and Notepad++. You can also try SublimeText, but this editor is paid software. **Programming languages;** There are more than a thousand different programming languages in the world. Many of them are a little less than completely useless. It can give a great career if you know 3-4 programming languages. By the way, they are not as complex as human languages. Programming languages are often

described by their paradigm, which is a way of categorizing types of functions. For example, JavaScript is a language that can be run in any web browser, and it deservedly occupies a leading position in the popularity rankings. It has a diverse set of functions: it supports imperative paradigms that are structured, object-oriented, and event-driven.

Programming languages have one feature - if two languages have similarities in paradigms, then, as a rule, they are similar in syntax. After learning JavaScript, you will be able to understand up to 75% of the code in Python or Ruby because they are similar.

### **Introduction to JavaScript-based programming;**

From now on, the JavaScript programming language will be used to give specific examples. Samples of the code will be printed in a special disproportionate font and highlighted in frames. The disproportionate font evens out the pins for each letter. This is

designed to make it easier for developers to find bugs in teams. As an example, consider the following images:

**Bob went out for the weekend and borrowed Alice's horse wihout asking.**

### **Proportional text**

**Bob went out for the weekend and borrowed Alice's horse wihout asking.**

### **Disproportionate text**

The sentences contain the following errors: an extra space after the word for, an extra apostrophe after the word “Alice”, and a missing letter in the word “without”. You may have noticed all the errors at once, but note that they are easier to notice in the second picture, where the disproportionate text is located.

### **Working with data in the code;**

Let's move on to the practical part and try to write some code. The main element in a computer program is a variable, which in turn determines the name for any information, whether number or text. Data should always be named.

There are two main reasons why the data should be named: For example, Facebook doesn't know when your birthday is, so it uses a variable with the common name donalds\_birthday to indicate the date or to indicate its absence. (Variables cannot contain spaces, so words must be separated by other characters.) A variable is assigned to any date you enter, and the program continues to use your data, hiding it behind the variable. It can be difficult for you to remember what this or that variable means. For example, you need to tell your computer that December 86th is not a real date. So we have to point out somewhere that December is the 31st day. But 31 is a number (data), so if you use 31 in all your code to indicate the number of days in that month, you'll be confused once. After all, we have other months. Thus, the number 31 can be assigned the name the\_number\_of\_days\_in\_december. Note You cannot use apostrophes in variable names.

For a variable to exist, it must be declared. The declaration of variables serves as a "birth certificate" for the data. Let's look at an example:

```
var the_number_of_days_in_december
```

The keyword var means variable. The use of abbreviations speeds up the work with the code. The variable must also be assigned a value:

```
var the_number_of_days_in_december = 31
```

Everything is very simple. Declare a variable, assign a value to it, and use it everywhere in the code, for example, the\_number\_of\_days\_in\_december instead of the number 31. Keep in mind that you can also declare variables for data that doesn't already exist. Let's go back to the examples. You can declare var donalds\_birthday and tell the application to wait for the value to be entered. Everything that the user enters for this variable will be used in the text named donalds\_birthday. Variables can contain more than just dates and numbers. For example, you can declare an entire line or piece of text:

```
var great_song_lyrics = 'pasito a pasito, suave suavecito'
```

Now you can write “great\_song\_lyrics” anywhere in the code and the computer will understand that it is 'pasito a pasito, suave suavecito'.

**Conclusions.** This article helps you to find out about the list of the required set of tools, because when you start doing something new, you always need to be as prepared as possible. There is also specific advice on where to start and what to look for. We also got acquainted with such a programming language as JavaScript, studied the essence of its work, and even wrote code in this language. In fact, the choice of the first programming language is a question for which it is impossible to find an absolutely correct answer. All programmers start somewhere, and no matter how difficult the choice of the first language is, that choice still has to be made. JavaScript is incredibly versatile for beginners. JavaScript itself is quite compact, but very flexible. A large number of tools have been written by developers on top of the main JavaScript language that unlock a huge number of additional features with very little effort.

## References

1. Chervonyi, M.A. (2017). Ya khochu navchytysia prohramuvaty [I want to learn programming]. *Osvita – Education*, 11. Available at: <https://studway.com.ua/code-part-1/>
2. Haverbeke, M. (2018). *[Eloquent JavaScript]*. San Francisco: No Starch Press.
3. Vasiliev A.N. (2020). *Java dlja vsikh [Java for everyone]*. Saint-Petersburg: Vydavnychi dim Piter.
4. Martin R. (2019). *Chystyi Kod [Sheer code]*. Kharkiv: Fabula.
5. Gookin D. (2019). *Prohramuvannia na C dlja chainykv [Programming in C for teapots]*. Moscow: Viliams.

УДК 621.383.51

## SOLAR CELLS: PRINCIPLE OF WORK AND THEIR APPLICATION

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**Анотація. Максимовська А.В. Сонячні батареї: принцип роботи та їх застосування.**

У даній статті розглянуто одне з альтернативних джерел енергії, сонячної енергії, та її перетворювач у електричну енергію – сонячну батарею. Надається коротка історична

довідка. Висвітлюється хронологія розвитку цієї галузі. Виявляються основні переваги та недоліки цього виду джерела енергії. Пояснюється, з чого складається сонячна панель, принцип її роботи та її використання. окрім розглядається принцип дії фотоелемента, на основі яких будуються панелі. Розкриваються проблеми використання енергії сонця як основного джерела енергії. Обговорюються коефіцієнти корисної дії батарей різних поколінь та залежність ефективності від будови.

**Ключові слова:** коефіцієнт корисної дії (ККД), перетворення, сонячна панель, p-n перехід, фотони, дірки

**Abstract. Maksimovskaya A.V. Solar cells: principle of work and their application.**

The paper deals with one of the alternative sources of energy, the solar one, and its converter into electric energy – the solar panel. A short historical background is presented. The chronology of this field development is considered. The main advantages and disadvantages are investigated. The application and the principle of solar panel functioning and its components are explained in the article. The principle of the photocell work, on the basis of which panels are built has been studied in detail. The problems of the solar energy application as the basic source of energy are considered. The efficiency of various generation solar cells and its dependence on solar panel structure are discussed.

**Keywords:** transformation efficiency, solar panel, p-n junction, photons, holes

### **Setting of the problem and the aim of the article**

General formulation of research and its topicality: Nowadays the alternative sources of energy play an important part in electricity production. The Sun is one of them. After inventing solar batteries new opportunities to energize spacecraft and electric cars have been provided. The Sun is an eco-friendly source of energy. Despite that, the amount of wide scale solar panels is small. The energy produced by the solar panels is 1% of the world's energy. For example, new buildings in Spain have been equipped with batteries since 2007 to provide hot water supply. The extensive use of solar panels can solve such problems as deforestation, depletion of coal and air pollution.

**Subject:** representation of the solar energy and solar panels.

**Objective:** demonstration of the operation principle and application.

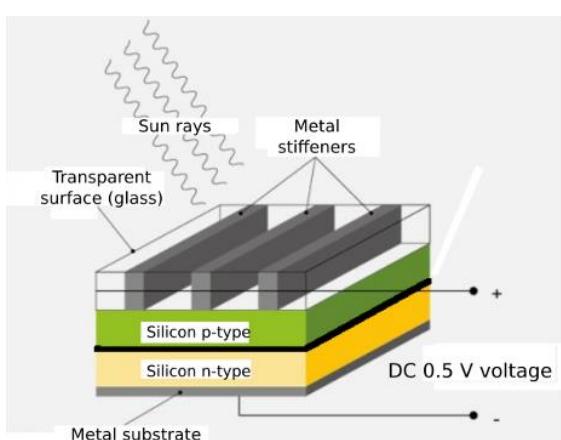
**Tasks of this paper:** determination of the structure of the solar panel,

investigating the principle of operation of the solar panel main part.

## History and introduction

The solar cell industry started in the 19<sup>th</sup> century. The rapid development of this field was caused by a large number of the transformation experiments. The first chemical solar battery was invented in 1839 by Henri Becquerel. 50 years later Charles Fritts noticed that selenium was sensitive to light. The transformation efficiency of the first solar battery was about 1%. Having explained the p-n junction D. Chapin, G. Pirson, K. Fuller constructed silicon single-crystal solar cell with 6% efficiency in 1954. Subsequently transformation efficiency reached 15%. Nowadays it is about 25%.

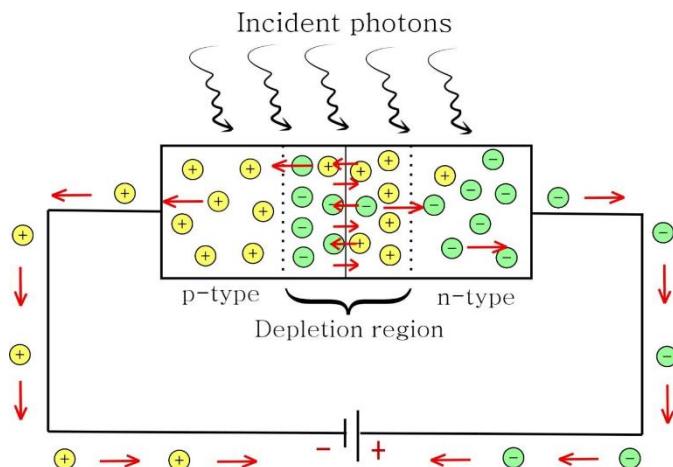
## The structure



A solar cell is a sandwich of two different layers of silicon that have been specially treated or doped (silicon p-type and silicon n-type). A photocell is an electronic device converting the energy of photons into electrical one. Photoelectric effect underpins its work. It is the main part of the solar panel. However, the panel does not work without such components as:

- The accumulator which stores energy.
- The voltage regulator which holds voltage in a certain range.
- The converter which transforms direct current into alternating current.

## The principle of the photocell operation



If the semiconductor with a p-n junction is illuminated, a photon possessing energy  $E = h * \nu$  falls into a neutral layer and the electrons use this energy to get free. Carriers

jump across the barrier of the depletion region. The holes move to the p-type zone, while electrons move to the n-type one. It leads to the increase of the carrier concentration in p-type and n-type zones. The electromotive force appears on the photocell outputs and when the circuit is enclosed, current flows.

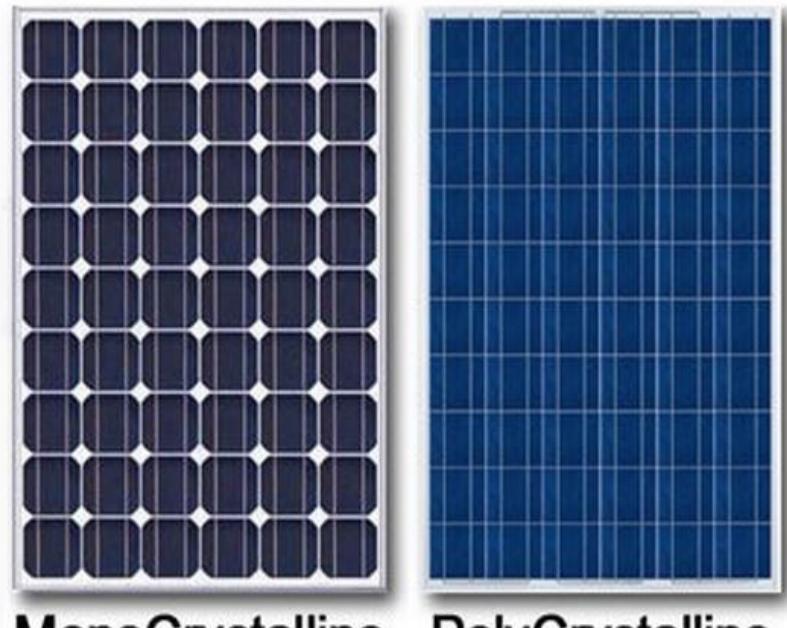
### **The solar cell efficiency and its generations**

There are three solar cell generations:

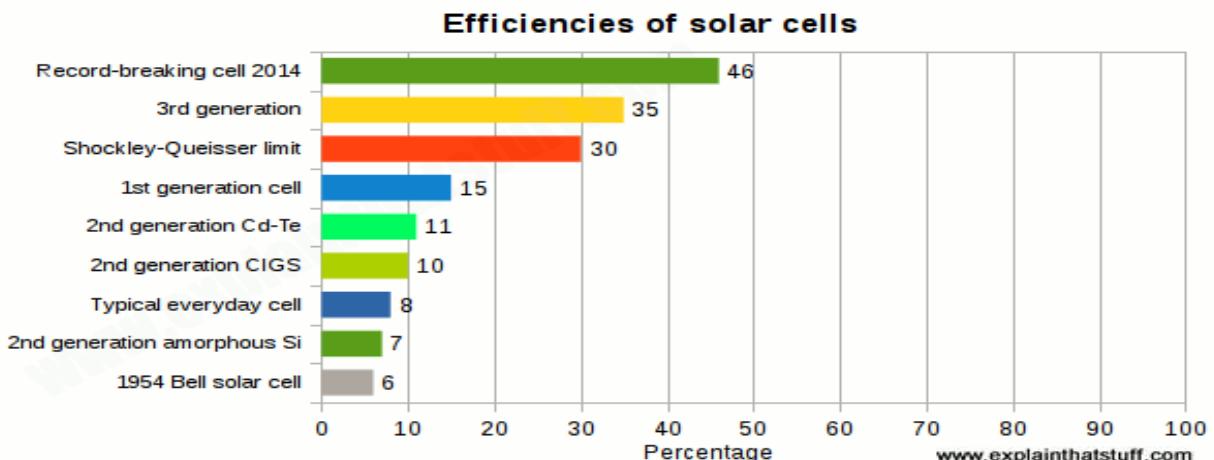
*The 1-st generation:* the first-generation was discovered in 1954 by the scientists from Bell Telephone to produce energy on the spaceship. The first solar panels are called polycrystalline. Their efficiency is nearly 15-17%. But they are the cheapest ones.

#### *The 2-st generation:*

the second generation is called monocrystalline, also they are known as thin-film cells. The thickness of the semiconductor layer in the thin-film cells is several micrometers. The second-generation cells are made of pure silicon. The efficiency of it is about 20-25% depending on the subgeneration.



*The 3-rd generation:* the third-generation cells are the combination of the first- and the second-generation cells. They are made of amorphous silicon, organic polymers, perovskite crystals. Sometimes plastic lenses are used in cells to focus solar light to increase the efficiency. The efficiency of the third-generation cell can reach 30%.



## The problems of using the solar energy

Despite the advantages of using solar energy as one of the main sources, it is cheaper to burn fossil fuels to produce electricity in fossil-rich countries. Production, installing and setting are labour intensive processes which require a trained staff. Investments in solar energy production are risky because it is a progressive field of science and new developments are made every year. Also the solar panel efficiency depends on the climate conditions, so it is not effective to install panels in countries with cloudy weather. In addition they take up a lot of space.

## Conclusions

On the basis of a comprehensive research we can assume:

1. The solar energy production is a rapidly growing field of science. The efficiency of current solar panels is about 25-30% and will grow in the future.
2. The photoelectric effect underpins the solar cell operation.
3. There are some solar energy advantages such as environmental friendliness, inexhaustibility and certain disadvantages: producing energy from the Sun is more expensive than other sources, the solar panels efficiency is lower in comparison with atomic energy.
4. Solar panels efficiency depends on the climate conditions: the highest transform efficiency is near equator, the lowest one is at the poles.
5. The solar energy gives opportunity to provide the energy on spaceship cost-effectively.

## References

1. Chebotarev V. I., Dumin A. N., Holodov V. I. (2008) Poluprovodniki v radioelektronike. Uchebno-metodicheskoe posobie.
2. Chris Woodford (2020). Solar cells. Available at: <https://www.explainthatstuff.com/solarcells.html>
3. Lewis Fraas, Larry Partain (1995). Solar cells and their application. Second edition.

УДК 004.4'2

## ANATOMY OF GAME ENGINE

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### **Анотація. Меглій О.В. Анатомія ігрового движка.**

Раніше відеоігри вважалися чимось несерйозним і навіть шкідливим для дитячої психіки, зараз же у ігор немає віку, на основі ігор проводяться спортивні змагання, деякі стратегії, наприклад, Civilization V і SimCity використовуються в навченні. Серцем кожної гри є ігровий движок, саме він визначає, як виглядають персонажі, що відбудеться після натискання тієї чи іншої клавіші, коли саме з'явиться інший персонаж і так далі. Ігрові движки, хоч і є ядром гри, дуже гнучкі: можна замінити складові або весь движок повністю без змін інших аспектів гри. Ця гнучкість ігрових движків наштовхує на думку про їх багатофункціональність та подальший розвиток. В даній статті розглядається архітектура ігрового движка. Окремо розглянута кожна складова, її функції та призначення.

**Ключові слова:** ігровий движок, візуалізатор, геймплей, ігрові механіки, ігрова фізика

### **Abstract. Megliy O.V. Anatomy of game engine.**

Previously video games were considered as something childish, frivolous and even harmful to the child's psyche, now everyone plays them, from children to old people. On the basis of games sports competitions are held, some strategies, for example, Civilization V and SimCity are used for teaching. The heart of every game is the game engine, it determines how objects and characters look, what happens after a key is pressed, when another character appears, etc. Game engines, although they are the core of the game, are very flexible: you can replace the components of the game engine or the entire engine completely without changing other parts of the game. It is also obvious that not all engines are equally easy to change. This flexibility of game engines gives rise to ideas about their multifunctionality and further development. This article discusses the architecture of the game engine. Each component, its functions and purpose are considered separately.

**Keywords:** game engine, visualizer, gameplay, game mechanics, game physics

## **Setting of the problem and the aim of the article**

General formulation of research and its topicality:

Game engines are improved every year, so far video games are rarely used in non-gaming areas, but since the engine is not exclusively a game component, it can be applied in many areas, it is only a matter of time.

Subject: Game engine architecture.

Object: Game engines.

Tasks of this paper: Definition and description of the components of the game engine.

### **1. General information**

The game engine is the core of the video game, it performs the basic functions but it is not exclusively a game component itself. The engine manages the rest of the game. The game engine can also be improved, existing functions can be improved and new ones added. An example would be the game Serious Sam 3 on the Serious Engine 3.5 and its predecessor Serious Sam 1 on the Serious Engine. The graphics of the game have been improved, the gameplay has been refined, and new mechanics have also been added. Thus the engine has been refined and updated, not re-created.

The functionality of the game engine can be divided into three parts:

1. Game mechanics and gameplay
2. Physics in the game
3. Rules for displaying objects

### **2. Gameplay and game mechanics**

#### *2.1 What are game mechanics and gameplay?*

Game mechanics are the rules that the player and the game follow. And the gameplay is the implementation of these rules. Weapons in the game are game mechanics, using weapons is gameplay. The number of game mechanics determines its complexity, the more game mechanics there are, the more difficult the game is, for example, in modern games there are a huge number of mechanics, it takes time to master them, and in the Tetris game there were only 4 mechanics and it is very easy to master it.

## *2.2 Core game mechanics and gameplay*

Not all mechanics are equally important in the game, and when creating a game, the emphasis is on the most important aspect - the core game mechanics, they allow you to perform the core gameplay. The player deals with game mechanics throughout the game, as they are needed to complete or win the game.

## *2.3 Core meta-gameplay*

The core meta-gameplay is when the player uses the core mechanic to use the non-core mechanics. For example, in any car racing game there is a road driving mechanics, the meta-gameplay in this case is using "nitro" to accelerate, you use a driving mechanics to use "nitro" mechanics.

## *2.4 Satellite game mechanics*

Satellite game mechanics are a great way to enrich the core gameplay without introducing new core mechanics to the game. [2] There are 3 types of satellite game mechanics: improvement, alternative and opposition mechanics. Improvement means improving mechanics by adding new or improving old functions in existing mechanics. Alternative mechanics is allowing the player to choose how to perform a particular action. For example, if you need to go through an obstacle, you can go under it or climb over it. Opposition mechanics prevent the player from reaching the goal, thereby enhancing the challenge.

## **3. Physics of the game world**

Physics in a game engine almost always means the simulation of rigid body dynamics. The term dynamics refers to the process of determining how these rigid bodies move and interact over time under the influence of forces. Also physics in the game includes physics of sound, tissues, hair, water. But only the rigid body dynamics and the physics of sound deserve special attention.

### *3.1 Collision detection system*

To process the dynamics of a rigid body you need a collision detection system, it detects if objects touch or intersect. Each object for this system is represented by the simplest geometrical figures that have their own orientation and position in space. When one figure is not enough for the system to describe an object adequately, a set

of shapes is used. So the table can be described as both a box or five complex figures.

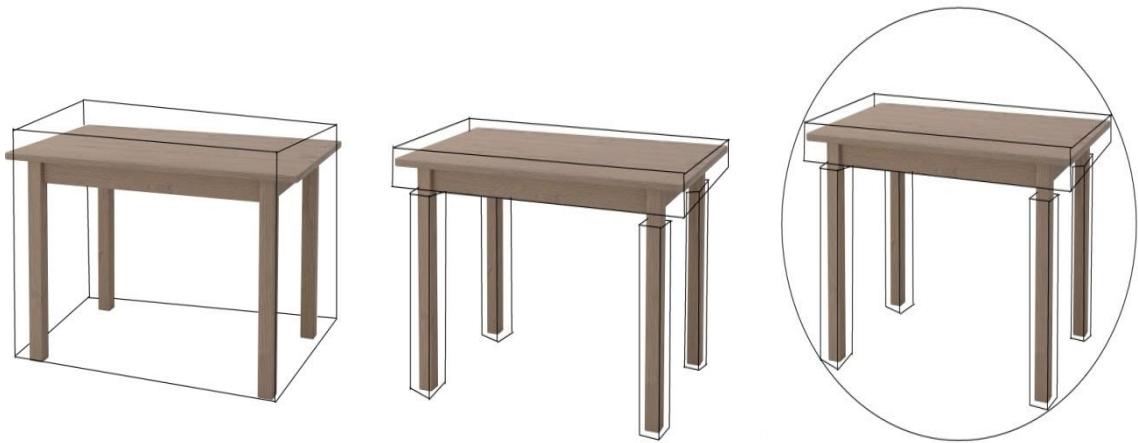


Figure 3.1. Representation of objects with the simplest geometric shapes.

a) Simple box b) Set of figures c) Bounding volume

Objects are enclosed in bounding volumes, they describe the boundaries of a complex composite object with a simple shape, and the system [8] does not need to test the subshapes for collisions if there is no collision with the bounding volume.

### *3.2 Reaction to collision*

When the engine receives the collision data, it calculates all the forces acting on the objects. The resulting speeds of objects and their speeds are calculated. The masses of objects, contact points, normal vectors and coefficient of restitution are used for the calculation. The consequences of the collision are calculated first, that is, the remaining forces are ignored as being negligible. When the forces of impact weaken the further movement of objects is calculated using the equations of motion: Newton's second law and the equations of rotational force.

### *3.3 Physics of sound*

There are four main tasks of a sound engine. [8] Sound synthesis is generating the sounds corresponding to certain events. Spatial processing for the correct reproduction of sound in space is responsible for the side from which the listener hears the sound and at what volume. Acoustic modeling is necessary for processing sounds in the presence of obstacles and reflections. Doppler shift is required to simulate the response of sound to the movement of a source or a listener. Mixing is needed for proper mixing of 3D and 2D sounds like gunfire and music.

## **4. Visualizer**

The visualizer provides the display of the image on the user's screen. It is very important to make a high-quality visualizer, since the quality of the graphics directly affects the sales of the game. The visualizer consumes about 50% of the CPU resources, so optimizing the visualizer is very important. When creating a visualizer, programmers must maintain a balance between good graphics and good optimization, since poor graphics will attract few customers, and with poor optimization, few people will be able to launch the game and, as a result, the game may not pay off.

### *4.1. Displaying objects*

Such requirements for the processor can be explained by how the picture appears on the screen. Objects are not stored in the engine or game files, the engine has a description of how these objects should look and the user's device builds objects based on these descriptions. The processor deals with creation and placement of edges, vertices and polygons, the more edges, vertices and polygons there are, the more processor requirements are. Therefore, when optimizing, the 3D artist removes all polygons, vertices and edges that the user cannot see.

### *4.2 Textures*

Without textures, we will only see the outline of the object. The type of textures is not determined by the engine. That is, the textures are in the game files, but the game engine displays them. There are usually a lot of textures, and to save place, they are compressed to speed up the process of displaying the world and objects, textures are transferred from the hard disk to the video card in a compressed form and expanded only before being imposed on the polygon. The polygon unit is pixel, the texture unit is texel. In the simplest case, when a texture is applied to a polygon, one pixel is equal to one texel, then the texture fits perfectly onto the polygon. If you apply a texture to a polygon and then reduce the polygon, artifacts may appear on the texture. Multiple filtering is used to compress textures to the desired size. The texture is compressed to the desired size on the hard drive with the correct processing, and then it is sent to the video card.

### *4.3 Caching*

In order not to send the same textures from the main drive to the video card, they are saved on the internal memory of the video card in the form of a cache. Caching is essential for fast displaying of the game world.

#### *4.4 Lighting*

There are three methods for rendering the game world. The first is rasterization, it converts a 3D object into a 2D image on the user's monitor. The object consists of polygons, the location of which is determined by the vertices, each vertex carries information about the position in space, the color of the polygon, the normal of the polygon, and so on. This information identifies how light falls on each pixel and determines its final color, but this method does not include light reflection from surfaces, shadows, and specular surfaces. The second method is ray tracing. This method uses rays in the calculations, it calculates each ray from the light source and the way it bounces off each object in its path. The ray tracing method gives a very realistic image, but requires a lot of processing power. The third method is path tracing, it cannot be used in real time, it is used in films and photos, where everything should be as believable as possible. It is very similar to the ray tracing method as it also uses rays in its calculations, but it is more complex and realistic. When using this method, the size of the light source is also important, since each ray from the source is rendered in detail.

**Conclusion.** A game engine is a very complex and fragile thing, but very flexible at the same time. It consists of game mechanics – to fill the game world and make it interesting for the player, the physics of the game world - to make the world playable and adequate, the visualizer - to display everything the player should see. Each of these components can be replaced or improved without affecting the rest of the engine and other components of the game, but this should be done very carefully as all their functions are very complex and important for the overall operation of the engine.

#### **References**

1. Brian Caulfield (2018). What's the Difference Between Ray Tracing and Rasterization? Available at: <https://blogs.nvidia.com/blog/2018/03/19/whats-difference-between-ray-tracing->

[rasterization/](#) 2. Carlo Fabricatore (2010). Game and game mechanics design: a key to quality in videogame. Available at: <http://www.oecd.org/education/ceri/39414829.pdf> 3. Dmitry Chekanov (2002). Anatomy of game engines. Available at: <https://3dnews.ru/183337/page-1.html> 4. Dustin K (2020). Beginner's Guide to Game Mechanics. Available at: <https://www.gamedesigning.org/learn/basic-game-mechanics/> 5. Harold Serrano (2016). How does a Physics Engine work? An Overview. Available at: <https://www.haroldsserrano.com/blog/how-a-physics-engine-works-an-overview> 6. Jason Gregory (2019). Game Engine Architecture Third Edition. 7. Patrick Hearn (2019). What is Path Tracing and Ray Tracing? And Why do They Improve Graphics? Available at: <https://www.online-tech-tips.com/computer-tips/what-is-path-tracing-and-ray-tracing-and-why-do-they-improve-graphics/> 8. Sharon Boller (2013). Learning Game Design: Game Mechanics. Available at: <http://www.theknowledgeguru.com/learning-game-design-mechanics/>

УДК 004.4

## **DEVELOPMENT OF AN APPLICATION FOR MONITORING THE HEALTH OF PATIENTS OF THE FAMILY DOCTOR "HEALTH HELPER"**

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**Анотація. Мощний Д.В. Розробка програми для моніторингу стану здоров'я пацієнтів сімейного лікаря «Помічник здоров'я».**

Активне впровадження інформаційних технологій у галузі охорони здоров'я призвело до кардинальної зміни життя людей, тому, для вирішення деяких проблем, з якими зіткнулись фахівці з цієї галузі, було прийнято рішення в створенні програмного застосунку, що забезпечує спілкування між пацієнтом та лікарем, дає можливість поставити просту діагностику захворювання та отримати своєчасну оцінку від лікаря. В ході роботи було задіяно багато спеціалістів з різних формувань. А саме, для вирішення цієї проблеми були використані такі методи дослідження: тестове опитування лікарів щодо інформації, які необхідно їм для первинної діагностики та прикладне програмування. В результаті, отримання свого унікального номеру, за яким лікар вас ідентифікує це все що необхідно щоб почати користуватися застосунком. Отримано робочий продукт, який має мінімальні вимоги до обладнання, базується на сучасних технологіях та напрямках. Вперше створено платформу для зв'язку пацієнта з лікарем первинної медичної допомоги в Інтернеті для

нашої країни.

**Ключові слова:** охорона здоров'я; е-медикамент; медична реформа; лікарі

**Abstract. Motsnyi D.V. Development of an application for monitoring the health of patients of the family doctor "Health helper"**

The active introduction of information technology in the field of health care has led to a radical change in people's lives, so to solve some of the problems faced by experts in this field, it was decided to create a software application that provides communication between patient and doctor, allows make a simple diagnosis of the disease and get a timely assessment from a doctor. Many specialists from different formations were involved in the work. Namely, to solve this problem, the following research methods were used: a test survey of doctors on the information they need for primary diagnosis and applied programming. As a result, getting your unique number by which your doctor identifies you is all it takes to start using the app. The received working product which has the minimum requirements to the equipment, is based on modern technologies and directions. For the first time, a platform for connecting a patient with a primary care physician on the Internet has been created for our country.

**Keywords:** health care; e-medecine; medical reform; doctors

**Introduction.** The goal of modern medical reform is to provide all citizens of Ukraine with equal access to quality medical services and to restructure the health care system so that the patient is at its center. Therefore, it is important to ensure comfortable communication between the patient and the doctor, to provide the necessary medical care at any time. Such communication can be done with the help of modern Internet communication tools. [5]

**General formulation of research and its topicality.** Development of an application that allows the patient to receive advice from a doctor at a convenient time for them is an urgent task.

**Setting of the problem and the aim of the article.** Based on the analysis of existing software that interacts with doctor and patient, survey physicians to systematize and summarize some medical indicators, identify the requirements that must meet the program and develop such an application.

**Object of research:** the process of information and communication between doctor and client.

**Subject of research:** The software application, which supports communication between people and the doctor, makes it possible to make a simple diagnosis necessary. To solve this problem, the following research methods were used: test descriptions of doctors, information on their need for primary diagnosis, preparatory programming. The scientific novelty of the work is that on the basis of the collected data some medical indicators were systematized and generalized, indicators necessary for establishing the initial diagnosis were established, which was reflected in the software application, with which the doctor can provide timely care to the patient. For the first time, a platform has been created to connect a patient with a primary care physician online.

## **Discussion and Results**

**General concept.** Now the problem of rising health care costs is becoming more actual. The active introduction of information technology in the field of health care has led to a radical change in the quality of life of people not only in our country but also around the world. In order to identify the need to improve the means of communication with the patient, the doctors of the primary health care center were interviewed. Doctors spoke about the need to create a program that will allow the patient to be under constant medical supervision without visiting the hospital, sending the doctor the most important indicators. At the same time, the patient can get the necessary consultation from a specialist and in case of deteriorating health get the necessary medical advice in a timely manner.

Therefore, one of the key aspects of the development is the creation and completion of a new international field of e-medecine [2].

**Software analysis** The service should not provide and have resources to provide paid medical services, which is essentially an additional income for doctors. This can frighten patients and cause some categories of patients to be out of the service.

Based on the above, it can be noted that in Ukraine there are no available programs for doctor-patient interaction.

To solve this problem, we need to create:

1. On the basis of the analysis of the existing software which carries out interaction of the doctor and the patient, interrogation of doctors to make systematization and generalization of some medical indicators, to reveal requirements which the software application has to satisfy.

2. To develop the program "Health Helper" which will help to communicate between the patient and the doctor, to quickly convey to the doctor changes in the patient's condition.

3. The application must have minimum hardware requirements.

## Development

### Design:

The cross-platform Java programming language, IntelliJIDEA development environment, JavaFX 8.0.192 visual interface creation platform, local SQLite database, Javax library (Javax.mail) and Gmail.API were chosen to create the application.

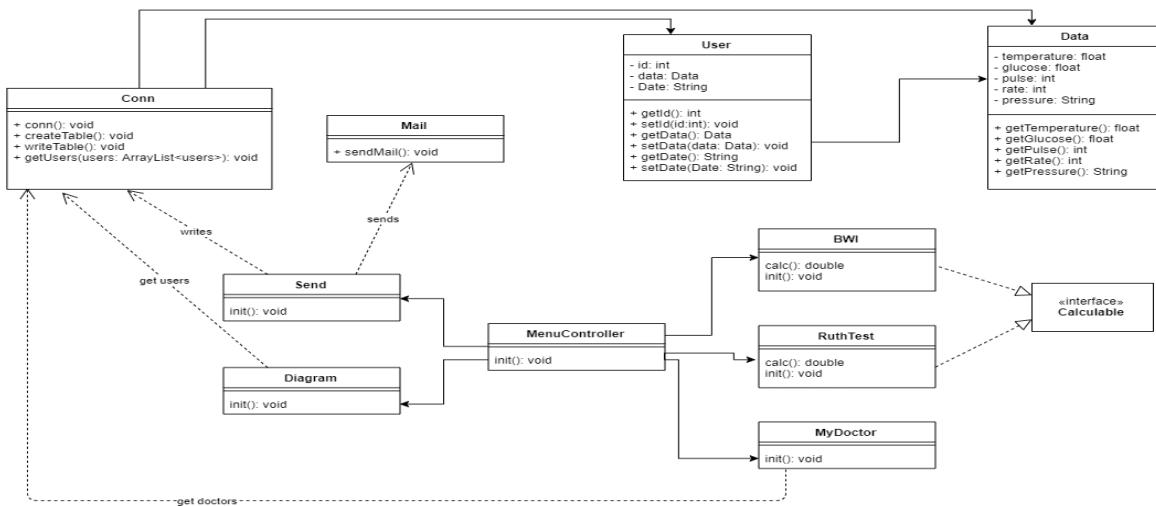


Fig. 1 - UML diagram

All class relationships are on this diagram. Google API Client Library for Java - Provides functionality common to all Google APIs, such as HTTP transport, error handling, authentication, JSON parsing, media download / download, and batch download. The library contains a powerful OAuth 2.0 library with a serial interface; lightweight, efficient XML and JSON data models that support any data schema; and support for protocol buffers.

IntelliJ IDEA is a commercial integrated development environment for various programming languages (Java, Python, Scala, PHP, etc. [3]) from JetBrains. The system comes in the form of a reduced functionality of the free version of "Community Edition" and a full-featured commercial version of "Ultimate Edition", for which active developers of open projects have the opportunity to obtain a free license.

The application consists of 11 Java-classes, 6 connected fxml-files, 3 "localizing" properties-files and a local database file. The Conn class is used to communicate with the database. In which the third-party library SQLite is imported. To send the result, the Send class was created, in which the Javax.mail library was imported for this purpose.

There are several basic methods in Main - setting up the start window and the method for creating a database and starting the Java FX-main platform. Static methods of the Conn class (classically applied) are called to create a database. The tab interface is created in a separate file (main.fxml) and connected to the appropriate controller class.

## Testing

1. Console markers were used for testing.
2. UI classes tested directly.
3. Business logic classes were tested directly.

4. JUnit was selected to do automatic testing of the application. All modules are tested by machine that allows to enable auto DevOps (**DevOps** is a set of practices that combines software development (Dev) and IT operations (Ops). It aims to shorten the systems development life cycle and provide continuous delivery with high software quality).

5. The software application was tested by family doctors in the conditions of the municipal non-profit enterprise Dnipropetrovsk Center of Primary Health Care, which was confirmed by the relevant certificate. Recommendations were made for further development of the application. In the future, it is planned to implement the software application in modern Ukrainian hospitals and cooperate with the Ministry

of Health of Ukraine.

### **UI classes:**

*MainController* is the main "framework" of the application from which the inheritance of other successor classes. *MyDoctor* class is linked to the database as follows: the ConD class calls the ReadDB method (1) and populates the ComboBox element.

One of the most important classes of the application is *SendMail*, which is the main function of the "Send Result" tab, for which appropriate fields and methods are created.

### **Business logic classes:**

*DMclass* is an embodiment of the classic Java FX chart application. *BWIclass* is a set of methods and calculator fields for body mass index. *RuthTest* class is a set of methods and calculator fields for calculating the Rufier sample using method (2). *Gmail.API* was selected to send an email.

JavaFX is a platform and set of tools for creating rich Internet applications (Rich Internet Applications, RIA) with the ability to download media and content. Sun Microsystems was first demonstrated at the JavaOne International Java Developers Conference in May 2007. JavaFX includes a suite of utilities that allow web developers and designers to quickly create and provide advanced web applications for desktops, mobile devices, televisions, and other platforms.

JavaFX consists of JavaFX Script and JavaFX Mobile. Starting with the release of JavaFX 2.0, it is possible to create JavaFX applications written entirely in Java. A rich graphics and multimedia API is available for application development, which simplifies the creation of visual applications.

SQLite is a lightweight relational database management system. Embodied as a library where much of the SQL-92 standard is implemented. The SQLite source code is distributed as a public domain, ie it can be used without restrictions and free of charge for any purpose.

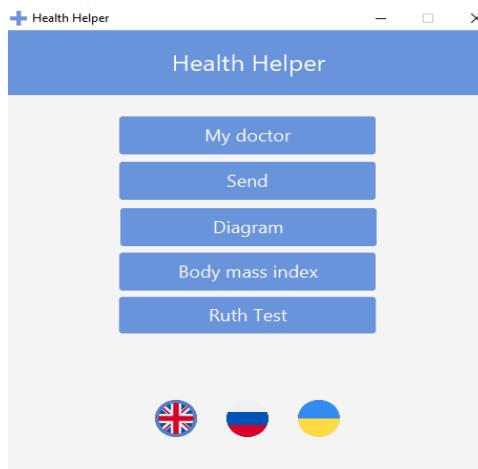
### **User instructions**

To start using the application you need to get your unique number with which

the doctor will identify you. Then go to the application and select the language that is convenient for you, and then you need to specify a unique number in the appropriate field in the "send the result".

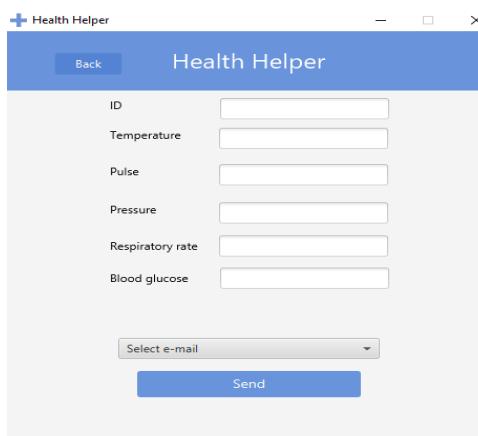
After filling in all the fields, click "send". This is the basic principle of combining a doctor with a patient. The application is divided into several semantic parts, one of which is used to count medical tests, and the other two illustrate and send the results. A set of functions has also been introduced to investigate test results.

The main menu looks like this:



*Fig. 2 - Main menu*

"Send" tab, the main tab of this application, where the user enters the main indicators and sends to the doctor, selecting the previously specified e-mail.



*Fig. 3 - Send tab*

With the help of classic indicators [1] such as: heart rate, temperature, pressure are the doctor determines changes in health, it may not be an accurate diagnosis, but

to determine the improvement or deterioration of human health, it will be much easier. Thus, doctors have the opportunity to remotely adjust the course of treatment and monitor patients.

**Conclusions.** Based on the analysis of the existing software that interacts with the doctor and the patient, surveys of doctors made a systematization and generalization of some medical indicators, identified the requirements that must meet the software application. For the first time, a platform has been created to connect the patient with the primary care physician online. Developed a software application "Health Helper", which should help to communicate between the patient and the doctor. The application has minimal hardware requirements. The directions of further improvement of the software application are outlined.

## **References**

1. I.C. Zozulya (2018) Ukrainian medical journal scientific and practical medical journal LLC "MIRON" [MORION].
2. Medychny portal[Medical portal]. [www.helsi.me/reform](http://www.helsi.me/reform)
3. [www.wikipedia.org](http://www.wikipedia.org)
4. Developers guide [www.developers.google.com/gmail](http://www.developers.google.com/gmail)
5. Reforma sistemi ohoroni zdorovya [Health care reform]. [www.kmu.gov.ua/ua/diyalnist/reformi/reforma-sistemi-ohoroni-zdorovya](http://www.kmu.gov.ua/ua/diyalnist/reformi/reforma-sistemi-ohoroni-zdorovya)

УДК 577.37

## **THE USAGE OF COFFEE GROUNDS IN SCIENTIFIC AND COMMERCIAL WORLD**

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**Анотація. Ніколенко Д.О. Використання кавової гущі в науковому та комерційному світі.**

У даній статті розглядається досить актуальна проблема, що охоплює питання охорони навколошнього середовища. Численні екологічні дослідження різних країн світу демонструють постійно зростаючу небезпеку, на яку наражається екологія нашої планети. Не викликає сумніву те, що через антропогенні фактори, а саме об'єми накопичених відходів, забруднення атмо-, гідро-, біо- та геосфери, глобальне потепління страждають живі

організми всіх царств природи. Але насамперед важливим здобутком людства є зростаючий інтерес щодо необхідності переробки всіх видів відходів або отримання з них корисної сировини. У статті надана інформація стосовно одного з таких продуктів – кавової гущі, здатність якої бути цінним матеріалом в різних галузях могла б дати нашому світу порятунок. Вона має різноманітний склад з органічних речовин та хімічних елементів, що безсумнівно дозволяє науковцям використовувати її як джерело цінних відкриттів. Похідні від цієї сировини знаходять своє призначення не тільки в науковому, а й у комерційному світові.

**Ключові слова:** кавова гуща, переробка, сировина, адсорбція, абсорбція, вуглекислий газ

**Abstract. Nikolenko D.O. The usage of coffee grounds in scientific and commercial world.**

In this paper rather urgent problem that affects environmental issues is considered. Numerous environmental studies around the world demonstrate the continuously increasing danger that the ecology of our planet is exposed to. There is no doubt that due to anthropogenic factors, namely the quantity of accumulated waste, pollution of the atmo-, hydro-, bio- and geosphere, global warming, living organisms of all realms of nature suffer. But first of all an important achievement of humanity is the growing interest in the necessity to recycle all types of waste or obtain useful raw materials from them. The article gives the information about one of these products – coffee grounds, the ability of which to be a valuable material in various industries could give our world salvation. It has a diverse composition of organic compounds and chemical elements, which undoubtedly allows scientists to use it as a source of valuable discoveries. Derivatives products of this raw material find their purpose not only in the scientific but also in the commercial world.

**Key words:** coffee grounds, recycling, raw materials, adsorption, absorption, carbon dioxide

**General formulation of research and its topicality.** The modern world is burdened by its need to produce waste that is not suitable for recycling. The rate of self-decomposition is incommensurably low compared to the amount of pollution produced. Therefore, modern scientists are to develop more specific methods of recycling refuse.

**Object-matter:** the retrieval of effective techniques of using the coffee grounds.

**Subject-matter:** coffee grounds.

**Objective:** to illustrate the benefit of usage the coffee grounds in diverse areas of science and business.

**Tasks:**

- To collect and organize information about the ways of using of the coffee grounds.
- To determine the structure and idea of these methods.
- To extrapolate potential development of these spheres of coffee grounds' usage.

**Materials:** online resources covering results of foreign scientists' research.

**Methods:** logical methods (analysis, synthesis, systematization of the text) and digital information processing.

**Discussion and Results.** To determine how useful coffee grounds can be we should know all about the composition of the subject. The scientists of the Kuban Technological University once have conducted researches in order to find the opportunity to use coffee grounds as a raw material for dietary supplements.

Kuban scientists were able to determine that coffee grounds contain a number of physiologically valuable ingredients: proteins, lipids, carbohydrates (mono-and disaccharides, starch), dietary fibers (cellulose, hemicellulose, which consists of arabinose, mannose and galactose, lignin and pectin), phenolic compounds, organic acids. Coffee grounds also contain several key elements such as nitrogen, calcium, potassium, ferrum, phosphorus, magnesium and chromium.

These qualifications of coffee were used by London company "Bio-bean" and it has introduced a highly efficient technology for recycling coffee grounds which allows grounds to be used as a raw material for the production of environmentally friendly bio-fuels for transport and granular composite for house heating.

The technology implies that using a biochemical extraction process with the addition of hexane coffee waste is dried and the oil which is contained there is released in high concentration. As a result of extraction the oil converts into biofuels in a ratio of 1:1. About 80% of the total mass of waste that remains after drying and extraction stages is granulated on pressing equipment. The volume of energy released

by burning coffee pellets is 1,5 times bigger than by burning sawdust. Since sawdust emits 2300 kilocalories (equivalent to 2-2,7 kW/h) it can be estimated that a kilogram of coffee waste can produce about 3450 kilocalories (equivalent to 3-4,5 kW/h).

Moreover, it is well known that solid waste from food companies is diverse in chemical composition and quantity. Many of them are not used or recycled, they are readily accessible and can be used as adsorbents for the purification of wastewater and natural waters that contain lead. It is known from the literature about the usage of coffee grounds for such purposes.

It was defined that the amount of adsorbed lead ions by such a sorbent does not depend on the type of coffee beans or the temperature at which the sorption process was implemented. The rate of adsorption of lead ions on coffee grounds is directly proportional to its amount. Experiments have shown that the concentration of contained in coffee beans proteins may not be the subject to the efficiency of adsorption of lead ions. Furthermore, the adsorption of lead ions decreased during protein denaturation.

Nevertheless, there is another fascinating method of using this product. By modifying already used coffee grounds into a carbon capture and sequestration material, this novelty can provide a simple, inexpensive way to eliminate greenhouse gases from the atmosphere such as carbon dioxide ( $\text{CO}_2$ ), carbon monoxide (CO) and sulfur dioxide ( $\text{SO}_2$ ).

Developing the new material at the Ulsan National Institute of Science and Technology (UNIST), South Korea, the researchers were soaking used ground coffee in potassium hydroxide and heating the resulting mixture to  $65^\circ\text{C}$ , while it was stirring for 24 hours [4, p. 2]. In addition, since the material is synthesized by the hydrothermal method, it has a high resistance to sorbing substances (it is able to absorb a lot of water and carbon dioxide without destroying the structure). The mixture was then dried in a drying oven at  $100^\circ\text{C}$ , following which it was placed in an argon furnace, where it was exposed to temperatures of  $700$ - $900^\circ\text{C}$  to activate carbon capture capabilities [3].

Finally, the scientists invented a stable material with such features. The authors

found that the saturation of the material with gas occurs in about two minutes. In addition, the absorption of water and carbon dioxide into the silicate structure is reversible, which gives a chance to the material to be reused after annealing, by which the absorbed substances will be removed from the material.

Likewise, according to the researchers, the time required for its production is much less than for other materials with similar features. The big thing was they were decreasing the fabrication time and they were using cheap materials,” said Christian Kemp, a researcher at the institute and a faculty member at Pohang University of Science and Technology [5]. The waste material was free compared to all the metals and expensive organic chemicals were needed in other processes – in his opinion this was a far easier way to go, explained Christian Kemp [5].

The property of coffee grounds for capturing CO<sub>2</sub> after the activation was determined by the researchers as impressively good, demonstrating a high rate of gas absorption also under pressure. The immense quantity of micropores and surface area in such an absorbent and their effect on the gas absorption have not been completely studied so far, as researchers avowedly admit, but the presence of sodium hydroxide may be a major factor in the successful activation of coffee grounds for CO<sub>2</sub> capture. It seemed when they added the sodium hydroxide to form the activated carbon it absorbed everything, said Kemp [5]. They had been able to took away one step in the normal activation process – the filtering and washing – because the coffee was such a brilliant absorbent, said team [5].

According to researchers’ data the new material may also have the supplemental advantage of being able to capture methane from the atmosphere and store it – and this after being filled with carbon dioxide – and then it can be used as a fuel with much better abilities than other fossil fuels. The team also demonstrated a function of the new material to store hydrogen at cryogenic temperatures and now researchers are aimed to improve hydrogen storage in the activated coffee grounds at less extreme temperatures [3].

Graduates of the University of California at Berkeley found that the structure of waste from brewed coffee has almost no difference from the hardwoods on which

wild mushrooms grow because they also have a lot of cellulose. Coffee grounds also contain several key elements for plant growth and this makes coffee grounds excellent biological humus. It is suitable for commercial mushroom cultivation when it is placed in an appropriate microclimate simulating a greenhouse or cellar.

Relatively recently the German company “Kaffeeform” in order to reduce the use of plastic began to avail the coffee grounds for the production of reusable cups. The project was founded by Julian Lehner.

The technology consists of pre-drying and mixing with plant fibers, natural resins and beech seeds. The compound is formed by an exposure of heat and pressure. Consequently, the coffee grounds of six cups of raw material turn into one cup and saucer. The final product is 100% biodegradable. What is important utensil made of this material is suitable for washing in a dishwasher.

**Conclusions.** To sum up it is necessary to note that the capacity of new discoveries in these branches is enormous. Every year there appear new and more ambitious ideas, some of which are revealing themselves in practical implementation. Owing to recycling and biodegradation in particular the usage of coffee grounds, humanity undoubtedly has an opportunity to deal with entire world around us.

## References

1. About bio-bean (2018) [Electronic resource]. – Access mode: <https://www.bio-bean.com/about/>
2. Die Kaffeeform Idee (2018) [The Kaffeeform idea]. [Electronic resource] – Access mode: <https://www.kaffeeform.com/de/story/>
3. Colin Jeffrey (2015). Coffee grounds recycled as carbon capture material. [Electronic resource] – Access mode: <https://newatlas.com/coffee-carbon-capture-methane/39299/>
4. K. Christian Kemp, Seung Bin Baek, Wang-Geun Lee, M. Meyyappan and Kwang S. Kim (2015). Activated carbon derived from waste coffee grounds for stable methane storage. [Electronic resource] – Access mode: [https://www.researchgate.net/publication/281554225\\_Activated\\_carbon\\_derived\\_from\\_waste\\_coffee\\_grounds\\_for\\_stable\\_methane\\_storage](https://www.researchgate.net/publication/281554225_Activated_carbon_derived_from_waste_coffee_grounds_for_stable_methane_storage)
5. Sarah Henry (2010). The Mushroom Guys: A business out of UC Berkeley. [Electronic resource] – Access mode: <https://www.berkeleyside.com/2010/11/12/berkeley-bites-nikhil-arora-alex-velez-the-mushroom-guys>
6. Waste coffee used as fuel storage (2015). [Electronic resource] – Access mode: <https://ioppublishing.org/news/coffee-waste/>

## AN OVERVIEW OF THE HIGH-LEVEL PYTHON PROGRAMMING LANGUAGE AND SOME OF ITS LIBRARIES

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**Анотація. Обозний Ю.Д. Огляд високорівневої мови програмування Python та деяких її бібліотек.**

Дана стаття є оглядом на сучасну високорівневу мову програмування Python. На даний момент існує величезна кількість різних мов програмування. Кожна з них відрізняється своїм синтаксисом, швидкістю виконання, і взагалі по-різному влаштована всередині. Тому варто зрозуміти, як вибрати потрібну мову програмування. У першій секції ми описали відмінності між двома видами мов програмування – компілюємими та інтерпретуємими. Так само були описані переваги мови програмування Python. Мова програмування Python володіє величезною кількістю інструментів для роботи з різними типами даних, такими як наукові результати, математичні обчислення, а так само систематизація цих даних. Такими можливостями володіють бібліотеки NumPy і SciPy, які описані у другій секції. Мову програмування Python можна так само застосовувати для сфер спілкування, а саме, (як приклад, наведений у цій статті) у створенні Telegram ботів. Володіння відмінною підтримкою бібліотеки aiogram, описаної в третьій секції, робить Python унікальним кандидатом для створення Telegram ботів саме за допомогою цієї мови програмування. Так само в третьій секції наведено приклад роботи з бібліотекою aiogram. У четвертій секції наведені висновки.

**Ключові слова:** айограма, інтерпретована мова, NumPy, Python, наукові обчислення, SciPy, бот Telegram

**Abstract. Oboznyi Y.D. An overview of the high-level Python programming language and some of its libraries.**

This article is an overview of the modern high-level programming language Python. At the moment, there are a huge number of different programming languages. Each of them differs in its syntax, speed of execution, and is generally differently arranged inside. Therefore, it is worth understanding how to choose the right programming language. In the first section, we described the differences between the two types of programming languages - compiled and interpreted. The advantages of the Python programming language have also been described. The Python programming language has a huge number of tools for working with various types of data, such as

scientific results, mathematical calculations, as well as organizing this data. The NumPy and SciPy libraries have these capabilities, which are described in the second section. The Python programming language can also be used for areas of communication, namely, (as an example given in this article) in the creation of Telegram bots. The excellent support for the aiogram library described in the third section makes Python a unique candidate for creating Telegram bots using this programming language. Also in the third section there is an example of working with the aiogram library. The fourth section contains conclusions.

**Key words:** aiogram, interpreted language, NumPy, Python, scientific computing, SciPy, Telegram bot

## 1. Introduction

Today, due to the increase in computerization, humanity is increasingly faced with the need to solve more and more complex technical problems. In this regard, IT companies have as big need of experienced and qualified programmers as never before. Therefore, people who decide to set foot on the path of a programmer first of all ask themselves, which programming language to choose. To answer this question, it should be said about the types of programming languages.

There are two types of language: compiled and interpreted [1, c 22]. Programs written using compiled languages are first converted into machine code (incomprehensible to humans), and then they are already executed. The advantage of such languages is the high speed of program execution. Examples of such languages are C, C ++, Erlang, and the relatively newer languages Rust or Go. The disadvantages of these languages are obvious: to run a program written in a compiled language, it must first be compiled. This is not only an extra step, but also a significant complication of debugging, because to test any change the program must be compiled again. In addition, compiled languages are platform-specific, since machine code depends on the machine on which the program is compiled and executed [2].

Unlike compiled languages, interpreted languages do not need machine code to execute a program; instead, the interpreters will execute the program line by line. The speed, of course, in such languages is lower, but today the power of personal

computers is constantly growing, and begins to provide a sufficient speed for the execution of interpreted programs.

When the speed of program execution is not a critical value, the most correct choice is an interpreted language, as it is a simpler and more flexible programming tool. Examples of interpreted languages are PHP, Ruby, Python. The latter, in turn, is gaining more and more popularity today. There are several advantages of this language[3]:

- after one day of study, you can start writing simple programs;
- short code;
- perfect for creating wrapper programs, import of C libraries is supported;
- you can use it from creating simple calculator programs to creating bots (aiogram), machine learning (TensorFlow) and controlling external devices (NI-DAQmx);
- very good support for mathematical calculations (libraries NumPy, SciPy).

## **2. Python in the scientific environment**

Many students, scientists and researchers who need to write programs related to the processing of mathematical data use Python today, and quite often they use the NumPy and SciPy libraries. The NumPy library is renowned for its wide range of tools for working with datasets. Methods for creating and filling certain types of arrays, proposed in this library, allow you to simplify the code and make it more readable, which allows another developer to easily understand what is happening on this or that line of the program. In addition to creating arrays, you can naturally perform various actions with them: returning the number of rows and columns, checking if an element is in the array, transposing (numpy.array (...) .transpose ()), converting a multidimensional array to one-dimensional (numpy.array (...) .flatten ()) etc. All relevant information can be found in the relevant documentation [4].

The SciPy library is built on top of NumPy and allows one to manipulate data, as well as visualize it using various high-level commands. If SciPy is imported SciPy, then NumPy is not needed to be imported separately. SciPy has a set of packages for different scientific computing:

- algorithms for cluster analysis;
- physical and mathematical constants;
- fast Fourier transform;
- solutions of integral and ordinary differential equations;
- optimization and numerical solution of equations;
- signal processing;
- statistical distributions and functions;
- and much more.

All of the above packages, how to interact with them and use them, can be studied in the documentation [5]

### **3. Python in working with Telegram**

Today, communication methods are very developed. All you need to connect with each other is any device with Internet access, and the presence of a messenger on it. One of the most popular messengers in the world is Telegram. This messenger contains bots that were designed to help users in a variety of ways, such as checking the weather (@weatherman\_bot), using the messenger as a Gmail client (@GmailBot), a reminder bot (@SkeddyBot), a password leak checking bot (@MailSearchBot) and many others. Anyone who knows the basics of Python programming can create their own personal bot. To create it, a special bot in Telegram (BotFather) is needed in order to register the newly created bot there. In response, a unique bot token will be created with a special "name" by which it will address Telegram servers. This token must be saved as a constant in the Python working file. Next, one needs to choose the library for further work. Today the aiogram library is gaining popularity [6]. This library is completely asynchronous, which allows not to resort to constant parallel calculations and not to use multithreading.

A simple example of using this library to work with a bot is further described. The simplest and first bot that newbies create is the echo bot. Its functionality is to respond to the user for his messages.

Firstly, the main file has to be created, which will launch our bot. The code is

shown in Fig. 1. As you can see from the first line, we are importing a file called “config”. In this file a token of the bot is written. You can see separately it on the Fig 2. Secondly, the crucial objects and modules from the library are needed. We create a variable on line 6 with which we refer to the Telegram API.

We also create a dp variable to create decorators which will respond to commands and text. And finally, on lines 11-13, we write the code that launches the bot on our machine and skips all past unnecessary messages.

```

1 import config
2 from aiogram import Bot, Dispatcher, executor
3 from aiogram.types import ParseMode
4 from aiogram.contrib.fsm_storage.memory import MemoryStorage
5
6 bot = Bot(token=config.BOT_TOKEN, parse_mode=ParseMode.HTML)
7 storage = MemoryStorage()
8 dp = Dispatcher(bot, storage=storage)
9
10
11 if __name__ == '__main__':
12     from handlers import dp
13     executor.start_polling(dp, skip_updates=True)
14

```

*Fig. 1. Main file content. Connecting the required library, modules and objects*

```

1 BOT_TOKEN = 'YOUR TOKEN MUST BE WRITTEN HERE!!!'
2

```

*Fig. 2. Bot token used as a constant in a separate file*

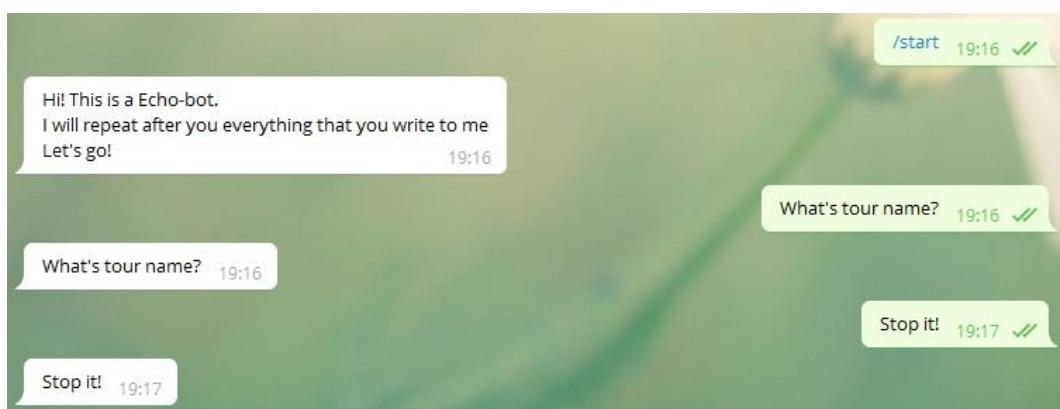
Further, the final “handlers.py” is explored, which contains the logic of the bot. The objects from aiogram library and variables bot and dp from “main.py” are also imported (see Fig. 3). From 5 to 10 lines, the bots work is written when the command “/ start” is entered. Next, from 12 to 14 lines, commands for the behavior of the bot when sending various messages to it are written. The bot operation result is shown in Fig. 4.

```

1  from main import bot, dp
2  from aiogram.types import Message
3  from aiogram.dispatcher.filters import Command
4
5  @dp.message_handler(Command("start"))
6  async def start(message: Message):
7      await message.answer("Hi! This is a Echo-bot.\n"
8                          "I will repeat after you everything that you write to me\n"
9                          "Let's go!")
10
11
12 @dp.message_handler()
13 async def echo_message(message: Message):
14     await bot.send_message(message.from_user.id, message.text)

```

*Fig. 3. The body of the bot, the written logic that the bot must obey.*



*Fig. 4. An example of a bot working directly in Telegram.*

#### 4. Conclusion.

The Python programming language gives us a significant number of tools for writing various kinds of software. This language is suitable for both beginners and professionals in programming. Python is hugely popular today, and developers, even entry-level ones, are widely in demand in the IT market. The scientific community widely uses this programming language for building models, calculations, solving equations, etc. The language is well supported by developers, it is being improved, and there are also a huge number of forums to solve one's problem.

#### References

1. A.A. Tyugashev. Osnovi programmirovaniya. Chast' 1. [Basics of programming. Part 1] / St. Petersburg. 2016
2. Tproger IT-portal[Electronic resource] / Access mode: <https://tproger.ru/translations/programming-concepts-compilation-vs-interpretation>, free. Lang. ru.
3. Python official site [Electronic resource] / Access mode:

<https://docs.python.org/3/tutorial/index.html>, free. Lang. eng. 4. NumPy official documentation[Electronic resource] / Access mode: <https://numpy.org/doc/>, free. Lang. eng. 5. SciPy official documentation[Electronic resource] / Access mode: <https://www.scipy.org/docs.html>, free. Lang. eng. 6. Aiogram official documentation[Electronic resource] / Access mode: <https://docs.aiogram.dev/en/latest/>, free. Lang. eng.

УДК 621.389

## **QUANTUM COMPUTING**

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### **Анотація. Палій С.С. Квантові обчислення.**

У статті розглядається проблема відсталості сучасної обчислювальної техніки та нездатність звичайних комп'ютерів вирішувати такі сучасні завдання, як складні обчислення в біологічній та хімічній галузях, також пояснюються основні переваги квантових обчислень та їх можливий вплив на сучасні шляхи управління, збереження та захисту інформації. Основна увага зосереджена на визначенні різниці між традиційними та квантовими комп'ютерами, процесах у квантових обчислювальних машинах, їх найважливіших властивостях, таких як необхідних умовах роботи, відмінностей квантової логіки в порівнянні з традиційною та можливих способах їх реалізації. Стаття включає деякі факти про ранні ідеї квантових обчислень, методи візуалізації квантового простору (наприклад, сферу Блоха) та їх вплив на сучасні дослідження в цій галузі науки. Велика увага привертається до принципів функціонування кубітів (а саме до поведінки іонів, спінів, стану суперпозиції та пов'язаних з ним проблемами та можливостями), пояснюється, як кубіти можуть бути створені в різних фізичних системах (наприклад, у молекулах за допомогою хімічних зв'язків або в затриманих у електромагнітних пастках груп іонів за допомогою руху атомів, що застосовується у сучасних атомних годинниках), їх можливості, переваги перед традиційними бітами та необхідні для належної роботи умови та обмеження. Крім того, у статті описується сучасний стан розвитку квантових комп'ютерів, їх можливі майбутні завдання та місця у науці, основні інвестори або пов'язані з ними проекти, а також проблеми, з якими стикаються квантові інженери в процесі їх розробки, причини низького рівня впровадження квантових комп'ютерів, незважаючи на їх теоретичну перевагу над традиційними в таких незвичайних завданнях, як складні аспекти фізики та біології.

**Ключові слова:** кубіт, суперпозиція, спін, іон, електрон, квантовий комп'ютер

**Abstract. Palii S.S. Quantum computing.**

The article deals with the problem of traditional computing obsolescence, and inability of common computers to deal with modern tasks like hard calculations in biological and chemical science, on the other hand are explained main advantages of quantum computing and its possible impact on current ways of managing, keeping and securing information. The focus is set on explaining difference between traditional and quantum computing, processes inside quantum computers, their most important properties such as required work conditions, difference of quantum logic over traditional and its possible ways of implementation. The article include some facts about early quantum computing ideas, methods of quantum space visualizations (such as Bloch sphere), and their influence on modern researches in that field of science. Much attention is drawn to principles of qubit functioning (especially ions behavior, spins, superposition state and related to them problems and outcomes), explained how qubits can be created in different physical systems (such as in molecules via chemical bonds or in held in electromagnetic traps ion collections via atoms motion, like in modern atomic clocks), their abilities, advantages over traditional digits-bits and needed for their proper work conditions and restrictions. In addition, the article describes current state of quantum computers development, their possible future tasks and occupations, main investors or projects related to them and also problems faced by quantum engineers in process of development and reasons for low implementation level of quantum computers despite their theoretical supremacy over traditional ones in uncommon tasks like difficult sides of physic and biology.

**Key words:** qubit, superposition, spin, ion, electron, quantum computer

**General formulation of research and its topicality.**

A new type of computing approaches, one that can take advantage of the very complexive modern tasks that computers are trying to penetrate. Behold quantum computers, first introduced in the 1980s, when scientists found a possibility to construct computers based on the laws of quantum physics instead of on classical ones.

Quantum computing could (and, possibly, will) change the entire world of information. It will affect medicine, overcome all existing methods of encryption and revolutionize AI. Huge companies like Microsoft, IBM and Google are competing to create reliable and powerful quantum computers. China has already invested billions

into this area.

Recently, Google claimed achievement of quantum supremacy – the first time a quantum computer outperformed a traditional one. Anyway, let's find out, what is quantum computing and how does it work.

### **Setting of the problem and the aim of the article.**

Nowadays, humanity faced the fact that traditional computers are no longer up-to date. It only seems that computers are capable of solving almost every problem. However, progress in science and technology is limited because of current computers inefficiency. Even the most powerful mainframes cannot achieve proper calculating of chemical structures or biological systems, which have too many interacting elements. So, quantum computers come into play. With their theoretically almost unlimited computing capability, it seems that there's no tasks they can't perform. The aim of the article is to explain, what is happening inside quantum computer during calculations, which principles of physics does it use, what do scientists and engineers need to properly operate that kind of system and will quantum systems be able to replace traditional ones not only in scientific use.

**Objective** of our work is to show superiority of quantum computing over traditional and explain key features of quantum computer functioning. The article considers the following **tasks**:

- To investigate history of quantum computing development
- To find out connection between information processing methods and possible results
- To understand basic principles of qubit functioning
- To decide, if quantum computers will replace common ones and in which spheres they might be used

**Research methods:** Theoretical analysis and generalization of scientific literature and periodicals devoted to comparison, formalization and analysis of quantum computing.

**Material:** Empirical basis relies on research of different internet resources, articles and information about different quantum computers.

**Discussion and results:** Every traditional computer uses the common behavior of electrons to make results by the way of Boolean logic (for any two specific input signals, there could be one and only one certain output signal). The basic unit of transaction used by such systems is the binary digit ('bit'), which can be either 0 or 1. In a conventional semiconductor, these two states are represented by low and high voltage levels within transistors.

In a quantum computing, those methods are totally different. Its main unit is the qubit (or `quantum bit`), which at one level also stores a 0 or 1 state (actually 0 and/or 1). Instead of transistors, a quantum computer interacts with qubits by bombarding atoms at perpendicular angles to one another, to line up the ions and keep them equivalently separated. When these ions are separated by enough space, their orbiting electrons become something like `addresses` for qubits.

While a common computer focuses on voltage changes, a quantum system is concerned with one aspect of electrons at the quantum level, which is called spin. Spin is indivisible component and it represents the angular movement of an electron as it orbits over the nucleus of an atom. The spin is always  $1/2$  (one-half); the only possible difference is polarity, which can be either up or down.

The up or down state of electron spin corresponds to the '1' and '0' states of the binary digit.

A qubit maintains the quantum state of one electron. It can attain the '1' and '0' state simultaneously. Taking into consideration that qubit's electron is spinning both directions at once, quantum mechanics calls this simultaneous state of both `here` and `there` superposition. It is impossible to capture an electron in a state of superposition because conditions for capturing cause such a superposition to collapse.

There are many possible states of superposition. Each next qubit in a quantum system is more important than the previous one. At example, in a system with  $n$  qubits, there is  $2^n$  possible superposition states for each qubit.

During that strange period while computer is working without any observation, a quantum processor is capable of calculating algorithmic functions on units that are more like wheels in one of Charles Babbage's difference engines than binary digits –

except with billions of settings rather than just 10.

Instead of Babbage's wheels, quantum developers have found a better way of representing qubits' spin states. Actually, they borrowed a model created by Swiss physicist Felix Bloch. Each superposition state a qubit may take can be represented by a vector in a 'Bloch sphere'. Using ordinary geometry, the vector may be expressed as a function of the cosine of that angle to the  $z$ -axis, added to the sine of that angle to the  $z$ -axis. (In quantum mechanics, functions that describe waves are represented as vectors in multi-dimensional Hilbert space. Typically, this makes the relationships between them much easier to solve. A Bloch sphere is a good way of simple representing a quantum function in two-dimensional Hilbert space, as something easier to visualize.)

The initial strangeness of superposition concerns writing a program to count number of all possible states. When Windows first started out, there was a problem – how to predict and program all possible user choices, when there were so many of them. The system it came up with was a kind of "user event trap" that read the "intelligent keyboard interface" for signals. Then it processed each signal through a list with pre-written interactions. This task became much more difficult with appearance of touchscreens by the way.

Actually, that method will not work in case of quantum computing because its logic works totally different. Instead, user feeds the problem to the system and hope that it will be solved [2].

Nowadays, it's quite a challenge to implement a quantum computer. Its hardware must satisfy several restrictions: the qubits must have weak interaction with environment to preserve their superpositions, they must have strong connections with one another to create logic gates and transfer information, and the states of the qubits must be able to initialize and read-out with high efficiency. Very few physical systems can satisfy these actually conflicting requirements, a notable exception can be a collection of charged atoms (ions) held in an electromagnetic trap [3]. Here, each atom stores a qubit of information in a pair of internal electronic levels. Each atom's levels are well protected from environmental influences – that's why such energy

levels are also used while creating atomic clocks. Acquiring larger numbers of qubits is achieved simply by adding more atoms to the collection. When appropriate laser radiation is applied to the atoms, only one of the two internal states fluoresces. This allows almost perfect detection of the state for each qubit. The atoms are coupled by virtue of their mutual Coulomb repulsion. A particular atom's internal state can be mapped onto the collective motion of the atoms, which can subsequently be transferred to another atom's internal levels. In this way, the quantum motion of the atom collection acts as a "data bus," which allows any quantum computation to proceed. Experimental activity in trapped ion quantum computation is still in its beginning because only single-ion and two-ion quantum logic has already been demonstrated. Extensions to larger numbers of trapped ions are suspended by a variety of technical difficulties, but there appear to be no fundamental limits to the scaling.

Another nearly ideal physical system that can be used as quantum computer is a single molecule, in which nuclear spins of individual atoms represent qubits. Using NMR techniques, invented in the 1940's and widely used in chemistry and medicine today, these spins can be manipulated, initialized, and measured. Most NMR applications treat spins as some kind of "bar magnets," whereas in reality, the naturally well isolated nuclei are non-classical objects. The spins' quantum behavior can be exploited to perform quantum computation; for example, the carbon and hydrogen nuclei in a chloroform molecule represent two qubits. Applying a radio-frequency pulse to the hydrogen nucleus addresses that qubit and causes it to rotate from a  $|0\rangle$  to a superposition  $(|0\rangle + |1\rangle)/\sqrt{2}$  state. Interactions through chemical bonds allow multiple-qubit logic to be performed. In this manner, applying newly developed techniques to allow samples with many molecules to be used, small-scale quantum algorithms have been demonstrated with molecules such as Alanine, an amino acid. This includes the algorithm described above, to test if  $f(0) = f(1)$ , as well as Grover's algorithm on a database with four entries. With current schemes, the difficulty of creating and maintaining quantum states grows exponentially with the number of qubits, i.e., the size of the molecules. Quantum computation is an exciting

challenge, and it is expected that future experimental developments will lead to a better understanding of the practical reality of quantum computers [1].

**Conclusions.** Quantum computers have the huge potential to completely reshape computation by making certain types of classically intractable problems solvable. While no quantum computer is yet powerful enough to carry out calculations that a classical computer can't, great progress is under way. A few large companies and small start-ups now have fully functioning quantum computers composed of several tens of qubits, and some of these are even accessible to the public through the cloud services. Additionally, quantum simulators are making strides in fields varying from molecular energetics to many-body physics. As small systems come online a field focused on near-term applications of quantum computers is starting to burgeon. This progress may make it possible to actualize some of the benefits and insights of quantum computation long before the quest for a large-scale, error-corrected quantum computer is complete.

## References

1. The CIO's guide to quantum computing <https://www.zdnet.com/topic/the-cios-guide-to-quantum-computing>
2. Quantum supremacy explained <https://www.wired.co.uk/article/quantum-computing-explained>
3. Future R&D Environments: A Report for the National Institute of Standards and Technology <https://books.google.co.uk/books?id=9r-Sk35D-KYC&dq>

УДК 519.186+519.863

## GENETIC ALGORITHM FOR SOLVING TRAVELLING SALESMAN PROBLEM

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**Анотація. Radchenko O.D. Генетичний алгоритм для вирішення задачі комівояжера.**

Ця стаття присвячена вирішенню задачі комівояжера за допомогою генетичного алгоритму. У роботі розглянуто та описано задачу комівояжера, актуальність її вирішення, та деякі способи знаходження оптимального результату. Він досягається за допомогою генетичного алгоритму та його операторів селекції та розмноження. Генетичний алгоритм

поділяється за способами реалізації цих операторів і має різні результати в залежності від обраної. Деякі з цих способів розглянуті та порівняні з рекомендаціями щодо використання. Генетичний алгоритм використовується для вирішення багатьох задач, наприклад оптимізація функцій та запитів в базах даних, різноманітні задачі на графах, налагодження та навчання штучної нейронної мережі, теорія наближень, ігрові стратегії, біоінформатика, синтез кінцевих автоматів та інше.

**Ключові слова:** генетичний алгоритм, графік, проблема продавця, вибір, кросове

**Abstract. Radchenko O.D. Genetic algorithm for solving travelling salesman problem.**

This article is fully devoted to solving the travelling salesman problem using a genetic algorithm. The travelling salesman problem, the relevance of solving it, and some ways to find the optimal result are considered and described in the paper. It is achieved through a genetic algorithm and its selection and crossover operators. The genetic algorithm is divided according to the methods of implementation of these operators and has different results depending on the selected one. Some of these methods are considered and compared with the recommendations for use. The genetic algorithm is used to solve many problems, such as optimization of functions and queries in databases, various problems on graphs, debugging and learning of an artificial neural network, approximation theory, game strategies, bioinformatics, finite state machine synthesis and more.

**Key words:** генетичний алгоритм, граф, проблема продавця, вибір, кросове

## 1 General formulation of research and its topicality

The primary task of every company is to find reserves to reduce shipping costs to increase competitiveness and profitability. In the structure of logistics costs 20 – 40% is accounted for by the transport component, so the optimization of transportation becomes an important element of planning. One way to optimize these costs is to use an algorithm to solve the salesman's problem.

Travelling Salesman Problem is an important task of transport logistics (the industry engaged in transport planning). The salesman must go around n points and return to the starting point. Man is guided by intuition and a set of heuristic findings, but the effectiveness of this approach has not been proven.

Note that the number of possible routes increases very rapidly with increasing n (it is equal to  $n! = 1 \cdot 2 \cdot 3 \cdot \dots \cdot n$ ), so it is almost impossible to find an exact solution in all cases. Due to the great practical importance of the task, approximate solutions will be useful, which require a huge check of variants in search of the optimal one.

Modern computers can handle large amounts of data, but because there are too many options, it takes a long time.

The purpose of this paper is to compare the efficiency and operability of the genetic algorithm, to develop recommendations on the feasibility of its use depending on the initial conditions.

## 2 Setting Of The Problem And The Aim Of The Article

### 2.1 Description of travelling salesman problem

*Travelling Salesman Problem* (also called TSP) consists in finding the most profitable route that passes through given cities at least once. The condition of the task indicates the criteria of profitability of the route (the shortest, cheapest, aggregate criterion, etc.) and the corresponding matrices of distances, costs, etc. It is usually specified that the route should pass through each city only once, in which case the solution is among the Hamiltonian cycles.

### 2.2 As a graph problem

To be able to use a mathematical approach to solve this problem, it should be presented in the form of a mathematical model. The travelling salesman problem can be represented as a model on a graph, that is, using vertices and edges between them [1].

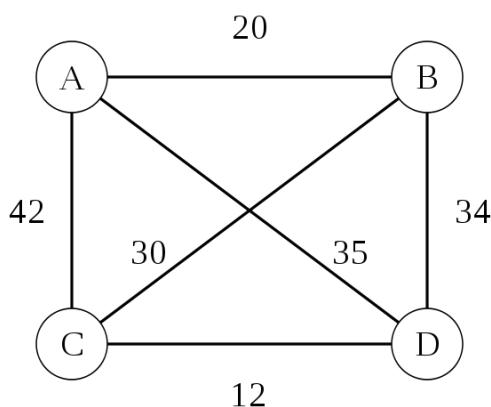


Figure 2.1 Symmetric TSP for four cities.

A **route** (also a Hamiltonian route) is the route of this graph, which includes each vertex of the graph once. The task is to find the shortest route [4].

### **3 Experiential/research outcomes**

#### **3.1 Description of genetic algorithm**

*Genetic algorithm* (GA) is an algorithm inspired by the process of natural selection that is commonly used to solve optimization and modeling problems by selection and combination of parameters. A feature of the genetic algorithm is the emphasis on the use of the "crossover" operator, which performs the operation of recombination of candidate solutions, the role of which is similar to the role of crossing in wildlife [3].

Many genotypes ("generations") of the initial population are created in some, usually random, way. Each genotype is associated with a certain value, which characterizes how well the phenotype solves the problem. Based on "adaptability", solutions are selected, "genetic operators" ("crossover" and "mutation") are applied to them, resulting in new solutions. For them, the value of adaptability is recalculated, and solutions for the next generation are selected("selection").

These actions are repeated iteratively, so the "evolution process" is simulated, which lasts several life cycles (generations) until the stopping criterion of the algorithm is met [2]. This criterion may be:

- finding a global or suboptimal solution;
- exhaustion of the number of generations released for evolution;

#### **3.2 Stages Of The Genetic Algorithm**

The algorithm starts with creation on the initial population. It does not matter how competitive it is. Then *Fitness* function is calculated for every *individual* from this population. The result of this step is population  $H$  of  $N$  individuals.

After that the crossover operator is applied for every new population, that is the result of previous selection. To make a "child" a pair of "parent" solution is selected. There are some ways of selecting parents (the best solutions, for example) and they will be described later. Crossover operator depends on data type. The main requirement for it is the ability of a child to inherit the traits of both parents. The mutation is applied of a percent of a population, which is an algorithm parameter and changes them in some way.

One of the main parts is selection. From whole population a part is selected, and the rest is discarded. The probability of surviving depends on Fitness function result.

The following methods of selection are used: tournament selection, roulette wheel selection, best solutions selection [5]. Consider them in more detail:

- **Tournament selection** – At the beginning individuals are divided into groups (usually from 2 individuals) and then the best is selected
- **Roulette wheel selection** – the probability of selection an individual (2.1) the more, the better its fitness is

$$p_i = \frac{f_i}{\sum_{k=1}^N f_k}, \quad (3.1)$$

Where  $p_i$  – the probability of selection individual  $i$ ,  $f_i$  – value if fitness function of individual  $i$ ,  $N$  – number of individuals in population.

- **Best solutions selection** – every selected individuals is better than any discarded

### **3.3 Application Of Genetic Algorithm For Travelling Salesman Problem**

One possible way to use a genetic algorithm to solve a travelling salesman problem is to math a gene to each given city and where the path as individual – a set of genes, and a population as a set of possible paths.

### **3.4 Comparison Of Selection Types**

For every number of cities from 5 to 40, 20 graphs were generated. For every graph, the result was found by each selection type and the average values were chosen [4].

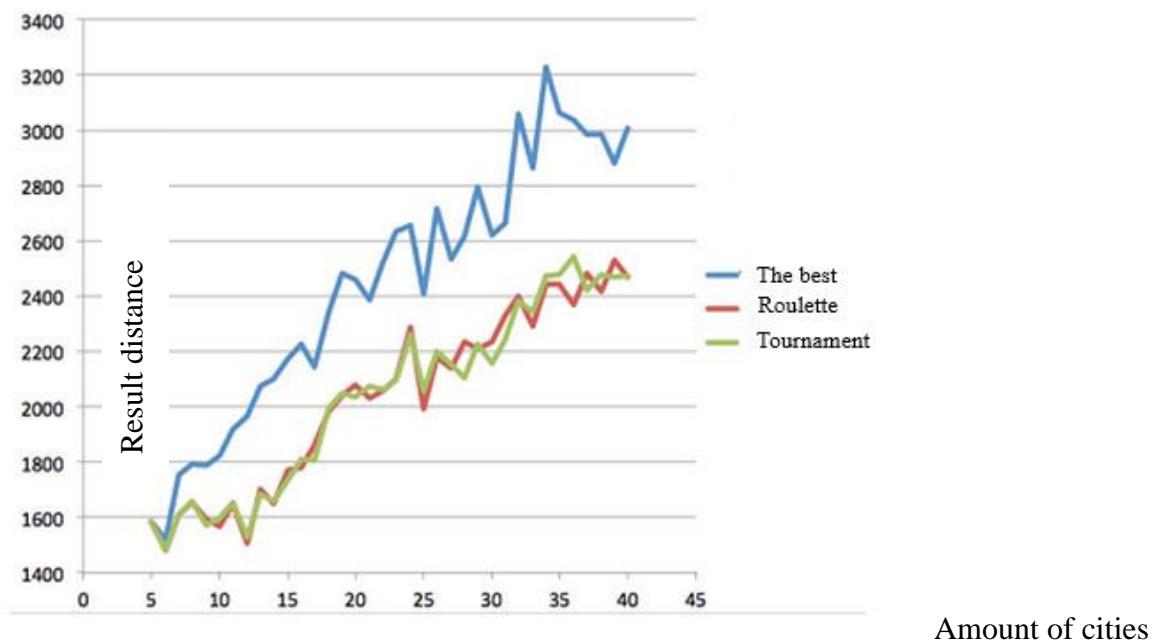


Figure 3.1 Genetic algorithms

## Conclusions

The analysis of genetic algorithms was performed in this paper.

The genetic algorithm uses three methods of selection of individuals for *crossbreeding*: selection of the best, using roulette or tournament. The worst results were shown by a genetic algorithm, which uses only the best individuals for crossing. Genetic algorithms with tournament and roulette selections have shown similar results. The algorithm, which uses only the best individuals for crossing, was on average 22% worse than the other two versions of the algorithm.

That is, the best choice for solving the problem will be a genetic algorithm based on the roulette method of selection.

## References

1. Asanov M. O. Diskretnaya matematika: Grafy, matroidy, algoritmy / M.O.Asanov, V.A.Baranskij, V.V.Rasin; Izhevsk: NIC "RHD", 2001, 288 p. (in Russian)
2. Gladkov L. A. Geneticheskie algoritmy: navch. posib. / L.A.Gladkov, V.V.Kurejchik, V.M.Kurejchik - 2-e vid. - M: Fizmat lit, 2006. - 320 p. (in Russian)
3. Emel'yanov V. V. Teoriya i praktika evolyucionnogo modelyuvannya / V.V.Emel'yanov, V.V.Kurejchik, V.M.Kurejchik; - M: Fizmat lit, 2003. - 432 p. (in Russian)
4. Levitin A.V. Algoritmy: vvedenie v razrabotku i analiz / A.V.Levitin; M.: «Vil'yams», 2006. – 576 p. (in Russian)
5. Skobcov YU. A. Osnovi evolyucionnyh vycheslenij: navch. posib. / YU.A.Skorobcov - Donec'k: DonNTU, 2008. - 326 p. (in Russian)

## PROSPECTS OF LIFE ON OTHER BODIES OF THE SOLAR SYSTEM

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**Анотація. Романчук А.С. Перспективи життя на інших планетах Сонячної системи.**

Ця стаття присвячена життю на інших тілах Сонячної системи, а саме їхнім середовищам та можливостям тайти в собі будь-яку з відомих людству форм життя. Автор розпочинає з висвітлення умов, які, вірогідно, є найважливішими для виникнення життя. У статті розглянуто всі планети Сонячної системи, деякі супутники Юпітера та Сатурна, як то Європа, Енцелад, Каллісто, Ганімед, Титан та Io, а також Місяць, Плутон та астероїди. Розглянуто такі вирішальні особливості, як температури на поверхні цих тіл, присутність води у будь-якому агрегатному стані та атмосфери, а в деяких випадках також атмосферний тиск та кількість сонячної радіації. В якості висновків до викладеного у статті матеріалу наведено загальну інформацію щодо того, які сподівання покладати на пошук інопланетного життя.

**Ключові слова:** інопланетне життя, середовище, температура, рідина на поверхні, атмосфера, астрономічне спостереження, космічна місія

**Abstract. Romanchuk A.S. Prospects of life on other bodies of the Solar System.**

This article is devoted to life on other bodies of our solar system, more precisely, what are their environments and abilities to harbor any form of life, as we know it. The author starts by talking about conditions that are likely to be the most important for the emergence of life. The article examines all planets in the Solar System, some of Jupiter and Saturn's moons, namely Europa, Enceladus, Callisto, Ganymede, Titan and Io, as well as the Moon, Pluto and asteroids. The deciding features, like temperatures on these bodies, presence of water in any of its physical states and an atmosphere, in some cases also atmospheric pressure and the amount of solar radiation, are given. As the conclusions of the article, general information is conferred on what to expect the search for extraterrestrial life to yield.

**Key words:** extraterrestrial life, environment, temperature, liquid on the surface, atmosphere, astronomical observation, space mission

**General formulation of research and its topicality.** Extraterrestrial life is hypothetical life that might occur beyond Earth and did not originate there. The

search for life on other planets is now very popular both with general public and scientific community, especially in light of the recent findings of phosphine gas in the atmosphere on Venus.

**Setting of the problem and the aim of the article.** Finding another life in the Solar System would have a large impact on science and culture. It is, therefore, important to be abreast of the current situation and research. This article attempts to paint a picture of what the search for extraterrestrial life has come to, so far.

**Discussion and Results.** The discovery of even a single example of extraterrestrial life, no matter how elementary, would cause a fundamental revolution in science. Life on Earth is based on carbon, hydrogen, nitrogen, and requires water. But science is still unsure, whether these exact particles are necessary for life, or could there be extraterrestrial organisms that are based on entirely different atomic structures. However, it is most likely that major atoms would have high cosmic abundance. Temperature of the planet should be such that chemical reactions are possible and liquids are able to vaporize and freeze, although not too easily. There should be a medium for molecular interaction – either a liquid or a very dense gas, a good solvent, as well as a source of energy.

Astrobiology is a term for the study of life everywhere in the universe, including Earth. It, therefore, accounts for the possibility of not finding life beyond our planet.

However, it is important to examine all variations of extraterrestrial life before giving up on searching for it. A planet may not have life and organic matter at all, be lifeless but contain fossils and organic matter, have biochemically simple life or a technically advanced civilization. It all lies on a spectrum and either one of these cases would greatly propel science forward.

What should be accounted for and kept in mind, are ambiguities of the test for life. Living organisms detected on other planets of the solar system might have come from spacecraft launched from Earth. So, pollution is an issue at play. There is also the fact that most instruments we now have for detection depend on assumptions that are no more than informed guesses, like extraterrestrial organisms eating sugars.

Henceforth, any discovery should be tested multiple times and using various instruments.

Let us now have a look into the environments of moons and planets of the solar system. Although, there is yet no definite evidence of life on them, some do have signs of possible life on them.

The Moon is an extremely unlikely home to any form of life, since its surface temperatures can go from around 100 K ( $-173^{\circ}\text{C}$ ) to around 400 K ( $127^{\circ}\text{C}$ ) in a matter of a day. Subsurface temperature is much more stable at about 230 K ( $-43^{\circ}\text{C}$ ), but it doesn't improve chances much, considering that there is neither liquid nor atmosphere on the Moon [0].

Mercury is rather similar in terms of the environment, with surface temperatures ranging from 100 K to about 620 K ( $347^{\circ}\text{C}$ ), highly variable atmosphere [454], very high levels of solar radiation and apparent absence of any liquid. Like with the Moon, underground temperatures are significantly milder, namely, a roughly constant room temperature at 1 meter below the surface, which doesn't make Mercury a desirable environment for life [0].

Mars, on the other hand, has conditions better suitable for life. Martian soil contains some elements that are necessary for growth of plants on Earth, such as magnesium, sodium, potassium and chlorine, but experiments also show that it has a pH of 7.7 and contains 0.6% of perchlorate, which makes it toxic [0]. The planet is tilted about  $25^{\circ}$  to its orbital plane, which results in seasonal changes that have been observed both visually and photometrically. There is color change associated with seasons. It was previously speculated to be a result of vegetation, but seasonal dust storms are a more convincing explanation. The “canals” – thin straight lines across the bright areas of the surface that extend for hundreds of kilometres and experience seasonal changes – have been the basis of the arguments for the existence of intelligent life on Mars and thought to be artificial in nature, but are now believed to be an optical illusion. There indeed are rectilinear features on the Martial surface, but they are natural and nothing more than mountain and crater chains, faults and terrain contour boundaries. The analysis of the Allan Hills meteorite (ALK84001), which is

thought to have originated on Mars, yielded carbonate globules that could be fossilized microbes. However, this proposal has been met skeptically and another – exclusively inorganic origin – has been put forward. In July 2018, the first stable body of water was discovered on planet. It sits at the base of the southern polar ice cap 1.5 km below the surface and is approximately 20 km wide. The search for life on Mars continues [0].

Venus is often called Earth's "sister" because of their similarity in size and mass, but conditions on the Venusian surface differ vastly from those on Earth. Its atmosphere is dense and consists of 96.5% carbon dioxide, the rest being nitrogen, atmospheric pressure of 9.3 megapascals and surface temperature of about 737 K (464 °C). Some studies suggest that Venusian atmosphere could have been much more Earth-like and there could have been a substantial amount of water on its surface, but a runaway greenhouse effect caused by the evaporation of the water created an immense level of greenhouse gases [0]. Unlike that near the surface, the temperature at the altitudes of about 50 km (31 mi) is mild and leaves possibility for the existence of life. Carl Sagan published an article, as early as 1963, proposing the hypothesis of microorganisms living in the upper atmosphere of Venus that employ ultraviolet light as energy source. In August 2019, the long-term pattern of UV light absorbance, resulting in change in weather, was reported and believed to be caused by a variety of absorbers, including unknown chemicals or colonies of microorganisms high up in the atmosphere. Therefore, it can't be surely considered to be a sign of life.

In the research from September 2020 by ALMA telescope, phosphine ( $\text{PH}_3$ ) was detected. This molecule would not be present in the Venusian atmosphere in such quantities – 20 ppb – since it reacts with water and carbon dioxide under the ultraviolet radiation. As of today, no known abiotic process could generate that amount of phosphine gas on terrestrial planets (unlike on gas giants). Henceforth, detected  $\text{PH}_3$  could be an indication of life. Numerous missions, be it to carry a radar to get new images of the surface, or to actually go through the atmosphere and sample the air, are now in the beginning stages. In April 2021, decisions on which one will

be continued are due to take place. The BepiColombo mission, launched in 2018 to study Mercury, will fly by Venus on August 10, 2021 and attempt to detect phosphine.

The signals of PH<sub>3</sub> were found during the re-analysis of data by Pioneer Venus Multiprobe from 1978 and the analysis of JCMT data, though much weaker ones in the latter case. By late October, the reviews of the analyses of the data collected by ALMA and JCMT have revealed background interpolation errors. An error-free subtraction results in either no detection of phosphine or a detection of only 1 ppb, which is 20 times below original estimate. On 16 November ALMA released a corrected version of the original data and a re-analysis that reports the average PH<sub>3</sub> abundance to be 7 times lower than stated in the previous analysis. They also consider it to be substantially variable in time and reconcilable with JCMT detection, although the later was in the advanced processing at the time. ALMA would continue observations after the expected reopening in early 2021 [0].

Jovian planets are rather similar to each other in terms of conditions and chances to have had life arise on them. Jupiter and Saturn's atmospheres consist mostly of hydrogen and helium, whereas Uranus and Neptune have relatively more "ices", such as water, ammonia and methane. Microwave studies of Saturn indicate the increase in atmospheric temperature with the increase of depth below the clouds. A similar situation is expected on other Jovian planets [0]. The possibility of ammonia-based microbial life was hypothetically proposed by Carl Sagan and Edwin Salpeter in 1976. Nonetheless, the likelihood of this was diminished by the findings of later experiments. Any molecules would be blown into the lower atmosphere by powerful gusts, where hellish pressures and temperatures wouldn't let them survive [0].

Jovian moons, on the contrary, are good candidates for extraterrestrial life in our solar system. Europa, the fourth-largest satellite of Jupiter, has a crust of water ice, a complex surface and a great amount of sulfuric acid – a potential power source –, as it was reported by the Galileo orbiter. An oxygen atmosphere and a liquid saltwater ocean beneath the frozen crust have been detected. Moreover, "prebiotic

chemicals” like methane and ammonia and very likely to exist on Europa, as they are in abundance on Jupiter and some of its other moons.

Callisto, second-largest moon of Jupiter, could have life in its subsurface ocean. However, the conditions don’t look very favorable. There is a lack of contact with rocky material and the lower heat flux from the interior of Callisto [0].

Other Jupiter’s moons, including Io and Ganymede, might also look promising. The first one is the most volcanically active place in the Solar System and could serve as an appropriate environment for some microbial organisms [0], while the latter one has salt water ice under its surface. Nonetheless, as suggests the analysis of NASA’s Galileo mission, Ganymede might have several layers of ocean separated by different phases of ice, hindering the water-rock contact **[Ошибка! Источник ссылки не найден.]**.

Enceladus’, sixth-largest moon of Saturn, environment is very interesting due to the presence of internal global salty ocean supported by circulation patterns, and energy source, complex organic compounds and a rocky core. Several robotic missions have already been proposed to explore Enceladus more thoroughly [0].

In 2008, the Cassini spacecraft revealed hundreds of lakes and seas of organic materials on Titan, Saturn’s largest moon. Dozens of them contain more liquid hydrocarbon than all of Earth’s oil and gas reserves together. It has been hypothesized that organisms could exist in the lakes of liquid methane and would metabolize at a freeze temperature of 94.0 K ( $-179.2^{\circ}\text{C}$ ). To date, methane-based life forms haven’t been detected anywhere, although a cell membrane capable of functioning in such conditions has been successfully modeled. Despite these biological possibilities, there are some obstacles to life on Titan, including a vast distance from the Sun, frigidity and the lack of  $\text{CO}_2$  in the atmosphere. Future conditions, on the other hand, could be far more habitable, as the temperature rises enough for Titan to support liquid water on the surface [0]. NASA’s Dragonfly mission is slated to land on Titan in the mid 2030’s with a VTOL-capable (vertical take-off and landing) rotorcraft with a launch date set in 2026 [1].

Pluto also could be a favorable target for future studies, as it most likely has a subsurface ocean, warm interior and organic molecules – at least on the surface. However, it is not clear yet, whether the degree of interaction between the ocean and the layers above and below it is sufficient to transfer heat and organics between them. Therefore, Pluto is not as tempting a target as Europa or Enceladus, but might be more suitable for life than Titan or Ganymede [0].

Comets and asteroids, as well as other small bodies, revolving about the Sun between the orbits of Mars and Jupiter, contain organic molecules. In November 2019, the detection of sugar molecules, including ribose, in meteorites was reported for the first time, supporting the idea that bio-ingredients essential for life can be produced by chemical processes on asteroids [0].

**Conclusions.** The search for life in the Solar System is not an easy venture and one that might not yield anything at all. However, if successful, it could greatly propel forward not only science, but also humanity's understanding of its place in the Universe. Even the slightest signs of extraterrestrial life would mean that we're not "alone", not the conclusion the world has come to, but the result of only one of the many paths evolution took, one example of how life could develop.

There is now already an immense interest in astrobiology and would grow even more if we are to find living organisms beyond our planet. In light of the recent discovery of phosphine gas on Venus and all the missions that are now on the beginning stages and that are already in action, the hope is not lost. The search for life on other bodies of the Solar System continues.

## References

1. Extraterrestrial life (2020). Available at [https://en.wikipedia.org/wiki/Extraterrestrial\\_life](https://en.wikipedia.org/wiki/Extraterrestrial_life)
2. Extraterrestrial life (2020). Available at <https://www.britannica.com/science/extraterrestrial-life/Searching-for-technical-civilizations>
3. Atmosphere of Mercury. Available at [https://en.wikipedia.org/wiki/Atmosphere\\_of\\_Mercury](https://en.wikipedia.org/wiki/Atmosphere_of_Mercury)
4. Mars. Available at <https://en.wikipedia.org/wiki/Mars>
5. Life on Mars. Available at [https://en.wikipedia.org/wiki/Life\\_on\\_Mars](https://en.wikipedia.org/wiki/Life_on_Mars)
6. Venus. Available at <https://en.wikipedia.org/wiki/Venus>
7. Life on Venus. Available at [https://en.wikipedia.org/wiki/Life\\_on\\_Venus](https://en.wikipedia.org/wiki/Life_on_Venus)
8. The Curious Idea of Jovian Life (2013). Available at <https://www.nature.com/scitable/blog/postcards-from-the->

[universe/the\\_curious\\_idea\\_of\\_jovian/#:~:text=The%20jovian%20atmosphere%20contains%20hydrogen,by%20turbulent%20weather%20and%20lighting.&text=Ammonia%2Dbased%20life%2C%20was%20not,survive%20in%20ammonia%2Drich%20atmospheres.](#) 9. Asteroid. Available at <https://en.wikipedia.org/wiki/Asteroid#Composition> 10. Life's prospects on Pluto. Available at <https://astronomy.com/magazine/2019/08/lifes-prospects-on-pluto> 11. Enceladus. Available at [https://en.wikipedia.org/wiki/Enceladus#Potential\\_habitability](https://en.wikipedia.org/wiki/Enceladus#Potential_habitability) 12. Titan. Available at [https://en.wikipedia.org/wiki/Titan\\_\(moon\)#Prebiotic\\_conditions\\_and\\_life](https://en.wikipedia.org/wiki/Titan_(moon)#Prebiotic_conditions_and_life) 13. Callisto. Available at [https://en.wikipedia.org/wiki/Callisto\\_\(moon\)#Potential\\_habitability](https://en.wikipedia.org/wiki/Callisto_(moon)#Potential_habitability) 14. Ganymede. Available at [https://en.wikipedia.org/wiki/Ganymede\\_\(moon\)#Subsurface\\_oceans](https://en.wikipedia.org/wiki/Ganymede_(moon)#Subsurface_oceans)

УДК 536.7

## THE QUESTION OF PERPETUITY: PERPETUUM MOBILE

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### Анотація. Саріогло А. Питання про вічність: perpetuum mobile.

Стаття присвячена розгляду декількох відомих розробок вічних двигунів та знайденню відповіді, чи справді можливо створити вічний двигун. Автор звертає увагу на проблеми в створенні двигуна: закони фізики. У статті наводиться інформація про історію перших ідей вічного руху. Відповідна інформація про нові ідеї і моделі вічного двигуна взята з наукових журналів та книг. Висновки статті дають відповідь на питання про те, як зробити вічний двигун. Мета статті - розглянути найбільш відомі моделі вічного руху, з'ясувати, чому вони не працюють, і порівняти їх з новими розробками.

**Ключові слова:** perpetuum mobile, вічний двигун, другий закон термодинаміки, закон збереження енергії, зовнішня енергія, механізм, модель, розробка

**Abstract. Sariohlo A. The question of perpetuity: perpetuum mobile.**

The article is devoted to reviewing several well-known designs of perpetual motion machines and finding the answer to whether it is possible to create a perpetual motion machine. The analysis of various models of perpetuum mobile is given in the article. The author pays attention to the problems in creating an engine. The article gives the information about the history of the first ideas of perpetual motion. Relevant information about the new ideas and models of perpetuum mobile is given from scientific journals and books. The main challenge is to make an infinitely working mechanism for constant energy production. The review of the most famous models of

perpetual motion is given.

**Key words:** *perpetuum mobile* (lat.), development, external source of energy, conservation law, mechanism, model, perpetual motion machine, second law of thermodynamics

**General formulation of research and its topicality.** A perpetual motion machine is an imaginary infinitely operating mechanism that gives away more energy than it consumes, or it receives heat from a single reservoir and turns it completely into work, e.g., to lift the weights [2,3,7].

In the XII–XIII centuries crafts began to develop more rapidly improving the machines that set in motion the mechanisms.) These were mainly water wheels and the wheels that were set in motion by animals (horses, bulls, etc. that walked in circles). Thus, the idea arose to come up with a machine that was powered by cheaper energy. That's exactly why mankind seeks to build the *perpetuum mobile* (lat.) However, to create a perpetual motion machine means to violate the first or the second law of thermodynamics. Nevertheless, scientists and inventors do not give up a hope because it opens up new possibilities. Mankind would forever get rid of the fear of lack of energy. A well-known example of the oldest perpetual motion machine is a cogwheel with weights attached to hinges. In 2017 scientists found a way to create a so-called perpetual motion machine which seems to violate the second law of thermodynamics and has a 100% efficiency [4].

### **Setting of the problem and the aim of the article.**

**The relevance** of the problem is a possibility to obtain the constant source of energy by means of a perpetual motion machine.

**The purpose** of the article is to study and analyze several "perpetual motion machines", to consider models that have been working for a long time but no one can answer why, and to get acquainted with the history of the perpetual motion machine and its types.

**The object** is to consider new options for generating energy.

**The subject** is precisely perpetual motors, the very first ones and new models.

**The task** of the article is to give the history of the development and the characteristic of perpetual engines.

**Materials of this article** include the study and analysis of the articles dedicated to perpetuum mobile, history of its appearance, the analysis of the structure, etc.

**Theoretical significance** of the article is to consider the latest ways to create perpetual motion machines, while the **practical** one is their specific structure and version of creation.

**Prospects for the analysis** of the article include the creation of other variants of perpetual sources of energy and explanation of why some models still work.

**Discussion and Results.** The history of the perpetuum mobile is still not precisely known; the perpetuum mobile was first mentioned in a verse by Bhaskar Acharya (1114-1185) in 1150, India [7]. He describes it as a wheel with long narrow vessels half-filled with mercury attached obliquely. The principle of operation was based on the difference in the moments of attractive forces created by the liquid which moves in the vessels placed on the circumference of the wheel. Unfortunately, no one has been able to exactly create a model of such an engine so far, but it is already clear that it will not work forever because we will not be able to get energy forever [7].

As we have already noted a perpetual motion machine is an ideal engine conceived so that, once started, it will run continuously and will not require additional energy input [8]. There are three types of perpetual motion machine. The first of them is capable of performing work indefinitely without expenditure of fuel or other energy resources, which contradicts the law of conservation and transformation of energy. The latter states that energy cannot be created or destroyed, it can only be transformed from one form into another [5]. A perpetual motion machine of the second kind would have to turn all the received heat into work, but this contradicts the second law of thermodynamics, namely the entropy of a closed system never decreases. Perpetual motion engines of the third kind include those that obtain energy from "nothing" [2]. They are inventors who want to get unlimited amount of energy from a "physical vacuum". Perpetual motion machines can be absolutely different in size, all of them are divided on the basis of use of such methods: 1) water lifting by

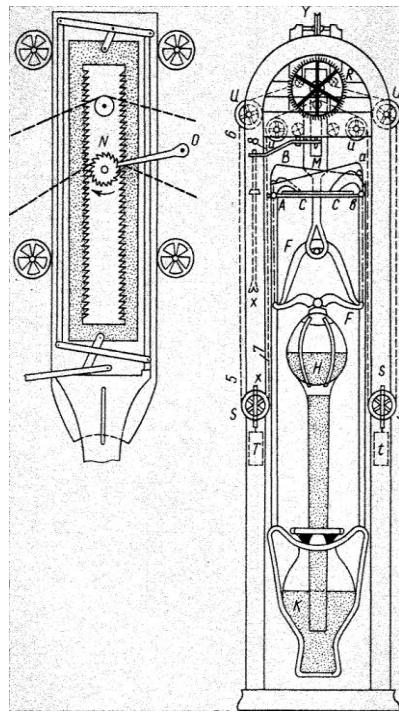
means of an Archimedean screw; 2) water lifting by means of capillaries; 3) use of a wheel with unbalanced weights; 4) natural magnets; 5) electromagnetism; 6) steam or air compression [7].

Known mechanisms that have worked or are working for a long time. Are they perpetual motion machines?



*Fig.1. Karpen Battery*

One famous example is the Karpen Battery (Fig. 1). The device still works today. Nicolae Vasilescu-Karpen invented this device in 1950. The model consists of two galvanic cells that drive a galvanometer motor and a switch that locks the circuit for every half-turn of the motor and then opens it. The motor's turnover time is long enough for the galvanic cell to fully recharge, changing its polarity in the process. Scientists still cannot explain why the device still works. Most of them believe that the principle of operation is the transformation of thermal energy into mechanical work. Interesting is that in 2006 they measured the power on the model and it was 1 W, as in 1950 [6].



*Fig.2.Cox Clock*

An older example, but no less famous, is the Cox Clock (Fig. 2). James Cox lived and worked in London, his mechanism survives to this day. The clock was created in 1774. The main difference of Cox's "perpetual motion" engine is the use of natural energy. The operation of the mechanism is based on the change in atmospheric pressure. The movement of mercury changed the internal wheels, when the mercury column rose (fell) inside the clock barometer, thus winding the clock. If the change in pressure was frequent, however, the gears of the clock would come out of their slots while the chain loosened to a certain point, after which everything would fall back into place. According to Cox, clocks were based on "philosophical and mechanical principles" [2].

All these mechanisms illustrate the possibility of creating a perpetual motion machine, but because we do not obtain any energy from them we cannot call them a full-fledged perpetual motion machine.

An example of an attempt to create a perpetual motion machine where we can get energy is a chain of floats. A rope with 14 empty cubic boxes is thrown over pulleys installed at the top and bottom of a tower filled with water. Under the action of Archimedes forces the bottom boxes are pushed outward and under the action of gravity the boxes on the surface are lowered into the water. Thus, the boxes fall

alternately from the air into the liquid and vice versa. Archimedes' law is applied here. The law is that bodies with lower density than water tend to float up to the surface. The perpetual motion does not work because the ejection force is the difference between the pressures of the water that act on the bottom and the top of the submerged object. Consequently, on the side of the liquid, the lowest tank which plugs the liquid's outflow will only be the pressure force on the surface; it will either balance or exceed the force that acts on the other tanks.

Finally, let us consider the latest example of a perpetual motion machine, which was developed in 2017. Russian scientists from the Moscow Institute of Physics and Technology have found a way to create a quantum device that violates the second principle of thermodynamics and has an efficiency that is actually exactly 100%. The second law of thermodynamics states that the value of entropy (a measure of the irreversible dissipation of energy) in a closed system either grows or remains constant. Scientists have found the conditions under which the entropy can decrease. The first is that it can occur in quantum systems of relatively macroscopic size. The essential difference is that in quantum world the entropy can appear without transfer of thermal energy, as in classical physics it can appear due to quantum entanglement [4]. There are still experiments underway to create a heat machine which scientists describe as a mechanism that consists of several qubits that can be in a state of quantum entanglement with each other. One of the qubits absorbs heat but because of its quantum nature this energy can only be used with a 50% probability. To get energy with 100% probability we need to reduce its entropy, to make the state "pure". The task can be solved by an auxiliary clean qubit which exchanges its quantum state from the thermalized "dirty" state of the working qubit. It is important that in this case there is no energy transfer between the two qubits. However, it takes a long time to get 100% of the energy and collect it so the experiments are still going on [1]. This cannot be considered the usual "perpetual motion machine" because here the transition to the quantum world is involved and, therefore, the classical laws of physics must be modified accordingly to account for quantum effects.

**Conclusion.** In this article we studied some perpetual motion machines.

Several of them are the examples of long-lasting devices. One of the example is a familiar model of the known engines. Another one is still being designed. However, the accumulation of experience over time can give us an answer to the main question, namely, whether it is possible to create a perpetual motion machine. Of course, it is unlikely to succeed in the macrocosm but anything is possible in the quantum world.

All experiments and scientific search are certainly no longer in vain because many of them became prerequisite for real scientific discoveries. Despite the fact that the patent for perpetual motion machines has been banned the scientists continue to create inventions that can work at least for a century. It seems that the very idea of the perpetual motion machine hides a secret.

## References

# **USING MACHINE LEARNING METHOD FOR IDENTIFICATION OF USEFUL INFORMATION FROM THE FLOW OF REGISTRATIONS OF TRAFFIC REGULATIONS AND ROAD ACCIDENTS**

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**Анотація. Шведченко Марія. Використання методу машинного навчання для виявлення корисної інформації з потоку реєстрацій ПДР та ДТП.**

У цій статті розглянуто методи обробки та аналізу великих даних. Також приведено дослідження наявних даних та приведені кроки, які треба зробити, задля цього на прикладі підготовки для обробки даних потоку реєстрацій ПДР та ДТП для тренування провісника. На даний момент в Україні дуже гостро поставлено питання щодо дотримань ПДР. Ціллю статті є розробка програми для визначення найбільш ймовірного географічного положення, час та тяжкість дорожньої події за допомогою метода машинного навчання.

**Ключові слова:** Машинне навчання, великі дані, SOM

**Abstract. Shvedchenko Mariia. Using machine learning method for identification of useful information from the flow of registrations of traffic regulations and road accidents.**

This article discusses methods for processing and analyzing big data. There is also a study of the available data and the steps that need to be taken, for this purpose, on the example of preparation for data processing of the traffic registration and accident registration flow for the training of the forecaster. At the moment in our country the issue of compliance with traffic regulations is very acute. The aim of the article is to develop a program to determine the most probable geographical location, time and severity of a road accident using the method of machine learning.

**Key words:** Machine learning, Big Data, SOM

## **General formulation of research and its topicality**

Nowadays, in Ukraine, the issue of compliance with traffic regulations is very acute. Every year, a fairly large number appear in the statistics - the number of people who died on the road. Often people knowingly or unknowingly violate traffic rules, but law enforcement agencies cannot physically monitor compliance with the rules by all road users. But the often negligent attitude to the traffic rules leads to terrible consequences, tragedies. That is why it is necessary to identify the most emergency places and places where people most often violate the common rule. It is

in these places that CCTV cameras should be located.

#### Results:

The format of the necessary input data for the correct operation of the program was described; the business model to provide this model in masses was developed.

#### **Setting of the problem and the aim of the article.**

##### Purpose:

- development of programs to determine the highest geographical position, time and difficulty of road division using the method of machine learning.
- Implementation of the project in use.

##### Tasks:

1. estimation of the percentage of accidents on this section of the road; assessment of the probability of increase or decrease of this percentage due to external factors (road condition, weather, etc.);
2. an estimate of the approximate time of day when an accident may occur at a given site;
3. assessment of regularities of traffic violations on this section of the road;
4. determining the probability of deterioration of the road due to external factors.
5. estimation of the percentage of accidents on this section of the road; assessment of the probability of increase or decrease of this percentage due to external factors (road condition, weather, etc.);
6. an estimate of the approximate time of day when an accident may occur at a given site;
7. assessment of regularities of traffic violations on this section of the road;
8. determining the probability of deterioration of the road due to external factors.

#### Research methods.

To achieve this goal were used:

1. methods of system analysis - for the formation of a conceptual model

of BigData;

2. methods of artificial intelligence - to identify patterns in the Big Data catalog;
3. methods of statistical analysis of data - to determine the semantic relationships between data sources.

### **Experiential/research outcomes**

1. Existing methods for processing and analyzing Big Data

#### **1.1 Combining models**

Processing speed is significantly related to the complexity of the mathematical apparatus used. The simpler the analysis mechanisms, the faster the data is analyzed.

You can build a data processing script so that the data is "passed" through a sieve of models. Here's a simple idea: don't waste time processing what can't be analyzed.

First, the simplest algorithms are used. Part of the data that can be processed using such algorithms is analyzed and excluded from further processing. The rest of the data is transferred to the next stage of processing, which uses more complex algorithms, and so on down the chain. The last node of the processing scenario uses the most complex algorithms, but the amount of analyzed data is many times less than the original sample. As a result, the total time required to process all the data is reduced by an order of magnitude.

#### **1.2 Parallel processing**

Another effective strategy for processing large amounts of data is to divide the data into segments and build models for each segment separately, followed by combining the results. Often in large amounts of data, you can select several different subsets for which it is advisable to build one model. In this case, instead of building one complex model for all, you can build a few simple for each segment. This approach allows you to increase the speed of data analysis and reduce memory requirements by processing smaller amounts of data in one pass. In addition, in this case, we speak above the analytical processing can be parallelized, which also has a positive effect on the time spent. In addition, different analysts can build models for

each segment.

### 1.3 Representative samples

In the presence of large amounts of data, you can use to build a model, not all the information, but some subset - a representative sample. A correctly prepared representative sample contains the information necessary for the construction of a qualitative model. The process of analytical processing is divided into 2 parts: the construction of the model and application of the constructed model to new data.

Building a complex model is a resource-intensive process. Depending on the algorithm used, the data is cached, scanned thousands of times, many auxiliary parameters are calculated, etc. Applying an already built model to new data requires resources tens and hundreds of times less. Very often it comes down to calculating a few simple functions.

Thus, if the model is built on relatively small sets and applied later to the entire dataset, the time to obtain the result will be reduced by orders of magnitude compared to trying to completely rework the entire existing data set.

### 1.4 Self-organized map (SOM)

A self-organized map (SOM) or self-organized function map (SOFM) is a type of artificial neural network that is learned through free training to obtain a small (usually two-dimensional), discrete representation of the input space of educational samples, mapname, and so on. Self-organizing maps are different from other artificial neural networks, so they involve competitive learning rather than error-correcting learning, and preserve the topological power structures of the input space.

### 1.5 Principal component analysis(PCA)

Principle Component Analysis (PCA) is a method used to highlight variations and identify strong patterns in a data set. PCA is often used to facilitate the study and visualization of data.

## 2. Research of available data

### 2.1 Construction of assumptions

The preliminary result of the use of predictors and models of classifiers should be dynamic:

1. determining the probability of an accident in a particular road situation by the following factors:

1. speeding
2. violation of order
3. violation of the priority of travel

2. determination of the most significant criteria and values for early notification in an autonomous manner or at the request of the probability and type of accident.

3. determination of extraordinary records of road accidents in order to prevent penetration into the database of obviously erroneous data.

4. development of recommendations for road services

## 2.2 Construction of several models of data processing

### 2.2.1 The first model. Search for extraordinary cases of road accidents.

In order to find the most remote cluster in the multidimensional space of accident factors.

The SOM algorithm is used, but it requires encoded and normalized input data. According to the results of the application of the standard SOM algorithm, the available data show the presence of five percent of extraordinary data, among which it is possible to identify some factors in the future.

### 2.2.2 Another model. Accident prevention due to speeding.

Aimed at finding statistical patterns that indicate that the coincidence of certain circumstances leads to an accident due to speeding because it allows you to predict the presence of the most significant factors.

The Confusing matrix method is used to control the quality of classification. In this method, the classification is divided into 4 groups:

- correctly calculated positive result
- incorrectly calculated positive result
- correctly calculated negative result
- incorrectly calculated negative result

## 2.3 Construction of the predictor

### 2.3.1 Construction of the predictor

A predictor is a program that calculates the probability of an accident at a specific location according to certain data.

The capabilities of the python programming language and the pandas and scikitlibraries were used to develop the predictor.

### 2.3.2 Construction of a predictor to search for extraordinary data

The predictor program has a common part - data encoding and replacement of missingdata with generalized values and data rationing.

#### 3.1 Database preparation

It is planned to gain access to data on registration of traffic accidents and road accidents in Ukraine. But firstly was created test database.

#### 3.2 Preparation of input data for the predictor

As the input data may be incomplete, it is necessary:

1. replace the missing information with a generalized value;
2. categorical data need to be coded;
3. scaling of the given data.

#### 3.3 Identification of the most important factors of different types of accidents

Once the predictor is trained on the input data, it contains information with the most virility input data. The description of the internal data structures of the predictor allows you to select the most statistically variable indicators. Thus we get the most significant input parameters.

### **Conclusions**

In the course of the research, there were:

1. Created and optimized the format of the necessary input data for the correct operation of programs, which is dependent on traffic violations and external factors.
2. A relatively small number was created for the shared database using NoSQL
3. The initial version of the programs was developed using the following methods:
  1. method of system analysis - for the formation of a conceptual model of

BigData;

2. method of artificial intelligence - to identify patterns in the catalog of BigData;

3. method of statistical data analysis - to determine semantic data from datasources.

4. The program showed a relationship between the following factors

Violatio n	Facto r
Violation of the speed limit	Drivers under the age of 30
Violation due to car breakdown	Drivers aged 40 to 55 who have a car that is over 10years old
Violations due to road conditions	In large cities, the percentage is lower than in small ones

## References

1. Laney D. The Importance of «Big Data»: A Definition [Text] [ElectronicResours] / Mark A. Beyer, Douglas Laney. – Access mode: <https://www.gartner.com/doc/2057415/importance-big-data-definition>
2. Jeff Sauro, PhD. 7 ways to hadle missing data – Access mode: <https://measuringu.com/handle-missing-data/>
3. Importance of Feature Scaling — Access mode: [http://scikit-learn.org/stable/auto\\_examples/preprocessing/plot\\_scaling\\_importanc e.html](http://scikit-learn.org/stable/auto_examples/preprocessing/plot_scaling_importanc e.html)
4. Analiz bol'shih ob#emov dannyh [Analyzing large amounts of data] - Access mode: [https://basegroup.ru/community/articles/very-large-data\(in Russian\)](https://basegroup.ru/community/articles/very-large-data(in Russian))

УДК 533.9.01

## PENETRATION OF ELECTROMAGNETIC WAVE INTO DENSE PLASMAS

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### Анотація. Сусаєв Я.В. Проникнення електромагнітної хвилі в щільні плазми.

У роботі аналітично досліджується поширення переходної електромагнітної хвилі через густу плазму у випадку нормального падіння хвилі з вакууму на плазмовий напівпростір. У той час, як самоузгоджені електромагнітної хвилі вже є добре вивченими та

описаними класичною теорією електродинаміки плазми, перехідні електромагнітні хвилі все ще не є достатньо добре вивченими – цей факт значно ускладнює опис початкової стадії взаємодії зовнішньої електромагнітної хвилі з плазмою і, особливо, аналіз даних, отриманих в результаті чисельного моделювання. Основним пріоритетом даної роботи є опис перехідного електромагнітного поля заломленої хвилі, що поширюється у холодній, незамагніченій, густій плазмі без зіткнень. Густа плазма представляє широкий інтерес для питань плазмової діагностики, нагрівання плазми, радіозв'язку, радіолокаційних програм, фотонних технологій тощо.

У якості результатів приводяться налітичні вирази для перехідних електрических та магнітних полів заломленої хвилі, що записані у простій інтегральній формі та містять неповні інтеграли Ліпшица-Ганкеля, також наводиться порівняння перехідні поля заломленої хвилі зі стаціонарними полями. Зазначені вирази були отримані за допомогою інтегрального метода Фур'є та можуть бути відтворені будь-яким науковцем, що вивчає формування плоских хвиль у дисперсійних середовищах. Крім того, у роботі надається порівняння між аналітичними та чисельними результатами, співвідношенням із якими виявилося відносно хорошим. Чисельні результати були отримані за допомогою програмного забезпечення Wolfram Mathematica та Python for science. Остаточні результати, отримані у цій роботі, можуть бути корисними при дослідженні процесів формування плоскої хвилі у плазмі, та також можуть бути підтвердженні будь-яким числовим моделюванням, що оперує у часовій області.

**Ключові слова:** перехідні процеси у плазмі, формування плоскої хвилі, хвилі у плазмі

**Abstract. Susayev Y.V. Penetration of electromagnetic wave into dense plasmas.**

The transient transmission of an electromagnetic wave through dense plasmas is studied analytically for its normal incidence from vacuum upon a plasma half-space. While self-consistent electromagnetic waves are well described by the classical plasma theory, transient electromagnetic waves in plasmas are still not fully studied, making it difficult to predict the initial stage of the external electromagnetic wave interaction with the plasma and, especially, to analyse the data obtained in the numerical simulations. The focus of the present paper is the transmitted transient electromagnetic field description, written for the homogeneous, isotropic, cold, unmagnetized, collisionless, and dense plasmas. The problem is of interest to plasma diagnostics, plasma heating, radio communications, radar applications, photonic technologies, etc.

As a result, the exact formulae for the electric and magnetic fields of the transmitted wave are written in simple analytical integral forms housing the incomplete Lipschitz-Hankel integrals, the comparison between the transient and stationary electromagnetic fields of the transmitted wave is provided. The formulae are obtained by the Fourier integral method and should be reproducible

by any scientist, studying plane wave formation in the dispersive media. Besides, a comparison between the analytical and numerical results is additionally provided, the correlation between the analytical and numerical data was demonstrated to be relatively good. The numerical results are mainly obtained by Wolfram Mathematica software and Python for science development kit. The final results of the present work may be useful for considering plane wave formation in dense plasmas and can be confirmed by any time domain numerical simulation.

**Key words:** transient processes in plasmas, plane wave formation, plasma waves

To-day numerical methods allow simulating the propagation of an electromagnetic wave through plasmas in real-time. However, while self-consistent electromagnetic waves are well described by the classical plasma theory, non-stationary (or transient) electromagnetic waves in plasma are still not fully described analytically, making it difficult to predict the initial stage of the external electromagnetic wave interaction with the plasma and, especially, to analyse the data obtained in the numerical simulations. Thus, the focus of the present paper is the transmitted transient electromagnetic field description, written for the cold, unmagnetized, collisionless and dense plasmas in a simple integral form obtained by the Fourier integral method [1]. Besides, an analytical comparison between the analytical and numerical results is additionally provided.

In this work, the following scientific model is considered. A homogeneous isotropic dense plasma occupies the semi-infinite half-space  $x > 0$  (on the right), vacuum occupies the semi-infinite half-space  $x < 0$  (on the left); hence, the vacuum-plasma interface is placed just at  $x = 0$ . An electromagnetic wave incident normally from a vacuum region at the plasma region meets the vacuum-plasma border at the moment of time  $t = 0$ , and then propagates further into the plasma region. Thus, the wave is partially reflected from the border and partially transmitted into the plasma.

Initially, the plasma is quiet: there is not any electromagnetic perturbation inside. After the transmitted wave begins to propagate through the plasma, it starts to interact with the internal plasma electromagnetic oscillations. According to the classical plasma electrodynamics theory [3], in the large time limit ( $t \rightarrow \infty$ ) the

electromagnetic wave in the plasma becomes stationary and can be described by the corresponding dispersion relation. The subject of our interest is the transient stage of wave formation: what happens with the transmitted wave before it becomes stationary? The  $y$  axis is directed along the wave electric field, and the  $z$  axis is directed along the wave magnetic field. In our model, the incident wave is assumed to be sinusoidal, and its electric field  $E_y$  and magnetic field  $B_z$  can be defined as  $\sin(\omega t - kx)$ , where  $\omega$  is the angular wave frequency,  $k = \omega/c$  is the vacuum wavenumber, and  $c$  is the speed of light in vacuum.

The main objective of this work is to describe the electric field of transmitted wave in dense plasmas, the permittivity  $\varepsilon = 1 - \omega_{pl}^2/\omega^2$  of which is negative by definition: that means, that the angular wave frequency  $\omega$  is less than the plasma frequency  $\omega_{pl}$ . Knowing the electric field behaviour, the magnetic field can be obtained later from Maxwell's equations.

The electromagnetic oscillations in plasmas without external magnetic field are governed by the telegraph equation (the same for electric field component, magnetic field component and plasma currents of each species):

$$\frac{\partial^2 u}{\partial x^2} = \frac{1}{c^2} \cdot \frac{\partial^2 u}{\partial t^2} - \frac{\omega_{pl}^2}{c^2} \cdot u,$$

where  $u$  can be any from above-mentioned unknown values. To describe the electric field of transmitted wave, the telegraph equation should be supplemented by initial and boundary conditions. Knowing, that both the electric and magnetic fields are continuous at the vacuum-plasma interface, the following initial conditionals for the electric field component can be obtained:

$$E_y(x, 0) = 0, x \geq 0,$$

$$\frac{\partial E_y(x, 0)}{\partial t} = 0, x \geq 0.$$

The boundary condition for the electric field can be obtained from the well-known solution [2] of the classical wave equation in vacuum and written as:

$$\left\{ \frac{1}{c} \frac{\partial E_y(x, t)}{\partial t} - \frac{\partial E_y(x, t)}{\partial x} \right\}_{x=0} = 2k \cos(\omega t), t \geq 0.$$

Thus, the problem of the transient electric field in plasma now consists of the

telegraph equation, two initial conditions, and one boundary condition.

Now, the stationary transmitted electromagnetic wave in dense plasmas is considered. Knowing the expressions for the electromagnetic field of a transmitted wave in the stationary case, analytical comparison between stationary and non-stationary (transient) cases will be available. Let the electric field  $E_y$  and magnetic field  $B_z$  of the stationary transmitted wave be given by the following complex expressions [3, p. 127]:

$$E_y \propto T \cdot e^{+i(\omega t - k_p x)},$$

$$B_z \propto T \cdot \frac{k_p}{k} \cdot e^{+i(\omega t - k_p x)},$$

where  $k_p = \omega_{pl}/c$  is the plasma wavenumber,  $T$  is the transmission coefficient. Taking into account, that the tangential components of the electromagnetic field are continuous across the vacuum-plasma interface, the following expression for the transmission coefficient can be obtained:

$$T = \frac{2k}{k+k_p}.$$

The main objective of this work is to describe the electric field of transmitted wave in dense plasmas, the permittivity of which is by definition negative. Thus, to obtain the expressions for the electric and magnetic fields of the transmitted wave in this case, the expressions for  $k_p$  and  $T$  shall be re-written with respect to the negative  $\varepsilon$ :

$$k_p|_{\varepsilon<0} = ik\sqrt{|\varepsilon|},$$

$$T|_{\varepsilon<0} = \frac{2}{1-\varepsilon} - i \frac{2\sqrt{|\varepsilon|}}{1-\varepsilon}.$$

Considering the obtained expressions for  $k_p$  and  $T$ , the final expressions for electric and magnetic stationary fields of transmitted wave in dense plasmas can be written as:

$$E_y|_{\varepsilon<0} \propto \frac{2}{1-\varepsilon} \left[ \sin(\omega t) + \sqrt{|\varepsilon|} \cos(\omega t) \right] \exp \left[ -k\sqrt{|\varepsilon|}x \right],$$

$$B_z|_{\varepsilon<0} \propto \frac{2}{1-\varepsilon} [\varepsilon \cdot \sin(\omega t) - \sqrt{|\varepsilon|} \cos(\omega t)] \exp[-k\sqrt{|\varepsilon|}x].$$

Now, knowing the expressions for stationary electromagnetic field, the transient case are to be considered. Luckily, in [4] the similar problem is studied, but for the case of underdense plasmas. Repeating the procedure for stationary field, which was described before in details, one can obtain the final expressions for the transient electromagnetic field of the transmitted wave propagating in dense plasmas:

$$E_y(x, t)|_{\varepsilon<0} = \frac{-2}{(1-\varepsilon)^{1/2}} \frac{ct-x}{\sqrt{c^2t^2-x^2}} \cdot J_1 \left[ \frac{\omega_{pl}}{c} \sqrt{c^2t^2-x^2} \right] + \frac{2}{1-\varepsilon} \left\{ kI_1 + \frac{\sqrt{|\varepsilon|}}{c} \frac{\partial I_2}{\partial t} \right\},$$

$$B_z(x, t)|_{\varepsilon<0} = \frac{2}{(1-\varepsilon)^{1/2}} \frac{ct-x}{\sqrt{c^2t^2-x^2}} \cdot J_1 \left[ \frac{\omega_{pl}}{c} \sqrt{c^2t^2-x^2} \right] - \frac{2}{1-\varepsilon} \left\{ \varepsilon kI_1 + \frac{\sqrt{|\varepsilon|}}{c} \frac{\partial I_2}{\partial t} \right\},$$

where  $J_1[x]$  is the Bessel function of the first kind.  $I_1(x, t)$  and  $I_2(x, t)$  functions are called incomplete Lipschitz-Hankel integrals [5, p. 384] and defined here as:

$$I_1(x, t)|_{\varepsilon<0} = \int_x^{ct} dg \cosh[k\sqrt{|\varepsilon|}(g-x)] \cdot J_0 \left[ \frac{\omega_{pl}}{c} \sqrt{c^2t^2-g^2} \right],$$

$$I_2(x, t)|_{\varepsilon<0} = \int_x^{ct} dg \sinh[k\sqrt{|\varepsilon|}(g-x)] \cdot J_0 \left[ \frac{\omega_{pl}}{c} \sqrt{c^2t^2-g^2} \right].$$

Summing up, an analytical model of the transient electromagnetic wave propagation through homogeneous isotropic dense plasmas is considered by analytical analysis of the solution of the similar underdense plasma problem [4], a comparison between the stationary and transient cases is also provided. As a result, the analytical expressions for the transient electromagnetic wave fields are obtained in integral form as functions of space and time, allowing one to simulate a transient electromagnetic wave propagation in dense plasmas numerically.

The analytical results obtained in this study may be useful for considering plane wave formation in plasmas and can be confirmed by any time domain numerical simulation.

## References

1. Budak, B. M., Samarskii, A. A. & Tikhonov, A. N. (1964). *A Collection of Problems on*

*Mathematical Physics.* Oxford: Pergamon Press. 2. Jackson, J. D. (1998). *Classical Electrodynamics*. New York: Wiley. 3. Krall, N. A. and Trivelpiece, A. W. (1973). *Principles of Plasma Physics*. New York: McGraw-Hill Book Company. 4. Pavlenko, I. V., Girka, I. O., et al. (2019). Transient transmission of electromagnetic wave through plasmas and formation of electrostatic oscillations with simulations by FDTD method. Unpublished manuscript. 5. Watson, G. N. (1966). *A Treatise on the Theory of Bessel Functions*. Cambridge University Press.

УДК 004.6, 004.8

## **RESEARCH OF EFFICIENCY OF DIFFERENT DATA STRUCTURES WITH SIMILAR BASE MODELS**

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**Анотація. Єна А.В. Дослідження ефективності різних структур даних із подібними базовими моделями.**

У сучасному світі через надзвичайно великі об'єми інформації дуже важливо слідкувати за ефективністю використовуваних структур даних. Досліджено ефективність п'яти різних структур даних базованих на бінарному дереві. Узагальнено переваги використання вбудованих, а також не маючих не обов'язкового функціоналу структур. Проведено аналіз кожної моделі та випадків, де їх використання буде раціональним.

**Ключові слова:** Структури даних, алгоритми, ефективність, бінарне дерево пошуку, самоврівноважені дерева, рандомізовані дерева.

**Abstract. Yena A.V. Research of efficiency of different data structures with similar base models.**

In today's world, due to the extremely large amount of information, it is very important to monitor the effectiveness of the data structures used. The effectiveness of five different data structures based on the binary tree has been studied. The advantages of using built-in as well as structures that have unnecessary functionality are summarized. An analysis of each model and cases where their use will be rational.

**Key words:** Data Structures, algorithms, effectiveness, binary-search tree, self-balanced trees, randomised trees.

### **General formulation of research**

Many researches where the authors compare different algorithms and data

structures with different amounts of data are already in existence. However almost all of them compare algorithms with different asymptotics and fundamentally different ideas that lie inside them.

The main idea of this research is to find out which data structure is the most useful for each type of data that we will look at. It seems that if algorithms have the same asymptotics then they will have approximately the same runtime duration on the same set of data. But in practice we can see that this time can differ several times.

In this article we will try to know why it is happening like that.

### **Setting of the problem and the aim of the article**

All data structures that were taken for our consideration are based on binary trees. All of them have mean asymptotics  $O(\log n)$ , where  $\log n$  is  $\log_2 n$ .

Total number of all data structures that we need for our research is 5. Here is the list of them:

1. Binary search tree
2. AVL tree
3. Red - Black tree (C++ std::set)
4. Splay tree
5. Link-cut tree

To analyse the result of our research we should know at least the main idea of algorithms that our trees are based on. It is really important because in the working process it can have a significant role in efficiency of developing products. All of them are realized in different libraries of vast amounts of programming languages so you just need to make the right choice to increase efficiency of your programm. So firstly we need a short review of each tree to introduce the topic.

### **Review of each data structure**

#### **Binary search tree**

The most simple and probably the least efficient tree from our list is the Binary search tree. The main idea of the algorithm is very simple - to insert another node to the tree we check if it's value is greater or less than root's and then we recursively do this operation to the right or left subtree of root respectively. The base of recursion is

an empty subtree - in this case we just set our new element as the root of this subtree.

The obvious disadvantage is a sorted set of data when each next element is greater or less than previous. It causes so-called baboos, when asymptotics of get and insert operation become  $O(n)$  and to process all data we get  $O(n^2)$ . However it is just an extreme case, in general case, when we have randomised data, usually it takes  $O(\log n)$  to process these operations. To avoid “bamboos” the next 2 trees were developed.

### **AVL tree**

The main property of this structure is auto balancing where one subtree of some node is higher than another for more than 2. Auto Balancing operation removes this imbalance by reorganising trees. This operation costs additional  $O(\log n)$  operations, But with that you cannot get such cases where get or insert operations cost more than  $O(\log n)$  operations, at each point of time tree is balanced, which means that in each subtree height of left and right subtree differs for not more than 1. Height of the tree is the longest path from root to each leaf.

So even for these 2 data structures we want to find out how much does balancing operation really costs and which dominance we get using AVL trees with sorted data sets.

Another 3 data structures are more complicated to explain so here will be provided a simple explanation of applied principles, to see more information refer to the literature section at the end of the article.

### **Red-black tree**

The main idea is that we paint each node in one out of 2 colors - red or black (of course that colors are conditional). In the process of reorganising, we change not only positions of nodes, but also colors. And because of that we have much more than 4 variants of rotations of nodes. That more careful division into more specific cases can cause more effective reorganising and even increase general efficiency.

### **Splay tree**

Unusual tree that shows its efficiency in specific cases. The main idea is that rebalancing happens during get operation, not after insert. Also after rebalancing the

element that has been searched sets as the root element of the tree. It seems unnecessary when we have fully randomised data, but when the same values appear side by side, this strategy shows its potential.

### **Link-cut tree**

Surely the most complicated and functional data structures from the list. We can do such things like linking trees, separating them, searching paths from one node to another, searching the lowest common ancestor of 2 nodes and all these operations are pretty fast. In fact, this data structure is included just to see, can we just peek all the time at the most functional data structure, or it can augment the running time of needed operations.

### **Tests on various data**

For now we need some data sets to make conclusions of efficiency of any tree in different variants of use. All of the data sets contain  $10^7$  queries, so with that asymptotics modern computers are able to produce all of them for 2-20 sec, However it will be more than enough to make some conclusions after we get the tests result. All the tests were written and ran in the g++17 compiler.

### **Short description of data sets**

1. Fully randomised data with approximately equivalent numbers of insert and get operations.
2. Randomised data with small number of get operations and vast amount of insertion operations.
3. Randomised data with small number of insertions and big number of get operations
4. Sorted in distinct order Randomised data with almost equal number of get and insert operations

After all data sets were described and all trees were discussed we finally came up to testing and taking results of our research. Here is the result of research:

	Binary search tree	AVL tree	Red-black tree	Splay tree	Link-cut tree
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Data set №1	5.31 sec	7.12 sec	4.18 sec	13.4 sec	9.45 sec
Data set №2	6.33 sec	8.14 sec	7.2 sec	15.3 sec	12.21 sec
Data set №3	9.47 sec	5.21 sec	3.93 sec	2.31 sec	7.41 sec
Data set №4	>20 sec	7.81 sec	5.31 sec	11.4 sec	13.71 sec

## Conclusions

The results of research are not really surprising. We discussed previously cases where each data structure can be good for usage and cases where you should avoid the usage of it. Here we can make 2 main conclusions:

1. Do not take functionality that you do not require. Additional functionality is the additional volumes of code and as the result - additional time for the computer to make some operations.
2. Think properly about the scenario with which someone can interact with your data. Especially in cases when data is somehow specific.

In addition we can see that built-in structures like std::set or std::map in C++ are the most efficient choices for general cases. Furthermore, they are developed considering features of programming language, that you might not take into account in self-written data structure.

So never neglect analysing data aspects. Effective code is the cause of high-quality programm!

## References

1. Kormen T., Lejzerson Ch., Rivest R., Shtajn K.(2005) Algoritmy: postroenie i analiz [Introduction to Algorithms]. Cambridge, Massachusetts.
2. Sleator D. D., Tarjan R. E.(1985) Self-Adjusting Binary Search Trees AT&T Bell Laboratories, Murray Hill, NJ
3. Martinez, Conrad, Roura, Salvador (1997) "Randomized binary search trees", Journal of the ACM 45
4. Seidel, Raimund; Aragon, Cecilia R.(1996) Randomized Search Trees. Berkeley, California.

## **SECTION IV**

### **CLIL BASED TEACHING METHODS**

УДК 378.147.227

### **THE USAGE OF CROSS-SENCE ACTIVITY FOR DEVELOPING AND ASSESSING SPEAKING SKILLS AT ESP LESSONS**

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PhD

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**Анотація. Холмогорцева І.С. Використання вправи кроссенс для розвитку та оцінювання навичків говоріння на заняттях з іноземної мови за фахом.**

У статті розглядається вправа кроссенс як методичний інструмент для розвитку та оцінювання навичків говоріння на заняттях з іноземної мови за фахом. Вправа кроссенс представляє собою ребус, що має форму таблиці (три на три) із зображеннями, які репрезентують певні поняття та ідеї, що або взаємопов'язані із центральним зображенням, або є послідовністю певних ідей, які ланцюжок яких асоціативно приводить до центрального поняття. В роботі надається стратегія створення ребусу, які включає в себе формулювання загальної теми, що повинна бути висвітлена при говорінні, визначення центрального поняття та можливих асоціацій з ним, пошук та вибір доцільних зображень, які відбивають певні асоціації, тощо. Також були розглянуті стації заняття, на яких завдання кроссенс можливо використовувати. Процес усного мовлення за цим завданням потребує значних знань як зі спеціальності, так і з мови. Крім того, що вправа кроссенс є гарним інструментом для розвитку та оцінювання навичків говоріння, це завдання відповідає таким вимогам як універсальність, адже може бути використано для будь-якого предмету, логічності – сприяє розвитку асоціативного мислення, та креативності, що виражена у пошуку вирішення завдання та розвитку креативного мислення.

**Ключові слова:** асоціації, вправа кроссенс, оцінювання, розвиток навичків говоріння

**Abstract. Kholmohortseva I.S. The usage of cross-sence activity for developing and assessing speaking skills at ESP lessons**

The article outlines the cross-sense activity as a speaking development and assignment instrument for ESP classes. The cross-sense activity is a puzzle which has the form of a table with nine cells (three to three) filled with images that represent certain notions and ideas either mutually connected with the central image or revealing the sequence of connective ideas leading to the center of the table. The present work provides strategies of constructing the puzzle including the

formulation of the general topic to be discussed, deciding upon the central notions and probable associations with it, searching and choosing appropriate images that can represent particular associations, and others. There have been considered stages of a foreign language lesson where the activity can be implemented. The production of an oral text during the cross sense activity requires both the knowledge of the subject and the language itself. Besides being a good tool for developing speaking skills, this activity proves to meet the requirements of being universal as it can be applied in different spheres of knowledge, logical (developing associative thinking), creative (finding ways of solving the task and promoting creative thinking).

**Key words:** assessment, associations, cross-sense activity, speaking skills development

**General formulation of research and its topicality.** Speaking is a complex phenomenon which presupposes the brain activity from finding words to putting them into a meaningful way. Speaking foreign languages makes this work twice as difficult, and communicating your ideas to people who are professionals in their field seems to make this work impossible. At the same time, nowadays the main task of an ESP teacher is not only to develop four basic skills of their students but to teach them implement these skills for a productive studying of their major and, consequently, for becoming the part of scientific community.

Content and language integrated learning (CLIL) presupposes the development of language and communicative competences and the achievement of command of a foreign language, high enough to support professional activity. Thus, assessing speaking in terms of CLIL should be undertaken not only with the account of knowledge of grammar, vocabulary, the ability to interact with the interlocutor, but also with the account of the professional orientation of students and interdisciplinary approach.

Training for the speaking test implies many different approaches to assessing speaking skills highlighted by the researchers: the oral proficiency interview where a student speaks with one or two examiners face to face [2], or with a specially designed software program [14]; the oral presentation which presuppose one speaker vs. the audience both life and hypothetical [1]; the interactive task where two or more test-takers have to solve a problem or make a decision [15], and the group discussions

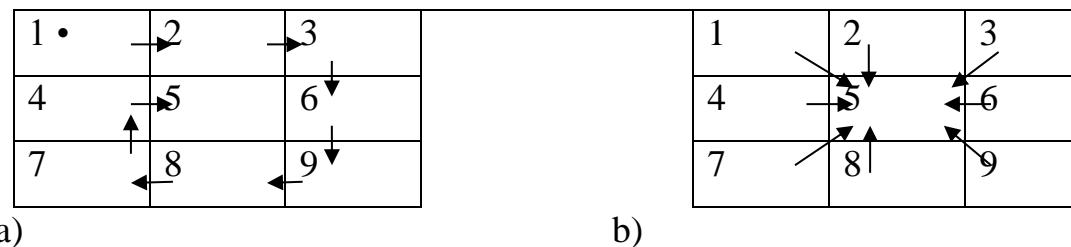
which engage four to six test-takers, such as Socratic seminars [12]. However, speaking for professional communication such as participating in a conference, conducting workshops, or delivering lectures usually involve all these approaches, so, the topicality of the article is represented by the need in elaborating assignments allowing to use if not all but almost all approaches mentioned above.

**Setting of the problem and the aim of the article.** Speaking assessment means that a student replicates the real life situations in terms of the brain activity and the social conditions in which the language is used. So, the problem of this paper is the need of elaborating speaking assignments, which are as close to the content we are interested in as possible. The object of the study is the ways of developing speaking skills with the account of professional orientation of studying, whereas the subject is the cross-sense activity as a way of training and assessing student's ability to communicate senses in the professional sphere.

This article aims to consider the cross-sense activity as a learning tool at the ESP lessons, which presupposes the following objectives:

- to outline the form and the ways of the cross-sense activity compilation;
- to study possible benefits and drawbacks of the cross-sense activity as a tool of developing speaking skills of non linguistic students.

**Discussion and results.** The cross-sense activity is a kind of a puzzle which has the form of a table that is composed of nine pictures representing the topic to be discussed. The activity was first introduced by S. Fedin and V. Buslenko in 2002 [13, p. 39] as another variant of a cross-word puzzle and since then it has been used as a teaching instrument in various subjects. The task of a test-taker is to find out the sequence between the pictures, to find associations and connect images with each other bearing in mind that the central picture represents the central notion of the topic to dwell upon. There are two ways of establishing connections:



where the first one (a) acquires the form of a helix starting from 1 and finishing at 5, and presupposes the sequence of senses; and the next one (b) – the form of a star which rays represent the interconnection of different items (ideas) with the central notion (5). Let's consider how it works.

The example of a cross-sense activity was designed for the students of chemistry with inorganic chemistry as a major. The first step is to study the central image (hydrogen gas) and to recollect how it can be connected with the first one. Then, one by one students establish connections or associations.



The answer to this puzzle: This is a sequence of actions (helix) to obtain

hydrogen gas in the laboratory conditions; 1) the starting point of the desired reaction is metallic zinc; 2) it should come in contact with a diluted sulfuric acid; 3) one places granulated zinc into a flask fitted with a two-hole stopper with the one hole to hold 6) a funnel through which the acid is delivered to zinc, and the other – 9) with a gas-exiting tube to collect the gas obtained; 8) the hydrogen gas is collected by displacing water in an inverted test-tube; 7) the gas should be tested by applying a lit candle or a glowing splinter and 6) if the gas in the test-tube is hydrogen, it will ignite making a “squeaky pop” sound.

#### How to create a cross-sense activity?

- First of all, the teacher should formulate the general topic for speaking. It shouldn't be too general as you need to test the acquisition of a newly learnt material.
- Then, think of a central notion and concentrate your attention on the associations you have with it.
- Consider key features of notions and ideas that you would like to bring attention to.

• Write down your ideas and associations and decide if it is going to be a sequence of associate ideas or a set of associations, i.e. what type of solution you choose – a helix or a star. The teacher may also decide not to show the central image, so that the speakers could guess the notion.

- Search and choose appropriate images that will illustrate the ideas.

The cross-sense activity can be used at different stages of the lesson:

- as a warming-up to introduce a new topic which is logically connected with the material studied;
- while studying a new topic in the classroom for developing speaking skills both as an individual work and as a pair or a group work too;
- as a speaking assessment tool at the end of a unit, term, year;
- as a homework for training vocabulary by using key words for the notions and associations with them.

#### **Conclusion.**

As we can see, the production of an oral text in a such task will require both the

knowledge of the subject and a good command of the language itself, so, cross-sense activities can be recommended for students with the level not less than B1. Besides being a good tool for developing speaking skills, this activity proves to meet the requirements of being universal as it can be applied in different spheres of knowledge, logical (developing associative thinking), creative (finding ways of solving the task and promoting creative thinking).

## References

1. Bhati, S. (2012). The effectiveness of oral presentations assessment in a Finance subject: An empirical examination. *Journal of University Teaching and Learning Practice*. 9 (2). Available at: <http://www.ro.uow.au/jutlp.vol9/iss2/6>.
2. Ginther, A. (2013). Assessment of speaking. *The Encyclopedia of Applied Linguistics*. John Wiley and Sons Publ. DOI:10.1002/9781405198431.wbea0882.
3. <https://www.fishersci.no/shop/products/azlon-gas-delivery-tube/p-8002910>
4. <https://www.indiamart.com/proddetail/conical-glass-funnel-13551631191.html>
5. <https://www.indiamart.com/proddetail/dilute-sulfuric-acid-20320185288.html>
6. <https://phasmophobia.fandom.com/wiki/Candle>
7. <https://www.rutland.co.za/products/500967>
8. <https://www.sciencephoto.com/media/482190/view/metal-acid-reaction-hydrogen-collection>
9. <https://slideplayer.com/slide/15524802/93/images/24/Testing+for+hydrogen+POP.jpg>
10. [https://www.thomassci.com/Laboratory-Supplies/Stoppers/\\_Rubber-Stoppers-Two-Holes?q=Two%20Hole%20Rubber%20Stoppers](https://www.thomassci.com/Laboratory-Supplies/Stoppers/_Rubber-Stoppers-Two-Holes?q=Two%20Hole%20Rubber%20Stoppers)
11. <https://utilityanalytics.com/2020/10/the-colors-of-hydrogen-brown-grey-blue-and-green-think-about-it/>
12. Ihda, N.A. (2012). *The Influence of Application Socratic Method with Images Media Towards Student's Creative Thinking Skills*. Surakarta. Program Study Biology-Teacher Training and Education Faculty. Sebelas Maret University.
13. Krossens – igra dlja eruditov [Cross-sense – a game for generalists]. (2002). *Nauka i zhism'*. [Science and life]. – 12, 36 (In Russian).
14. Pereira, J. A., Sanz-Santamaria, S., Perurena, I., Gutierrez, J. (2012). Interactive speaking practice, assessment and exercise sharing with Babelium plug-in. *Theses of 1<sup>st</sup> Moodle Research Conference*. Hetaklion, pp. 107-114.
15. Sinekop, O.S. (2019). Assessment criteria of the studying results of differentiating professional English communication of future IT specialists [Kryteriji otsin'uvann'a rezul'tativ dyferentsijovanoho navchann'a profesijno orientovanoho anhlomovnogo spilkuvann'a majbutnikh IT-fakhivtsiv]. *Foreign languages*. – Inozemni movy, № 3 (99), pp. 3-17. (In Ukrainian). DOI: doi.org/10.32589/1817-8510.2019.3.

## **THE PRACTICAL IMPLEMENTATION OF CLIL PRINCIPLES IN CLASS WITH STUDENTS-ECONOMISTS IN THE PROCESS OF LEARNING FOREIGN LANGUAGES**

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**Анотація. Кривко М.Ю., Сапронова О.Г. Практичне впровадження принципів CLIL на уроці зі студентами-економістами у процесі вивчення іноземних мов.**

У статті розглядається проблема розуміння процесу вивчення англійської мови як інтегрованої частини засвоєння контенту предметів в університетах. Термін CLIL визначено як освітній підхід, що включає ряд моделей, які відрізняються залежно від мети викладання іноземних мов. У статті здійснено аналіз науково-методичної літератури з проблеми впровадження CLIL у навчальний процес вишу. В роботі висвітлено практичне застосування CLIL методів в процесі вивчення англійської мови за допомогою соціальних мереж, застосування знань з інших предметів, передачі досвіду викладача-експерта та культурних аспектів на уроці зі студентами-економістами спеціальностей «Підприємництво, торгівля та біржова діяльність», «Менеджмент маркетингу», «Інформаційний маркетинг, реклама та зв’язки з громадськістю» Харківського національного університету імені В.Н. Каразіна. Автори дійшли висновку, що у випадку, якщо принципи CLIL вводяться в дію на заняттях з іноземної мови на немовних факультетах університету, це підвищує лінгвістичну компетентність студентів. Подальші дослідження будуть присвячені питанню інтеграції методів CLIL у процесі вивчення англійської мови на філософському факультеті Харківського національного університету імені В.Н. Каразіна.

**Ключові слова:** вища школа, економісти, іноземні мови, комплексне навчання за змістом, методи, мовна компетентність, студенти

**Abstract. Kryvko M.Yu., Saprunova O.G. The practical implementation of CLIL principles in class with students – economists in the process of learning foreign languages.**

The article deals with the problem of understanding the process of learning the English language as an integrated part of studying content subjects at universities. The term of CLIL is defined as an educational approach that includes a number of models which differ depending on a goal of foreign languages teaching. The article analyzes the scientific and methodology literature on the problem of the CLIL implementation in the educational process of a higher school. The paper highlights the possible ways of the practical using of CLIL methods in the process of learning the English language using social networks, some knowledge from other subjects, expert-teacher's

experience transferring and cultural aspects in class with students–economists of the specialty «Entrepreneurship, trading and stock exchange activity», «Marketing management», «Informational marketing, advertising and public relations» at V.N. Karazin Kharkiv National University. Authors concluded that if CLIL principles are put into action in non-linguistic faculties of the university, it increases students' linguistic competence. Further researches will be devoted to the issue of CLIL methods integration in the process of learning English in the Faculty of Philosophy in V.N. Karazin Kharkiv National University.

**Key words:** (CLIL) Content-language integrated learning, economists, foreign languages, a higher school, language competence, methods, students

**General formulation of research and its topicality.** Today our society needs specialists with developed professional communicative English language skills for the successful relationship in the globalized environment. Therefore, the primary task for higher educational institutions should be aimed to find effective methods for training young people in accordance with these requirements motivating students to learn English and enrich their vocabulary with a variety of professional words increasing their foreign language confidence.

Thus, understanding the process of learning English as an integrative part of content subjects studying at universities is seen as the only mechanism that results in increasing of students' underlying linguistic competence and language output.

**Setting of the problem.** Therefore, today the problem of the practical implementation of CLIL principles in class with students-economists in the process of learning foreign languages is becoming remarkable in the process of learning foreign languages in universities.

The analysis of science literature let us confirm that certain aspects of this problem were considered by foreign and Ukrainian researchers.

Thus, positive and negative aspects of using integrated lessons in the process of learning English are described by M.V. Nazarova.

Researchers N.V. Baturina, Yu.S. Rukovishnikov, I.V. Batunova studied the role of CLIL for students of non-linguistic specialties in universities within the work capabilities of both content subjects teachers and foreign languages ones as well as

prospects for its implementation in higher professional educational process.

T.A. Baranova, A.M. Kobicheva, E.Yu. Tokareva analyzed the process of studying the discipline «International Business» by students taught due to both CLIL method and a traditional program. Scientists proved experimentally that the widespread use of CLIL educational technology leads to students' competence development in a foreign language during the process of mastering a professional discipline confirming its effectiveness and the need to use modern educational programs.

D. Coyle gives a comprehensive overview of CLIL summarising the theory which underpins a content subject teaching through another language and discusses its practical application outlining the key directions for the research and practice development.

Researchers E.V. Kartseva, A.A. Flaksman considered the need to use technologies of subject-language integrated learning along with the methodology of teaching a foreign language for professional purposes within the discipline «Foreign language in a professional activity».

Despite a number of works that described this issue in some aspects, the problem of the practical implementation of CLIL principles in class with students-economists in the process of teaching foreign languages has not been the subject of special research yet.

So, the topicality of this problem, its insufficient practical development led the authors to the choice of research topic «The practical implementation of CLIL principles in class with students -economists in the process of learning foreign languages».

The topic of the article is an integrated part of the work of the Department of English Language and the Department of Business Foreign English and Translation of V.N. Karazin Kharkiv National University.

**The subject** of the research is CLIL (Content-language integrated learning). **The object** of the research is the practical implementation of CLIL principles in class with students – economists in the process of learning foreign languages.

**The aim of the article.** The aim of our work is theoretically substantiate the practical implementation of CLIL principles in class with students - economists in the process of learning foreign languages at universities.

**Research tasks:**

1. To define the term «CLIL».
2. The analyze of studying the problem of the implementation of CLIL principles in educational process in higher schools.
3. To highlight the possible ways of the practical implementation of CLIL principles in in class with students-economists of V.N. Karazin Kharkiv National University in the process of learning foreign languages.

**Discussion and Results.** We agree with scientist E. Samoylova who thinks that the current requirements for future specialist training include mastering a certain specialty or proficiency in one or more foreign languages at a high professional level [4, URL].

Researches show that today subject-language integrated learning in many European countries is used in two subjects which are studied through CLIL (Content-language integrated learning).

The term CLIL was introduced into science by David Marsh in 1994 to denote academic disciplines or their individual sections taught in a foreign language. According to D. Marsh, CLIL is an educational approach that includes a number of models which differ depending on the goal of foreign language learning. In other words, CLIL is a series of educational technologies which share common basic principles (*content, communication, cognition, culture / citizenship*) but they are different in a way in which a foreign language is introduced to a special discipline [2, p.1].

It should be noted, that this method has appeared in the Ukrainian system of higher education recently, but it has already been included into the curricula of leading universities. The CLIL method is seen as one of the effective ways to develop interdisciplinary ties and allows educational institutions to modernize their training system.

According to CLIL researchers O.N. Burdakova, A.A. Jalalova and N.P. Raud, three teaching models within the CLIL methodology is distinguished: 1) multilingual teaching; 2) auxiliary / subject and language additional integrated teaching; 3) subject courses with the language support [1, URL].

Thus, CLIL is focused on both subject content and language material. N.V. Popova, M.S. Kogan and E.K. Vdovin note that teaching English for professional purposes contains 20% of subject content and 80% of language content, but CLIL - more than half of subject content with less language one. The combination of English for professional purposes and CLIL is, in our opinion, an optimal variant for teaching a foreign language at a university [1, URL].

The ability for self-education, mastering innovative technologies and realizing prospects and opportunities for their use, the adaptability to new social and professional conditions, teamwork skills are competencies that Content-Language Integrated Learning forms during the educational process in a higher school [3, URL].

**The practical implementation of CLIL principles in class with students – economists in the process of learning English at V.N. Karazin Kharkiv National University:**

- 1) using social networks;
- 2) a cultural aspect;
- 3) transferring an expert-teacher's experience;
- 4) using knowledge from other subjects.

Firstly, the lecturer M. Ju. Kryvko created two groups of students-economists in Facebook where they posted on Economics or about themselves. Besides that, students were asked to write essays on the topics they were learning at that moment but after putting their works on Facebook it was found out more emotionally: some visual material was selected, moreover, many of students did it stylishly and beautifully developing their creativeness.

Thus, we can say that this approach in an educational process realizes person's talents, self-expression or self-affirmation through learning the English language.

Furthermore, assessments for all posts were student's oral answers in class. It was a kind of retelling the content information giving in their reports. Sometimes students preferred to express main ideas with their own words. Also, after presenting their posts they had a dispute asking or answering questions on the theme studied by them and expressed their personal opinions and attitude. At the end they tried to sum up results.

So, we think that doing such kinds of oral exercises helps to develop person's communicative skills and a spontaneous reaction in any linguistic situation.

Secondly, students-economists of the specialty «Entrepreneurship, trading and stock exchange activity», «Marketing management», «Informational marketing, advertising and public relations» carried out an experiment paying their attention to the cultural aspect in CLIL. For example, they were asked to share their ideas in English in posts on Facebook. Topics were different: about places of interest in Kharkiv or their hometowns.

It should be noted, that about 80% of students in groups is from other regions of Ukraine: Lugansk, Donetsk, Poltava, Kryvyi Rih, Kherson and others. So, everyone put posts with beautiful photographs of their small towns and highlighted that information proudly. After that, they gave talks about their cultural environment including historical elements of their native land and identified themselves with the significant information about that area. This way, it was a piece of their small hometowns promotion.

Thus, we can see the maximum of content personalization in this activity. We think that person's emotional attitude occurs at all stages of doing this kind of task from writing to putting it on social networks, from giving a talk to a presentation.

Thirdly, having some experience in the entrepreneurship activity or the legal and accounting support of business, the teacher can help her students to discuss how these activities are realized in practice: what is the registration of an entrepreneur or a company, what is a legal entity and what way it differs from a physical person. Business psychology or decision-making one, for example, the topic «Consumption and its stimulation» are discussed, too. So, students of the specialty

«Entrepreneurship, trading and stock exchange activity», «Informational marketing, advertising and public relations» showed themselves like future businessmen taking or analyzing all information through a prism of their future business.

Therefore, we gave assignments on economic topics in the light of their practical application. For example, while studying abbreviations in English, the terms of the Incoterms (International Commercial Terms) system can be learnt better if its meaning, history, using in contracts are found out from the Internet. Students were given a task to draw up a fragment of a contract using these Incoterms.

Finally, while discussing different topics on Economics in class, students use information and knowledge gained in other subjects sharing their ideas in English. This interaction of disciplines also enriches their vocabulary and teaches how to integrate received knowledge.

**Conclusion:** So, today the priority in foreign language learning at universities is the enrichment of students' professional vocabulary developing their communicative skills.

Thus, the use of the social network, the cultural aspect, the expert-teacher's experience with the use of the knowledge from other subjects help CLIL principles to be put into action in class in non-linguistic faculties of the university increasing students' linguistic competence and foreign language output. It is important to note that within the framework of subject-language integrated learning, additional hours are not required to teach the language, because it is learnt in the process of studying a special discipline.

The study of the problem of the CLIL implementation in the process of learning foreign languages in the educational process of the university has broad prospects, because this issue remains topical in modern scientific and pedagogical discourse. Further research will be devoted to the question of CLIL methods integration in the process of learning English in the Faculty of Philosophy of V.N. Karazin Kharkiv National University.

## **References**

1. Burdakova O. N. (2011). Metody`ka y`ntegray`rovannogo`ya y` yazыku v uchebnom processe

Narvskogo kolledzh TU [Methods of integ o predmetu bucheny rated discipline and language teaching in classes of Narva College of the University of Tartu]. Available at: <http://docplayer.ru/42474789-Metodika-integrirovannogo-obucheniya-predmetu-i-yazyku-v-uchebnom-processe-narvskogo-kolledzha-tu.html>. 2. Соуле Д. (2010). СЛІЛ: Сонтент анд Лангуаге Інтегратед Леарнінг. [CLIL: Content and Language Integrated Learning]. *Самбридже Універсітет Пресс*, 182 п. 3. Ly`tvysko O. M. (2015). Kompetentnostno-ory`enty`rovannaya model` obuchenya: preymushhestva metody`ky` CLIL v prepodavany`y` professy`onal`no-ory`enty`rovannogo angly`jskogo yazyka [Competent oriented teaching model: advantages of CLIL teaching methods in professionally oriented English language]. Available at: [https://www.pglu.ru/upload/iblock/b86/litvishko-o.m.\\_-chernousova-yu.a.\\_-kompetentnostno\\_orientirovannya-model---v\\_.pdf](https://www.pglu.ru/upload/iblock/b86/litvishko-o.m._-chernousova-yu.a._-kompetentnostno_orientirovannya-model---v_.pdf). 4. Samojlova E. V. (2014). Aktual`nye problemy y` perspektiv`y prepodavany`ya y`nostrannogo yazyka studentam neyazykovykh specy`al`nostej vuzov v ramkakh y`ntegry`rovannogo podxoda [Topical problems and teaching prospect of foreign language for non-linguistic university students in the network of the integrated approach]. Available at: [https://cyberleninka.ru/article/n/aktualnye-problemy-i-perspektivy-prepodavaniy-inostrannogo-yazyka-studentam-neyazykovyh-spetsialnostey-vuzov-v\\_ramkah/viewer](https://cyberleninka.ru/article/n/aktualnye-problemy-i-perspektivy-prepodavaniy-inostrannogo-yazyka-studentam-neyazykovyh-spetsialnostey-vuzov-v_ramkah/viewer)

УДК 811.111:378.147.091.33

## **CLIL ELEMENTS AND INSTRUMENTS FOR TEACHING NON-LINGUISTIC STUDENTS**

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**Анотація. Лешньова Н.О., Павлова Л.В., Сергеєва О.А. Елементи і інструменти CLIL для навчання студентів немовних факультетів.**

Стаття присвячена розгляду інструментів реалізації технології CLIL під час навчання іноземної мови студентів нелінгвістичних спеціальностей вищих навчальних закладів. У статті розглянуті основні аспекти методології, принципи та інструменти використання предметно - мовного інтегрованого навчання в умовах обмеженої кількості учбових годин, відведених для занять з англійської мови на немовних факультетах. Використання нових інструментів навчання студентів немовних напрямів, їх розуміння професійно-орієнтованих текстів, вільне спілкування на фахову тематику є досить актуальним тому, що розвиток міждисциплінарних зв'язків, а саме, поєднання навчання іноземної мови з підготовкою до майбутньої професійної діяльності, виявляється значимим з точки зору конкурентоспроможності майбутнього фахівця. Застосування елементів предметно-мовного

інтегрованого навчання (CLIL) та розвиток інструментів реалізації даної методики допомагає підготувати майбутнього фахівця до іншомовного професійного спілкування. Дослідження результатів впровадження елементів методики CLIL показує, що ефективність підходу до вирішення багатьох поставлених завдань з підготовки студентів очевидна, при цьому треба зосередитись на пошуку відповідних інструментів для оптимального впровадження методів CLIL. Важливо розглянути специфічні особливості використання цього підходу в умовах сучасного українського закладу вищої освіти та спробувати проаналізувати як позитивні, так і негативні його наслідки. Перед сучасною українською вищою школою постає завдання підготовити конкурентоспроможних фахівців, які в умовах глобалізації достатньо оволодіють навичками іншомовного спілкування у своїй професійній діяльності. Студенти технічних спеціальностей усвідомлюють значення іноземної мови для своєї роботи, та подальшої кар'єри. Тому так необхідно застосування викладачами таких технологій навчання, які дозволяють їх студентам більш ефективно використовувати час, відведений на засвоєння іноземної мови. У статті також розглядаються проблеми, які можуть з'явитися в процесі інтегрованого навчання.

**Ключові слова:** Змістовне та мовне інтегроване навчання, когнітивні потреби, модель навчання, часткове занурення

**Abstract. Leishnova N.O., Pavlova L.V., Serheieva O.A. CLIL elements and instruments for teaching non-linguistic students.**

The article deals with the elements and tools of CLIL technology implementation in foreign language teaching of students of non-linguistic specialties of higher educational institutions. The main aspects of the methodology, principles and tools for the application of subject-language integrated learning under the conditions of a limited number of teaching hours devoted to English classes are considered.

The use of new tools for training students at non-linguistic schools, their ability to understand professionally oriented texts, communicate freely on professional topics is quite relevant as the development of interdisciplinary links, namely, combining foreign language learning with preparation for future professional activities, is important in terms of a future specialist's competitiveness.

The application of subject-language integrated learning (CLIL) elements and the development of tools for the implementation of this technique helps to prepare future professionals for foreign language professional communication. Studying the results of the implementation of the CLIL elements has shown that the effectiveness of this approach in dealing with numerous issues of training students is obvious, and it is necessary to focus on finding appropriate tools for the optimal implementation of CLIL methods. It is essential to take into account the peculiarities of using this

approach in a modern Ukrainian institution of higher education and try to analyze both its positive and negative consequences. Ukrainian higher education has a task to train competitive specialists who, in the conditions of globalization, will sufficiently master the skills of foreign language communication in the field of their professional activity. Technical students are aware of the importance of a foreign language for their work and future careers. Therefore, it is necessary for teachers to apply such learning technologies that will enable their students to make use of the time spent on a foreign language learning more effectively. The problems that may arise in the process of integrated learning are also discussed in the article.

**Key words:** Content and language integrated learning, cognitive needs, partial immersion, teaching model

### **General formulation of research and its topicality.**

Currently, one of the priority tasks of higher education in Ukraine is the tuition of a highly qualified specialist who can effectively compete in the labor market. Creating conditions for the further actualization of the acquired knowledge throughout the entire professional life is seen as an important issue. Today, due to the global processes taking place in society, new professions are constantly appearing and old ones disappear. Therefore, it is important for an educational organization to prepare a graduate who is able to withstand these changes and be ready for continuous learning and self-education.

### **Setting of the problem and the aim of the article.**

As the overwhelming majority of advanced scientific research is written in English, students at non-linguistic universities should have access to world knowledge bases, as well as the ability to exchange the information received in their professional environment. Thus the formation of professional foreign language competence has become vital. It is obvious that to achieve new results new teaching methods should be used. Consequently, novel ways and approaches to effective training future specialists must be developed.

### **Discussion and results.**

A term “Content and language integrated learning” (CLIL) was first proposed by a foreign scientist D. Marsh in 1994 [4]. At first, it meant teaching certain

disciplines in a foreign language. In 2001, the methodology has been modernized and explained by D. Marsh as the study of a foreign language as a tool for studying other subjects [5]. Nowadays it is this idea that distinguishes this approach from many others.

K. Bentley describes CLIL as an evolving educational approach to teaching and learning, in which subjects are taught through a non-native language [1]. K. Bentley is a course on CLIL for those ones who want to work as a CLIL teacher.

However, in spite of the obvious advantages of CLIL, there are definitely several characteristic problems associated with its implementation. They concern the whole structure of the educational institution, which does not imply binary learning, the joint development of work programs by teachers from different departments and collective teaching. Choosing the proper type for the integration of a foreign language and subject disciplines, which would ideally fit a particular higher educational institution, taking into account all its features, and at the same time would not require serious organizational changes seems to be rather difficult.

Three CLIL types were specified as the basic ones in the work of K. Bentley [1] depending on the duration and number of CLIL lessons in the program: partial immersion (about half of the lessons from the program), modular model (15 hours per semester) and lessons with emphasis on the tongue (45 minutes per week). : 1. The "Soft" type is a language-focused teaching model, delivered on a regular basis once a week, with a duration of approximately 45 minutes. At the same time, within the framework of a language course conducted by a linguist teacher, some topics of the subject discipline are studied. 2. "Modular" type is a teaching model with an emphasis on the study of a subject discipline, carried out on a regular basis in the amount of at least 15 hours per semester. In this case, the linguistic teacher or subject teacher selects the sections of the subject discipline taught in a foreign language. 3."Strong" (Hard) type which is a partial immersion model with an emphasis on the study of a subject discipline, occupies about 50% of the curriculum, that is, half of the disciplines are taught in a foreign language. In this case, the content can duplicate what was taught in the native language or be completely new.

Particular attention should be paid to the development and creation of textbooks based on CLIL taking into account some aspects, namely: the topics covered should correspond to the level of training students; to activate previously acquired knowledge [3].

The training materials must be authentic and meaningful; they must offer a good choice of information sources. It should also be emphasized that the level of complexity of the texts should not exceed the level of students' language training. Various interactive materials can serve as a basis for creating an increased cognitive load. Various videos and flash animations, audio podcasts, web quests and other materials can be chosen for developing students' competence. Based on the phenomenon that is to be studied, discussions should be held regularly to let students demonstrate their attitude to the materials under consideration. Such discussions greatly improve communicative skills of their participants and also pursue a dual purpose - the development of language skills based on subject-oriented topics for discussion. Soft CLIL seems to be more appropriate for teaching students at the School of Radiophysics since it assumes the study of some topics of the subject discipline within the framework of a language course conducted by a linguist teacher. It is also obvious that not every linguist teacher will be able to lecture on an entire course on a subject discipline in a foreign language. And the "soft" CLIL model allows the teachers to do this in small volumes, while keeping the focus on a foreign language.

Researchers believe that the characteristic elements for subject-based integrated learning classes are: 1. Content – to stimulate the process of learning and developing skills both in English and in the students' professional field. It is obvious that for successful CLIL approach realization, students' skills and abilities which are connected with their professional training must be taken into account. 2. Communication – to teach students to use means of a foreign language to gain knowledge of other subjects. 3. Cognition – to develop students' thinking skills for a better understanding of language and subject. 4. Culture – culturological knowledge. Understanding the features of individual cultures will help students socialize more

effectively in the modern multicultural society, better understand their own culture and stimulate its preservation and development [6].

The culture of speech should be developed paying attention to the cultural characteristics of the country of the target language, and it should contribute to socialization in the multicultural environment [2].

We believe that a foreign language is to be used at the lesson as a source for obtaining and developing professional knowledge. Teachers must be constantly aware of the interdisciplinary connections and include them in all 4 aspects of training at a foreign language lesson, namely, listening, reading, speaking and writing.

Particular attention in CLIL-based English teaching should be given to motivating students who value the opportunity to learn new things without thinking about the language. We have developed pedagogical support of subject teaching in a foreign language. The teachers of the English language department got acquainted with the work programs on other disciplines, on the basis of which the corresponding professionally-oriented materials for students were selected.

CLIL approach does not imply the strict use of language material as opposed to a foreign language, so it is the teacher who selects the most appropriate language tools which are able to implement the content of the classes. The choice of exercises offered to students must be made on the basis of the benefits the students can obtain. When we begin to work on a new text, we give a vocabulary exercise when students match the English words with their Ukrainian equivalents. Reading texts students are asked to fill in the gaps with the given words. After reading a text on the given professional topic a TRUE/False exercise may be given. Students are supposed to read the corresponding statements and react saying if they are true or false and give reasons. When the group gets acquainted with a new topic a speaking exercise can be done. Students are divided in groups of four. Each student in the group has got some information which other students do not have. Students should complete all the gaps in the text by asking other group members questions. Finally the teacher can control if the students have mastered the new material asking questions. We also consider that holding “round tables” and conferences for students can be motivating enough

and intensify the process of acquiring new knowledge.

The study of professional vocabulary should be emphasized. Sometimes we ask students to learn the definitions of the terms they need for understanding some professional aspects. When studying professionally significant topics and problems in a foreign language, and participating in discussions, students' interest in the subject increases significantly. Students' satisfaction with their achievements is a special aspect of this methodology. They learn in practice to use a foreign language for professional communication. There is also noticeable progress in overcoming the language barrier. Students stop worrying about grammar mistakes and focus on the professional problems.

For the formation of the communicative competence of students of non-linguistic specialties, it is important to provide them with the opportunity to think in a foreign language. In this case language serves to formulate ideas.

Reading texts in a foreign language is another important step. Since English is not a priority for students of technical specialties, the purpose of reading for them is the information itself, contained in the texts with which they deal in the classroom. That is why these texts must be carefully chosen to meet CLIL requirements.

**Conclusion.** CLIL approach is considered to be a good method for stimulating the educational and cognitive abilities of students, increases motivation as the main mechanism for activating the process of teaching a foreign language at non-linguistic schools of universities. This method has been shown to focus students' attention on interesting and meaningful materials. Professionally - oriented topics meet the cognitive needs of students and provide the active acquisition of new data. The teachers of a foreign language must work hard on developing new tools to provide an effective CLIL application.

## References

1. Bentley K. The TKT Course: CLIL Module. – Cambridge: Cambridge University Press, 2010. – 124 p.
2. Gladyshev M.O. Vykladannya social`no-pedagogichny`x dy`scy`plin za metody`koyu integraty`vnogo navchannya. Visnyk Zaporizkogo nacional`nogo universytetu. Pedagogichni nauky`. 2017 №2 (29) s.45-48
3. Kyrychenko T.O., Rygel` T.M. Navchannya inozemnoyi movy` studentiv ekonomichny`x special`nostej z vykorystannyam clil texnologiyi. Innovacijna

pedagogika 2020 № 24, t.1 s.76-79. — URL:  
[http://www.innovpedagogy.od.ua/archives/2020/24/part\\_1/16.pdf](http://www.innovpedagogy.od.ua/archives/2020/24/part_1/16.pdf) 4. Marsh D. Bilingual Education & Content and Language Integrated Learning. – Paris: International Association for Cross-cultural Communication, Language Teaching in the Member States of the European Union (Lingua), University of Sorbonne, 1994. – P. 49. 5. Marsh D., Maljers A., Hartiala A. K. Profiling European CLIL Classrooms. – Languages Open Doors. Jyväskylä: University of Jyväskylä, 2001. – P. 15–55. 6. Yefendiyeva S.M. Stanovleniya ta rozvytok innovacijnyx metodiv navchannya v suchasnj osviti. VDNZ Ukrayiny «Ukrayins'ka medy'chna stomatologichna akademiya» 2016. — URL: [http://elib.umsa.edu.ua/bitstream/umsa/6261/1/Stanovlenia\\_ta\\_rozvytok\\_innovatsiynykh\\_metodiv.pdf](http://elib.umsa.edu.ua/bitstream/umsa/6261/1/Stanovlenia_ta_rozvytok_innovatsiynykh_metodiv.pdf)

УДК 378.048.2

## THE CLIL METHOD OF TEACHING

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### **Анотація. Савченко Н.М. Метод викладання CLIL.**

Стаття має за мету розглянути роль предметно-мовного інтегрованого навчання студентів немовних спеціальностей у вищих навчальних закладах. У статті представлені моделі та особливості використання методології CLIL у вищій школі. У статті проаналізовано методологію та основні особливості технології CLIL в цілому; також зазначено, що CLIL технологія є одним із можливих методів, спрямованих на підготовку фахівців, на яких вимагає сучасне суспільство.

Технологія CLIL є надзвичайно актуальною, оскільки вона інтегрує викладання контенту навчальної програми з викладанням мови, яка не є рідною. Комплексне навчання покращує міждисциплінарні зв'язки, посилює мотивацію до вивчення іноземної мови, розвиває пізнавальні та практичні навички.

Сучасна соціальна, політична та економічна ситуація вимагає впровадження інтегрованих підходів до системи вищої освіти з метою підготовки майбутніх фахівців, здатних до інтелектуальної гнучкості та комплексного вирішення завдань. У статті також висвітлені труднощі та проблеми, які можуть виникнути у викладачів, які дотримуються цієї технології.

**Ключові слова:** CLIL, інтеграція, метод, прийоми, міждисциплінарні зв'язки

**Abstract. Savchenko N.M. The CLIL method of teaching.**

*The article aims to consider the role of the subject-language integrated teaching of students*

*of non-language specialities in higher educational institutions. Models and peculiarities of using CLIL methodology in higher educational institutions are provided in the article. The paper analyzes methodology and core features of the CLIL technology in general; points out that the CLIL technology is one of the possible methods aimed at training the specialists the modern society calls for.*

The CLIL technology is highly *actual* as it integrates the teaching of content from the curriculum with the teaching of a non-native language. Integrated learning improves interdisciplinary connections, intensifies motivation to study a foreign language, develops cognitive and practical skills.

Current social, political and economic background demands introducing integrated approaches to the higher education system in order to train future specialists capable of intellectual flexibility and integrated task solution. The article also highlights the difficulties and problems the academic staff may experience while following this technology.

**Keywords:** CLIL, integration, method, techniques, interdisciplinary connections

New globalized societies put novel pressures on education to prepare students to function across multilingual globalized spaces.

The language teaching methodology is always in search of new methods which will reinforce the learning process, involve students more in the context, make the learning more meaningful and content based. It seems that all these areas may be covered due to the integration of **CLIL** which is still in infancy in terms of its principles, strategies, teaching techniques and the actual working material but is of wide appeal.

**THE TOPICALITY** of the article is that **CLIL** is highly *actual* in the world as it *integrates* the teaching of content from the curriculum with the teaching of a non-native language. Modern requirements for the training of a future specialist in a higher education institution include not only the development of a number of specific competencies, but also the mastering of one or more foreign languages at a high professional level.

The term CLIL is introduced as subject-linguistic integrated learning, the content of which focuses on two subjects [4]. Within this approach, the content is system forming; it defines the subject of learning, the purpose, the task, that is, the set

of theoretical knowledge and skills. Bilingual educational contexts provide potentially rich learning environments which – if they are to realize this potential – will demand new ways of developing shared reciprocity around teacher–learner pedagogic understanding [5]. With regard to the content of CLIL, the scope of the subject and linguistic content can vary in one way or another, creating content-led and language-led models. When designing a course based on the CLIL method, a person must take into account 4 Cs: “Content –development and acquisition of new knowledge, skills, subject area skills; Communication –learning to use the language to acquire knowledge; Cognition –development of cognitive and mental abilities, solving problem situations; Culture –identification of a part of culture, with the awareness of the existence of an alternative culture, that is, the path to intercultural understanding” [1; P. 68-70].

The first model is considered as teacher-based learning with extensive English language medium instructions using active students’ involvement into pair or group work. The second model is teacher-based learning with partial English medium instructions with limited students’ involvement. There is an equal division of language amount during the process of teaching. This model is also subdivided into two types: single and dual-focused with a lot of switching between two languages. The third model is teacher-based instruction with limited English medium instruction. Native language dominates over English and there is a lot of switching. The subdivision into types is the same as in the previous two models. The fourth model combined learning model with specific English medium instruction. Both languages are used in the learning process [3].

Despite the large number of advantages of implementing these methods into the educational process, there are a number of problems. One of the main problems is the lack of sufficient knowledge of foreign language teachers, and vice versa, the bad knowledge of a foreign language by subject teachers. So, for the implementation of such programs in universities, highly qualified teachers are required who are able to give lectures and conduct practical classes and seminars at least in two languages.

Thus, the question of teacher training is massive and complex. It must be

understood that this type of training does not happen overnight. It is a long process. The most efficient approach, if neither the speediest nor cheapest, may be to train a group of teachers who then teach in real classrooms for two years while attending monthly meetings to reflect on problems and successes, and who then participate in a “train the trainers” course in which they learn how to train other teachers using a “cascade” model, thereby disseminating the methodology as widely as possible [2].

It is also necessary to mention the problem of the curriculum development and preparation of educational material that would satisfy the needs of students. It is also necessary to understand the fact that learning through a foreign language can aggravate the process of mastering the subject.

Moreover, students’ poor knowledge of foreign languages can be another problem, which leads to an increase in students’ workload, as well as to a number of psychological problems connected with learning some material in a foreign language [3].

Nevertheless, CLIL can be a motivating force for both teachers and students, but it is important that the training is planned in a controlled and positive manner if it is to be implemented successfully [2].

So, CLIL is a fantastic method to empower students of all ages and levels of fluency. Due to CLIL lessons, students obtain the tools to grow, they acquire and activate cross-disciplinary skills by using a language different from their own. It’s also a great method to promote positive attitudes towards language learning from an early stage. Students won’t be corrected on every single error they make. Instead, they’ll be encouraged to keep talking and learning in the language, which lets them feel good about their ability to communicate from the get-go.

### **Conclusions.**

CLIL is a powerful tool that has many benefits, including increased motivation for learning and cognitive development. It is necessary to introduce this methodology in the educational process of universities. That’s because the CLIL curriculum balances bilingual education and language learning. Rather than being the focus of teaching, language becomes a tool for communication. Repeated exposure and

stimulation helps students to assimilate the language while learning content that will greatly expand their horizons and promote curiosity. For this purpose, universities need to conduct training for teachers and students, increase the level of foreign language proficiency of students and teachers, and encourage the use of information and communication technologies for classes.

## References

1. Coyle D., Hood Ph., March D. CLIL: Content and Language Integrated Learning. Cambridge, Cambridge University Press, 2010. – 170 p.
2. Coyle, D. (2006). Content and language integrated learning: Motivating learners and teachers. *Scottish Languages Review*, 13, 1-18. Available at: <http://blocs.xtec.cat/clilpractiques1/files/2008/11/slrc Doyle.pdf>
3. Kuzminska N., Stavytska I., Lukianenko V., Lygina O. (2017). Application of CLIL methodology in teaching economic disciplines at University Available at: <file:///C:/Users/A4F7~1/AppData/Local/Temp/167150-367871-1-PB.pdf>
4. Marsh D. *Content and Language Integrated Learning (CLIL). A Development Trajectory*. Available at: <http://www.includenetwork.eu/> DOCUMENTS/36\_CLIL\_A\_DEVELOPMENT.pdf.
5. Ruiz de Zarobe, Yo. & Coyle, D. (2015). Towards new learning partnerships in bilingual educational contexts: raising learner awareness and creating conditions for reciprocity and pedagogic attention. *International Journal of Multilingualism*, 12(4), 471–493. Available at: <https://doi.org/10.1080/14790718.2015.1071020>.

УДК 811.111

## DEVELOPING SEL AS A DIMENSION OF SPEAKING SKILL ENHANCEMENT: A CLIL PERSPECTIVE

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**Анотація. Шамаєва Ю.Ю., Пешкова О.Г. Розвинення навичок соціально-емоційного навчання як вимір вдосконалення мовленнєвих навичок: аспект предметно-мовного інтегрованого навчання.**

Стаття присвячена розгляду питання розвинення навичок мовлення при навчанні англійській мові як іноземній у скопусі розвинення соціально-емоційної царини у термінах предметно-мовного інтегрованого навчання. В результаті проведеної розвідки виявлено ключові характеристики зазначених парадигм, що є специфічними саме при навчанні іноземним мовам. На методологічному підґрунті антропоцентричного лінгводидактичного мейнстриму розроблено кластер видів діяльності, орієнтованих на розвинення соціально-

емоційних компетентностей через вдосконалення навичок мовлення в освітньому середовищі предметно-мовного інтегрованого навчання. Через вдосконалення навичок мовлення англійською запропоновано шляхи формування та розвинення таких навичок ХХІ століття, як аналітичне мислення і інноваційність, активне навчання і стратегії навчання, комплексне розв'язання проблем, критичне мислення і аналіз, креативність, оригінальність та ініціативність, лідерство і соціальна включеність (впливовість), технології: використання, моніторинг і контроль, технології: розробка і програмування; життєздатність, стресостійкість і гнучкість; обґрунтування, розв'язання проблем і формування ідей. Експериментально доведено ефективність розробленої системи стратегій, що інтегрує у собі аспекти соціально-емоційного та предметно-мовного інтегрованого навчання.

**Ключові слова:** англійська мова, лінгводидактика, соціально-емоційне навчання, предметно-мовне інтегроване навчання, мовлення

**Abstract. Shamaieva Iu.Iu., Pieshkova O.G. Developing SEL as a dimension of speaking skill enhancement: a CLIL perspective.**

The article focuses on considering the issue of developing speaking skills within the framework of teaching English as a foreign or a second language in the scope of enhancing the social-emotional learning dimension in terms of content-language integrated learning. As a result of the study conducted the authors have revealed the most distinctive characteristics of the above-mentioned paradigms that have proved to be peculiar specifically for the process of teaching foreign languages. On the comprehensive methodological basis of the anthropocentric linguodidactic mainstream there has been a cluster of activities oriented at developing social-emotional competences through improving speaking skills in the academic environment of content-language integrated learning designed. On the basis of enhancing English language speaking skills the authors have experientially outlined ways of forming and developing such key skills of the twenty-first century as critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy, flexibility, leadership, initiative, productivity, social skills. The research theoretical and practical outcomes have confirmed the TEFL/TESOL efficiency of the developed system of strategies which integrates major aspects of social-emotional and content-language integrated learning approaches.

**Key words:** content-language integrated learning, English, linguodidactics, social-emotional learning, speaking

**General formulation of research and its topicality.** At present all learners need and deserve twenty-first century learning opportunities to thrive as leaders,

workers, and citizens of tomorrow. Learning, especially foreign languages acquisition, takes place throughout life in many places and spaces of both academic and non-academic nature. From birth through their careers, learners need a broad range of experiences that develop their skills, dispositions and abilities to succeed. In this connection, the challenge globally facing educational leaders today and constituting the focus essence of our work is the necessity to reconcile the two currently most actual frameworks of the Partnership for 21<sup>st</sup> Century Learning with a special emphasis on CLIL (Content and Language Integrated Learning) methodology and the Every Student Succeeds Act (ESSA), holding SEL(Social Emotional Learning) as its major priority, through developing learners' speaking skills, which explicates the topicality of our research. It is even more obvious if we consider the fact that these both perspectives cite the need to infuse academic skills and foreign language knowledge with the paramount importance of non-academic skills in diverse communication environments, making the future of work and civic life depend upon it.

**Setting of the problem and the aim of the article.** Nowadays sitting atop the three fundamental school and university outcomes of experience, knowledge and skills pathways is such a universal requirement for learners to succeed in life as Collaborative for Academic, Social, and Emotional Content and Language Integrated Learning. According to E. Allensworth and H. Hart [1], within this framework the key principles are the following: 1) to drive research conducted in foreign (in the majority of cases, in English) languages, advancing the knowledge base about CLIL and SEL by synthesizing, conducting, and commissioning research activities; 2) to guide practice in the ecology of a foreign language, translating research into action through partnerships and field-tested resources and tools<sup>4</sup> 3) to inform policy, supporting and developing CLIL and SEL policies and guidelines by means of educating policymakers about their value; 4) to convene networks, bringing together experts, practitioners, and policymakers to accelerate and sustain CLIL integrated with SEL in communities nationwide. All this has predetermined the aim of our work which consists in developing a comprehensive system of TEFL/TESOL strategies to

enhance university learners speaking skills within the scope of CLIL and SEL blended methodological mainstream.

**Discussion and Results.** Today it is universally acknowledged that foreign language educators' mission is definitely to help make evidence based social and emotional content and language integrated learning an inalienable component of language education from preschool through high school in life-long terms, which is critical at a time when educators, parents, students and employers increasingly recognize the value of emotional intelligence as an instrument of educating the whole person, equipping learners for success both in educational establishments and in life [2; 4]. To implement this there is a necessity to design a novel advanced age and culture responsive complex of educating -through-language activities to foster social, emotional, cognitive, verbal and cultural dimensions of linguodidactics for learners to prosper in life versatility.

In the present paper we offer a glimpse of our unique recently developed and experimentally pilot-tested pack of CLIL speaking activities aimed at improving SEL competencies that we regard as an embodiment of 21st Century skills – 12 abilities that today's students need to succeed in their careers during the Information Age. The outcome of our work is based on the results of an extensive relevant field literature analysis, resulting in a hypothetical assumption that SEL competencies (via CASEL) and their constituent elements and the skills enumerated in the P21 framework are very similar and need enhancing through strengthening learners' speaking skills in the format of CLIL.

Having mapped the 21st Century skills to SEL competences, we have come up with the following results. Such P21 skills as Personal Responsibility, Accountability, Self-Direction and Personal Productivity can be coupled and taught together in CLIL terms with the SEL competence Self-management as the ability to successfully regulate one's emotions, thoughts, and behaviors in different situations – effectively managing stress, controlling impulses, and motivating oneself. P21 social and cross-cultural skills go together with social awareness as the ability to take the perspective of and empathize with others, including those from diverse backgrounds and cultures,

which implies the ability to understand social and ethical norms for behavior and to recognize family, school, and community resources and supports. People skills, collaboration and communication can be mastered simultaneously with the SEL relationship competence as the ability to establish and maintain healthy and rewarding relationships with diverse individuals and groups, the ability to communicate clearly, listen well, cooperate with others, resist inappropriate social pressure, negotiate conflict constructively, and seek and offer help when needed. Ethics, social responsibility and critical thinking can be developed alongside with SEL responsible decision-making, standing for the ability to make constructive choices about personal behavior and social interactions based on ethical standards, safety concerns, and social norms [3], which also presupposes realistic evaluation of the consequences of various actions, and a consideration of the well-being of oneself and others.

There turns out to be just one SEL competence left unmatched, requiring developing individually. In our research it is self-awareness as the ability to accurately recognize one's own emotions, thoughts, and values and how they influence behavior. The ability to accurately assess one's strengths and limitations, with a well-grounded sense of confidence, optimism, and a "growth mindset." On the basis of our CLIL experience, the evolution of this competence presupposes developing the skills of identifying emotions, of accurate self-perception, of recognizing strengths, building self-confidence, construing self-efficacy.

Bearing in mind that virtually all the P21 skills fit neatly into the SEL competency framework and SEL take place while teaching and learning through CLIL communication at various stages, the benefits of the speaking skills development SEL and CLIL strategies as TEFL/TESOL activities to be implemented at any point in class, both off- and online, become obvious and welcoming to follow.

For example, to teach self-awareness while developing speaking skills in English within the framework of CLIL paradigm there are mindfulness verbal meditations, developing students' abilities to focus on the present and accept one's circumstances, at the same time reducing stress and anxiety. WE have also tried

combining verbal meditations with breathing exercises to help learners develop mindfulness without overextending their attention span.

For that matter, reflective speaking has proved to be advantageous as it not only assists students in developing self-awareness but empathy and compassion. You can start each day by letting students three to seven minutes to speak freely about a prompt that encourages self-reflection, and by practicing reflective speaking on a daily basis, students learn how to consider their thoughts and feelings in a self-aware way. Together with this, creating vocabulary lists of emotions is a valuable contribution into broadening learners' emotional understanding.

To develop self-management in a CLIL environment, we have introduced grounding techniques as a stress management exercise to orient someone in the present when they are emotionally overwhelmed. Thus, students learn how to calm down and manage their emotions. Grounding techniques might include eating a piece of candy and describing its taste in detail, taking ten deep breaths and sharing positive associations or memories every time you chest rises, listening to energetic or relaxing music for one minute and then speak about images it has evoked.

To work at responsible decision-making you can, for instance, turn to "What would you do?" activity, giving your students a list of situations in which they would have to make an important choice, having them verbally share answers to each situation by themselves, then discussing their answers in class (for example; "You are eating a delicious cookie and your friend asks if he can have a bit. How do you respond?" or you see a new girl standing all alone by the window at recess. What do you say to her?")

To raise your students' social awareness, you can realize social service projects and report on their results, analyzing their results and making conclusions. It can be clearing litter in a nearby park, holding a clothing or book drive for a local shelter or asylum, creating care packages for families in need.

To develop relationship skills it would be a good idea to play team puzzle games commenting on everything you do, or to arrange a conflict-resolution-read-and-discuss-along activities, turning further discussions to recent conflicts and ways

of solving them.

**Conclusions.** The results of our theoretical and practical work suggest that cognitive processes, involved in learning a foreign language, and that control social and emotional intellectual development of learners as ethno-semantic individuals are closely interwoven. This means that providing both SEL and CLIL is the best way to help students develop their speaking as communication skills for them to succeed. Our research experience has proved that students who are taught in such a comprehensive multimodal way are more likely to achieve high grades, have higher self-esteem, develop more positive stress-coping mechanisms, view teachers and peers positively. With this in mind, the perspective of our work is to perfect and develop our evolving integrative SEL and CLIL initiative for the sake of developing all cognitive skills of foreign language learners still more intensively and efficiently, turning to methods of linguoculturology and psycholinguistics.

#### References

1. Allensworth, E M., and Hart, H. (2018). *How do educators influence student achievement?* Chicago, IL: University of Chicago Consortium on University Research. Retrieved from: <https://consortium.uchicago.edu/publications/how-do-principals-influence-student-achievement>
2. Ball, Ph. (2018). Putting CLIL into practice. Oxford: Oxford University Press.
3. Dale, L. and Tanner, R. (2019). *CLIL activities*. Cambridge: Cambridge University Press.
4. Tedick, D. and Lyster, R. (2019). *Scaffolding language development in immersion and dual language classrooms*. London: Routledge

УДК 811.111'276.6:33:378.147.091.33

## CLIL-MODEL AND STRATEGIES FOR TEACHING BASIC ECONOMIC DISCIPLINES

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**Анотація. Юрченко В.В. Модель та стратегії інтегрованого навчання для викладання базових економічних дисциплін.**

Метою даної статті є сформувати оптимальну модель інтегрованого навчання, що поєднує традиційний спосіб викладання базових економічних дисциплін (економічної теорії, макроекономіки, мікроекономіки, міжнародної економіки) із інноваційними підходами до

формування навичок мовленнєвого спілкування в процесі вивчення іноземної мови. В результаті аналізу потенційних складових цієї моделі виявлено наявність проблеми теоретичної складності та термінологічної перенасиченості англомовного матеріалу економічних дисциплін, що може приводити до проблем засвоєння зазначеного матеріалу. Запропоновано стратегії подання лекційного та практичного учебового матеріалу, що мають сприяти подоланню зазначеної проблеми та підвищенню якості й результативності навчання в цілому. Стратегії розроблено на базі деяких традиційних (візуалізація, персоналізація, історифікація) та сучасних (гейміфікація, навчання у співпраці, метод проектів, проблемне навчання, кейс-метод) підходів до навчання економічних дисциплін та іноземної мови.

**Ключові слова:** модель навчання, стратегія навчання, візуалізація, персоналізація, історифікація, гейміфікація, навчання у співпраці, метод проектів, проблемне навчання

**Abstract. Yurchenko V.V. CLIL-model and strategies for teaching basic economic disciplines.**

The article aims at forming an optimal model of integrated learning, combining the traditional way of teaching basic economic disciplines (economic theory, macroeconomics, microeconomics, international economics) with innovative approaches to the formation of communicative skills in the process of studying a foreign language. As a result of the analysis of potential components of this model, the problem of theoretical complexity and terminological oversaturation of English-language economic theoretic material is revealed, which can lead to problems of mastering the specified material. Strategies for presenting lecture and practical educational material are proposed, which should help to overcome this problem and improve the quality and effectiveness of education in general. The strategies are developed on the basis of some traditional (visualization, personalization, historicization) and modern (gamification, cooperative learning, project method, task-based learning, case-method) approaches developed for teaching economic disciplines and foreign languages.

**Key words:** learning model, learning strategy, visualization, personalization, historization, gamification, cooperative learning, project method, task-based learning

### **General formulation of research and its topicality**

The problem of integrated learning attracts researchers with its complexity, since there is an infinite number of options and possible combinations of elements of different disciplines with foreign languages, and, according to a well-known expert in psycholinguistics and a strong supporter of integrated learning Irina Zimniya, 'foreign language, because of its immensity, infinity and absence of any definite subject, has

the widest potential for integration with both the humanities and the sciences' [3, p. 35-36]. The problem of integrated learning has been studied by both foreign [1], [6] and Ukrainian [3], [7] scientists, but it can not be considered as definitely resolved for each of the potential areas of integrated learning, including economics.

### Setting of the problem and the aim of the article

The purpose of this article is to develop a model and strategies for the organization of integrated learning of theoretical economic disciplines (economic theory, macroeconomics, microeconomics, international economics) and foreign (English) language. Such a model should simultaneously ensure the mastery of these economic disciplines and in-depth study of a foreign language for professional purposes. However, this model of education should be drastically different from the teaching of a foreign language for professional purposes (e.g. ESP), because it aims at not only linguistic but also professional training. On the other hand, this model of teaching can in no way be limited to teaching economics in a foreign language. Therefore, one of the tasks of this study is to identify those components of teaching economic disciplines and a foreign language, which in this case are subject to integration, and to build a model of integrated learning as such. Another key task is to propose some strategies for teaching according to this model, taking into account the potential problems associated with the integration of two disciplines that have both some common features and a lot of significant differences.

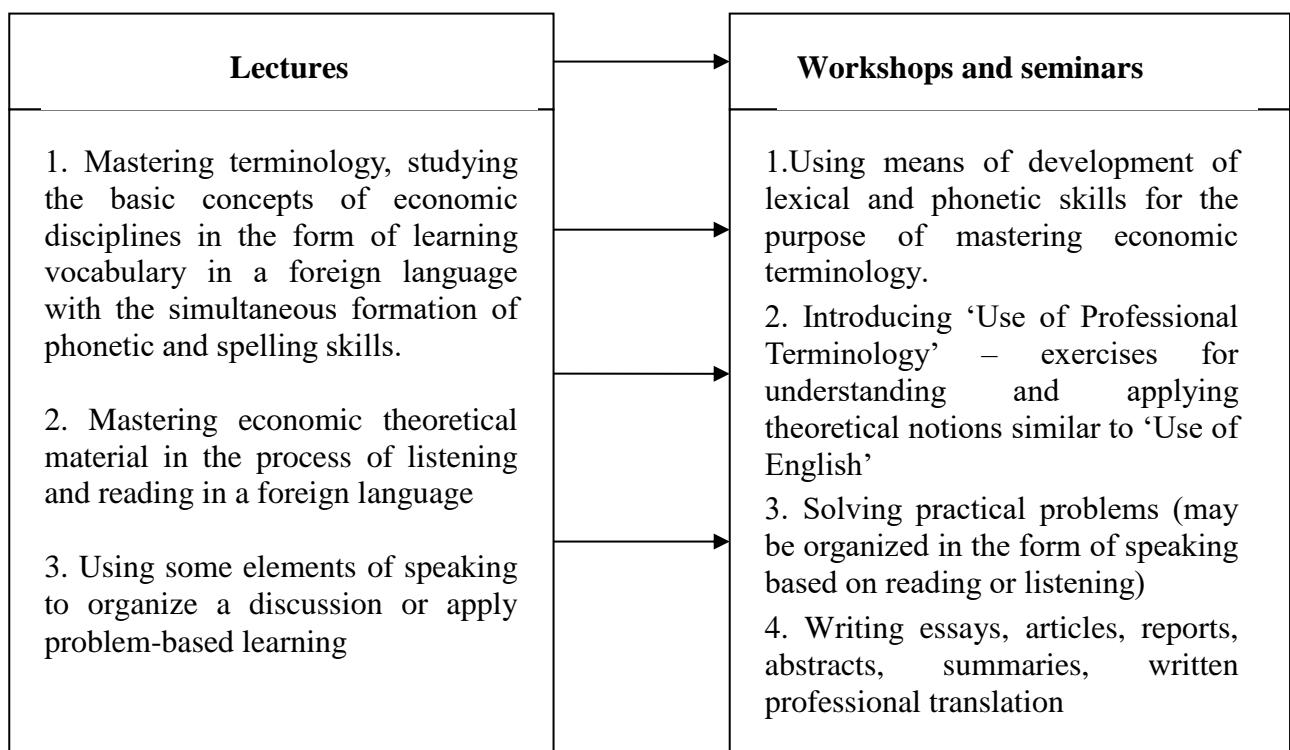
### Discussion and Results

Teaching of a theoretical economic discipline is usually organized as a lecture course, which aims to learn theoretical information, and an accompanying series of workshops and seminar classes aimed at deepening theoretical knowledge by achieving some practical tasks: analyzing practical examples, solving problems, playing games and doing interactive exercises, situational modeling.

Learning a foreign language means solving two interrelated overlapping groups of educational tasks. It includes (a) mastering language tools, which are phonetic, orthographic, lexical, grammatical, and (b) forming verbal communicative skills, i.e. oral and written speech, represented respectively by listening and speaking and

reading and writing. Speech skills are usually divided into two groups: receptive skills (listening, reading) and productive skills (speaking, writing).

In our opinion, the main organizational idea of the integrated course of economics and foreign language should be to make students acquire strong economic knowledge during lectures, workshops and seminar classes in the process of communicating in a foreign language. Therefore, training process can be organized, for example, according to the following general scheme (Fig. 1):



**Fig. 1. Components of CLIL-Model and their optimal combination**

The use of this model of learning should provide acquisition of theoretical knowledge and practical skills in economics, increase the level of language skills (lexical, phonetic) and develop speech skills (listening, reading, speaking, writing). We can see that the model does not include activities developing grammar skills, as it is aimed at students who already have an intermediate or upper intermediate level of language training.

One of the problems associated with the teaching of economic disciplines is the high level of complexity and terminological saturation of the material. The need to

present material in a foreign language exacerbates this problem and forces to seek solutions in the creation of appropriate teaching strategies that should diversify the material and ways of presenting it, and thus reduce the double pressure on the listener resulting from the integration of theoretical disciplines, which are rather difficult to understand even in a native language, with a foreign (non-native) language. Such strategies may include:

#### I. Strategies for presenting lecture material:

Visualization strategy – involves the maximum possible accompanying of theoretical points with illustrative material (schemes, tables, graphs, diagrams, mental maps, semantic blocks, semantic grids), showing video presentations, using video and audio material during lectures.

Personalization strategy – aims at teaching theoretical material with a parallel presentation of biographical information about prominent economists and fragments of their work, along with the historical context, the circumstances of creation of different theoretical statements. According to this strategy, courses in economic theory, micro- and macroeconomics should be focused on the individuals who gave rise to their basic theoretical developments. For example, when studying the decreasing phenomenon of marginal utility in the course of economic theory [5, p.221-232], we should focus on the way of life and personal contribution to the development of the theory of marginalism of such scientists as W.S. Jevons, L. Walras, C. Menger, F. von Wieser, E. von Bohm Bawerk, A. Marshall, J. R. Hicks, J. B. Clark.

Historicization strategy is to some extent similar to the previous one. It implies the need to create a vivid digression into the history of each theoretical achievement, of each individual topic of the economic discipline. For example, considering the modern theory of international trade in the course of international economics, we must trace its evolution back to the views of mercantilists (XV-XVII), and then to the theories of absolute advantages of A. Smith (XVIII) and comparative advantages of D. Ricardo and J.S. Mill (XVIII-XIX), and further – to the neoclassical Heckscher-Olin theorem, to the Leontief's paradox (XX), and the latest theory of the life cycle of

goods and the theory of competitiveness of M. Porter. As well, when studying the current state of balance of payments theory, we must trace its history back to the first theory of automatic self-regulation of balance of payments by D. Hume and D. Ricardo (XVIII) and also mention the Keynesian theory of balance of payments regulation, the theory of external and internal equilibrium by R. Harrod and T. Scitovsky, the instrumental-target method of balance of payments regulation by J. Meade, J. Tinbergen and others, theory of normative regulation of balance of payments, monetarist theory of balance of payments regulation [4, p. 35-36].

Strategy applying the socio-cultural approach. This strategy implies using the achievements of linguistics and linguoculturology and applying them to certain categories of economic theory ("demand", "supply", "money", "inflation" and others). Secondly, it is possible to create economic-regional and economic-cultural plots in a foreign language in order to diversify the educational material and increase the interest of students in its study.

## II. Strategies for presenting material during workshops and seminar classes:

a. Diversification of language and speech activities. This strategy aims at providing students with the opportunity to learn economic information in the form of exercises traditionally used in teaching vocabulary, grammar, listening, speaking, reading, writing in a foreign language class. For example, in order to master economic terminology, traditional and innovative ways of presenting lexical material can be used, including: a) verbal ways of semanticization without translation (definitions, contexts, descriptions of situations, use of synonyms, antonyms, holonyms or meronyms, hyperonyms or hyponyms, analysis of methods of word formation and structural components of the word, associations with words in the native language), b) visual nonverbal methods of semanticization without translation (cards, photos, comics, photo collage); c) logical-visual verbal methods of semanticization without translation (semantic grid, semantic map, semantic lattice, semantic block, graph / diagram, component semantic analysis) [2]. Visualization will provide stronger memorization, because to reveal the meaning of words, students will make some effort, develop language guessing, explain the nature of syntagmatic

connections between words.

b. Gamification of educational process. This strategy implies using games and interactive exercises, modeling educational space, movement in educational space, etc.) It deals with the game method of training which is based on game as a special kind of activity, which may be entertaining, stimulating, communicative, diagnostic, aimed at self-knowledge and self-realization. The game usually contains an element of competition. Moreover, the chances of winning depend not only on the level of educational competence, but also on intelligence, ingenuity, speed of response and so on.

c. Learning in cooperation and project work. The main idea of cooperative learning is the idea of students' interaction during classes. It means that students are not only individually but also collectively responsible for the success of each team member. In the process of learning, students form small groups (3-4 people) and receive a common task to determine the role of each team member. The task is solved by joint efforts and more capable and prepared students help the less prepared.

The essence of the project method of teaching is students' looking for common solution of the problem and presentation of the final result in the form of a project. The methodological literature offers various versions of projects in the field of foreign language learning: a) dramatization projects (staged situations, dramatization of the text); b) information projects (preparation of a message, news block); c) publishing (preparation of an article, booklet, mini-newspaper); d) scenario activities (lesson-tournament, lesson-excursion) and others.

4. Task-based learning and case study. This strategy involves the analysis (under the teacher's guidance) of the problematic statements of economic theory and related practical situations and implies high level of independent self-sufficient activity of students aimed at solving them. The problem method is characterized by the fact that the teacher does not offer knowledge and methods of activity in its final form, they only set landmarks and direct the search process, they don't declare what is true and what is not, but constantly think, argue with opponents, involve students in active process of substantiation of a certain point of view, in searching for arguments.

The essence of case method is to develop a set of educational materials that relate to a particular practical situation; the conditions of the task are usually professionally oriented, and it often does not have an unambiguous solution.

5. Using information, communication and multimedia technologies. Multimedia technologies in teaching simultaneously use several information environments: graphics, text, video, photography, animation, high-quality sound. Through a combination of sound, graphic, animation and text effects, multimedia successfully mimics the effect of immersion in an active language and professional environment, implementing modern linguistic, methodological, pedagogical technologies. Most often, the multimedia effect is provided by special training programs supporting the educational process.

### Conclusions

The study allowed to form the optimal model of integrated learning, which combines the traditional way of teaching basic economic disciplines (economic theory, macroeconomics, microeconomics, international economics) with innovative means of developing communicative skills during foreign language classes. The problem of theoretical complexity and terminological oversaturation of English-language economic theoretical material has been revealed, which can lead to problems of mastering the specified material. To overcome this problem and improve the quality and effectiveness of education in general the author has proposed some strategies for presenting lecture and practical educational material. All the strategies are based on the relevant highly motivating teaching methods aimed at increasing students' activity and self-sufficiency.

### References

1. Конышева А.В. Современные методы обучения английскому языку. Минск, 2005. 176 с.
2. Кошкина Е.Г. Основные принципы организации занятия по иностранному языку на этапе работы с иноязычной лексикой. URL: <https://www.hse.ru>data>2012/10/26> (Дата обращения: 15.09.2019)
3. Осова О. О. Теоретико-методичні засади реалізації інноваційних технологій навчання іноземних мов у вищих педагогічних навчальних закладах: монографія. Харків, 2017. 348 с.
4. Практикум з навчальної дисципліни „Міжнародна економіка” для студентів галузі знань 0305 „Економіка і підприємництво” всіх форм навчання / Укл. Бестужева С.В.,

Юрченко В.В. – Х.: Вид. ХНЕУ, 2012. – 92 с. 5. Экономическая теория: Учебник / Под общ. ред. акад. В.И. Видяпина, А.И. Добрынина, Г.П. Журавлевой, Л.С. Тарасевича. – М.: ИНФРА-М, 2003. – 714 с. 6. Davies, P. Success in English Teaching. Oxford, 2002. 221 p. 7. Fedicheva N. V. Teaching English as a Foreign Language: an Educational Guidance for Students of Higher Educational Establishments. Lugansk, 2011. 240 p.

Наукове видання

«ACADEMIC AND SCIENTIFIC CHALLENGES OF DIVERSE FIELDS OF  
KNOWLEDGE IN THE 21<sup>ST</sup> CENTURY»

«АКАДЕМІЧНІ ТА НАУКОВІ ВИКЛИКИ РІЗНОМАНІТНИХ ГАЛУЗЕЙ  
ЗНАНЬ У 21-МУ СТОЛІТТІ»  
МАТЕРІАЛИ ДОПОВІДЕЙ НАУКОВОЇ КОНФЕРЕНЦІЇ

Англійською, українською мовами.

Відповідальний за випуск: Шамаєва Ю.Ю.

Технічні редактори: Лошакова С.Є., Юрченко В.В., Носачова М.С., Єршова І.Ш.

Формат 60x84/16. Ум. друк. арк. . Наклад 100 пр. Зам. №

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Тел. (057) 705-24-32  
Свідоцтво суб'єкта видавничої справи ДК № 3367 від 13.01.09