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## MODELS AND METHODS TO STUDY COOPERATION AND COMPETITION IN PAIRS OF RATS WHILE EXHIBITING FORAGING ACTIVITY IN THE INTERACTIVE RAT TOUCH SCREEN CHAMBER

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Different methods and models of competitive and cooperative interactions are applied by researchers to study behavior of social animals in groups. In the present study we represent the model and methods to study and analyze the characteristic features of development of cooperative relations in pairs of rats while executing instrumental skill in the complex interactive environment. These methods are implemented using Rat Touch Screen Chamber complex (Lafayette Instrument, USA) controlled through the Lafayette Instrument's versatile ABET II hardware and Whisker's Control system and fitted with a touch monitor for conditioned signals representation and execution of operant behavior by rats for earning food or water rewards. Basing on this platform, we created the applications that allowed to display stimulus and to detect behavioral acts in order to simulate competitive and cooperative relations between two rats. In addition to that, algorithms for the obtained data analysis were developed and implemented.

Keywords: competition, cooperation, Touch Screen, clinical signs, instrumental behavior, rats

Study of behavioral and neurophysiological mechanisms that underlie social relationships in animals is an issue of current importance in the physiology of higher nervous activity of mammals and birds, especially in the populations of social animals. One of the most complex forms of zoosocial behavior is cooperative interaction. Ethologists usually study animal cooperative behavior observing the processes of cooperative hunting [13, 9]. cooperative brood care [18], and cooperation in defense against predators [5]; for example, cooperative rearing was found in Slendertailed Meerkats [3]. Thus, the ability of animals within the population to cooperate may strengthen relations among the subjects and increase their chances of survival. To study cooperative behavior, researchers developed different instrumental models where animals in pairs have to cooperate in order to receive positive reinforcement. These models were applied to chimpanzees [1, 4, 12], elephants [17], dogs and wolves [14, 16], dolphins [3], and birds [11]. Since cooperation is a complex behavioral action, different neurophysiological and social parameters such as cognitive abilities of animals [15] and hierarchical status of a subject [10] contribute to the effectiveness of cooperation. Cooperation in rats and the role of ultrasound communication in this process were studied in the experiments of Gavrilov V.V. [6]. He used a model of operant foraging behavior in which rats in pairs learnt to press a lever simultaneously for a food reward after a set of individual learning sessions. The results of the experiment indicated different patterns of electrical activity in the brain when animals performed individual actions and when they exhibited cooperative behaviors. What is more,

specific electric potentials in the brain arose during ultrasound communication. These data indicate that rats are capable of learning and performing cooperative actions and that ultrasound may mediate communication when rats exhibit cooperative behavior [7, 8].

Therefore, the aim of this study was to develop and to test a model of learning cooperative behavior in rats and to reveal the factors that may affect the learning process and its effectiveness.

#### Materials and methods of research

Male Wistar rats  $(190 \pm 10 \text{ g} \text{ bode weight})$ at the start of the study), two months of age, were used in the study. Animals were housed in the groups (5-6 per cage) under standard laboratory conditions of a 12:12-hour light/ dark cycle with room temperature maintained between 20 °C and 22 °C. The animals had ad libitum access to food and water. All the procedures used in this study were performed in strict accordance with the Directive 2010/63/ EU on the protection of animals used for scientific purposes and approved by the official Ethical Committee in Biomedical Research appointed by the P.K. Anokhin Research Institute of Normal Physiology.

The Rat Touch Screen Chamber (Lafayette Instrument, USA) was used in the study to design the experimental model of cooperation in rats. The chamber is equipped with modular panel with two troughs for food or/and water (pellet feeders) on one side and touch sensitive display (touch screen) for stimulus presentation (stimulus lights) on the other. This interactive environment provides an opportunity of cognitive assessment in animals by enabling the researchers to display a prearranged signal on the screen and, at the same time, by allowing the animals to execute operant feeding or drinking behavior in order to achieve food or/and water reward. The size of the chamber where animal can explore the territory (animal work space) is  $30.5 \times 26.0 \times 20.0$  cm with the monitor viewing area (effective display area) of 10.25" W  $\times$  7.9" H where the stimulus light is displayed.

Based on the ABET II hardware (Lafayette Instrument's versatile ABET II and Whisker's Control system) platform which controls the chamber, we developed and launched the software application that allowed to set the time for operations, run automated food and water supply, detect different types of actions performed by animals, such as touching the screen within the stimulus light area, opening the door of the food trough, and so on. Automated pellet and water dispensers outside the chamber provided water and food supply (water, 0.5 ml, and one food pellet, 45 mg). Food troughs were fixed on the side opposite to the monitor (thirty centimeters apart); a video camera (Logitech C270 WER HD 960-000635) for recording rats' behavior was placed above the cage.

For the sessions of learning cooperation by two rats for earning food reward, the chamber was divided into two equal parts by a metal mesh, so that each part of the space contained a food trough and a half of the sensory display. Metal mesh did not impede communication between two animals through the visual, tactile, olfactory, and sound afferentations.

#### **Experimental procedure**

The experimental procedure comprised of three parts:

• Determination of the hierarchical status of each animal (once in two weeks).

• Individual learning of rats to earn food and water reward (20 sessions, twice a week).

• Cooperation learning in pairs of animals (14 sessions, twice a week).

#### **Determination of the hierarchical status**

Before and throughout the sessions of individual and cooperative learning we evaluated ranks (hierarchical statuses) of the animals in each group according to the dominancy based on the competition for access to water in the drinking vessel after 24 hours of water deprivation. After water deprivation, rats of one group were placed into the empty cage surrounded by the transparent plastic walls for 30 minutes. A drinking vessel with water was attached to the plastic wall and was fixed at some distance from the floor of the cage so that a rat had to climb on the platform (plastic cube,  $10 \times 10 \times 10$  cm) in order to reach the bottle. Since only one rat could fit the space of the platform, animals had to compete with each other, thereby demonstrating dominance over other animals in the group. The recording of animals' behavior was performed during each of the 30-minute sessions; then, total number of behavioral acts when a rat drank while standing on the platform and total duration of drinking acts for each animal were calculated. To determine the hierarchical status of animals, we compelled the sociometric matrices in which the ranks were calculated as the sum of the victories divided by the sum of the defeats for each rat. The victory/defeat ratio reflected the dominance of individual animal relative to the other animals of the same group.

#### **Individual learning**

Before learning cooperation, rats were trained individually to acquire an instrumental skill of earning food reward after applying a light touch to the conditioned signal (stimulus light) on the certain area of the touch screen. Prior to the individual learning session, rats were deprived of food for 24 hours. Light, sound, and other stimuli in the environment were minimized during the experiments. When a rat touched one of the stimulus lights on the screen (green cross on one side and blue circle on the other side), control software run automated dispensers for food supply (food pellet, 45 mg) to the opposite feeding window that was on the same side of the chamber as the stimulus light. When pellet dispenser was activated, short sound from the side of the automated dispenser signified pellet entry into a food trough; thus, a rat could recognize a moment when a food pellet was delivered. Duration of the first learning session was 1 hour, of the second session -40 minutes, of the third one -30 minutes, and then 20 minutes for each of the remaining sessions.

ABET II hardware system used in the present study contained a set of programs for planning, collection, and analysis of the experimental data. There programs allowed to provide chronological sequence of output signals (displaying of the stimulus lights on the screen, running automated food and water supply) and input signals, such as quantitative measure of behavioral acts (touching the image of the stimulus, feeding and drinking, opening and closing the doors of the food trough). For the sessions of individual training we performed quantitative measure of the time parameters of behavioral acts and calculated latent periods between them. Cognitive abilities of the animals were evaluated according to the learning rate throughout the sessions and the total number of effective eating and drinking patterns during each session.

#### Cooperation

After the sessions of individual training, rats of one group were placed in pairs into two separate parts of the experimental Rat Touch Screen Chamber for acquisition of the cooperation skill for earning food reward. The chamber was the same as one used in the experiment on individual learning and was modified and adjusted according to the conditions required for cooperation: metal mesh divided the chamber into two parts; each part contained a half of the screen and one feeder. Animals were paired randomly; once formed, pairs remained unchanged throughout the experiment. Since cooperation implies behavioral synchronization in touching stimulus light and consequent earning food reward by two rats, two types of events were detected during the session: 1) effective cooperation achieved by the coordinate touching the stimulus light on each part of the screen by two rats within the period of 5 seconds (latent period) followed by delivering two food pellets; 2) no cooperation detected when a second rat touched the image of the conditioned signal with delay (incoordinate behavior), i.e. with the latent period of more than 5 seconds ("delay") or when a second rat did not make an operant response by touching the stimulus light within the 10-second period after the first rat ("no response").

For each experimental trial we recorded temporal dynamic of the events: time of the stimulus light displaying, time when a rat touched the conditioned signal and looked inside the food trough, and time when the food pellets were delivered. Characteristics of the behavioral patterns were calculated and analyzed for each pair of animals and included total numbers of effective coordinated acts of cooperation, of incoordinate acts, and of the failures of cooperation. The following parameters were calculated individually for each rat: number (N1) and latent periods (LP1) of events when a rat touched the stimulus light first; number of events when a rat touched the stimulus light after first rat (N2, "cooperation") with the latent period of up to 5 seconds (LP2  $\leq$  5 s, "delayed response"); number of touches with the latent period of more than 5 seconds (LP3 > 5 s); the number of events when a second rat did not touch the conditioned signal after the first rat's touch (N4, "no response").

Analysis of the proportions between different behavioral patterns for animals in each experimental pair during the trials of cooperation allowed to identify leaders and followers within a pair and to reflect the general effectiveness of cooperation among the animals of one group. In most cases, leadership (dominance) detected when an animal touched the stimulus light first, was characteristic for a rat with the higher rank determined by the victory/defeat ratios in the competitions for access to water. Nevertheless, the effectiveness of cooperation also depended on the response of the second animal: cooperation was effective when a second animal recognized the action of the first one and responded by touching the stimulus light within 5 seconds. The average latent period of the coordinate response (touching the image of the conditioned signal after the first animal) was  $3,7 \pm 0,4$  seconds.

Data processing and analysis were performed using ABET II Analysis and MS Excel software.

#### Conclusion

The results of the experiment on implementation of the model of cooperation in rats shown that this model allows to effectively and precisely determine rats' individual abilities, including cognitive abilities, required for cooperation with other animals from the group and, together with additional analysis and observations, to reveal the factors that may affect abilities for cooperation. vacuolization of the affected cells, and then the destruction of the monolayer [25].

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## ANTAGONISTIC PROPERTIES OF STREPTOMYCES STRAINS ISOLATED FROM THE TECHNOGENIC SOILS OF KYRGYZSTAN

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The antagonistic properties of Streptomyces bacterium strains against to phytopathogens of agricultural crops were studied. Among the studied strains were selected N3.3/OR; N4KG1; N1KG1; IVOR-K; IOR-K(1), III-OR-K; N2KG2; N3.1/OR as a very strong, wild spectral antibiotic effective antagonists, and the Streptomyces long-ispororuber N6KG2; Streptomyces londisporoflavus N3-OR; Streptomyces albiianatus N2KG1 strains had good antagonistic activities against to Penicillum test-culture. In future, the isolated Streptomyces strains as biotechnologically strong potentiated ones for agricultural production of ecologically clean biological products against to phytopathogens should be recommended.

Keywords: Streptomyces bacterium, strains, test-culture, antagonistic properties, technogenic soils, ISP4 nutrient medium

The antagonistic soil microorganisms by emitting of antibiotics will destroy the cells of phytopathogenic bacterium and hyphae of micromycetic fungus then they will stop their existence in the conditions of nutrient substrate competition. Due to necessity of complex protection of agricultural crops and woods from the phytopathogenic microorganisms, it is important to study microbiological facilities that include antibiotic forming antagonistic bacterium.

Antibiotic forming capacity of Actinomycets is an intensive investigation object of many countries of the world [1, 3, 6]. The antibiotics obtained from Actinomycetes comparatively to chemical preparations are well absorbed, non-toxic, and easy to dissolve in nature, it does not pollute the environment [9, 8]. Several characteristics of microbiological products: selectivity to phytopathogens, high activity allows using them in low concentration; and prevents the accumulation in agricultural products and the environment. Using of antagonistic micro cultures against to phytopathogens will protect the plant from bacterium and fungus development not only during of growing seasons also during of storage of agricultural products and seeds [5].

The keen demand of time – obtaining of high activity and stable cultures of microorganisms became one of the main directions of modern microbiology and biotechnology. Microbiological production need to antagonistic-bacterium obtained by highly effective genetic-engineering method. The antagonisticbacteria are tolerant to different fungicides at least during of yield conservation, and adapted to hydrothermal conditions of soil.

The aim of investigation is a study of antagonistic features of *Streptomyces* cultures and selection of high effective strains.

#### Materials and methods of research

17 strains of bacterium belongs to *Strepto-myces* family from laboratory collection were used as object of investigation. The used strains were isolated from different types of soils of Kyrgyzstan's mining plant's radioactive residues storage areas – Orlovka, Orlovka-Boordu, Kadzy-Say (table 1). Described Streptomyces bacteria were selected as tolerant indicators (8) to high concentrated heavy metals.

The names of *Streptomyces* culture species, the soil's type and place of isolation, and others are demonstrated in the table 1.

*Streptomyces* bacteria isolated from the Kyrgystan's technogenic soils were identified by Gauze's and Bergey's manuals (Gauze, 1983; Bergey, 1994).

The antagonistic properties of *Streptomyces* strains were checked by methods of 3<sup>th</sup> times repetition of on two different nutrient medium (ISP 4 and Chapek), perpendicular lines (Rudakov, 1971), agar blocks (Egorov, 1986).

Spore forming Gram (+) bacterium – *Bacillus subtilis*, micromycetic fungi – *Penicillum sp.* cultures were used as Test-cultures. Antagonistic activity was identified by mm measuring of test-object's destroyed zones.

#### Results of research and their discussion

To effective show of antagonistic activities the nutrient mediums for creations of optimum conditions for growing of Actinomycets strains and test-cultures were selected.

**1. IVOR-K strain of** *Streptomyces fumosus* since 6-day of investigation made worse the *Bacillus subtilis* test-culture's growing. During all days of investigation (6; 10; 15) the lysis zones of other test-cultures (*Penicillum sp.*) did not exceed 2 mm (tab. 2, fig. 1, a). On the results of investigation was identified that this strain of *Streptomyces* is a good antagonist for bacillary bacteria (*Bacillis subtilis*), but not for micromycets fungus. At 6-day of investigation IVOR-K strain made worse the lysis zone of test-culture to 25 mm. This strain of *Streptomyces* bacteria emits the antibiotic extracts in big number that stopped the growing of testculture.

**2. IIOR-K strain of** *Streptomyces luridus* at the Chapek nutrient medium after 6 days of investigation made worse the growing of Bacillus subtilis making the lysis zones 7 mm;

after 8-15 days size of lysis zone was 10 mm, at ISP 4 nutrient medium during 8-15 days size of lysis zone did not exceed 5 mm. So, Streptomyces IIOR-K strain showed the medium antagonistic influence against to spore-forming bacteria (fig. 1, b). And during of all days (6, 8, 10, 15) of investigation other test-culture Penicillum's lysis zone did not exceed 2 mm (tab. 2). The growing zones of microorganisms were more actively at ISP 4 medium then Chapek ones.

## Table 1

N	Collection num- bers of Strepto- myces cultures	Species names of strains	Sections	Series	Place of strain's isolation
1	IV OR-K	Streptomyces fumosus	Cinereus	Chromogenes	5 km from Boordu radioactive uranus residues storage (Orlovka town, Kemin region), type of soil is light-brown
2	II OR-K	Streptomyces luridus	Roseus	Fradiae	1 km from Orlovka-Kashka residues storage, type of soil is gray
3	N3.2/OR	Streptomyces griseoruber	Cinereus	Violaceus	200 m from Orlovka mining plant
4	N3.1/OR	Streptomyces chromofuscus	Cinereus	Chromogenes	200 m from Orlovka mining plant
5	OR-K(1)	Streptomyces ro- seochromogenes	Roseus	Fuscus	Orlovka-Bordu restudies storage
6	OR-K(2)	Streptomyces lincolnensis	Roseus	Lavendulae- Roseus	Orlovka-Bordu residues storage
7	N3.3/OR	Streptomyces rubrogriseus	Cinereus	Violaseus	200 m from Orlovka residues storage
8	III-OR-K	Streptomyces mellinus	Roseus	Fradiae	3 km from Orlovka-Bordu residues storage, gray and black soils
9	N3-OR	Streptomyces londisporoflavus	Helvolo- Flavus	Helvolus	Orlovka residues storage
10	ml-3.5	Streptomyces viridogenes	Cinereus	Chrysomallus	Orlovka town, soils around "Jansyz" pond
11	ml-3.6	Streptomyces heliomycini	Cinereus	Aureus	"Jansyz" pond lees
12	N2KG1	Streptomyces albiianatus	Roseus	Fradiae	200 m from Kadzy-Say mining plant
13	N2KG2	Streptomyces tauricus	Roseus	Roseoviola- seus	200 m from Kadzy-Say mining plant
14	N6KG2	Streptomyces longispororuber	Roseus	Ruber	50 km from Kadzy-Say radioactive uran residues storage area (Barskoon v.)
15	N6KG4	Streptomyces steffisburgensis	Azureus	Glaucescens	50 km from Kadzy-Say radioactive uran residues storage area (Barskoon v.)
16	N1KG1	Streptomyces griseomycini	Cinereus	Achromogenes	200 m from Kadzy-Say mining plant
17	N4KG1	Streptomyces chromofuscus	Cinereus	Chromogenes	3-5 km from Kadzy-Say mining plant

The species content of bacteria belongs to Streptomyces family

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Table 2

Ν	Collection	ISP4 medium							Chapek nutrient medium								
	number of Streptomy		Days of investigation (6; 8; 10; 15)														
	ces culture	В	acillus	s subtil	is	F	Penicil	lum sp	).	В	acillus	s subtil	is	Penicillum sp.			
		6	8	10	15	6	8	10	15	6	8	10	15	6	8	10	15
1	IV OR-K	_	_	_	_	2	2	2	1	25	25	25	25	2	2	2	2
2	II OR-K	5	5	5	5	2	2	2	2	7	10	10	10	1	1	2	2
3	N3.2/OR	3	5	5	17	1	1	1	1	3	3	3	3	1	1	1	1
4	N3.1/OR	2	2	2	2	1	1	1	1	15	15	15	15	1	1	1	1
5	OR-K(1)	10	11	11	11	2	2	2	2	10	11	11	24	1	1	1	0.5
6	OR-K(2)	9	9	9	9	1	1	1	1	8	8	8	8	2	2	2	2
7	N3.3/OR	12	12	12	12	1	1	1	1	15	40	55	57	1	1	1	1
8	III-OR-K	3	3	17	17	1	2	2	2	5	10	10	11	1	2	2	5
9	N3-OR	4	4	4	4	1	1	1	1	10	12	12	12	1	2	2	5
10	ml-3.5	-	_	—	_	1	1	1	0	15	15	16	16	3	2	2	1
11	ml-3.6	3	9	11	11	1	1	1	1	3	3	3	3	2	2	4	4
12	N2KG1	2	2	2	2	1	1	1	1	3	3	3	3	1	2	2	10
13	N2KG2	—	_	—	_	1	1	1	0	15	15	16	16	0	0	0	0
14	N6KG2	1	1	1	1	35	35	35	35	1	1	0	0	—	—	—	—
15	N6KG4	1	1	1	1	1	1	1	1	_	_	_	_	_	_	_	_
16	N1KG1	24	24	27	27	1	1	0.5	0.5	25	25	25	25	1	1	1	1
17	N4KG1	25	25	50	50	1	1	1	1	18	18	30	30	2	2	2	2

#### Antagonistic activity of Streptomyces strains



Fig. 1. Antagonism of IVOR-K strain to 2-test-cultures (a) B. subtilis and (b) Penicillum sp.; lysis zones of IIOR-K strain to (c) B. subtilis and (d) Penicillum sp.

**3.** N3.2/OR strain of *Streptomyces griseoruber* during 15 days showed antagonistic activity at the ISP 4 nutrient medium more than at Chapek, in other words in 10-15 days was observed thinning of Bacillus subtilis test-culture, lysis zone was 17 mm (fig. 2, a). At the two studied nutrient mediums N3.2/OR, strain did not show antagonistic activity against to Penicillium test-culture, lysis zone did not exceed 1 mm.

4. N3.1/OR strain of *Streptomyces chromofuscus* after 6 days made the lysis zone of Bacillus subtilis 15 mm. Until the last days of investigation, test-culture did not grow into N3.1/OR strain. So, this strain showed the strong antagonistic activity against to spore-forming bacteria (fig. 2, b).

**5.** OR-K (1) strain of *Streptomyces roseochromogenes* at 15 days made the lysis zone of *Bacillus subtilis* 24 mm. At all days (6; 8; 10; 15) of investigation, the lysis zone of Penicillium was 2 mm. At the both of nutrient mediums the growing zones of actinomycets strain and bacteria were active (fig. 3).

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Fig. 2. The antagonistic activities of N3.2/OR strain against to test-cultures (a) B.subtilis; (b) Penicillium sp. and N3.1/OR strain to (c) test-culture – B. subtilis



Fig. 3. The antagonistic struggle of OR-K(1) strain against to test-cultures (a) B.subtilis and (b) Penicillium sp.

6. OR-K(2) strain of *Streptomyces lincolnensis* – in 15 days the lysis zone of *Bacillus subtilis* was estimated 9 mm. During of checking days (6; 8; 10; 15) Penicillum test-culture's lysis zone did not exceed 1-2 mm; it means that both of investigated strain and Penicillum have a similar antagonistic capacity at ISP 4 and Chapek nutrient mediums.

**7.** N3.3/OR strain of *Streptomyces rubrogriseus* – at Chapek nutrient medium the lysis zone of Bacillus subtilis after 6 days was 15 mm, after 8 days was 16-40 mm, in 10 days was estimated 55 mm, after 15 days was 57 mm. In other words, the test-culture is almost completely destroyed. At ISP 4 nutrient medium in 15 days, *Basillus subtilis* retreated to 12 mm. During of checking days (6; 8; 10; 15) Penicillum test-culture's lysis zone did not exceed 1mm. The growing zones of actinomycets were more active at Chapek than ISP 4 medium (tab. 1).

8. IIIOR-K strain of *Streptomyces mellinus* in 15 days showed more antagonistic activity on ISP 4 nutrient medium than Chapek. In other words, in 10-15 days it as N3.2/OR strain destroyed Bacillus subtilis test-culture making the lysis zone 17 mm. At studied two nutrient mediums, antagonistic activity of IIIOR-K against to Penicillum was not strong, because a size of lysis zone did not exceed 2 mm. But, Streptomyces II-IOR-K strain did not inoculated by test-culture, so maybe emitting metabolite's effects of both microorganisms are equally.

**9.** N3-OR strain of *Streptomyces londisporoflavus* – in 15 days at Chapek nutrient medium the lysis zone of Bacillus subtilis was 15 mm, and during investigation days (6; 8; 10; 15) at ISP 4 medium it's lysis zone estimates 4 mm. In 15 days at Chapek nutrient medium the lysis zone of Penicillum was 5 mm and at ISP 4 at 6; 8; 10 days it estimated 1 mm, at 15 days it was 2 mm and Penicillum was thinning. So N3OR strain showed the antagonistic activity against to Penicillum.

## **Biological sciences**



 (a)
 (b)
 (c)
 (d)
 Fig. 4. The antagonism of ml-3.5 strain against to test-cultures (a) B.subtilis; (b) Penicillium sp. and Ml-3.6 strain to test-culture – B. subtilis (c) and Penicillium sp. (d)



Fig. 5. The antagonistic struggles of N2KG1 strain against to test-cultures (a) B. subtilis and (b) Penicillium sp. and (c) – N2KG2 strain to B. subtilis

10. ml-3.5 strain of *Streptomyces viridogenes* at ISP 4 and Chapek nutrient mediums dilutes the air mycelium of *Bacillus subtilis* and *Penicillum* test-cultures, and the rise of other colonies of the Streptomyces bacterium among test culture (fig. 4, a, b). 11. Ml-3.6 strain of *Streptomyces helio-*

11. MI-3.6 strain of *Streptomyces helio-mycini* at Chapek nutrient medium in 15 days made the lysis zone of Bacillus subtilis test-culture 3 mm. And at ISP 4 nutrient medium in 15 days it estimated 11 mm, therefore this nutrient medium (KAA) makes good condition for isolating antibiotic substances of named strain, so this strain is a good antagonist against to Bacillus subtilis (fig. 4, c). The lysis zone of Penicillum at Chapek nutrient medium was 4 mm, the growing of test-culture at both of nutrient mediums was thinned (fig. 4, d).

**12.** N2KG1 strain of *Streptomyces albiianatus* – during 6-, 8-, 10-, 15 days of investigation lysis zone of Bacillus subtilis did not exceed 3 mm. At Chapek nutrient medium the lysis zone of Penicillum between 6-10 days was 1-2 mm, at 15<sup>th</sup> day estimated 20 mm. So, N2KG1 strain could be recommended as active antagonist against to Penicillum (fig. 5, a, b).

**13.** N2KG2 strain of Streptomyces tauricus after 6 days destroyed the Bacillus subtilis test-culture to 15 mm (fig. 5, c), but was not observed the antagonistic influence to Penicillum.

**14.** *Streptomyces longispororuber* N6KG2 of Streptomyces bacterium had bad growing ability at Chapek nutrient medium. Named strain during antagonism with Bacillus subtilis changed some of cultural-morphological properties (pic.6a) and between 15 days substrate mycelium of N6KG2 strain emitted into substrate a green pigment belonging to culture. Emitting of such pigment in big quantity is explained by that strain has a strong antibiotic ability. At Chapek nutrient medium antagonistic activity of N6KG2 strain against to Penicillum test-culture was a high: in 15 days the lysis zone was estimated to 35 mm (pic. 6, b).

15. N6KG4 strain of *Streptomyces steffisburgensis* in comparison with other cultures had a bad antagonistic activity, because during investigation days (6; 8; 10; 15) lysis zones of both test-cultures did not exceed 2 mm.

16. N1KG1 strain of *Streptomyces griseomycini* showed the active growing at both KAA and Chapek nutrient mediums. After 6 days of investigation a lysis zone was estimated 24 mm (pic. 6 c), and during 8, 10, 15 days size of lysis zone was 27 mm. N1KG1 strain is a strong antagonist against to bacillus subtilis test-culture was proved on the results of investigation (tab. 1). During investigation it was observed that the lysis zone of Penicillum test-culture did not exceed 1 mm, but its air mycelium had very thinned.

**17.** N4KG1strain of *Streptomyces chro-mofuscus* during antagonism struggle after 6 days destroyed Bacillum subtilis that had lysis zone 18 mm, after 8-10-15 days its lysis zone estimated 30 mm. So, was observed that N4KG1 strain is a strong antagonist against to Bacillus subtilus test-culture. The lysis zone of Penicillum did not exceed 1-2 mm, but till last day of investigation did not observe the strain transition into itself.

#### Conclusions

On the results of investigation was observed that many of *Streptomyces* strains are good antagonists against to Bacillus bacterium than Micromycets fungi. So, on the investigation's results the following strains N3.3OR; N4KG1; N1KG1; IVOR-K; IOR-K(1); III-OR-K; N2KG2; N3.1/OR were selected as strongest antagonists against to *Bacillus subtilis* test-culture and N3OR; IIOR-K, OR-K (2) strains were selected as a strong antagonists. The *Streptomyces* N6KG2; N3-OR; N2K-G1strains comparatively to above described strains during investigation days (6; 8; 10; 15) made the lysis zones of *Penicillum spp.*1-20 mm and was observed that the substrate mycelium of named fungus growing became low. So, on the results of investigation 3 strains of *Streptomyces* bacterium: N6KG2 strain of *Streptomyces* longispororuber; N3OR strain of *Streptomyces* londisporoflavus; N2KG1 strain of *Streptomyces* albiianatus were selected as stronger antagonists against to *Penicillum* test-culture.

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## **BIOCHEMICAL MARKERS OF SKIN AGEING**

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As the ageing process develops, gradual and subtle changes take place in the structure and functions of different systems, including the skin. The skin ages along with the whole organism and it is impossible to restrain this process only in the skin, without affecting the whole body. There are a lot of instrumental methods of studying age-related changes in skin elasticity and resilience. Hard work is being done on creating this type of devices based on data concerning mechanical, optical, acoustical and electrical parameters of skin obtained with non-invasive methods. However, these methods do not provide quantitative assessment and do not examine biochemical changes developing in tissues. It is attributed to the fact that the issue of interaction between the device and the skin has been little explored, besides, the skin – the research object – consists of several layers (the upper layer – epidermis, the main layer – derma, and subcutaneous fat) having their own specific characteristics which determines heterogeneity of its properties. It all makes difficult to interpret the results in exploring the characteristics of the skin. So, the aim of this work is to find the most adequate indices of skin ageing markers excluding the use of biopsy and confirmation with instrumental methods.

Keywords: skin, aging, PCNA, Ki67, p53, hyaluronic acid

Ageing is a universal and natural process which is characterized by graduality, irregularity, and steady progress, and it inevitably affects all the levels of a biological organization to a certain extent. The development of skin ageing processes leading to disorders in metabolic processes in derma and subcutaneous fat is contributed by many factors, such as life style, nutrition, associated diseases, environmental factors, etc. As a result of ageing process, significant changes in skin cells (as well as in the cells of the whole organism) take place: mitotic activity of skin cells goes down, synthesis processes degrade gradually, modified proteins are accumulated, and so on. This all causes an impact on a person's skin and appearance which plays an important role in the process of elder people's social adaptation. It is remarkably difficult to slow down natural processes of ageing. It is accounted to the fact that skin ageing is directly linked to ageing of the whole body.

Lately, along with integral biological age which reflects the degree of age-related changes in biological capabilities of the organism at each stage of the ontogenesis and determines the life expectancy or death probability in a certain period, it has also been proposed to determine the biological age of systems, organs, and cells. In this connection, the term 'biomarker of ageing' is used and defined as a complex of parameters reflecting the functional ability of a tissue, an organ or a cell in the absence of a disease. And it is evident that biomarkers of ageing should carry information about the functional condition of an organ or a tissue and metabolic processes taking place in them, it should reflect fundamental biological processes, and correlate with physiological

age. To sum up the information on the proposed criteria for selecting biomarkers of ageing, a list of main requirements for them can be formed:

1. age-related changes of a marker should develop at a speed reflecting the ageing pace [4, 9];

2. the marker should correlate with physiological age [4, 9];

3. the marker should carry information about the functional condition of an organism, metabolic processes system and about regulatory specifics [4];

4. the marker should reflect fundamental biological processes [9, 13];

5. the marker should predict the life expectancy or serve as a retrospective ageing parameter [9];

6. the marker should reflect changes taking place in a relatively short period of time [9, 13];

7. the marker should be able to forecast the parameter for an elder age [13].

It is evident that it is rather difficult to choose an index that would meet all the requirements [1, 17]. Nevertheless, the task of searching and defining the complex of parameters that can be used as biomarkers of an organism's ageing, systems or cells remains urgent.

Defining different markers of ageing is a pressing problem of gerontology and dermatology. It is connected with the fact that the skin, exposed to external influences, the most important of which is ultraviolet radiation, often undergoes regressive changes at a younger age in comparison with other organs, and timely application of effective prophylaxis measures can prevent development of early and accelerated involutive changes. The index most often used in dermatology as a morphological marker of skin ageing is the content of collagen

and elastic fibers in derma as it is believed to integrally reflect a complex of changes in the main elements of derma, in particular, changes in fibroblasts' synthesis of matrix proteins and in the activity of the enzymes, participating in their polymerization and degradation; this index is also believed to reflect the morphofunctional condition of derma. However, a considerable drawback of this biomarker is its inability to reflect the state of epidermis. In this connection, a more perspective solution should work out a wider complex of morpho-functional skin parameters which will take account not only of the content of collagen and elastic fibers in derma, but the state of epidermis as well. It has been found that the main fundamental processes that determine stability of structural and functional organization of a tissue and skin are cellular differentiation, cell renewal and cell death. Coordination of biosynthesis, metabolism processes and reproduction of genetic information in different cell populations of epidermis and derma is carried out by cells (presented in skin) of traditional regulatory systems – nervous, immune, and endocrine - which form a local neuro-immune-endocrine system of skin. It is known that the skin in different body parts ages at a different speed which is determined by its exposure to external influences. On this basis, two types of skin ageing are identified: natural or chronologic ageing which includes displays of normal maturity, typical for all people, and photoageing which includes a complex of changes caused by UV.

Mechanical properties of skin are determined to a great extent by its structure which is a complex system of three-dimensional interweaving of collagen fibers in proteinpolysaccharide matrix [10]. In old age, the most pronounced changes are the ones in skin connective tissue structures which show themselves in flattening of papillae situated in thinned reticular layer, basophilic degeneration of collagen with fibers breaking and turning into amorphous lumps and granules. In subepidermal layer, elastic fibers disappear, collagen fibers disperse to basal substance, the contact line between derma and epidermis gets smoother. Derma atrophies with age, besides, dystrophic changes take place in fibrous structures, the number of cellular elements such as fibroblasts, labrocytes, and blood vessels goes down, and capillary loops shorten. As collagen ages, its structure acquires additional intra- and intermolecular links containing chromophores which results in an increase in the structural stability of collagen, a change in color characteristics of this protein, a rise in absorption and fluorescence [5]. As an organism ages, extracellular matrix proteins undergo considerable modification which decreases the content of I, II, VII type collagen in derma. With age, unlike non-fibrillar proteins, the structure of collagen changes to become more firm and resistant to proteinases [20].

The quantity of fibroblasts in derma progressively falls with age. Age-related decrease in the number of these cells in derma is, probably, the most important factor for signs of skin ageing appearing. Fibroblasts produce all the components of the intercellular substance including collagen and elastic fibers and the amorphous component [15]. Most probably, it is a decrease in the quantity of fibroblasts that causes disorders in the renewal process of the derma intercellular substance. It is a wellknown fact that appearance of skin ageing signs is connected with changes in the state of intercellular substance.

An important role in regulating of an organism's homeostasis is played by the hormone melatonin, also known as N-acetyl-5-methoxytryptamine, serotonin derivative (in its turn, serotonin is an L-tryptophan derivative).

It is known that epidermis cells are characterized by expression of melatonin components and serotonin biosynthesis system. Research of the affects caused by these biogenic amines on skin cells has revealed its considerable variability depending on the type of cells and conditions of their cultivation. For example, melatonin inhibits apoptosis of HaCaT keratinocytes cultivated without serum and their proliferation in environment supplemented with serum. Besides, it stimulates growth of melanocytes in environment poor in growth factors and, on the contrary, suppresses their growth in the presence of these factors.

To add, in vivo the variability of affects caused by melatonin can be explained by fluctuations in sensitivity of receptors to external influences. It can be regulated by melatonin itself as well as by other regulatory peptides, for example, estrogens. Besides, sensitivity and distribution density of melatonin receptors in human skin changes during the day; it depends on lighting environment and is not connected with the content of this hormone in blood.

Exogenous serotonin in physiological concentration stimulates proliferative activity of quiescent cells of L929 and L-41 lines and does not exert significant influence on proliferating cells.

During the process of skin ageing, the index of melatonin and serotonin expression in

epidermis and derma cells remains stable till an age of 50-55. A decrease in the expression of these biogenic amines is caused by reduction in the number of melatonin and serotonin producing cells. The PCNA (Proliferating Cell Nuclear Antigen) protein is polyfunctional and it is a part of DNA polymerase  $\delta$  which is necessary for DNA synthesis and repair. This protein is found in cells which are in G1, S, G2, and M phases of the cell cycle [19]. Expression of PCNA is seen in the lower part of epidermis, mainly in the basal layer. Skin ageing was associated with both relative (index) and absolute number of PCNA immunopositive cells. That is why age-related changes in quantitative indicators of their expression can reflect ageassociated changes in DNA-repair system and proliferative activity of cells. Consequently, PCNA may be regarded as a marker of proliferating cells and cells that are in active phases of cell cycle, and not in G0-phase [19]. That is why age-related decrease in the number of fibroblasts in derma is partly explained by a decrease in the number of cells in the cell cycle. Besides, age-related changes were also found in the expression of other markers of the cell cycle (Ki-67, p53, p21) in derma fibroblasts [12]. Age-related decrease in the number of fibroblasts in derma can also be caused by a slower renewal speed of this cell population or by less active formation of new fibroblasts from their poorly differentiated predecessors [18]. Agerelated reduction in the number of stem cells in skin is illustrative in this regard [11]. In addition, a fall in derma fibroblasts in the course of ageing process may result from activation of apoptosis [14, 16]. The found close connection between PCNA and Ki67 indices reflecting the content of antigen positive epidermis cells can serve as evidence of the fact that in covered skin areas the expression of PCNA is typical, first of all, for proliferating cells.

The results of serial sections' analyzing which were colored by PCNA, Ki67 and p53 antibodies, support this assumption as well [6]. It has been found that the distribution density and localization of cells expressing PCNA coincide more frequently, though not always, with those of Ki67 antigenically responsive cells. Ki67 is referred to cancer tumor antigen. Expression of Ki67 allows marking out cells that are in an active phase of the cell cycle all over (G1, S, G2, M-phases) [20]. Immunocoloring of keratinocyte nuclei by anti-Ki67 antibodies was seen in the basal layer, and more rarely in the lower parts of the spinous layer of epidermis. Analysis of dependence between morphometric indices of Ki67 expression and the patients' age revealed a decrease in the quantity of immunopositive cells per 1 mm and a decline in Ki67 index which shows that proliferative activity of epidermis cells decreases as a body ages. Statistically significant changes in these two indicators were seen even in cases of patients aged 49-55, and over 60 the absolute and relative (Ki67 index) number of dividing cells fell almost twice [6]. Decline in proliferative activity of basal layer cells was associated with epidermis thinning and a decrease in the number of cell rows in it.

Thanks to its high biocompatibility and biological activity, absence of antigenicity, hyaluronic acid (HA) has been used in different medical spheres for many years [2]. HA accelerates epithelization, stimulates microcirculation, migration and proliferation of fibroblasts, plays a certain role in transporting a list of cytokines and growth factors, reduces endogenous intoxication by blocking lipid peroxidation, activating bactericidal factors, and increasing sensitivity to antibacterial substances [3]. As a polyanion, HA is able to bind and hold water molecules with the use of hydrogen bonds. This ability does not change event if water concentration in the environment decreases. Negative charges formed due to dissociation of its carboxylic groups begin to attract cations, in particular, osmotically active sodium ions, which leads to an increase in intradermal pressure providing turgor of skin [7].

HA content in the skin is maintained through autoregulation mechanisms on the feedback principle. Increased HA content HA in the skin, intensifies dissociation or supply from outside promote production of catabolite enzymes leading to step-by-step transformation, decrease in the length of the initial chain and formation of fragments with their own biological activity. Biological characteristics of HA are, first of all, connected with its size (molecular mass). Probably, fragmentation of HA resulting from enzymatic degradation or free radical oxidation is another mechanism of homeostasis regulation that optimizes migration and proliferation of cells depending on changes in environmental conditions [8]. For example, an increment in the activity of hyaluronidases is one of the factors stimulating an increase in the activity of fibroblasts participating in synthesis of new HA molecules which is used in aesthetic medicine in the biorevitalization techniques and results in recovering the changed homeostasis and reconstruction of quality intracellular matrix.

Speaking about chronological ageing and photoageing of skin, there is a close connection

between expression of melatonin, Ki67 antigen, and p53 protein in the skin. As the secretion of melatonin having cytostatic and antioxidant effects goes down, p53 protein characterized by proapoptotic effects begins to accumulate in cells, which reflects a complex of adaptive changes aimed at maintaining the homeostasis of ageing skin. P53 protein is a transcriptional factor regulating the cell cycle acting as a suppressor of malignant tumors development. The gene of this protein is normally considered an antioncogene and is located on the short arm of chromosome 17 (17p13.1). In epidermis of young patients (19-27 years old) immunocoloring of keratinocyte nuclei by p53 antibodies was seen in the cells of the lower and middle sections. Moreover, the more keratinized the cells were, the less dense was distribution of immunopositive nuclei. Epidermis thinning associated with skin ageing was characterized by levelling the gradient of immunocoloring of their nuclei depending on the differentiation of keratinocytes and by a tendency for an increase in p53 index. Apparently, an insignificant decrease in the absolute number of immunopositive keratinocyte nuclei is a consequence of epidermis thinning and the age-related fall in the total number of cells in it.

Expression of p53 protein was also found in derma cells. The absolute number of immunopositive cells and p53 index tended to grow as patients got older.

#### Conclusion

To sum up, age-related specifics of morpho-functional state of ageing skin are most fully reflected by indices of PCNA and p53 proteins expression – among all the studied parameters – which means that these can be used for assessing the biological age of skin. All the markers mentioned above are easily identified in immunohistochemical reactions, reflect fundamental processes and provide information about the functional state of skin. Their changes intimately correlate with patients' physiological age, and have peculiar age-related dynamics properties as well.

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## ECOLOGICAL-CYTOGENETICS ORIGINALITY OF SOME MAMMALS OF KEMIN REGION (KYRGYZSTAN)

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The results of study of karyotypesof isolated mammal, living in mountain conditions of Tien-Shan are given in this article. Additions in karyologic isolated mammal, living in mountain conditions of Tianshan are brought. Stability karyotype – the house mouse, the wood mouse, gray hamster, a big-eared hedgehog, the bat-dwarf in all breadths of their geographical spaces-lives is determined. For the first time in Kyrgyzstan chromosomal polymorphism inside a kind, at kinds – wood sleepyhead, tianshan baby-mouse, tamarisk chick-weed, tianshan wood field-vole, narrow skull field-vole, natural mole-rat, a gray marmot is determined. For the first time occurrence atits under influence of the raised natural radiating background at karyotype-tamarisk chick-weed, Kyrgyz field-vole and natural mole-rat is determined.

Keywords: ecology, cytogenesis, karyotype, a biodiversity, a chromosome, chromosomal polymorphism, a population, isolation, variability

Recently, one of the main directions in biology is the researches concerning conservation of biodiversity, species gene-bank and their bio-productivity. Biodiversity is studied at different levels of living systems. Currently, the study of biodiversity at the level of chromosomes attracts the researchers' attention, as differentiation at the level of karyology in isolated micropopulations is not always accompanied by morphological variability.

The study of chromosomal variability has great importance for assessment of genetic potential of wild animals. Stability of cytogenetic indexes of animals can be used as a biological indicator of interaction with the environment and identification of the consequences of environmental impacts. Since mammals are adjusted to life in different environmental conditions, their biological diversity is also emphasized. Therefore studies of mammals'karyotypes determine originality of populations within species, and some peculiarities of individual variability at the initial phase of divergence being a valuable factual material of biodiversity of mammals'species. The consequences of isolation leave their mark on karyotypes, which isexpressed in chromosomal polymorphism within the species at the level of population. Solution of these issues has great value for the development of the theory and practical problems of environmental cytogenetics. Such studies assess the impact of the environment on heredity and determine the continuity of exposure to environment, provide an opportunity to determine the causes and level of variability, as well as the driving force of evolution.

#### Materials and methods of research

The expeditionary gathering of animals carried out in the area of Kemin region and lab-

oratory studiesserved as the object of the study. Specimens of mitotic chromosomes were prepared of bone marrow cells according to the standard method [8, 247].

Hemiechinus auritus Gmclin. The karyotype ofeared hedgehog of Kemin population consists of diploid set 2n = 48, number of limbs NF = 96. Our findings agree with the literature data. According to the obtained results the karyotype autosomes of Kemin population consist of gradually decreasing row of 17 pairs of metacentric, 6 pairs of submetacentric chromosomes. In a row of metacentric chromosomes 2 pairs – the smallest metacentric chromosomes are found. While comparing karyotypes of spatially andbiotopically isolated populations of Hemiechinusauritus Gmelin biotopical and cytogenetic originality of karyotypes can be watched. According to morphology of twoarmed chromosomes and the results of all studies stability can be noted.

Pipistrellus pipistrelius Schreber. The karvotype of common pipistrelle, inhabiting in Kemin region, consists of the diploid number of chromosomes 2n = 44. Arms of autosomes  $NF^a = 50$ . Autosomes consist of 3 pairs of large metacentric, 1 pair of medium sized submetacentric chromosomes and gradually decreasing row of 17 pairs of acrocentric chromosomes. In a row of acrocentric chromosomes 3 pairs of the smallest acrocentrics can be observed. Sex chromosomes of male consist ofmetacentric and submetacentric chromosomes. While comparing the obtained data of common pipistrelle'skaryotype of Kemin population with other data it may be noted that the karyotype has spatial and biotopical stability.

**Marmota baibacina Kastschenko**. The karyotype of gray marmot of Kemin population has the following peculiarities. Diploid

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number of chromosome set is 2n = 38. Autosomes arms NF<sup>a</sup> = 70. 36 autosomes consist of 6 pairs of metacentric, 6 pairs of submetacentric, 5 pairs of subtelocentric and 1 pair of acrocentric chromosomes. X chromosome of metacentric, Y chromosome of submetacentric chromosome. While comparing the obtained data with other literature data, according to the number of diploid set the karyotype is the same all through the life, but according to the morphology it has spatial and biotopical chromosomal polymorphism.



Fig. 1. The karyotype Hemiechinus auritus Gmclin of Kemin population



Fig. 2. The karyotype Pipistrellus pipistrelius Schreber of Kemin population



Fig. 3. The karyotype Marmota baibacina Kastschenko of Kemin population

Sicista tianschanica Salensky. In the analysis of the karyotype of Tien Shan birch mice of Kemin population, we determined that the diploid number of chromosome setlike the karyotype of Issyk-Kul population is 2n = 32. But when comparing the morphology of the chromosomes of karyotypes of both populations we found out their morphological variability. Karyogram was made in each group according to the gradually decreasing row. Autosomes consist of four groups of chromosomes. The first group consists of 5 pairs of metacentric chromosomes, two of them are large, two are medium, and the other are of small size. The next group consists of 4 pairs of submetacentric chromosomes, one pair which is large, the others are ofmedium size. The third group consists of 3 pairs of subtelocentric chromosomes. One pair of them is large, one pair is middle and the last pair is

smallest. The last group consists of 3 pairs of acrocentric chromosomes. Sex chromosomes are composed of submetacentric and subtelomeric chromosomes. We note that according to our data, karyotypes of isolated micropopulations of Sicistatian schanica typehavespatial and biotopical chromosomal polymorphism.

**Apodemus sylvaticus Linnaeus**. According to our data, the karyotype of Kemin population consists of the diploid number of chromosomes 2n = 48. Arms of autosomes NF<sup>a</sup> = 46. All chromosomes are acrocentrics. They consist of gradually decreasing row. Sex chromosomes are composed of acrocentric chromosomes different insize. When comparing the karyotypes of spacially and biotopically isolated populationsit can be found out that the diploid number and morphology of chromosome set is stable.



Fig. 4. The karyotype Sicista tianschanica Salensky of Kemin population



Fig. 5. The karyotype Apodemus sylvaticus Linnaeus of Kemin population



Fig. 6. The karyotype Cricetuius migratoriys Pallas of Kemin population



Fig. 7. The karyotype Meriones tamariscinus Pallas of Kemin population

**Cricetuius migratoriys Pallas**. According to our data, the karyotype of gray hamster of Kemin population consists of diploid number of chromosomes 2n = 22. Chromosome arms NF<sup>a</sup> = 44. Chromosomes in karyogram make 3 groups. The first group is from gradually decreasing row of 5 pairs of metacentric chromosomes. The second group consists only of 1 pair of submetacentric chromosomes. The third group – of 5 pairs of subtelocentric chromosomes. The sex chromosomes are not identified. When comparing the obtained data with the literature data, the morphology of chromosomes is stable.

Meriones tamariscinus Pallas. According to our data, the karyotype of tamarisk gerbil of Kemin population consists of diploid number of chromosomes 2n = 40. Arms of autosomes  $NF^a = 74.38$  autosomes consist of four groups. The first group is from gradually decreasing row of 7 pairs of metacentric chromosomes. The second group consists of 5 pairs of submetacentric chromosomes, the third group of6pairs of subtelocentric chromosomes. The last group is composed of only 1 pairof acrocentric chromosomes. Sex chromosomes are composed of metacentric chromosomes different in size. During karyological studies, point chromosome sets - acentrics were found on some metaphase plates. Cells with such peculiarities comprise 1.47% of the total number of analyzed sets. We associate this peculiarity of karyotype of tamarisk gerbil of Kemin populations with high natural radiation background of some local parts of areal of "living space".

During capture of tamarisk gerbils, in some parts of its areal from the natural background was from 72  $\mu$ R/hrto 118  $\mu$ R/hr. We assume that under the influence of highbackground the primary radiation phenomena happened at the level of chromosomes – the break ofchromonema and formation of painted fragmentsacentrics. These acentrics being devoid of centromeres are incapable of correct orientation on the cleavage spindle, do not move to any pole, and these cells are eliminated. One of abiotic environmental factors – high natural radiation background – reduces the natural population growth of this species. **Microtus Kirgizorum Ognev**. According to our data, the diploid set of Kyrgyzfield vole consists of 2n = 54 chromosomes. Arms of autosomes are NP<sup>a</sup> = 76. Autosomal chromosomes form 3 morphological groups. The first group consists of gradually decreasing row of 7 pairs of metacentric chromosomes. The second group – also of gradually decreasing row of 5 pairs of submetacentric chromosomes. The last third group consists of 14 pairs of acrocentric chromosomes. Sex chromosomes are acrocentrics. Point chromosome sets – acentrics were found on metaphase plates of Kyrgyz field vole like tamarisk gerbil.



Fig. 8. The karyotype Microtus Kirgizorum Ognev of Kemin population



Fig. 9. The karyotype Microtus gregalis Pallas of Kemin population



Fig. 10. The karyotype Ellobius talpinus Pallas of Kemin population

Studied species	Sex	2n	NF <sup>a</sup>	М	Sm	St	Α	Sex	Peculiarities
								chromosomes	
Marmota baibacina of Kemin population	3	38	70	12	12	10	2	X(M), Y(Sm)	_
Marmota baibacina of Karatal- Zhapyryksky population [1, 78]		38	74	8	18	8	4	Sex chromo- somes are not identified	_
Dryomus nitedula of Kemin population	Ŷ	48	90	16	18	10	2	X(Sm), X(Sm)	_
Dryomus nitedula of Kadamjaypopula- tion [5, 147] [6, 81]	6	48	90	18	20	6	2	X(St), Y)A)	—
Sicistsa tianschanica of Chon-Kemin population	4	32	54	10	8	6	6	X(Sm), X(St)	—
Sicista tianschanica of Issyk Kulpopula- tion [1, 102] [3, 102]	8	32	56	10	12	4 j	4	X(A-St),Y(A)	_
Meriones tamariscinus of Kemin popu- lation	Ŷ	40	74	14	10	122	2	X(M), X(M)	Acentrics are found
Meriones tamariscinus of Toktogul population [4, 147]		40	74						4 metaphase plates are determined
Microtus gregalis of Kemin population	3	36	50	10	6	-	18	X(M), Y(A)	_
Microtus gregalis of Aksay population	8	36	50	10	4	4	16	X(Sm), Y(M)	—
Ellobius talpinus of Kemin population	Ŷ	54	54	2	-		50	X(A), X(A)	Acentrics are found
Ellobius talpinusof Chuya, IssykKul population [7, 91]	Ŷ	54 52 56	NF = 56	2	-		50	X(A), X(A) X(A), Y(A)	Heterotrophs are deter- mined

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Microtus gregalis Pallas. The karyotype of narrow-skulled vole of Kemin population consists of diploid number of chromosomes 2n = 36. Arms of autosomes are NF<sup>a</sup> = 50. Autosomes consist of 3 morphological groups

of chromosomes. The first group is 5 pairs of metacentric, the second group is 3 pairs of submetacentric and the third group is 9 acrocentric chromosomes. All groups are made according to decreasing row in size. Heterochromosomes:

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X chromosome consists of large metacentrics, Y chromosome – of smaller acrocentrics. The karyotype of narrow-skulled vole of Kemin population was compared with the karyotype of Aksai population consisting of the diploid number of 2n = 36, NF<sup>a</sup> = 50. The compared karyotypes of populations differ in morphology of autosomes, and in morphology of geterohromosomes. Thus, on the basis of these comparisons spatial and biotopical chromosomal polymorphism of narrow-skulled vole karyotypes can be seen.

Ellobius talpinus Pallas. According to our data, the karyotype of northern mole vole of Kemin population consists diploid set ofchromosomes 2n = 54, arms of autosomes are  $NF^a = 54$ . Sex chromosomes are acrocentrics. When analyzing the karyogram common vole of populations Kemin it can can be noted that there are no sharp differences in the morphology of the chromosomes, metacentrics can be seen only in two points, the rest are acrocentric chromosomes. Acentric sets are found in metaphase plates of northern mole vole, like tamarisk gerbil. We associate this peculiarity with the conditions of the natural radiation background of this environment - "living space". Due to the influence of this physical factor the same phenomenon as in the karyotype of tamarisk gerbil is observed.

Based on the conducted karyological researches of cytogenetics of some mammals of Kemin population the above-mentioned information can be summarized. The stability of karyotypes of eared hedgehog, common pipistrelle, wood mouse and grey hamster is seen in the number of chromosomes and morphology in all investigated "living spaces". Variability of karyotypes offorest dormouse, Tien Shan birch mouse, tamarisk gerbil, narrow-skulled vole, northern mole vole, gray marmot is manifested in the form of spatial and biotopical chromosomal polymorphism (table).

Due to the increase of the natural radiation background in certain local areas acentrics are formed in the karyotypes of tamarisk gerbil, northern mole vole, Kyrgyz field vole.

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## STRUCTURE AND BIOLOGICAL PROPERTIES OF THE COMPLEX OBTAINED BY THE POLYMER MODIFICATION IN AN IODINE-CONTAINING VAPORS

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A chitosan-iodine complex was obtained by modification of polymer powder in the vapor of an iodine-containing sorbate and studied by electron and IR spectroscopy, optical rotation dispersion. It was found that the electronic spectra of an aqueous solution of the modified chitosan (the source one and that stored for a year) showed intense absorption bands of triiodide and iodate ions, and also polyiodide ions, bound to the macromolecule by exciton bonding with charge transfer. Analysis of the IR spectra shows destruction of the network of intramolecular and intermolecular hydrogen bonds in the iodinated chitosan powder in comparison with the source polymer and the formation of a new chemical substance. E.g., the absorption band of deformation vibrations of the hydroxyl group disappears in the modified sample, and that of the protonated amino group shifts toward shorter wavelengths. The intensity of the stretching vibration band of the glucopyranose ring atoms significantly reduces. Heating of the modified sample at a temperature below the thermal degradation point of the polymer leads to stabilization of the chitosan-iodine complex. The optical activity of the chitosan modified in iodine-containing vapor is characterized by an anomalous dispersion of specific optical rotation [ $\alpha$ ] with negative and positive values. The absolute value of [ $\alpha$ ] significantly exceeds that of the source polymer. The calculated dispersion and rotational constants of electronic transitions in the optically active chromophores confirm the exciton-bound interaction between chitosan and polyiodide chains. Based on our studies, the hydroxyl and amino groups of the aminopolysaccharide have been recognized as the centers of retention of polyiodide chains in the chitosan matrix. It was revealed that therapeutic doses of the chitosan-iodine complex had no antibacterial action and exhibited no cytotoxicity. Prolonged iodine release from the chitosan matrix occurs in an acidic medium simulating the acidity of gastric juice.

Keywords: chitosan-iodine complex, modification, electronic and IR spectroscopy, optical activity, biological activity

Iodine is one of the most indispensable nutrients and is a unique (by biological activity) medicine in a pharmaceutical aspect. It is mainly used as part of an inclusion complex with polyvinyl alcohol or polyvinylpyrrolidone rather than in an individual form [1]. Iodine inclusion in such a synthetic polymer matrix allows reducing its concentration in the corresponding pharmaceutical and its toxic effects on the body, achieving a pronounced prolonged effect, and increasing the efficiency. Meanwhile, iodine immobilization in a biologically active polymer matrix, e.g. in chitosan, along with the foregoing, will make it possible to obtain a biodegradable dosage form with better biocompatibility with human dermal tissues as compared to iodine adducts with synthetic polymers [2, 3]. This determines the relevance of studying of the interaction of chitosan with iodine to find conditions for stabilizing this compound in the aminopolysaccharide matrix.

The following ways to prepare iodine-containing chitosan derivatives with a fixed iodine amount in the polymer matrix are known: addition of molecular iodine and iodic acid salts to a chitosan solution [3], mixing of polymer and iodine solutions [4-6], and restricted swelling of a solid form of chitosan (film, flakes) in iodine-containing solution [7, 8]. However, the iodine-chitosan complexes thus formed are thermally and kinetically unstable (their decomposition at 20-25 °C proceeds in ~5-10 days). R.Kh. Murzagildina [9] describe modification of chitosan films in the vapor above crystalline iodine to form film samples of iodine-containing chitosan with increased antibacterial activity. In order to obtain iodinecontaining derivatives, O.A. Belyakova [10] modified chitosan powder (the source material to produce film samples) in the vapor above an iodine-containing medium. Aqueous and water-alcohol solutions of iodide and iodineiodide, crystalline iodine were used as such media. In Ref. [11] it has been shown that the chitosan-iodine complexes obtained in this way are stable to heat treatment and storage (longer than a year).

Chitosan belongs to the class of optically active (chiral) polymers. The presence of asymmetrically substituted carbon atoms (chiral centers) in the chitosan macromolecules leads to the appearance of the optical activity of one unit and, as a consequence, that of the macromolecule as a whole [12, 13]. Chitosan modification in iodine-containing vapor may affect the general chiral structure of the polymer sample and, accordingly, may reflect on both the chiro-optical properties and the biological activity of the preparations obtained on its basis. For example, the difference in the optical activities of films made of chitosan of different molecular weight and modification is known to strongly affect their bacteriostatic action, until full loss of bactericidity [13, 14].

The aim of the present work was the preparation, spectroscopic analysis and evaluation of the biological activity of powdered chitosaniodine complex obtained by polymer modification in iodine-containing vapor.

#### Materials and methods of research

The chitosan-iodine complex was obtained by modifying chitosan powder in the vapor phase of iodine-containing media by the method described elsewhere [15]. A sample of chitosan hydrochloride with a viscosity average molecular weight of 38 kDa, a deacetylation degree of 80 mol%, and a bulk density of 0.78 g/cm<sup>3</sup> (Bioprogress Ltd., RF) was used. The vapor formed above crystalline iodine, 0.63 and 1.26% aqueous iodine-iodide solutions, and 5 and 10% water-alcohol iodine-iodide solutions was used as the sorbate. Aqueous and water-alcohol solutions of potassium iodide (KI) were used for comparison.

#### **Experimental part**

Obtaining of the chitosan-iodine complex

To obtain the chitosan-iodine complex, an air-dry polymer powdered sample was kept in the vapor formed above the surface of an iodine-containing media at  $20 \pm 2^{\circ}$ C to achieve an equilibrium sorption degree ( $C_s(t_{\infty})$ , wt%). The sorbed vapor amount was measured gravimetrically, by weighing the polymer sample on an analytical balance OHAUS Discovery DV215CD (accuracy  $\pm 0.0001$  g). The modified samples were stored under standard conditions: room temperature and normal atmospheric pressure.

#### **Spectroscopic analysis**

Absorption spectra were recorded on a UV2550 Shimadzu spectrophotometer (Japan) in a wavelength range of  $\lambda = 250-750$  nm with an accuracy of 0.3 nm in quartz cuvettes 1 cm wide relative to water. For analysis, aqueous solutions of polymer samples were used with concentrations of 0.01 and 0.1 g/dL. The IR spectra of powdered samples were recorded on an FSM 1201 (RF) Fourier spectrometer with an accuracy of 0.1 cm<sup>-1</sup>.

### **Optical rotation dispersion**

Optical rotation dispersion (ORD) spectra were recorded on a PolarAr3001 spectrophotometer, Optical Activity Ltd (GB) in a range of  $\lambda = 400-600$  nm at 25 °C. A temperaturecontrolled quartz glass cuvette 1 dm long was used, the solution concentration was 0.1 g/dl. The experimental conditions were standard, the error in measuring rotation angles did not exceed  $\pm 0.002$  deg. For the mathematical processing of ORD experimental curves, the Drude equation was applied:

$$[\alpha] = K/(\lambda^2 - \lambda_0^2),$$

where  $[\alpha]$  is the specific optical rotation, *K* and  $\lambda_0$  are the rotational and dispersion constants, respectively.

### Assessment of biological properties

The bactericidal activity was assessed by the in vitro diffusion method in agar relative to strains of the test cultures of Staphylococcus aureus (209 P) and Escherichia coli (113-13). To examine the kinetics of iodine release from the chitosan-iodine complex, a semipermeable cellophane membrane and model media simulating biological fluids were used: 0.1 M HCl solution with pH 1.1 (gastric juice), acetate buffer with pH 5.8 (saliva), borate buffer with pH 7.6 without and with the addition of pancreatin as an enzyme (the small intestine medium). The experiment was carried out at 37 °C during 4 h. The iodine released into the aqueous phase was analyzed spectrophotometrically, by its maximum absorption at  $\lambda = 600$  nm. using water-soluble starch as an indicator, the released iodine concentration was estimated from a calibration line. Cytotoxicity was evaluated by the in vitro method of culturing a test cell culture in a nutrient medium supplemented with aqueous solutions of some preparations based on iodine, chitosan and the chitosan-iodine complex. The MA-104 macaque embryo kidney epithelial cell line was used from the collection of the Virology Research Institute of the Russian Academy of Medical Sciences (RF). Cell adhesion and proliferation were observed on an inverted BiolamP microscope (RF).

#### **Research results and discussion**

It was established earlier that air-dried chitosan powder had a high affinity for iodine-containing vapor [10]. For example, when sorption of the vapor formed above an aqueous and water-alcohol solutions of potassium iodide with no iodine added, the maximum achievable values of the sorption degree are ~50–90 wt%. Iodine addition to the vapor-generating medium leads to an increased sorption degree (by 3–5), up to  $C_s(t_{\infty}) \approx 250-300$  wt%. An intermediate value of  $C_s(t_{\infty}) \approx 100$  wt% is observed during sorption of the vapor above crystalline iodine. In this case, the sorption kinetics of the vapor of iodine-containing media by chitosan powder is described by anomalous sorption curves, indicative of structural rearrangements of the polymer matrix [16, 17] and the formation of a new chemical substance [10].

As the vapor of iodine-containing media is sorbed, the color of the chitosan powder changes from light beige to dark brown and even black. The aqueous solutions of the source chitosan sample are colorless, while those of the modified one show red-violet staining. Besides, the solubility of the sample modified in the vapor of iodine-containing media changes. The source chitosan hydrochloride is readily soluble in water up to the formation of highly concentrated solutions ( $\geq 4-5$  g/dl). The water solubility of the modified chitosan decreases, but solubility in a 60–70% aqueous ethanol solution is acquired.

To establish the chemical composition of the chitosan adducts with iodine-containing vapor, freshly obtained samples and those stored for a year were analyzed by electron and IR spectroscopy.



solutions (1) and solutions of the chitosan hydrochloride sorbed the vapor over iodine-iodide aqueous solution (2, 5), water-alcohol iodine-iodide solution (3) and crystalline iodine (4): the source sample (2-4) and that stored for a year (5)

The spectrum of the aqueous  $I_2 + KI$  solution (comparison solution) exhibits two maxima at wavelengths of ~290 and ~350 nm, corresponding to the absorption bands of  $I_3^-$  and  $IO_3^-$  ions, respectively (Fig. 1, curve *I*). The spectrum of the aqueous solution (of a comparable concentration) of the chitosan hydrochloride powder sorbed the vapor over the aqueous iodine solution is also characterized by the absorption maxima of  $I_3^-$  and  $IO_3^-$  ions (curve 2). However, for the spectrum of the iodinated chitosan solution, a bathochromic shift of the

maxima of the spectral bands by  $\sim 3-5$  nm with simultaneous hyperchromic effect is characteristic. In addition, a third absorption band with a maximum at  $\sim 500$  nm is present in the spectrum of the solution of the polymer modified in iodine-containing vapor. It is believed that the absorption maximum at  $\sim 500$  nm for the I<sub>2</sub>-chitosan complex is due to the formation of exciton bonding between polyiodide ions and the macromolecule with charge transfer [4].

Similar spectra (with three intense absorption bands at  $\lambda = -290$ , -350 and -500 nm) were also observed for the solution of the chitosan hydrochloride powder absorbed the vapor over water-alcohol iodine-iodide solution and crystalline iodine (Fig. 1, curves 3 and 4). In this case, the hyperchromic effect of the maxima of the absorption bands of  $I_3^-$  and  $IO_3^-$  ions is significantly higher compared with both the solution of the sample kept in the vapor above the aqueous iodine-iodide solution (curve 2) and the iodine-iodide solution with no chitosan (curve 1). It should be noted that the spectrum of the chitosan adduct with iodine-containing vapor stored for a year has the same absorption maxima as the solutions of the freshly modified sample (curves 2 and 5). The intensity of the peaks at  $\lambda \sim 290$  and  $\sim 350$  nm increases, but that at  $\lambda \sim 500$  nm decreases. Nevertheless, the qualitative composition of the I<sub>2</sub>-chitosan complex does not vary, which confirms its stability when stored under standard conditions.

It was found that when the modified sample was heated at a temperature below the thermodestruction point of the polymer, the chitosan-iodine complex was stabilized. E.g., for an aqueous solution of the chitosan hydrochloride sorbed the vapor over aqueous iodine-iodide solution and heated at 130 °C for 15-60 min, a significant increase in the intensity of the absorption bands at  $\lambda \sim 290$  and 350 nm is characteristic, as well as a small increase of that at ~500 nm in comparison with the reference solution of the non-heated modified sample. When further heat treatment (120–150 min), the intensity of these absorption bands decreases, but the optical density values of the reference solution was not achieved. According to the literature data, during the heat treatment of chitosan, acylation of its amino groups and cross-linking of the chains may occur [18], the "hairpin" structure of the macromolecule may be stabilized [19]. Since the intramolecular hydrogen bonds formed under these conditions are sufficiently stable, they could be responsible for the stabilization of the chitosan-iodine complex during its heat treatment.

IR spectrometry has detected changes in the deformation and stretching vibrations of functional groups and other macrochain fragments caused by diffusion of the iodide-containing vapor into the chitosan matrix. For example, in the spectrum of the source chitosan hydrochloride powder, intense absorption bands with maxima at  $\sim$ 1,600 and  $\sim$ 1,380 cm<sup>-1</sup> are present, corresponding to antisymmetric deformation vibrations of the protonated amino group  $-NH_2^+$  and deformation vibrations of the hydroxyl group –OH (Fig. 2, curve 1). In addition, an intense absorption band at ~1,060 cm<sup>-1</sup>, belonging to the stretching vibrations of the C-O, C-N, and C-C bonds of the glucopyranose ring, was recorded in the IR spectrum of the source sample [20]. After sorption of iodine-containing vapor by the polymer, the maximum of the absorption band at  $\sim 1,600$  cm<sup>-1</sup> in the IR spectrum shifts toward shorter wavelengths (by ~100 cm<sup>-1</sup>), and the peak at  $\sim$ 1,380 cm<sup>-1</sup> disappears (curve 2). The band intensity at  $\sim$ 1,050 cm<sup>-1</sup> significantly reduces, which may be due to destruction of the network of intramolecular and intermolecular hydrogen bonds. All this testifies to the interaction of the sorbate vapor with the functional groups of chitosan during diffusion of the iodine-containing component and to some physicochemical coordination of iodine in the polymer matrix [21].



Fig. 2. IR spectra of the source powder of chitosan hydrochloride (1) and that modified in iodine-containing vapor (2)

Similar spectral (UV, IR) characteristics were also obtained in other works [5, 6] when studying of the complexation of water-soluble and acid-soluble chitosan with iodine in water and in an aqueous solution of nitric acid. The authors explain the results obtained by the formation of a host-guest chitosan-iodine complex consisting of an internal polyiodide chain surrounded by an ensemble of interconnected hydrogen bonds among the chitosan chains. Both hydroxyl and amino groups of the aminopolysaccharide were suggested to be the main centers to hold the polyiodide chain inside the chitosan matrix [5]. The results of our work confirm this assumption for the system "chitosan-iodine-containing sorbate vapor" as well.

For a more detailed study of the spatial structure of the powdered chitosan-iodine complex, its specific optical rotation [ $\alpha$ ] was measured, since optical activity is extremely sensitive to any, even subtle, structural changes in a polymer system. The sign and integral intensity of ORD depend on the structure and conformational features of the macrochains. For comparison, a source sample of chitosan hydrochloride and the chitosan adduct with iodine obtained by adding I<sub>2</sub> to the polymer solution were taken.

The ORD curve of the aqueous solution of the source powder of chitosan hydrochloride lies in the region of negative values of specific optical rotation, has neither a maximum, nor a minimum, nor an inflection point, i.e. belongs to the normal type (Fig. 3, curve 1). Dispersion curves of this kind are typical for the polysalt form of chitosan, either in solution or in a condensed film form. In particular, an analogous type of monotonous ORD curves with levorotation was observed for chitosan solutions in acetate buffer [12, 22], acetic acid [23, 24], as well as in chitosan acetate films [12, 13]. Analogous  $[\alpha] = f(\lambda)$  dependences also take place for chitosan films in the polybasic form obtained from acetic acid solutions of the polymer with subsequent transferring to the polybasic form using NaOH [13]. Iodine addition to the aqueous solution of chitosan hydrochloride leads to the appearance of an anomalous ORD curve characterized by both positive and negative values of specific optical rotation with  $[\alpha]$ sign inversion at  $\lambda \sim 480$  nm (curve 2). In this case, in the ranges  $\lambda < -450$  nm and  $\lambda > -530$ nm, the absolute value of optical rotation is higher than that of the solutions of the source chitosan hydrochloride. The sample sorbed iodine vapor (equivalent to the introduced I, additive) is also characterized by anomalous dispersion. However, the  $[\alpha] = f(\lambda)$  dependence twice changes the  $[\alpha]$  sign at  $\lambda \sim 465$ and ~585 nm, passes through maxima and is characterized by even higher absolute values of specific optical rotation (curve 3).



Fig. 3. ORD of the aqueous solutions of the source chitosan hydrochloride (1), the same solution with iodine addition (2), and the sample sorbed the vapor over crystalline iodine (3). The iodine addition to the chitosan solution is equivalent to the value of the sorption degree of the iodinecontaining vapor over crystalline I,

For the theoretical isolation of spectral bands of optically active chromophores and for obtaining additional parameters of electronic transitions in the macromolecules, the single-term Drude equation was used. Mathematical processing of our experimental ORD curves has revealed that the optical rotation of the source and modified (I, addition, iodine-containing vapor sorption) chitosan hydrochloride in aqueous solution is due to the contribution of optically active chromophores with different positions of their absorption bands (Table, the dispersion constant  $\lambda_0$ ). The contribution of the space-electronic transition to the total optical activity of the source and modified polymer system also differs (the rotational constant K).

The source chitosan hydrochloride in aqueous solution is characterized by one space-electron transition in the UV region (Table). I<sub>2</sub> addition to the polymer solution shifts the absorption wavelength of the optically active chromophores into the visible region. The rotational constant changes sign and increases by absolute value, although not very significantly. For the chitosaniodine complex obtained by modifying the polymer in the vapor over crystalline iodine, even higher values of  $\lambda_0$  and K are observed (the treatment was carried out using the left branch of the dispersion curve). The results of our mathematical processing of the ORD spectra are in satisfactory agreement with the experimentally obtained electron spectra of the chitosan adducts with iodine-containing vapor, in particular, with the electronic transition with the absorption maximum at  $\lambda \sim 500$  nm (Fig. 1).

It should be noted that the chitosan-iodine complex obtained by mixing the solutions of the polymer and  $I_2 + KI$  in acetate buffer showed an electron spectrum with an exciton absorption maximum at 500 nm and mutually separated bands with opposite signs (+, -) at 460 and 540 nm in the circular dichroism spectrum [4]. Therefore, the recorded  $[\alpha] = f(\lambda)$  spectrum of the aqueous solution of the chitosan-iodine complex, the calculated therefrom value of  $\lambda_0 \sim 530$  nm and published data [4] confirm the possibility of exciton dissociation with charge transfer and the exciton-bound interaction of chitosan and polyiodide chains.

Our evaluation of biological activity showed that the powdered chitosan-iodine complex in therapeutic doses had no bactericidal action against both gram-positive (*S. aureus*) and gram-negative (*E. coli*) microorganisms. Moderate bactericidal activity was observed only when the therapeutic concentration of the drug was doubled.

Values of the rotational and dispersion constants in the Drude equation for the source and modified chitosan hydrochloride in aqueous solution

Aqueous solution of chitosan hydrochloride	Drude equation constants				
	Dispersion constant Rotational cor				
	$\lambda_0 (nm)$	K·10 <sup>-6</sup>			
Source polymer	$300 \pm 5$	$-2.07 \pm 0.05$			
Source polymer + $I_2$ additive	$450 \pm 5$	$2.12 \pm 0.14$			
Chitosan-iodine complex (the polymer sorbed iodine-	$530 \pm 15$	$6.73 \pm 0.13$			
containing vapor)					

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Fig. 4. MA-104 cell culture after 2 days of cultivation in the standard nutrient medium (a) and that supplemented with aqueous solutions of our preparations based on iodine (b), chitosan hydrochloride (c) and the chitosan-iodine complex obtained by polymer sorption of the vapor over crystalline iodine (d). The concentration of the medicines administered corresponded to the therapeutic dose

When studying of iodine release from the modified chitosan matrix, it was established that the release of the medicinal substance in a 0.1 M HCl solution was prolonged, iodine release began immediately after the start of the experiment. In acetate buffer, the release of iodine is limited and begins only after 3 h of sample exposure in this model medium. In the borate buffers without or with the addition of pancreatin, no iodine release from the chi-tosan-iodine complex was observed.

Cultivation of the epitheliocyte cell culture of the macaque embryo showed no cytotoxicity for the chitosan modified in iodine-containing vapor. E.g., the adhesion and proliferation of MA-104 culture cells in the nutrient medium supplemented with solutions of chitosan hydrochloride and the chitosan-iodine complex occurred at the same time as in the reference medium. On the 2<sup>nd</sup> day of observation the cell culture in the standard nutrient medium formed a complete monolayer (Fig. 4 a). In the nutrient medium with the preparations of chitosan hydrochloride (Fig. 4 c) and the chitosan-iodine complex (Fig. 4 d), the monolayer was formed more slowly and small fields with the absence of cell growth in separate areas were observed. Nevertheless, on the 3<sup>rd</sup> day of cultivation, the formation of a full epitheliocyte monolayer was observed. In the nutrient medium supplemented with  $I_2$  solution, mass death of MA-104 cells was observed (Fig. 4 b). Only single cells showed adhesion, but did not proceed to division.

On the basis of our studies it can be concluded that the preparations based on the chitosan-iodine complex, as well as on the source polymer, exhibit no cytotoxicity. This fact testifies to the iodine in the chitosan matrix being in a bound state, weakly diffusing into the culture medium, and not adversely affecting the adhesion and proliferation of epithelial cells.

#### Conclusions

Our experiments and published data allow us to assume the following mechanism for the chitosan-iodine complex formation while the polymer is modified in the vapor of an iodinecontaining medium. At the first stage, the molecules of the sorbed components of the vapor phase condense on the surface of the polymer powder particles, and then diffuse into their bulk. As the iodine-containing vapor sorption does not obey Fick's law [10], the different rates of conformational changes in the macromolecules when the amorphous phase of the polymer is filled with sorbate molecules and

competing diffusion lead to a break of the intermolecular and intramolecular hydrogen bonding in the polymer and increase the segmental mobility of macromolecular chains [16, 25, 26]. Iodine interacts with the functional groups and other fragments of the microchains and a new chemical substance is formed (Fig. 1-3). Taking into account the fact that the chitosan macromolecules take on a helical conformation in highly ordered regions [19], it was assumed that iodine is embedded into the internal cavity of the helical regions of the mobile chitosan macromolecule to form a charge transfer complex. The hydroxyl and amino groups of chitosan serve the centers of iodine retention inside the macromolecular chain. The structural difference between our chitosan-iodine complex and the classical polysaccharide-containing amyloiodine clathrate is that the inner layer of the two-layered cylinder is represented by shorter polyiodide chains and the outer layer is by a "loose" polymeric helix.

Evaluation of the biological activity and cytotoxicity of our chitosan-iodine complex indicates the promise of its use in the design of iodine-containing preparations with controlled release, which would not adversely affect the microflora in the living organism.

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Study questions: We offer new interesting view for the amount of metabolic water formation from triglyceride. We hypnotized that water can be form during oxidation not only from fatty acid fatty acids protons but also from ADP and phosphoric acid when ATP is synthesized. This alternative way can give more water. In this work we calculate how many water it could be form during oxidation of the different biological molecules.

#### Keywords: organisms, chemical reactions, cellular metabolism

The living organisms' use the water as a universal solvent and it can participates in the chemical reactions and emerged from others reactions. The part of water which was formed during the process of cellular metabolism is considered to be metabolic water. There are several ways in which it may be formed: one of them through H+ HOwithdrawing from the same or different substances and interaction of protons and electrons with molecular oxygen (in the respiratory chain). The purpose of work is assessment of quantitative and qualitative of the metabolic water formed by oxidation of the main power substrate in the organism. The ways of using new formed water also will be considered.

# The water formed during the fatty acids oxidation

Oxidations of organic substances in the organisms are accompanied by energy exchange. This is a main source of metabolic water. For example: palmitic acid has structure of C16H32O7 and, processed from hydrogen that can lead to maximum formation of 16 molecules H2O, however one mole which is oxidazed is followed by formation of 146 mole of H2O [1, 3, 11]. Palmitic acid belongs to the fatty acids with an even number of carbon atoms. Mainly oxidation of similar fatty acids is carried out through the following stages: activation, transport into mitochondrion, beta-oxidation, Krebs's cycle, electron transport chain and oxidative phosphorylation. During the oxidation of palmitic acid the metabolic water, is mainly formed by two types of reactions:

1. ADP + Pi - ATP + H20;

2. 2e- + 2H+ + 1/202 -"H20.

The first reaction is catalyzed by FoF1AT-Pase. If considered that the coefficient of oxidizing phosphorylation (P/ O) NADN is equal to 2.5 ATP [7, 9] on each molecules of NADN are synthesized by 2.5 molecules of ATP and consequently the same amount of water. Each number of electrons and protons which are transferred to molecular oxygen from the redox coenzyme can give one more molecule of water. Thereby 3.5 equivalents of H20 are formed in a case with NADN. It is easy to count that one molecular palmitic acid during oxidation is formed from 31 equivalents of NADN or 31 x 3.5 = 108.5 equivalents of H2O.

If considered that P/O = 1.5 (for FADN2) [6, 8] and the mentioned above reactions, then total FADN2 will give 2.5 equivalents of H20. In total, oxidation of a palmitic acid formed 15 equivalents of FADN2 and 15-2.5 = 37.5 equivalents of H20. Thus, the amount of the formed metabolic water will be 108.5 + 37.5 = 146equivalents of H2O (Fig. 1).

In case of use of P/O = 3 or 2 for NADN and FADN2 respectively [1, 8] the amount of water formed will be 31x4 = 124 and 15x3 = 45and total 169 equivalents of H2O. Calculations in oxidation of palmic acid presented by Lehninger's show that 1mole will give 146 mole of H2O [1]. If from 169 to subtract 23 (the water which is used at stages beta-oxidations and Krebs's cycle) will give the same 146 equivalents of H2O. The equations offered for calculation of balance of water are labor-consuming therefore it is simpler to use the equations offered by author earlier [3].

# The water formed during the triacylglycerol oxidation

The catabolism of triacylglycerol (TAG) consists of the stage hydrolysis to free fatty acids and a glycerol with the subsequent oxidation of products. Stages of fatty acids oxidation include oxidation of a glycerol which is formed through transformation in dihydroxy-acetone phosphate, glycolysis, oxidative decarboxylation of pyruvate, Krebs cycle, electron transport chain and oxidative phosphorylation. For a quantitative assessment amount of water which is formed during oxidation TAG we used the follow equation H2Omet tg = 8 (m1 + m2 + m3) - 1.5a + 2.5 [3] where m - the amount of double bound in the fatty acid; a- the number of double bound in the fatty acid.

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Adding the corresponding number of atoms in the equation, we calculated water balance of oxidation 1-palmito-2-oleo-3-stearoglitserol:

H20met tg = 
$$8(16+18+18)-1.5-1+2.5 = 417$$
.

One mole of the TAG is equal to 860 g and its oxidation given the following water weight:

417-18 = 7506 g of (18 -the molecular weight of water). Drew up the corresponding proportion, and solving it we will get 872.79 g of water for 100 g of fat or 8.73 g of H2O for 1 g of TAG oxidation, that results many times differs from the commonly accepted data (1.07 g of water on 1 g of TAG [4, 5, 6, 8].



Fig. 1. Full oxidation of palmitoyl-Coa



Fig. 2. Two ways of full glucose oxidation



# The oxidation of carbohydrates and water formation

Oxidation of carbohydrates can be discussed on glucose. In fig. 2 there are two ways of glucose oxidation were shown. In the first way it was formed by 10 NADN and 2 FADN2 that will make 10 x 3.5 = 35 and 2 x 2.5 = 5 water molecules respectively or 40 moles of water on 1 mole of glucose. Given the fact that in glycolysis 2 molecules of water are formed, and in Krebs's cycle 4 molecules H2O were used (in two turnovers of a cycle) we will have 38 moles of water on 1 mole of glucose. The second way of glucose oxidation is formed by 14 NADN and 4 FADN2, which will give 59 moles of water. Taking into account the water which is formed in glycolysis (2H2O) and used in Krebs (8H2O) cycle as a result we will have 53 moles of water on one mole of glucose (Fig. 2).

Oxidation of 1 mole glucose (or 180.2 g) gives 38 moles of water, allow for the fact that its molecular weight of 1 mole water (18 g) we have 684 g of H2O, making up and solving the proportion, we get 379.58 g of water on 100 g of glucose or 3.8 g (after rounding) on 1 g according to. In the second way of oxidation after similar calculations we found that 5.3 g of water on 1 g of glucose. According to A. Lenindz-

her in case of oxidation of 1 mole glucose 44 moles of H20 is formed [1], which in recalculation will give 4.4 g of H2O. All three results will not be approved with reference data 0.55 g of water on 1 g of glucose [6].

# Formation of water during of oxidation of proteins

The catabolism of proteins includes the following stages: hydrolysis of proteins to amino acids, deamination or transamination, transformation of a carbon skeleton of amino acid to an intermediate metabolite of Krebs cycle, Krebs's cycle, electrons transport chain, oxidative phosphorylation. Because, there is a wide variety of amino-acids compositions in food and endogenous proteins only approximate calculation is possible. The calculation which is carried out for glutamic acid gives 4.04 g of H2O on 1 g of a substratum. According to reference data for proteins this size is equal to 0.41 g on 1 g of proteins (Fig. 3) [6].

### The daily amount of metabolic water

The diet consisted of triacylglycerols 100 g, and carbohydrates 400 g, and of protein 100 g [3] gives 873 g of H20 on 100 g of oxidation a triacylglycerols, from 1520 to 2120 g of H20

on 400 g of carbohydrates, 404 g of H20 on 100 g of protein (calculation was carried out with use of the data obtained by the author). Summarizing the results received above the daily amount of metabolic water will be from 3397 to 2787 g. This is enormous quantity which much exceeds these literatures data- 300 g of H2O per days of [4, 5, 6, 8]. People don't excrete this amount of water in the environment. The seeming paradox is easily explained by recirculation of the received water in ATP synthesis and decay. The most part of the water received in ATP synthesis reaction is then used in the exergonic reactions of hydrolytic splitting of ATP to ADP and Pi or to AMP and PiPi. In a day a person will metabolize about 400 g of endogenous protein (in hydrolysis reactions) and several hundred grams of an endogenous glycogen. Hydrolysis of food polymers in a gastrointestinal tract also uses a huge amount of water. Therefore, each molecule of metabolic water will be reused, gradually leaving the organism in accordingly with his need for water.

### Possible participation of metabolic water in work of FoF1ATPase

The final stages of carbohydrates, proteins and triacylglycerol catabolism is followed by formation of metabolic water, formed in the mitochondrion. Therefore the bulk of metabolic water is formed in these organelles. It is known that mitochondrions can change the volume, increasing or reducing [2]. Organelles should have an effective system of water removing by osmosis is unreal. At the cytoplasmatic membranes of many cells aquaporins exist which form the channels for water; however such proteins are not found in an internal membrane of mitochondrions. The most suitable applicant for a role of the water channel is FoF1ATPase which makes the return transfer of protons to mitochondrions matrix. Protons in the water environment are connected with a water molecule forming a hydroxonium ion (H3O +). If the hydroxonium ion freely moves in matrix on the channel formed by FoF1ATPase, then it is reasonable to assume that the same channel can be used for a transfer of the metabolic water outside. In the reaction catalyzed by Fo-F1ATPase there are conformational changes in catalytic beta-subunits of the enzyme [10]. Allegedly, return to initial conformation of these subunits can be performed due to the fact that the metabolic water hydrostatic pressure which is coming out through FoF1ATPase. Thus, recurrence in work of the enzyme is maintained both by ions a hydroxonium, and the hydrostatic pressure of metabolic water.

### The formation of water in the respiratory chain

Process of transfer of electrons in a respiratory chain is accomplish by their transition from high energy levels to lower and the marked-out energy and is used for creation of transmembrane electrochemical potentially. It is logical to assume that the water formed by such electrons shall be more low-energy, than which is formed by other methods. We will transform Enstein's equation E = mc2 to m = E / c2. Solving, this equation we will receive that transformation of electron leads to lowered energy, as result it's weight will decrease. The facilitated electron will leave on more distant orbitals that can increase a valence angle between oxygen and two atoms of hydrogen in a water molecule. Time of existence of such water will be measured in nano seconds, but it can be enough for making biological effect. For example, such water can enter to competitive relations with water of hydrate covers biopolymers can change their activity, and therefore a metabolism and transport through a mitochondrial membrane.

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## IMPLEMENTATION OF DEVELOPMENT FUNCTION OF BUSINESS ENTITY IN INVESTMENT AND CONSTRUCTION CYCLE

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Modern definitions of "development" are analysed. Three marketing situations related to initiation and implementation of development services are synthesized in classification development of the institution of a regional investment and construction complex (ISC). The definition of a developer as an ISC institution, integrated into all stages of the investment and construction cycle, based on its primary competence is given. Considering development as an integrated management function of the investment and construction cycle, based on its primary competence is given. Considering development as an integrated management function of the investment and construction cycle, aimed at reducing transaction costs, the authors logically pass to the synthesis of theoretical principles of its implementation. In this context, the essence and nature of development") and its bearer — a subject ("developer") are elaborated, which are a theoretical foundation, on which arguments on the organizational and economic principles of its integration into the investment and construction cycle may be based. Amplification of concepts of development as a form of economic and business practice is logical in the context of its operational and management functions analysis in the investment and construction cycle and their cost-economic parameters.

Keywords: Entrepreneurship, Development, Integration developer, Transaction Costs

Integration of subjects of investment and construction activities in the international capital markets indirectly through a business entity, it is positioned as "developers". What meets the established international practice, identifying the leaders of investment and construction activities, "general managers" ("general manager" - Hillebrandt P., 2000.) process, "... the transformation of investment capital in real estate" [1]. In the Russian practice of investment and construction activities "development" also emerged, on the one hand, positioned as an offer on the market, on the other hand, as an expression of a request from consumers – portfolio of interests. [2]. Formation of development as a new type of market services in today's regional investment and building complex (ISC) noted by many scientists and experts (see eg) [3]. Only one can distinguish Petersburg ISK more than 30 organizations that position themselves as "professional developer organization."

#### Background

Scientists, of course, noticed objectively observed process of integration into the regional development of the Russian Federation SUIT (2003-2013 years). Understanding the function of development in the development of investment and construction activities in Russia can be traced in many works, but, despite the relatively high number of publications, scientific discussion about the content of the institutional development as a function of the regional action is not completed. Nature development is understood as a function of ambiguously. Thus, a number of scholars, under development to mean the capital market, reflecting on the investment and construction cycle as an integrated system. As the allocation of the financial management function in the traditional, unchanged on the institutional form of investment and construction cycle is understood in. The authors of are inclined to the view of the real estate development as an organizational form of integration of investment and construction holdings, and in proposed their understanding of marketing as a form of positioning in the market of construction services. There is also a developers point of view on how business entities specializing in the real estate market It can be seen, and other points of view on development, each of which, on the one hand, explains one aspect of its operation, and, on the other hand, does not give an integral answer on its nature. It is therefore necessary to develop a picture of the genesis of this institutional form, formalizing an appropriate definition. To solve the problem analyzed the most famous definitions of development are considered forms of implementing the classification function and evolution of concepts of marketing situations that trigger in real estate development investment and construction cycle. The totality of these solutions has allowed to formulate a definition of scientific development, expressing the nature of the function:

- Understanding of the function as the operational development of the marketing concept developer and manager of real estate investment is lost with respect to the current stage of development of Russian regional ISC;

- Foreign authors in agreement in defining the conceptual core of development: the conversion of investment capital in real estate and related administrative processes; - Most of the "deployed" definitions have a process Defining the nature of a number of definitions simply list operations attributable to the developer within the investment and construction cycle. That is, this does not represent Defining the nature of the object.

The results allow to conclude that foreign authors are given only conceptual vision function, Russian – either localized to the level of a single operating functions (marketing, investments), or use the transfer operations attributable to the studied function. Certainly, we can agree with many of the existing conceptual and process interpretations, in particular, we share the position Helebrandt P. (Hillebrandt, P., 2000.) on the innovative development of the territory or property. But we do not see an objective definition of development, which could form the basis for a theoretical description of the business and organizational principles of its economic behavior.

On the other hand, generalized conceptual definition in foreign sources is complemented by the current classification of development organizations. The implication is that "... the diversity of developer contracts is not possible to localize it as a media unit process" [4]. The classification is based on a criterion for investment capital developer that defines two types of organizations. "The speculative developer" (English. - Speculative development) - the organization, post their own money in real estate (a subgroup released "Real Estate Development") [5] or land (allocated subgroup of "land development"). And the "fi-development" (eng. – Fee development) developer for a fee, not participating in its capital project, and is performed in relation to a management function. In Western countries (US, Western Europe) called types of development are equal to 50% to 50% prevalence [6]. However, in 2000 Gruneberg SL and Ive G.J. questioned the principle of determining the nature of the real estate development company, the evolution of their functions on the basis of "... the sources of investment capital for construction projects" [7]. We also share this doubt: in the surveyed organizations, domestic real estate management functions in relation to the investment and construction cycle is not associated with the presence in the subject of business investment asset. It is significant that as investors considered legal entities and individuals, as well as shareholders (residential properties). In any case, the general function of the developer is determined by money management within the investment and construction cycle, and not the management of assets owned.

#### Materials and methods of research

The methodological basis of the study of this work was the work of foreign and domestic economists who study the problems of institutional development of the regional CSI and the results of the research schools of St. Petersburg Architectural University: "Methodological problems of the effectiveness of investment and construction activity in the non-manufacturing sector", "Methodological problems of efficiency Regional investment and construction complexes as a self-organizing and selfregulating system". The main method of research is systematic and situational analysis.

#### **Case history**

Expand the essence and nature of development is possible through marketing, contract situations in which demand its competence, which is seen as a prerequisite for the evolution of the institute of managerial decisions on the placement of investment capital, management of the construction process, the implementation of the financial result from the operation of the property. On the subjective point of view of function initiation occurs when a developer solution of the customer's investment objectives. Primary investor financial competence as a carrier plans to place assets in real estate, it is not having a sectoral competence, invites "developer" - a specialist in the field of investment and construction management process measurement of financial perspectives, placement, construction and operation of the property. However, the designated view of the relationship does not change, and if the investment capital in the ownership of real estate development company, for example, in the case of holding structures. Division holding, business units enter into contractual relations because of different functional competence: holders of financial assets, marketing and sales organizations, production and construction, and others, but the subject of relations, initiating the function of development – the investor.

With the position of the subject observed variability investor and developer relations. Ivanov AS It identifies three subjects of relations: entrepreneurial idea, land and property. Accordingly, the three subjects of relationships raises three marketing situation initiation function development (consolidated view in Figure, Table) [8]. If the investor has the entrepreneurial idea of the material nature, that its implementation will be based on the purchase (lease) of land and property – the main fund for the implementation of the technological components of the business. This seems to be the
first marketing situation (B, Figure, Table) -adeveloper decides (for the investor) with the task of determining the optimal position of the property to the realization of the idea (technology) and relevant functional object land. The vectors in Figure represent sequential logic functions and initiate related subject area. The second situation is initiated (A, Figure, Table) the presence of an investor of land with the possibility of implementing it in the property for various purposes (residential, commercial, industrial, etc.). Choosing the best of the property from the standpoint of building land, its infrastructure within predetermined investment criteria - the subject of interaction between the developer and investor. The third situation (C, Figure, Table) occurs when an investorcustomer has an idea of the performance parameters of the property in respect of which the investment is made. For example, a retail store within the distribution network, which has a clear construction and operational parameters specified network franchise. In this case, the investor sets the developer the task of finding and assessment of land for the implementation of the investment project on it.

## Results of research and their discussion

Thus, the above described situation demonstrates the primacy of marketing relations "in-

vestor - developer" in the initiation of the investment and construction cycle. Indeed, if we talk about the issue of improving the management of regional SUIT by reducing transaction costs, the objective requirement for the cycle is determined by the presence of the manager of marketing (in other words - in business, commercial) competence in the field of real estate. Its presence "... allows the developer to see the horizon of the problem of building solutions – receive income on investments in real estate (land) capital investment" [2]. Entities having jurisdiction "marketing real estate" can reasonably be transferred from the investor a comprehensive, integrative (a position to cover all the operating components of the cycle) administrative function – development. An analysis of the definitions of classification approaches and points of initiation can reasonably offer a definition of development as a function of modern investment and construction cycle. Development as a function of management of investment and construction cycle in the interests of the investor (the customer) is based on the competence of the "marketing real estate", which differs from those previously expressed an emphasis on managerial activities of the developer, the customer of its implementation – the investor, the selection criteria artist - competence "marketing real estate."

	Marketing situation d	evelopment
	Initiation	Function
A	The property (lease) of the subject (the investor) has a plot of land in respect of which there are many variants of the functionality (with reasonable limitations).	The developer creates options (business idea) use of land from the standpoint of efficiency of plac- ing it on various objects.
В	The customer (investor, developer) has the entrepre- neurial idea (trade, production, etc.).	The developer determines the optimal configura- tion of the object to implement entrepreneurial ideas, the second defines the relevant land.
С	The customer has a need to form a given functionality and technical requirements of the object (online store, Residential, etc.).	The developer determines the most efficient site for the object with the specified functionality.

...



Three marketing situation initiation function developmen

Of course, the function is realized in the investment and construction cycle of business entities. From the position of the current English and Russian professional vocabulary entity that implements a function called "developer – the subject of developing the object." In the description of the content and business processes, economic activities, correct linguistic form from the standpoint of norms and rules of the Russian language – "a development organization" to be considered as synonymous "developer."

"Developer – an entrepreneur, initiating and organizing the best possible options for the development of real estate". [9]

However, a study of economic activities of developers revealed the ambiguity of organizational forms of realization of business practices. Detects mono organizations that include the name and positioning the same function: BKN-Development; BTK Development; START Development; Hans Development of St. Petersburg; CMS Development and others. The practice of implementation of development function is built on direct contractual agreements with investors in the framework of marketing situations (Figure). In the performance of control functions they attracted general contractors, industrial customers and other stakeholders, speaking to an investor as a management structure for the implementation of an integrated investment and construction of the project.

Also found a group of companies and holdings (Ecoestate; Becar; Prime Group; SUIT Universe; Lenoblzem; Megastil; LSS; Petrotrest and others), positioning itself as a developer company, but do not have the specialized legal entities. For example, the structure of "real estate development holding company LenSpetsSMU" in 2013 presented 29 legal persons, entities 9th – Institute for Regional investment and construction complex. "LenSpetsSMU" acts from the position of the developer of the integrated holding structure, in the absence of dedicated business units of the same name. That is, in the implementation of development function involved a number of legal persons holding related contractual relationship. Thus, regardless of the organizational form of building contract, the structure of affiliation of subjects to implement the function of development – an integrated process is implemented by a set of business units of the holding (s), or integrated into the framework of the contract specialized organizations. The stated position allows to update and develop the economy of presentation on the subjects of building a regional SUIT – media developer functions.

Developer – an entrepreneur, whose function is integrated management at all stages of the investment and construction cycle (the investment, construction, operation) in order to achieve economic goals of the investment project. Developer – an integrated regional investor claim.

## Conclusions

Idea about the property development as an institutional feature of modern regional CSI integrated into all stages of the investment and construction cycle. The analysis process is allowed to formulate a number of policy conclusions and develop the theory of economy of construction:

1) the integration of investment and construction activities in the international capital markets in real estate indirectly through business entities, is positioned as "developers";

2) clarify the understanding of the function of development – investment management stroitpelnym cycle, based on the competence of the artist – real estate marketing;

3) development of a specific developer as an integrated regional institution CSI investitionno control all stages of the construction cycle, to achieve the economic goals of the project. From this definition previously expressed different release types of economic activity – management; spread it on all stages of the investment and construction cycle; integrated nature of the business from a position of units, implements development function; expressed responsibility for the economic results of investment and construction projects;

4) Explain and demonstrate the principle of integration in the implementation of development function of holding and network (combined on the basis of the contract) by the subjects of regional investment and construction complex.

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# DEFINITION OF APPROACHES FOR IDENTIFICATION OF RISKS AT THE ENTERPRISES

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In article approaches and methods for identification of risks in modern conditions are considered. Part of them is based on quantitative approach, and a part on qualitative. One are based on the detailed analysis, and others on integrated. However all methods have a common goal – to reveal and describe the risks existing in the organization. It is more effective to use at the same time several methods as it will allow to obtain more reliable information for further assessment of risk. Also it is necessary to consider economic efficiency of the applied methods. For achievement of more thorough risk analysis at absence in the organization of the corresponding experts it is necessary to invite experts in the field of the analysis and assessment of risks and also it is possible to ask for the help in the specialized companies.

Keywords: modern conditions, risks, enterprise

For the analysis of features of structure of the enterprise and risks following from this, it is expedient to use a method of structural charts. This received at this method are used for assessment of internal enterprise and commercial risks. The type of structural charts depends from:

- size of the enterprise;

- type of management; organizationally - legal forms of the enterprise;

- the principle of division of powers and duties at the enterprise.

For the large enterprise it is more effective to make the basic chart for all enterprise in general, and then to build charts for divisions, departments and services. For identification of risks, trade and technological process of realization of the goods and services connected with material support of division it is necessary to lead discussions with key personnel. This method gives the chance of assessment of risk in dynamics and development of the forecast for prospect. But these estimates are subjective and depend on the attitude of the person towards risk [1].

The following method of identification of risk – the cards of streams reflecting technological streams of productions. This method is used for identification of basic elements (knots) of production on which his reliability and stability depends. At violation of the mode of elements and their exit out of operation there is an interruption of all production or there are critical emergencies. At the same time the process recorded in the concrete card can cover some one kind of activity of the organization, all internal productions or a separate technological chain [8].

All listed above methods are convenient that it is possible to receive them using modern means of communication. But there is a probability that when using these methods some moments will be not clear and there will be additional questions. Besides some facts could be missed. In this regard there is a need of obtaining additional information and check on places of its reliability. In this case the method of inspection trips is used. The efficiency of this method depends on qualification of experts who carry out this method. Inspections give the chance to reveal and specify separate nuances of the developed program of management of risk, to estimate possible costs for management at this enterprise, and to make recommendations about regulation of risk level. When carrying out this method it is necessary to define accurately the list of tasks which have to be solved. After definition of tasks it is necessary to make the program of visit of the enterprise. It is necessary to construct a certain logical scheme of identification of risks so that to minimize an opportunity to miss something essential. There are several ways for achievement of it. For example, preparation for each of subjects of special maps with the list of questions which should be specified.

Also inspections can be unexpected and beforehand informed. At unexpected inspection it is possible to reveal real deviations from the planned course of technological process or the violations of safety rules taking place. At the preliminary notice employees by the time of the beginning of inspection already possess necessary information that significantly reduces expenses of time [3,7].

The risk is one of the major financial categories, and as a result impact on degree and size of risk renders the financial mechanism, by means of special strategy and levers of financial management. Association of strategy and receptions creates a risk management. In its basis purposeful search of ways and the organization of the subsequent work on decrease in degree of risk is put [2].

The main goal of a risk management consists in receiving the maximum profit at a risk ratio, balanced, optimum for the businessman, with profit, this purpose is similar to the main criterion function of business.

The risk management is a control system of risk and the financial relations which arise in management process. Representing a control system, the risk management consists of two subsystems: the operated subsystem (object of management) and the operating subsystem (the subject of management).

The object of management in a risk management is presented by risk, risk capital investments and the economic relations of economic entities in the course of realization of risk. In Russia huge rates interest concerning risk management questions increases, and activity show not only experts, but also people who were far from economy, risk management and insurance recently [4].

Keen interest in a risk management is explained by the processes happening in modern Russian economy and in the insurance market, in particular. It is caused by the fact that in national economy deterioration in risk situations in the domestic commodity market is observed. Owners the enterprise have no desire or opportunity to participate in the investment projects directed on updating of fixed capital in volumes sufficient for its normal functioning. The policy of the state, despite attempts to change a situation to the best, but isn't possible to change situation yet.

In the developed European countries now production companies do replacement of the equipment each seven ten years which is to normal working conditions and creates acceptable conditions for creation of a risk management system, including use of an insurance and further reinsurance. Drawing a parallel with our country, it is possible to reveal that a situation on the verge with critical as for a risk management and insurance it is considered that "in due time" to update the equipment of times in forty years. So respectable "age" of the equipment and respectively strong wear of fixed capital, is also the main reason for severe losses of a domestic production on the world scene. Not less important factor aggravating a risk situation of the industry of Russia is shortage of responsible and qualified specialists. Thus, in industrial sector of modern economy of Russia the risk situation strongly differs from European towards uncertainty and huge complexity. In general, it is obvious that the risk situation in industrial and infrastructure sector of economy of modern Russia qualitatively differs from European towards bigger complexity and uncertainty, therefore, relevance of the questions connected with a risk management accepts the increasing value which won't cease to increase and in the future [4].

Interesting feature of a risk management in the Russian Federation, is, ensuring risk management of the enterprises of participation of consumers with mechanisms in the solution of approaches of the effective organization of reinsurance of the insured objects, it is connected with specifics of the Russian market of insurance and its low capitalization.

Absence of qualified specialists in the field of risk management, leads to emergence of undesirable "amateur performance", for avoidance of it is necessary to designate limits of applicability of a professional risk management, and to establish who can hold the risk manager's position in practice.

The main tool of a risk management is presented by insurance, as system of the relations on transfer of risks from the businessman to the insurer. Other tools used in a risk management are: self-insurance; carrying out preventive measures for prevention of negative impact of risks on activity of the organization; creation and ensuring functioning of societies of a mutual insurance; carrying out situation analysis following the results of which the directions on decrease in the extent of damage in case of negative influence of risks are developed [2,7].

As it was already told above development, justification and implementation of comprehensive programs the risk of management demands involvement of highly qualified and skilled specialists. But practice shows that a question of the one who and how has to realize this system of organizational and economic actions in the conditions of the developed market economy remains open. Ordinary managers who the works which are responsible for numerous sites settle down at various levels of an administrative branch and often are appointed traditionally executing functions on risk management. In the recent past of qualitatively organized, systematic risk management at the enterprises of the domestic industry didn't exist, experts were practically not attracted [12].

For the last decade situation coolly changed: the control system of risks undergoes and will continue to undergo the high-quality changes demanding from the Russian industrialists of proper response. More and more clear are a need and importance of allocation of a risk management in an independent subsystem of management of business activity, relevance of introduction of specialization and professionalizing of performance of functions of the risk manager is obvious [9].

The regular risk manager (one employee or the whole structural division) or the insurance broker operating in interests of the consumer of the made production and services in protection of the risks based on the principles of outsourcing can hold a position of the managing director of risks. The insurer if he doesn't represent the captive company, shouldn't execute function of the risk manager as it is the main tool on protection against risks

The increasing interest among domestic and foreign businessmen is caused by the instruments of protection against risks presented by mechanisms of self-insurance and societies of a mutual insurance. Growth of interest is very obvious, it is connected with changes which happen the last two decades in the relations of insurers and insurers. They are caused by noticeable strengthening of pressure upon consumers which proceeds from suppliers of insurance services.

The leading role in this process can be played as regular risk managers involved in structure of business and the insurance brokers. These organizational forms of government can be used by risks with great success for the solution of problems of a risk management. In parallel, it is always necessary to consider that the control system of a risk management demands high qualification, and especially, almost significant experience. It is supposed that in the next some years, well organized largescale training of qualitative professional risk managers by such curricula and programs to which it will be organically combined foreign and Russian achievements in the field of the theory and practice of risk management and which will meet completely specific requirements of modern domestic economy, a leading role when forming the market of services in risk management won't be provided vet, will occupy the insurance brokers having at the moment knowledge and necessary experience in the developed special Russian conditions.

Development of strategy and tactics and the next ways of implementation of programs of risk management through insurance brokers, gives to consumers, now, enough certain advantages. First, it is necessary to understand that the insurance brokers possessing special qualification and experience exercise risk management, for example, for a great number of various consumers that in comparison with the regular risk managers occupied in structure of business shows possession of unique knowledge and opportunities for formation of conditions and increase of efficiency of execution of these programs by insurance brokers. It occurs thanks to synergetic effect when experiment on development and implementation of programs of a risk management for various consumers is creatively used for other structures of business.

As the main tool of a risk management insurance acts, it is necessary to consider the following, one of the main tasks of a risk management is the anticipation of behavior of insurance companies in a situation when there comes need to pay insurance compensation on insured event. In the solution of this question of possibility of the broker is much wider as proceeding from the essence of own professional working activity it has a much bigger experience with various insurers, insurance brokers are familiar with policy of payments of insurance compensations of tens companies when the regular risk manager has knowledge of units of such companies [11].

At all this it is necessary to consider that fact that the most part of the insured production objects of the Russian Federation demands additional reinsurance, generally domestic owners of the industrial enterprises prefer the foreign market of insurance services. One more important and necessary function of the professional risk management wishing to be demanded is the organization and control of reinsurance. Obviously, as in this situation it is easier for insurance broker to define now that will support, and that won't support the foreign reinsurance market, than to the regular risk manager. At this stage overcautious persons of the foreign companies very seldom agree to conclude bargains on proportional contracts of reinsurance. More or less balanced conditions connected with the cost of reinsurance protection can be provided only with a placement combination in the foreign and domestic markets to use of the verified disproportionate schemes.

This reception in turn will significantly complicate work of the risk manager on participation in the organization and realization of insurance (reinsurance) protection, on management of losses of the industrial enterprise. Now it is difficult to the risk managers occupied in structure of business to take the qualified part in development and realization of various functions necessary for protection of consumers, but at regular structures and experts serious advantage before risk managers from outside as they remain more clear for the consumer will remain in most cases, and the third-party companies will be compelled to prove the loyalty. In other words, all this once again proves that in economy there are no universal perfect recipes, but at the moment insurance brokers, at the correct organization of their activity, look slightly more preferably than the regular risk managers occupied in structure of business. Very important thus that they, carrying out functions of risk managers, sought for providing an optimum combination of interests of consumers and service providers on protection against risks. Only then brokers will be able to become for the clients operating in Russia rather effective risk managers.

So, today becomes more and more obvious that the objective requirement of modern domestic economy consists in development not only the insurance market, as systems of the relations between insurers, insurers and the state, but also wider and difficult complex of the relations on ensuring protection of businessmen and house farms from risks. The relations on risk management, according to the contents, are beyond far insurance. Activity of professional risk managers has to become in modern conditions a key factor of development of these relations.

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# MANAGEMENT OF FINANCIAL RISKS ON THE BASIS OF INFORMATION MAINTENANCE

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In article the problem of emergence of financial risks when using information space is considered. Expansion and receiving profit were always the leading purpose of any organization. These two concepts are the cornerstone of the most part of solutions of economic subjects. The information system of a financial risk management represents a functional combination which provides indissoluble, purposeful process of selection of the corresponding informative indicators. These indicators are necessary for assessment, identification, preparation of effective administrative decisions which are necessary for neutralization of financial risks of the enterprise.

#### Keywords: management, financial risks, information maintenance

Depending on sources of obtaining information and contents of this information, risks will gain certain features which are characteristic for concrete risk. In other words, the structure and structure of data on various risks will strongly vary. In this regard, information support of process of management of risks is an independent specific problem.

Today information became the major resource which defines competitiveness of the organization in the XXI century. Without use of an automated control system for information streams, it is rather difficult to organization to achieve progress in competitive fight both in firm, and with external agents and environment [1].

Expansion and receiving profit were always the leading purpose of any organization. These two concepts are the cornerstone of the most part of solutions of economic subjects.

Information system of a financial risk management represents a functional combination which provides indissoluble, purposeful process of selection of the corresponding informative indicators. These indicators are necessary for an assessment, identification, preparation of effective administrative decisions which are necessary for neutralization of financial risks of the enterprise [1].

There are certain requirements to information which are as follows:

- The contents and structure of information have to be agreed with coordination structure of a control system of risk;

- Obtaining information at all levels has to be quick;

 The volume of data which are necessary for adoption of administrative decisions has to correspond to their contents and originality;

- Information needs to be obtained from various sources, it demands coordination of a control system of risk with other departments.

From the requirements given above it is possible to draw a conclusion that information which is necessary for management of risk is very various, its volume and structure can significantly change, and access to this information has to be rather quick.

All listed requirements can be fulfilled only if the information technologies used for information processing are used.

Identification of potentially dangerous financial, operational or system events and timely informing on their approach of all interested becomes more and more actual, the certificate to that is more and more tough policy of regulators on extension of requirements for ensuring stability to risks of a different orientation worldwide [3].

One of the most frequent examples of efficiency in the sphere of financial risks is decrease in risk at the worsening quality of the crediting which became possible thanks to distribution of risks between different specialized financial institutions, in particular, by hedge funds, banks, etc.

Besides division into the expected and unexpected risks is very important as well possibility of classification of types of risks that certainly will help with their classification.

Traditionally riskiness of a portfolio or the business solution is based on division of types of risks. Though modern researchers allocate a set of types of risks which the companies can face, it is possible to assume that key risks for the company after all are credit, market and operational risks.

The credit risk assumes risk of the losses connected with change of credit quality of an asset. This risk is generally expressed in change of category of recoverability of a loan, up to full nonpayment, and also in change of compensation rates for fight against this risk that can't but affect the cost and respectively a range of services [4, 9]. The market risk is under the influence of various market indicators which include interest rates, exchange rates, the cost of factors of production, demand, etc.

The operational risk assumes possibility of losses owing to failures in operating activities, caused by failures in work of the personnel (for example, the fraud, mistakes caused by a human factor), production and business processes (malfunctions or mistakes in work of system, natural or technogenic cataclysm, etc.).

The risk of information systems is the subspecies of operational risks of the company which is constantly influencing activity of the organization and connected with business process change, or their separate characteristics in the sphere of information technologies. It is capable to lead to catastrophic risks.

Risk reasons:

1. non-compliance with safety rules of work with information;

2. behavioural factors;

3. lack of information of the personnel of the organization concerning the principles of work with information or information systems;

4. imperfection of information support;

5. use of the software products inappropriate to features of the company.

Risk consequences:

1. loss of competitive advantage, decrease in profit;

2. the violation of process of data storage connected with loss or distortion of information;

3. increase of probability of failures in work of information systems;

4. financial losses as a result of purposeful impact on functioning of information system.

Features of risk management of information systems:

1. control is exercised by experts of IT of the sphere;

2. decrease in probability of emergence of information risks promotes timely training of the personnel;

3. information risks of the company decrease at implementation of continuous monitoring of the used information system [11];

4. control of efficiency of information systems can be transferred to the 3rd persons (most often to producers or workers).

The financial risk is the risk arising in process of management of financial means of the organization and representing probability of loss of means or a part of profit, or obtaining the unplanned income.

Shares on 2 main groups:

1. the risks connected with purchasing power of money;

2. the risks connected with a headband investment (investment risks).

The risks connected with purchasing power of money are presented in the form inflationary, deflationary currency and risk of liquidity.

The risks connected with an investment of a headband are presented by credit risk (risk not of return), percentage risk, risk of the missed benefit, risk of decline in yield, risk of real financial loss.

Ensuring information security — one of the main tasks of the modern enterprise. Threat can be posed not only technical failures, but also inconsistency of data in various registration systems which meets nearly at every second company, and also unlimited access for employees to information. How to reveal and minimize information risks (IT risks), read in this article [14].

Information risks — it is danger of emergence of losses or damage as a result of application of information technologies by the company. In other words, IT risks are connected with creation, transfer, storage and use of information by means of electronic media and other means of communication.

IT risks can be shared into two categories:

- The risks caused by information leakage and use by her competitors or employees for which can damage to business;

- risks of technical failures of operation of channels of information transfer which can lead to losses.

Work on minimization of IT risks consists in the prevention of unauthorized access to data, and also accidents and failures of the equipment. Process of minimization of IT risks should be considered in a complex: at first possible problems come to light, and then is defined, in what ways they can be solved.

The knowledge and understanding of different types of risks was always considered as very important component of decrease in risk as allowed to create various procedures for decrease in concrete risks by concentration of efforts on concrete threat of potentially negative impact and development of special strategy and procedures for fight against potential negative consequences.

It is important to note that similar classifications are very important, however it should be noted that they can also represent a source of a certain threat. In particular, on the one hand, possibility of identification of risk allows to describe it, to control, even to measure to a certain degree, and also to appoint responsible for prevention and elimination of negative consequences. With another, it is always possible that the reason of negative impacts lies somewhere between those risks which were classified at the first analysis stage. It creates failures in work on control, an assessment and appointment of executives [6].

The maintenance of system of information support of a financial risk management, its width and depth are defined by branch features of activity of the enterprises, their organizational and legal form of functioning, volume and extent of diversification of financial activity and some other conditions. Concrete indicators of this system are formed for the account as external (being out of the enterprise), and internal sources of information. In a section of each of groups of these sources all set of the indicators included in information system of a financial risk management is classified previously.

Creation of information system of a financial risk management is inseparably linked with introduction at the enterprises of the automated information technologies of financial management. Application of such technologies assumes use of the various software, modern computer aids and communication, the maximum approach of terminal devices on accumulation, storage and processing of information to workplaces of financial risk managers [17].

At the same time, it is necessary to consider that high extent of automation of financial information system strengthens risk of decrease in its safety, increases its vulnerability in relation to destructive influences of competitors and other interested persons.

It is necessary also to note that creation of the centers of the analysis and an assessment of the risks shared on types of risks is a complexity source in coordination and association of efforts in case of approach of dangerous events. In simpler situation when risks are rather accurately shared, such distribution of functions doesn't cause serious difficulties, the system works effectively.

For this reason, today researchers and managers of the companies even more often address to opportunities of a complex assessment of risks, including as it will be shown later, by means of packages of the specialized software allowing to create the information management system risks of the company. In fact, such system allows to reflect business solutions in much more obvious form, than it was made earlier. Of course, often similar decisions only structure the risk profile and values set for its assessment are subjective, however it should be noted that the values entered during the certain period of time already have value for the subsequent analysis at observance of necessary procedures of drawing up and ranging of the similar phenomena. Besides, it is necessary to tell that existence of similar systems not only can't replace need of the human analysis of the obtained data, but also imposes new requirements to training of specialists.

In general, It should be noted that effective information support of information assumes existence besides traditionally important elements, such both the speed and stability of the received results, and new features, namely opportunity to combine risk indicators, with operational or financial performance, so to be the real tool at acceptance not only decisions on acceptance, management and transfer of risk, but also at adoption of business solutions.

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# NEW APPROACH TO PREDICTING CHANGE IN AQUATIC ECOSYSTEMS WITHOUT HAVING LONG-TERM MONITORING DATA

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This work presents an analytical approach to predicting change in the components of aquatic ecosystems. The approach makes it possible to use hydrobiological data that covers a vast geographical region without long-term monitoring data. To address the absence of long-term data we suggest using space-for-time substitution approach whereby space and time variations are equivalent. It helps to have a "time scale" from geographical latitude of sampling points. Time series received are supposed to be used for prediction models' creation using artificial neural network method. New approach approbation was carried out upon original data on phytoplankton of 12 Eastern Siberia large rivers within 2000-2011. Three variables that had been previously found the strongest statistical relationship with climatic parameters were chosen as predictable indicators of phytoplankton: number of species/ number of families ratio, mean algal cells volume and total number of species in the sample. The prediction of these indicators changes was made, and the biological significance of neural network models was obtained as a result of this research. The main advantages and disadvantages of the approach were determined.

Keywords: prediction approach, space-for-time substitution, artificial neural network, alternative to long-term studies, climate change, phytoplankton, Large Subarctic Rivers, Eastern Siberia, Far North

According to IPCC assessment report, during the 20th century the average annual temperature at the surface of the Earth increased by 0.6°, the ice cover duration of inland waters in the middle and high latitudes of the northern hemisphere decreased by 2 weeks [1]. Issues of assessment and prediction of changes in the structure of aquatic ecosystem communities become more relevant due to global climate change. Obviously, the basis for building predictable models is the database obtained as a result of long-term monitoring observations. But due to the remoteness and inaccessibility for researchers at the vast areas of Far North, there is a lack or complete absence of longterm data on aquatic ecosystems. In contrast according to a number of researchers, transformations caused by global climatic changes may be the most dramatic in northern regions with continuous spread of permafrost [2]. Eastern Siberia is among these.

We discuss the aspects of the spatial floristic and coenotic structure of the largest rivers of Eastern Siberia phytoplankton in our last publication [3]. The materials that guide the study are an array of data on the phytoplankton of 12 large subarctic rivers, their hydrochemical, hydrological and morphometric parameters and climatic characteristics of the catchment areas. The information we obtained on phytoplankton has a wide geographical scale, but was not monitored, instead was selected on the rivers of Eastern Siberia in different years during the summer runoff low. From this the most important factors of the environment involved in the phytoplankton of large subarctic rivers spatial structure formation in the gamma-diversity scale were identified. The results we obtained

show that the formation of the spatial structure of phytoplankton in the rivers of NorthEastern Siberia occurs mainly under the influence of climate.

The aim of this research is to propose an approach to predicting change in the components of aquatic ecosystems due to global climate change in the absence of long-term data, exemplified by the phytoplankton of large rivers of Eastern Siberia.

## Materials and methods of research

As the material for this publication we use the data on phytoplankton of 12 large rivers of Eastern Siberia: Lena, Vilyui, Kolyma, Aldan, Olenyok, Vitim, Indigirka, Amga, Olyokma, Anabar, Yana and Chara (Fig.1). The study area lies from 106° 53' to 160° 58' E in the meridional direction, and from 56° 13' to 73° 10' N in latitudinal direction. 800 plankton algological samples were collected in 2000-2011 from rivers both near banks and at middle course, within the surface water level (0-0.3 m of depth), during the summer runoff low (June-August) at the maximum phytoplankton vegetation period. Collection and processing of phytoplankton samples were carried out according with the methods of hydrobiology [4].

The analyzed data set includes 3 quantitative variables: number of species/number of families ratio, mean algal cells volume ( $\mu$ m<sup>3</sup>) and total number of species in the sample. The data set contains only 303 observations (cases), which have no omissions that are inadmissible in the statistical data processing.

The statistical analysis procedures were performed in Statistica Automated Neural Networks (SANN) of Statistica 10 software package.



Fig. 1. Map of the studied area. References: 1 – Anabar River; 2 – Olenyok River; 3 – Lena River; 4 – Yana River; 5 – Indigirka River; 6 – Kolyma River; 7 – Vilyui River; 8 – Vitim River; 9 – Chara River; 10 – Olyokma River; 11 – Amga River; 12 – Aldan River

### Results of research and their discussion

The results of our previous studies revealed a special regulatory role of environment climatic factors in the formation of phytoplankton spatial structure in the Eastern Siberia rivers [5]. The main ones (air temperature, Dynamic Habitat Index, duration of ice-free periods on rivers) are those regional climatic factors that determine the overall ecological stress of high-latitude habitats. The complex of climatic parameters included in the obtained statistical models indicates an important regulatory function of the vegetation period duration. The main results of our research indicate that the shorter the ice-free period, the lower the floristic proportions of plankton, the smaller the mean cell volume, the smaller the total number of species and more in the Chlorophyta and Bacillariophyta phyla, the smaller the total number of species, and the larger the number of Cyanoprokaryota [6]. The key to understand the "environment-phytoplankton" model in the studied region, which is the important discriminating factor that we determined, is the geographical latitude of sampling points. We show that with increasing latitude of sampling points, the basic floristic relations are reduced, that means the proportion of monotypic taxa increases. To use this data in constructing a

predictable model, we suggest a space-for-time approach. The application of this method assumes that the spatial and temporal variations are equivalent as is known [7, 8].

The most important environmental factors in the spatial structure formation of the river phytoplankton in Eastern Siberia identified earlier by us are the duration of the ice-free period and the average annual air temperature, both change equivalently according to the "geographical scale" (with a decrease in the latitude of sampling points) and the "time scale", this follows from IPCC specialists' report [1].

From the perspective of this, when implementing our data to build a predictable model, the absent "time scale" should be replaced with the "geographical latitude of sampling points " variable. To construct the model, we chose the artificial neural network method [9] because of neural networks ability to model nonlinear dependencies [10].

The data was entered into our analysis as time series ranked by decreasing latitude of sampling points. We used three indicators that has the strongest statistical dependency on the environmental parameters as the predictable parameters of phytoplankton [6]: number of species/number of families ratio, mean algal cells volume and total number of species in the sample.

Index	Networks	Training per-	Test perfor-	Validation	Training	Hidden acti-	Output acti-
	name	formance	mance	performance	algorithm	vation	vation
1	MLP 151-8-1	0.96	0.74	0.60	BFGS 14	Logistic	Identity
4	MLP 151-8-1	0.88	0.67	0.57	BFGS 9	Tanh	Logistic
5	MLP 151-8-1	0.76	0.73	0.55	BFGS 5	Exponential	Tanh
2	MLP 151-3-1	0.75	0.70	0.60	BFGS 6	Logistic	Identity
3	MLP 151-2-1	0.54	0.72	0.61	BFGS 6	Logistic	Logistic

Summary of active networks (number of species/number of families ratio)



Fig. 2. Time series projection for variable "Number of species/number of families ratio". References: 1 – Species/families ratio; 2 – [1.MLP 151-8-1]; 3 – [2.MLP 151-3-1]; 4 – [3.MLP 151-2-1]; 5 – [4.MLP 151-8-1]; 6 – [5.MLP 151-8-1]

At the first stage the predictable model included floristic species/families ratio. To reveal the data internal cyclicity an analytical method of Time Series spectral (Fourier) analysis was used. The results showed that within the 303 observations data pool there is a periodicity, the value of which corresponds to 151 units. Using data on the internal periodicity and applying the time series regression we trained 50 neural network models with the condition of a random subsampling method. 5 more performance networks were left in the analysis, which will predict the analyzed series of observations (table 1).

All networks represent a multilayer perceptron by type with 151 input, 1 output and 2 to 8 hidden neurons. In addition to architecture of neural network models, the summary presents the training algorithm and the number of the final iteration on which the model is obtained, as well as the method for activating hidden and

output neurons. Networks are ranked by their performance, which is the correlation between the original data series and the predictable one, the closer this value is to 1, the better the model.

In order to predict changes in the floristic variable outside our sample set, a time-series projection was constructed (Fig. 2), where each next value of the time series is constructed from the previous values of the same time series. A continuous gray curve indicates the initial data series, other curves illustrate the predicted series for each neural network model. As we see in the graph of projections, most models, including the more performance ones, predict the growth of the floristic species/families ratio.

At the second stage, the total number of species in the sample indicator was included in the analysis. The results of Time Series spectral (Fourier) analysis showed the presence of internal cyclicity of data with 15 units period. A summary of 10% of the best neural network

Table 1

models is presented in Table 2. Since the indicator of phytoplankton species total number showed a less dependency on environmental factors in our earlier studies [6], the productivity of the obtained models is somewhat lower than at the previous stage of analysis.

The time series projection graph (Fig. 3) shows that all more performance models predict a small increase in the total number of species in the sample.

At the final stage, the mean cell volume was included in the analysis. The analytical check revealed the existence of cyclic data with a 11 units period. 50 neural network models were constructed, information on the 5 more performance ones are presented in the table 3.

The mean cell volume index, according to our information [6], had the least strong dependency on environmental factors of the three phytoplankton indicators included in our analysis. This is why our neural network models showed relatively low performance. The graph of the time series projection illustrates the prediction of a small decrease in the plankton algal cell volume (Fig.4).

Therefore, the results of our analysis show that due to current trends in climate change, one should expect an increase in floristic proportions as the most probable response of high-latitude phytoplankton communities, that means reduction in the number of monotypic species in the planktonic flora. It is also possible that the phytoplankton cells will decrease in size, which may be due to eutrophication of rivers. The possible increase in the number of algal species in the sample will probably results from invasive plankton species.

Table 2

Index	Networks name	Training	Test perfor-	Validation	Training	Hidden	Output acti-
		performance	mance	performance	algorithm	activation	vation
3	MLP 15-2-1	0.59	0.37	0.42	BFGS 39	Exponential	Tanh
25	MLP 15-2-1	0.56	0.24	0.38	BFGS 23	Logistic	Identity
9	MLP 15-5-1	0.51	0.24	0.32	BFGS 7	Identity	Identity
7	MLP 15-7-1	0.51	0.23	0.32	BFGS 6	Identity	Identity
20	MLP 15-7-1	0.51	0.22	0.31	BFGS 6	Identity	Identity

Summary of active networks (total number of species in the sample)



Fig. 3. Time series projection for variable "Total number of species in the sample". References: 1 – Total number of species in the sample; 2 – [3.MLP 15-2-1]; 3 – [7.MLP 15-7-1]; 4 – [9.MLP 15-5-1]; 5 – [20.MLP 15-7-1]; 6 – [25.MLP 15-2-1]

Index	Networks name	Training	Test per-	Validation	Training	Hidden	Output
		performance	formance	performance	algorithm	activation	activation
16	MLP 11-7-1	0.38	0.39	0.73	BFGS 6	Logistic	Identity
17	MLP 11-2-1	0.37	0.38	0.74	BFGS 7	Logistic	Identity
18	MLP 11-6-1	0.38	0.37	0.74	BFGS 6	Logistic	Identity
19	MLP 11-5-1	0.37	0.40	0.74	BFGS 7	Logistic	Identity
20	MLP 11-3-1	0.37	0.39	0.74	BFGS 5	Logistic	Identity

Summary of active networks (mean cell volume)



Fig. 4. Time series projection for variable "Mean cell volume". References: 1 – Mean cell volume; 2 – [16.MLP 11-7-1]; 3 – [17.MLP 11-2-1]; 4 – [18.MLP 11-6-1]; 5 – [19.MLP 11-5-1]; 6 – [20.MLP 11-3-1]

### Conclusions

We presented an approach that makes it possible to predict changes in the components of aquatic ecosystems using data that covers a vast geographical region without long-term monitoring information. The approach has its limitations. Thus, the "time scale" introduced by us into the analysis is obtained by the spacefor-time substitution, has no real time values, therefore is not locked to time, and does not allow to analyze the time scale of the obtained prediction. The result of the prediction only states the current change trend in the analyzed variable. In addition, the analysis of time series allows one model to perform a prediction for only one target variable.

Despite the limitations, our approach will be useful for statistical prediction of aquatic ecosystems components in the poorly studied regions of the North and Siberia, which often lack long-term monitoring data on many components of aquatic ecosystems. An important advantage of the proposed approach is that it is based on analytical methods of statistics and allows you to get away from subjectivity in prediction problem solutions, which become more relevant today.

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Table 3

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The article opens a subject of responsibility of health workers in professional activity, types of responsibility for professional offenses and crimes, also speaks about necessity of the unique medical code. Health and life of citizens are one of the basic elements protected by the Russian Constitution (article 41). Everyone has the right to health protection and medical care. Mistakes of health workers can lead to violation of the rights of citizens for health and life. The greatest harm to the patient and or his relatives brings violation of confidentiality of information on life and health of the patient mentioning its cultural and social wealth. It is information on sex change, existence incurable a disease, the facts from private life of the patient. Obligatory condition of responsibility for infliction of harm is the causal relationship between illegal behavior and the done harm. For example, if harm isn't a consequence of illegal behavior of the causer of harm, and has happened for other reasons, because of non-compliance with medical recommendations by the patient or owing to specific features of an organism of the patient, in the causer of harm there will be no duty to compensate harm.

Keywords: medical activity, professional responsibility, professional crimes, medical code, health workers

Professional activity of the health workers is based on three main concepts: professional training, professional ethics and professional legislation. Doctors and health workers receive professional skills in educational institutions of system of medical education. Ethical bases of a profession in process of studying of norms of medical ethics.[2] The international base of assessment of professional and moral qualities of health workers are such well-known documents as "Universal Declaration of Human Rights" (1948), "The declaration of the rights of the child" (1959), "The convention of the UN on the rights of the child" (1989), the Geneva declaration (1949), "The international code of medical ethics" (1949), "The convention on the rights and advantages of the person in connection with application of achievements of biology and medicine" (1996) which precisely and in detail state standards of professional medical morals.

Now the most vulnerable link is professional legislation. The main issue promoting emergence of the conflicts between doctors and patients is the lack of the accurate legislative base. The legislation of the Russian Federation defines the following types of responsibility of health workers for non-execution or inadequate execution of professional obligations:

- moral;
- disciplinary;
- material;
- civil;
- administrative;
- criminal.

The moral responsibility is such type of responsibility which comes at violation by health workers of moral and ethical standards and the principles and rules of conduct based on them during performance of a professional duty. She comes at violation by health workers of the principles of ethics and medical ethics [6].

The disciplinary responsibility is such type of responsibility which comes at commission by workers of minor offense on the bases provided by the Labor Code of the Russian Federation. The labor legislation understands non-execution or inadequate execution by the worker as the concept "minor offence" through his fault of the labor duties assigned to him. For commission of minor offense the employer has the right to apply the following types of disciplinary punishments to the worker: remark; reprimand; dismissal on the corresponding bases [3].

Administrative responsibility is a type of responsibility which comes at violation of the established state or public order, infringement of property, the rights and freedoms of citizens the existing order of management, etc.

This Code of the Russian Federation has regulated such questions as protection of the personality, protection of the rights and freedoms of the person and citizen, protection of public health, sanitary and epidemic wellbeing of the population, protection of public morality, environmental protection, an established order of implementation of the government, public order and public safety, property. Administrative offense involves administrative punishments which can be applied in such look as:

- prevention;
- administrative penalty;

- confiscation of the tool of commission of violation or subject;

- deprivation of the special right granted to the natural person;

- administrative detention;

- disqualification, etc. [4]

The liability of the parties can be concretized by the employment contract signed in writing or the agreements attached to it. The employer who has caused damage to property of the worker indemnifies this loss in full, and his size is estimated at market prices, acting in this area at the time of compensation of damage [3].

Civil responsibility is such type of responsibility which comes at violation of the established norms of civil law, non-execution or inadequate execution by the person of the duties with the legal consequences violating the subjective civil rights of other person. This responsibility consists in application to the offender (debtor) for the benefit of other person (creditor) or the state established by the law or the contract of corrective actions.

The civil legislation defines cases of emergence of civil responsibility and without fault when harm of life or to health of citizens is caused:

- a source of the increased danger;

- as a result of illegal condemnation of the citizen;

- illegal criminal prosecution;

- Dissemination of the data discrediting honor, advantage and business reputation, etc.[6]

Criminal liability – a type of responsibility which comes at commission by health workers of the guilty socially dangerous act forbidden by the Criminal code of the Russian Federation under the threat of punishment. To consequences of crimes against life and health the term "harm", is applied to material consequences – "damage".

Criminal liability comes for commission of crime with the signs defining socially dangerous act provided by the Criminal Code of the Russian Federation and characterized as crime. Crimes where the health worker can be the subject of crime:

1. Crimes of small gravity:

– Office forgery (Art. 292 of the Criminal Code of the Russian Federation).

2. Moderately severe crimes:

- Negligent homicide (Art. 109 of the Criminal Code of the Russian Federation);

- Causing heavy or moderately severe harm to health on imprudence (Art. 118 of the Criminal Code of the Russian Federation);

– Infection with HIV infection (Art. 122 of the Criminal Code of the Russian Federation);

- Illegal production of abortion (Art. 123 of the Criminal Code of the Russian Federation);

- Not assistance to the patient (Art. 124 of the Criminal Code of the Russian Federation);

- Substitution of the child (Art. 153 of the Criminal Code of the Russian Federation);

- Illegal private medical and pharmaceutical activity (Art. 235 of the Criminal Code of the Russian Federation);

– Negligence (Art. 293 of the Criminal Code of the Russian Federation).

3. Serious crimes:

- The illegal room in a psychiatric hospital (Art. 128 of the Criminal Code of the Russian Federation).

4. Especially serious crimes:

- Murder (including euthanizing) (Art. 105 of the Criminal Code of the Russian Federation);

- Deliberate causing heavy harm to health (Art. 111 of the Criminal Code of the Russian Federation);

- Taking of a bribe (Art. 290 of the Criminal Code of the Russian Federation).

In the long term, all sections Medical the code has to be compounded and completely correspond to other branches of the right: criminal, civil, labor, family, international. Creation of the medical code – Complex and multilevel work which performance considerably will facilitate professional activity of health workers will also be a guarantee of health of patients and also the basis for prosecution, both medical personnel, and patients.

Features of forensic medical examination in cases of involvement of health workers to criminal liability for professional offenses [5].

Cases on charge of health workers of cases of professional offenses usually arise: 1) according to the complaint of patients (or their relatives); 2) at the initiative of administration of treatment and prevention facilities.

In order to avoid insubstantial accusation of the doctor a certain order of initiation of legal proceedings at professional offenses of health workers is provided. As a rule, before initiation of legal proceedings upon the revealed gross blunders and defects of delivery of health care the departmental special commission for conducting office investigation at the level of regional, city and other higher body of health care is created.

Tasks of the commission: 1. comprehensive assessment of the organization and quality of delivery of health care and also date of a post mortal examination or medico-legal research; 2. registration of results of office investigation in the form of "Conclusion" in which deciding part the revealed short comings and errors of delivery of health care, the reason and a condition of their emergence, communication with a disease failure are specified; 3. the direction of materials of check (no later than 3 days after its end) in prosecutor's office. Legal sciences

When an inspection is carried out upon the demand of prosecutor's office, term her shouldn't exceed one month. Originals of medical documents, written explanations of the health workers who have allowed violations are subject to transfer to prosecutor's office together with "Conclusion".

When obtaining results of office investigation the prosecutor decides on initiation of legal proceedings, and the investigator (at initiation of legal proceedings) issues the decree on purpose of forensic medical examination.

Forensic medical examination in such cases is carried out "commission" as a part of the forensic scientists and highly skilled doctorsclinical physicians having, as a rule, academic degrees and ranks or a long standing and experience.

Except "Conclusion" of departmental office investigation, all criminal case file, including original medical documents (cards out-patient and the inpatient, operational register, sick-lists, X-rays, electrocardiograms, etc.), and in case of death – the Conclusion of forensic medical examination of a corpse or the protocol of post mortal examination of a corpse and this all additional and laboratory researches is provided to medico-legal commission of experts.

Typical questions which are raised on permission of examination is the following:

 timeliness and correctness of diagnostics of the damages or diseases which are available for the patient;

 timeliness, completeness, correctness and efficiency of performing treatment.

In case of carrying out surgery:

– existence or lack of indications (absolute or relative);

- timeliness and correctness of technical performance of operation;

- correctness of preoperative preparation and postoperative maintaining patient;

- existence of defects in diagnostics and treatment of a trauma or disease;

 by whom specifically they were allowed; their reasons;

- a role and a causal relationship with the come adverse effects;

- correctness of maintaining medical documentation.

Except listed, on permission of commission of experts also other questions following from features of a concrete case can be raised.

According to the criminal procedure legislation the commission of experts can request additional materials, be present at interrogations of defendants and witnesses, to ask them through the investigator questions. The health worker made responsible with the consent of the investigator has the right to be present at discussion of questions and answers, to specify details of the facts of the case, to raise additional questions on permission of commission of experts, to announce branch any of experts and to ask to designate other persons as experts.

It is also necessary to distinguish professional medical offenses and crimes and medical mistakes.

The main signs qualifying a medical mistake are: observance by health workers provided by the law and customs of rules of professional behavior. In medical practice situations when health or life of the patient can be kept meet or aren't kept depending on a number of subjective and objective factors. A problem of qualification of a medical error most often connect with such situations.

In medical literature several opinions on the concept "medical mistakes" are expressed. One experts consider that this "nonpunishable" conscientious delusion in the absence of negligence, negligence which has entailed deterioration in a condition of the patient or his death. According to other look the medical mistake is the wrong, negligent, unfair actions at delivery of health care.

From the legal point of view among medical errors the patient needs to distinguish illegal guilty acts of health workers and cases of infliction of harm in the absence of fault. Illegal, guilty acts are qualified as crimes or offenses and attract criminal, disciplinary, civil liability. If in infliction of harm health of the patient doesn't have fault of medical stuff, then there is no specific structure of offense also, so, there is no responsibility also. Thus, it is necessary to speak about existence of the subjective and objective reasons of mistakes at delivery of health care.

The subjective reasons of punishable medical mistakes which lead to infliction of harm to health of the patient or his death are, for example, inattentive or incomplete inspection of the patient, negligent performance of operations, inadequate assessment clinical and dates of laboratory, the wrong wording of the diagnosis, negligent care of the patient. They are made owing to imprudence or the insufficient level of knowledge.

Types of medical mistakes:

1) diagnostic (in recognition of diseases and their complications, viewing or the wrong diagnosis of a disease or a complication);

2) medical and tactical (are as a result of diagnostic mistakes);

3) technical (miscalculations in carrying out diagnostic and medical manipulations, procedures, techniques, operations);

4) organizational (disadvantages of the organization of these or those types of a medical care, necessary operating conditions of this or that service);

5) deontological (in behavior of the doctor, his communication with patients and their relatives, an average and junior medical staff);

6) mistakes in filling of medical documentation (obscure, inexact records of operations, the wrong maintaining the diary of the postoperative period, an extract at the direction of the patient in other medical institution) [7].

Harm can be done to the patient by any employee of healthcare institution which provided it a medical care. Definition of negligence of personnel can be simple in some affairs, but in others to give the correct qualification happens very difficult. Often there is a question: who bears responsibility from quite big stuff of clinic which can include the general practitioner, the consultant, other specialists of hospital and also junior medical staff.

Definition of a causal relationship between estimated negligence of stuff which allegedly became the harm reason and harm can be also somewhat difficult. A claim can be submitted immediately against the doctor when there are bases to assume negligence from its party. If harm is done by the employee of healthcare institution, then the patient can use several opportunities for protection of the violated rights: to submit the statement of claim against the specific health worker from whom, according to him, harming, against medical institution or against both took place, attracting medicoprophylactic organization as the codefendant. In practice many claims are submitted against healthcare institutions.

The objective reasons of medical mistakes (atypical course of a disease, abnormal anatomic features of the patient, unexpected allergic reaction) though attract infliction of harm to health of the patient or his death, but don't attract legal responsibility.

Jurisprudence on the affairs bound to infliction of harm to the patient at delivery of health care recognizes lack of fault of medical institution, medical personnel if the last didn't expect and couldn't expect that its actions will do harm to health of the patient.

Summing up the result, it should be noted the following. The main tasks of the state in the field of protection of public health:

- improvement of quality and increase in availability of medical care;

 implementation of the federal and territorial target programs aimed at providing sanitary and epidemiologic wellbeing of the population;

- creation of the economic and social conditions promoting decrease in prevalence of negative risk factors and reduction of their influence on the person.

Also health workers need not to forget about basic provisions from an swear of the doctor and about moral aspects of their professional activity, certainly, based on professional abilities, knowledge, skills and to be guided by base of the current legislation and knowledge of legal consequences of the actions or nonactions [1].

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## PRACTICAL CASE OF SUPERVISION OF A PATIENT WITH MENDELSON'S SYNDROME

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The article deals with the discussion of Mendelson's Syndrome as one of severe complications, developing with improper conduct of prenatal procedures in obstetric anesthesiology. The relevance of Syndrome is that with late diagnosis it can conduct to death. The discussion touched upon issues of pathogenesis, clinics, misdeeds resulting in the development of the Syndrome. The article adequately covers matters of the Syndrome prevention while emergency rapid interventions and preventive treatment relating to prevention. The article also provides an example of successful removal of this Syndrome and an example of clinical management. According to medical statisticsover the past five years, lethality resulting from aspiration Syndrome in Chuvash Republic is 0,5-1 %.

Keywords: Mendelson's Syndrome, intubation, regurgitation, aspiration pneumonia, bronchial obstruction, acid stomach contents, metabolic acidosis, respiratory alkalosis, hypoxemia, clinical performance, case history

Mendelson's Syndrome (medical term: Gastric Juice Aspiration Syndrome) is a medical condition developing within the process of oppression of laryngo-pharyngeal reflux. For the first time, Gastric Juice Aspiration Syndrome was diagnosed and described in 1946. The author of the investigation was S.L. Mendelson. The pathologywas viewed as the most severe complication developing with improper conduct ofprenatal procedures in obstetric anesthesiology. There are the numbers of factors that predispose to aspiration or regurgitation of gastric juice: the impairment of consciousness, which are associated with being under general anesthesia or alcohol (drug intoxication); the effect of previously used sedatives; the patient's craniocerebral injury; staying in the coma. The relevance of Syndrome is that acidcomponent of stomach goes directly to the bronchus, lungs and lower respiratory system. This results in a formation of inflammatory reaction, which is worsening due to burn of external surfaces of mucous membranes. The pathology clinical performance is developing within several minutes and is worsening within some following hours. There are 3 consecutive phases in this pathological changes: the acute larvngo and bronchiolospasm, the partial relief of bronchiolospasm and the gradual increase in the symptoms of acute respiratory failure. The aspiration pathology morphologically manifests the alveolar exudate, it contains the fibrin, polymorphonuclear leukocytes and macrophages. The strengthening pulmonary edema can affect both local areas and large areas, up to the manifestation of necrosis of alveolar septa. The Mendelson's Syndrome is characterized by damage of the endothelium of the capillaries and vascular thrombosis. This causes atelectasis, which is associated with the gradual destruction of the surfactant

lining the alveoli. The another pathological process is taking place together with this: the massive exudation of erythrocytes with the formation of hyaline membranes. When the particle of fluid enters the lungs, hemorrhagic edema first develops, gradually complicated by a granulomatous reaction with damage to the bronchioles and alveolar wall. Severity of injury depends on gastric juice acid level pH and volume of this liquid entered the respiratory system Mendelson's Syndrome relates to iatrogenic complications. It has poor course of disease and high risk of mortality. The cause of patient death can be [1]:

• airway obstruction with pieces of undigested food resulting in asphyxiation.

• symptoms of severe aspiration pneumonia in case when stomach content enters lungs, in this environment acidity can be even below 2,5;

• Gastric Juice Aspiration Syndrome presents at patients when gastric juice enters bronchi and trachea.

Worsening of respiratory failure of 1-3 grade presents on the first level of Gastric Juice Aspiration Syndrome and may cause deathresulted from asphyxiation.

According to medical statistics in Chuvash Republic [7], 0,5-1% of deaths with use of anesthesiaare directly related to non-compliance of preventive rules and subsequent development of Aspiration Syndrome. It becomes the reason of 0,09% of maternal mortality, and with the necessity of general anesthesia in operative delivery this figure grows up to 0,68-26%.

Statistics and analysis of death cases evidence that not every medical practitioner has worked outsufficientawareness related to risk of developing of Mendelson's Syndrome. For that very reason mistakes are made in methodology of prevention, diagnosis and follow-up treatment of the pathology [4]. All the reasons can be divided into several groups depending on the source of their origin. With a full stomach pathology occurs in patients: those who took food for 2-6 hours immediately before the beginning of surgery; having acute diseases of the digestive tract; suffering from renal insufficiency or being on dialysis; having a craniocerebral injury or damage to the skeleton; being in the coma; during the 3rd trimester of pregnancy.

Only one possible reason for Gastric Juice Aspiration Syndrome in such cases is damaging ability of chime acidity. Aggressive substrate is a cause of bad chemical burns of lungs mucous membranes resulting in development of airway edema. In the process, a rapid destruction of bronchiole and alveoli epithelial take place and also the transudation of transudate to the alveoli. The patients are diagnosed with non-cardiogenic pulmonary edema and respiratory distress syndrome.

The initial decrease of the normal tone of the cardiac pulp of the esophagus can be observed: at the patients with acute or chronic diseases of the gastrointestinal tract and lower esophagus duodenal ulcer and stomach, esophagitis, enterocolitis, diverticulum, gastritis, hernia of the esophageal diaphragm; at the patients with signs of heartburn; at the patients who are in the state of muscle relaxation or drug depression; in the presence of esophageal reflux or chronic constipation; at the pregnant women at 2-3 weeks of gestation, this is due to the natural processes of reducing gastrin production and increasing the volume of progesterone secretion, as a result, the development of hypotension of the cardiac sphincter of the esophagus and hypomotoric of the stomach (a typical symptom of the pathology is heartburn). If pieces of undigested food together with gastric juice enter airways, mechanicalblockage of medium bronchi take place. Ultimately, it results in bronchiobstruction [1, 5, 9].

There should be signs of an increase in intra-abdominal pressure in such cases: at the patients with obesity; with fibrillation of the muscles of the anterior abdominal wall, this is periodically observed after the administration of muscle relaxants having a depolarizing effect; when the gas mixture enters the stomach during mask ventilation; with paresis of the intestine and bloating; with diagnostic or procedural palpation (or other pressure on the abdomen from the outside); often elevated intra-abdominal pressure is observed in pregnant women in the third trimester and in newborns.

In Mendelson's Syndrome etiology the part of high acidity of stomach contents is precisely determined. The most active influence on respiratory systemis observable in aspiration of liquid with pH value no more than 2,5. If the value is higher, the lung abnormalities are temporary. Degree of damage is influenced by the volume of liquid from stomach that have entered the respiratory system and also the presence of pieces of food in it, that can increase destruction of mucous membrane. The lowest alarming levels are 0,3-0,4 ml/kg of body mass, or no more than 25 ml. If >0,4 ml/kg of acid contents enters the lungs, it results in heavy damages.

In the first moments after aspiration reflectory narrowing of bronchia happens promoting cough, expiratory dyspnea, blue skin, tachycardia, low blood pressure. Due to these symptoms Mendelson's Syndrome can be confused withbronchial asthmaattack.

The pathology has 3 stages: 1. Cough, shortness of breath, cyanosis of the skin, tachycardia, lowering blood pressure. 2. In the second stage there is a temporary stabilization of the patient's condition – dyspnea and blood pressure decrease. 3. The third stage begins approximately in 48 hours. It is characterized by symptoms of bronchitis and pneumonitis. The bacterial complications are especially dangerous. The patient may have fever, cough with phlegm, leukocytosis.

After the ingestion of gastric contents in the respiratory tract, a clinical picture appears, similar to severe respiratory failure. In addition, it is characterized by other symptoms: bronchospasm; cyanosis; dyspnea; tachycardia; progressive pulmonary edema.

In some cases initial measurements are so evident that they cause instantaneous cardiac arrest. If the patient can be resuscitated successfully then irregularities of general circulation and pulmonary blood flow will follow, against which growing arterialhypotension develops with decrease of cardiac output.

Patients appear to experience frank hypoxaemia. It results in increase of pulmonaryvascular resistance. There is increase in pressure in pulmonary artery. In the violation of tissue perfusion, metabolic acidosis worsens in conjunction withrespiratory alkalosis [1, 5, 9].

Evidence of one or other symptom is directly related to vastnessof lung tissue damage. Clinical performance can be blurred out, in thisfunctional shifts are less obvious. More severe symptomsmight become apparentin only 1-2 days after aspiration. In this, signs of respiratory failure will deepen gradually.

In connection with rapid development of the Syndrome the first place goes to preventive measures and early diagnostics. In the first stage of Mendelson's Syndrome moist and sibilant rale of different grade are audible.In parallel, there is increase of CVP resulting in jugular venous distention. The last symptom is obvious in visual observationwhich helps to suspect exactly the Gastric Juice Aspiration Syndrome.

The basis of primary diagnostics is a triad of symptoms – tachypnea, tachycardia, cyanosis. Besides, the doctor should pay attention to the fact that it's impossible to eliminate hypoxaemia, even if the patient is supplied with pure oxygen for breathing. The symptom is a sign of venous blood bypass. Further symptoms of pathology are: increased resistance to inspiration, arterial hypoxaemia, "blizzard" in pneumonography [5, 6, 8, 9].

In diagnostics of Gastric Juice Aspiration Syndrome the monitoring of gas measurement is very important. Patients appear to experience decrease of PaO2 to 35-45 mm mercury column. X-ray examinations is of great importance in diagnostics of Gastric Juice AspirationSyndrome, which in period of worsening allows to identify even small areas of diffuse infiltration of lung tissue, focusof hypoventilation, diffuse blackening of lung field ("shock lung"). In pulmonary edema they merge into large focuses. Further complication depends on infective factor. Aspiration Syndrome is very often complicated with abscess formation.

Prevention of Mendelson's Syndrome, aimed at reducing the risk of stomach contents aspiration, lies in obligatory gastric emptying with thick gastric tube. The procedure is obligatory for parturient women and patients who are appointed by urgent surgery under anesthesia.

Experience has shown that besides regurgitation and vomiting the patient may have inactiveinflowing of stomach contents into lower segments of respiratory system. To minimize the risk of aspiration, the patient is awake when intubated. Induction is made with pulmonary agents. During the process the head end of operating table is raised, and in intubation in lateral position the

tightening of in nominate cart should be made (Celic method). On rare occasions use of field block anesthesia is allowed.

10-12 hours before the beginning of elective operation meal and drinks are forbidden to the patients. Maximum 50 ml of water hourly is permitted, but the complete cessation of drinking should be 2 hours before anesthesia. If necessary, antacids, H2-blockers(not later than 1 hour before the operation intravenously injectibly) [1, 3] and prokinetics can be prescribed. Additionally, intake of acid neutralizing medicines is made, for instance, sodium citrate (30 ml 30 min before) and metoclopramide [3]. At the moment, medicines on the basis of magnesium trisilicate and magnesium, dihydroxy-aluminum aminoacetate, magnesium oxide are not used for decrease of aspiration. Experience has shown that they are not effective enough in neutralizing of acid stomach contents. The fact that provides a further threat is that when entered bronchi and lungs these medicines themselves cause chemical pneumonitis [3].

### Clinical Case of Diagnostic of Mendelson's Syndrome

Objectively: Moderate condition. The patient is conscious, adequate, moderately restless.Cutaneous integument is of pale-pink colour, clean. The temperature is 36,7C.Breathing is on her own, adequate.By percussion: there is a clear percussion sound above lung fields. Vesicular respiration in the lungs goes through all the fields, no rale. Respiration rate is 20 per minute. Peripheral oxygen saturation (SpO2)-99-100%. Heart sounds are clear and rhythmic. There is apical systolic murmur. Haemodynamics is stable. Blood pressure is 110/70 mm mercury column.Heart rate = PS - 120beats per minute. The tongue is wet with white coat on it. The belly is of increased volume due to gravid uterus and has limited participation in breathing. With deep palpation you feel tension. Contractions are present. To monitor diuresis a stationary urinary catheter is fixed, with it urine is taken in volume of 200 ml of straw vellow colour.

The woman is taken to surgery as a matter of urgency for delivery. Combined endotracheal anesthesia is planned (CEA). To prevent aspiration syndrome (Mendelson's Syndrome) 40 mg of Quamatel administered by intravenous injection H2-histamineblocking agent; head end of the bed is raised.

In general anesthesia the inflow of acid stomach comtents into airways happened. On ECG-monitor, tachycardia is 140 beats per minute, blood pressure lowered to 70/40 mm mercury column, SpO2-40%. The endoscopist is called to the operating room. Lavageof tracheobronchial tree is made immediately with hormones, antibiotics with the following repetitive aspiration. Then the patient is intubated, the artificial lung ventilation in Volume Simv mode is carried on, Respiratory volume-550 ml, respiration rate is 12 per minute, SpO2-79%. The respiration in lungs is harsh, goes through all the fields, isolated dry rales are audible. Blood pressure is 100/60 mm mercury column, heart rate is 120 beats per minute. The patient is delivered

successfully. Extent of blood loss is 600-700 ml. The path finder in stomachisim stalled for aspiration.Pneumonography: RDS (Respiratory Distress Syndrome)I-II grade; bilateral pulmonary edema. • Le – 18\*109/l. • ABB (Acid-Base Balance) – Ph -7.466 Be – -1.0 PaCO2 – 30.4 PaO2 – 129.7 PaCO2/FiO2 – 328.

For further treatment the woman is moved to the intensive care department. Prescriptions: artificial lung ventilation with medication synchronization, antibacterial therapy, gluco-corticosteroids, fluid therapy, therapeutic bron-choscopy – once a day, prevention of stress ulcers – Omez – 40 mg\* twice a dayintravenously.

In the next two days artificial lung ventilation is applied in mode Volume Simv, then ALV in autonomous breathing mode with oxygen flow under pressure. Therapeutic bronchoscopy was carried out daily.

In blood tests: Red cells:3.22\*10\*12; HB-85 r/π; Le-10,8\*10\*9; Tr-150\*10\*9. Total protein – 61.7 g/l; fibrinogen 4.84g/l.Blood gases: pH-7.421; BE– -0.1.

The woman in 10 days was moved from the intensive care department to the gynecology department. Later she was released safely.

### Conclusion

To date, issues of prevention of Mendelson's Syndrome remain relevant for pulmonology, anesthesiology, obstetrics and emergency medicine. In the case of pathology themortality in Chuvash Republic affects 0.5-1% of patients. To avoid the development of Mendelson's Syndrome, a strict adherence of proper algorithm of anesthetic support is required. This is particularly true for acute surgical cases.

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# PSYCHOPHYSIOLOGICAL COMPLEX FOR STUDYING CHARACTERISTIC FEATURES OF PEOPLE IN THE PROCESS OF BIOLOGICAL FEEDBACK TRAININGS IN DIFFERENT SOCIAL CONTEXTS

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A psychophysiological complex including synchronous registration of encephalograms and heart rate variability of two subjects in the process of their individual and joint activity on the basis of biological feedback was developed. At the first step, the subjects separately trained to hold the height of the column within the target range presented on the display by changing the tension of the hand flexors which was recorded by the telemetrically electromyographic sensor. The model of competitive activity was based on the rivalry of participants to maintain the height of their columns within the target range as long as it possible. During the cooperative activity, the subjects had to keep the height of one column that depended on the integral index calculated for EMG signals from both subjects. The complex developed allows to carry out a comparative analysis of the psychophysiological mechanisms of individual and joint activities in different social contexts.

Keywords: electroencephalogram, heart rate variability, electromyogram, biological feedback, joint activity, competition, cooperation

Studies of psychophysiological features and neurophysiological mechanisms of social relationships between people in the family, cultural, educational, and professional activities in the human community are issues of importance for many scientists. Different researches and surveys have been launched to study the relationships between mother and child [11, 13, 16], singers and musicians [17, 19], performers and the audience [1], circus jugglers [10]. Some authors also have studied the psychophysiological mechanisms of interaction between doctor and patient [7]. The neurobiological basis of the cooperative social behavior has been investigated by using economic games that allow to reveal the direct, indirect, and generalized reciprocity and altruism in individuals [18].

Nowadays, the researchers use awide variety of sensorimotor tests in which two or more subjects have to simultaneously perform different tasks in different contexts: individual, competitive or cooperative ones [14, 20]. As an example, there are studies on the role of negative and positive feedback in the effectiveness of cooperation between individuals [5, 6].

Psychophysiological processes, including neurophysiological and somato-vegetative mechanisms involved in the integration of a person into joint group activity has been studied insufficiently which. In modern literature, these processes are referred to a new field of neurosciences called "neuro-socio-ethology".

As far as we know, Duane T.D. and Behrendt T. [8] were the first who performed simultaneous EEG recording of the brain activity in several subjects. They tried to calculate the correlation between the electroencephalographic characteristics of two people. Previously, this multi-subject technique of the analysis of the brain activity was not commonly used by researchers. However, it has been recently revived and called the "hyperscanning" method. Some research groups have increasingly begun to study the synchronous changes in the activity of different brain regions in people performing joint activities by recording the spectral-coherent characteristics obtained through the methods of electro- and magnetoencephalography, as well as fNIR and fMRIneuroimaging methods.

The hyperscanning technique is also frequently used to reveal and analyze the correlation between the activity of different brain structures of two people during the intersubjective social interaction [3, 4, 9, 19]. For the present, the coherent activity of the brain structures is shown in civil aviation pilots during their joined activity on training vehicles [22]. It may be also assumed that the method of hyperscanning may help study the emotional component of interaction between some individuals while they are listening to the music [1]. In other studies, the researchers, using the method of hyperscaning of magnetoencephalograms, found that the synchronous activation and correlation between the brain activity of two subjects in kinematic tasks depend on the role of individuals during interaction: leadership or fellowship [12, 21]. It is believed that determination of the neural mechanisms of intersubjective coherence of the brain activity would allow to use these mechanisms as the neuromarkers of the quality of the social interaction in daily life and professional activities [15]. However, in many studies, the researches use different and often disparate models of individual and joint activity.

Taking into account the abovementioned, the aim of this study was to develop and approbate computer-based models of competitive and cooperative interaction between two subjects and to perform comparative study of the psychological and neurophysiological mechanisms of competition and effective cooperation.

### Methods

The following psychological questioning methods which allow to reveal individual personal qualitieswere used in the study: situational and personal anxiety (Spielberger), state of health & activity & mood (SAM), selfefficacy in the areas of substantive activity and interpersonal communication (methods Maddux and Scheer, modification of Boyarintseva).

The complex included synchronous recording of electrocardiograms in the standard lead in two subjects using the hardware-software system "Varikard" (LLC "Ramena", Ryazan, Russia). The standard values of heart rate variability (HRV) were calculated in accordance with the "International Standard for Registration, Physiological Interpretation and Clinical Use of Cardiac Variability" 1996. The analysis of HRV parameters was carried out at all stages of the survey: starting from the background state of operative rest, then with individual and joint activity for each subject separately. In addition, a cross-correlation analysis was performed to compare the dynamic of changes in the HRV parameters of the two subjects.

The complex also included synchronous 8-channel telemetry electroencephalograms registration in two subjects using the MP150 + BioNomadix system (BIOPAC Systems, Inc. USA) in the following areas of the cerebral cortex of both hemispheres: frontal, central, parietal, and visual. EEG hyperscanning provided subsequent cross-correlation analysis of changes in spectral-coherent characteristics between brain activities in two subjects.

Coherence and spectral capacities in the cerebral cortex regions were calculated and then compared in the following EEGfrequency ranges: theta, alpha 1 and 2, beta 1 and 2 rhythms. Synchronous ECG and EEG registration allowed to perform the cross-correlation analysis of the characteristics of HRV and EEG in both of the subjects.

Therefore, in order to determine the role of the emotions and the cognitive impact of an inefficient joint activity (competition and cooperation), neurophysiology response to the particular condition was explored using the measurements of behavioral, electroencephalographic (EEG), cardiac and autonomic (by biofeedback device) parameters. In the present study we first performed the complex analysis and monitoring of these components all together in order toprovide a complete analysis of the emotional impact in the case of inefficient cooperation.

### Models

Modelling individual learning, competitive and cooperative behavior in the dyads was performed using the "BOS-Kinesis" program (OOO Neurotech, Taganrog city, Russian Federation). This software and hardware complex is based on thetelemetric recording of physiological signals and consequent appliance of the characteristics of these signals as biofeedback (BFB) in a variety of trainings. Registration of the electromyographic signals (EMG) was performed with the "Kolibri" sensors that were attached to the skin of the hands at the area above the flexor muscles of the leading hand of a participant. The "BOS-Kinesis" program provides the apparatus for online mathematical data processing of the EMG signals, which is converted into the dynamics of changes in the total spectral power of the EMG. In our study the values of the spectrum power were determined by the dynamically changing height of the column displayed on the screen so that the participant can see the result of his actions. Five-second calibration of the EMG signal was performed at the beginning of each training session, during which the participant was instructed to make the maximum wrist flexion with the sensor installed onit.

The average level of the EMG spectral power signal achieved during the calibration determined the average level of the column, as well as the upper and lower thresholds, and ranges according to which the effectiveness of the BFB EMG training is calculated: "Fail, below the line" - [0%; 20%]; "Good, below the line" – [20%; 40%]; "Excellent" –  $[50\% \pm$ 10%]; "Good, above the line" – [60%; 80%]; "Fail, above the line" - [80%; 100%]. The experimenter had the opportunity to change the thresholds and ranges of evaluation of the BFB EMG training effectiveness. The participants had to maintain the height of the column within the middle range that had green color by changing contractile force of the flexors. The green color of the column signified high effectiveness of action ("Excellent"). When the height of the column approached the threshold values, the bar's color turned to yellow (the result is "Good"); when the column height deviated significantly from the target rangeand was higher or lower of this range (the result is "Fail"), the bar's color turned to red. After automated processing of the primary data of the BFB EMG training, the program calculated the percentages of the durations of the periods during which the height of the column fell into the "Excellent", "Good, above the line", "Fail, above the line", "Good, below the line", and "Fail, below the line" ranges and then calculated their maximum and average durations.

At the first stage of the examinations, two subjects were trained individually (3 sessions, 3 minutes each). After that, the participants had to perform a BFB EMG training together in a pair in the competitive context. Before the session began, they were instructed to follow competitive nature of the test. A person who acquired a higher score of effectiveness was considered as the winner. During the training session, the participants were sitting in front of one monitor which showed two bars each of which reflected the effectiveness of the corresponding person. Similar to the stage of individual training, the parameters of performancewere obtained for each participant in the pair during competition.

At the next stage of the testing procedure, we studied psychophysiological processes during cooperative activity of two subjects using the same BFB EMG training methodology. The same as in the previously described stage, the subjects sat next to each other in front of one monitor. However, unlike the previous stages, the subjects were instructed to cooperate their actions in order to regulate the height of one common column by changing muscle tension. The height of the column was determined by the dynamic pattern of the result and calculated by the individual parameters of the participants. Before conducting the test on cooperation, the procedure of calibration of the EMG signal was performed for both subjects in order to correctly evaluate the contribution of each subject to the result.

The evaluation of the cooperative activity was performed under two conditions: 1) when the subjects saw the dynamic changes in both common and individual columns; 2) when they could only see the common column without feedback about the success of maintaining the height of the individual columns; this situation was considered as so-called blind cooperation based on integrated joint performance. After the sessions of cooperative activity, individual performance indicators, as well as integral indicators of the dynamics of changes in the resulting height of the common column were calculated and analyzed. The developed psychophysiological complex also included video recording of the individual and joint actions of the subjects, as well as the changes in the results of the BFB EMG trainings displayed on a computer monitor. These records were fully synchronized with the recorded EEG activity, which further allowed to perform a qualitative temporary postline analysis of the correlations between the changes in the brain activity of participants and their effectiveness at all stages of the surveys. The system of simultaneous cardiac rhythm registration in two patients was also equipped with the option of introducing on-line behavioral marks throughout the survey process.

In order to identify the changes in the physiological parameters of the EEG and HRV related to competitive and cooperative activity only, we performed the control experiment in which the participants had to perform the same task on the different computers independently from each other.

The developed in this study models were tested on healthy male and female volunteers (20–35 years old) who were paired up and people in a pair knew each other. No material reward was implied for individuals for the participation in the experimentsince it was supported by their own interest. The tests were performed after informing the subjects about the purposes of the research. The participants were introduced to the principles of Biomedical and Neuro Ethics and gave their voluntary consent to be examined and to take part in the surveys [2].

The results of the preliminary examinations of eight pairs of subjects shown that the characteristics of the BFB EMG training in the social context significantly differ from individual activity. The ratios of the periods of muscular overload to the periods of insufficient tension reflect the levels of competitive and cooperative motivation. Thus, the model of cooperation allowed to determine the leader and the follower within the dyads, as well as to identify some pairs that were incapable of effective cooperation.

### **Ethical statement**

All the experimental procedures were performed in accordance with the Additional Protocol to the Convention on Human Rights and Biomedicine, concerning Biomedical Research [2] and approved by the official Ethical Committee in Biomedical Research of the P. K. Anokhin Research Institute of Normal Physiology.

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# THE ELECTIVE DISCIPLINE "FUNDAMENTALS OF MEDICAL TRANSLATION" WITHIN THE FRAMEWORK OF POSTGRADUATE MEDICAL EDUCATION

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English is the language of international communication for all of mankind. It allows all people to communicate with each other, regardless of nationality and place of residence. The meaning of English in the modern world is so great that its knowledge is not a privilege or a luxury. Any educated person is obliged to speak English, as it is his key to further self-education and self-improvement. This language is a living communication tool for scientists around the world. After all, international conferences, the study of world's experience and the exchange of scientific information occur only with the use of English. The aim of the research is to assess the necessity of the elective discipline "Fundamentals of Medical Translation" within the framework of postgraduate medical education. The results will allow to determine the level of English proficiency, and give information about real needs and interests in this field. The main tasks are associated with the identification and elimination of problems when using English medical literature. A survey was conducted among 50 master's program students and residents of KSMU (Karaganda State Medical University). It has been established that all respondents are aware of the practical importance of studying of specific features of medical translation as a necessary link in training of highly educated specialists.

#### Keywords: language competence, professional-oriented English, medical translation, specific training, postgraduate medical education

"Kazakhstan should be accepted all over the world as a highly educated country, whose population uses three languages. They are: the Kazakh language is the state language, the Russian language as the language of interethnic communication and English is the language of successful integration into the global economy", Nursultan Nazarbayev said [1]. Today, integration of Kazakhstan into the world community depends on the awareness and realization of a simple truth: the world is open to those who can master new knowledge through mastering the dominant languages. The special significance of English cannot be overestimated in the modern world. It is used by a huge number of people on the planet. For most of them, it is not a native language, but it is being studied due to various circumstances. There is unbelievable willingness for learning English in all segments of society, from childhood to schoolchildren, students, young professionals.

Modern medical literature, information on new achievements in diagnosing of various diseases, methods of treatment is presented mainly in English. Due to the pervasive introduction of the principles of evidence-based medicine, the use of English-language databases is important. In particular, these are MED-LINE, Best Evidence, Clinical Evidence, EM-BASE, and Cochrane Library. In searching for evidence-based information, it is necessary to develop an adequate search methodology (keyword search, search according to the names of authors, etc.), which requires knowledge of the English language and skills of translation of medical literature.

The volume of special information belonging to different fields of knowledge is rapidly growing in the modern world. However, the level of the specialist's knowledge is largely determined by one of his most important professional qualities – the ability to work with the text containing necessary information, including the text in a foreign language. Nowadays, the problem of performing by a specialist this type of activity is one of the most urgent problems; and the knowledge of a foreign language is one of the conditions for its solution. The ability to perform effective information retrieval and work with sources of professionally relevant information is, on the whole, one of the factors of realizing the urgent tasks of the modern society and, first of all, optimizing the use of resources and time, as well as human efforts for scientific and technological development [2].

As a result of the analysis of the scientific sources, we have determined that vocational competence is an integral part of professional competence as an integrative quality of personality, the basis of which is intellectual activity aimed at developing skills to operate with professional foreign language terms and concepts, solve tasks of a professional nature with the help of the variety of linguistic means, have a sufficiently high level of communication skills and be able to perform cognitive, creative and professional activity in a foreign language environment. [3].

The in-depth study of the English language is especially important in postgraduate medical education. Deep knowledge of English is necessary for full-fledged research and development, since without this knowledge, it is impossible to use information of evidence-based medicine; it is extremely difficult to work with medical and laboratory equipment. Young specialists are not fully able to take advantage of the capabilities of the modern computer and information technology to solve professional problems. Knowledge of the English language is necessary for conducting theoretical and experimental studies, preparing theses, abstracts, reviews, reports, publication of papers, participation in conferences.

The importance of profound knowledge of English is also declared in the basic principles of Karaganda State Medical University. Its knowledge will promote the development and strengthening of partnerships at the national and international levels, ensuring high competitiveness of the university in the internal and external markets of educational services, scientific, clinical and innovative activities.

Medical translation is an expression (in written or oral form) of special scientific and medical information that has already been expressed in another language, by its means. Distinctive difficulties in the translation of medical literature are the abundance of abbreviations, the availability of many special terms, grammatical and stylistic features of texts.

The importance of the equivalence of medical translation is extremely considerable, it seems appropriate to quote Hippocrates: "Do no harm," because inaccurate translation can lead to improper treatment, and even to the death. The case of Willy Ramirez will suffice to illustrate this point. The 18-year-old Mexican entered the Florida hospital in a coma in 1980. The friends who brought him to the hospital did not speak English. In conversation, they often used the word "intoxicado". As it turned out later, they sincerely believed that Willie could poison himself with poor-quality food. There was no interpreter in the hospital, so the doctors were forced to seek help from a medical orderly who spoke both languages. But it is one thing to speak a foreign language. and it is quite another one to be able to translate from one language into another language, especially taking into account all the subtleties of special terminology. Medical orderly translated the Spanish word "intoxicado" as the English word "intoxicated" – a state of alcoholic or narcotic intoxication. Doctors began to give him drugs specifically from drug overdose, especially since some symptoms were similar. After a while it turned out that Ramirez had a cerebral hemorrhage, which could have been avoided if the doctors had given the right medicines. The young man was paralyzed, and he remained an invalid for life. The word "intoxicado" is now known as a "71 million dollar word", because it was Willy who was paid exactly that kind of cash compensation.

When translating medical terms from the English language, there are such difficulties as the discrepancy in the grammatical structure of languages, the possible ambiguity of the term, the variability of the composition and the heterogeneity of modern special terminology, as well as the complexities associated with the developed system of abbreviation and the tendency to shorten terms. Modern authors also note the additional difficulties that arise when the interpreter does not understand the appropriate terminology in the translating language, does not understand the subject of speech, does not know how to use the dictionary properly, when the translator lacks background knowledge about the country of the language.

When translating international and pseudointernational terms, the interpreter must take into account the differences in the traditions of their use in English and Russian-speaking medical practice; take into account the asymmetry of the volume of values of English and Russian terms; carefully analyze the context; use special reference literature (monolingual and bilingual dictionaries). When translating into Russian the terminological neologisms, it should be remembered that the language elements do not necessarily require a literal translation (dictionary correspondence). A feature of the translation of terminological neologisms is the impossibility of preserving the sequence of components of the original term due to typological differences in the grammatical systems of the English and Russian languages, which dictates the need for using a combined translation. [4].

*Educational aim* of the elective discipline "Fundamentals of Medical Translation" is learning and development of practical skills of translation from English into a mother tongue and vice versa and formation of the basis of the terminological competence required for professional interaction.

Learning outcomes:

• knowledge of translation peculiarities of anatomical, clinical, pharmaceutical terms from English into a mother tongue and vice versa;

• understanding of authentic texts of professional directions, mentality peculiarity, national character and household culture of English speaking community;

• pronouncing points of view, evaluation of ideas and forming of conclusions: to develop ability to solve independently particular tasks of professional activity while translating;

• reproducing personal understanding and skills: to have skills of organized efficient partnership in conditions of group professional communication:

• ability to continue further individual study: to demonstrate knowledge of basic principles of independent work on translation of original medical books.

The aim of the research is to assess the necessity of the elective discipline "Fundamentals of Medical Translation" within the framework of postgraduate medical education. Tasks:

1. to develop a questionnaire on the need for the elective discipline "Fundamentals of Medical Translation" within the framework of postgraduate medical education.

2. to conduct questioning among master's program students and residents of KSMU.

3. to develop recommendations for wider implementation of the elective discipline "Fundamentals of Medical Translation" within the framework of postgraduate medical education.

Material and methods: the survey was conducted among 20 master's program students and 30 residents of KSMU. Methods:

- sociological research method (questionnaire);

- statistical, for processing the data obtained in research, using computer programs (Microsoft Excel, etc.).

Questionnaire covered the following issues.

1. Do you consider it necessary to study English medical literature?

A) it is necessary;

B) it is not necessary, all information is available in Russian and Kazakh:

C) sometimes there is a need.

2. How often do you use English medical literature?

A) often:

B) sometimes (1-2 times a year);

C) never.

3. What problems do you have when using English medical literature?

A) there are no problems, I freely translate and use new knowledge in my practical activities;

B) there are problems with translation and use of information written in English in practical medical activities in the Republic of Kazakhstan:

C) I do not use English medical literature.

4. Do you consider the elective discipline "Fundamentals of Medical Translation" useful?

A) yes;

B) no.

5. What problems of medical translation would you be interested in? (multiple answers may be considered)

A) grammatical features of medical translation:

B) special features of medical translation (terms, abbreviations, etc.);

C) other (indicate what would be interesting to you);

D) I do not consider the elective discipline "Fundamentals of Medical Translation" to be useful.

The results of the survey were as follows:

1.100% of the respondents consider it necessary to study English medical literature.

2. 64% of the respondents often use English medical literature, 19% - sometimes, 17% – never.

3. 64% of the respondents freely translate English medical literature and use information written in English in their practical activities; 19% of the respondents have problems with translation; 17% of the respondents have never used English medical literature.

4. 100% of the respondents consider the elective discipline "Fundamentals of Medical Translation" to be useful.

5.18% of the respondents are interested in grammatical and special features of medical translation, 82% of the respondents are interested only in grammatical features.

## Conclusions

Medical translation is a very complex and time-consuming activity that requires a special approach. It can cover several directions and a range of texts at once. They include scientific articles and documents, medical reports and annotations to medications, excerpts from the history of disease and scientific research, etc. Therefore, both the reputation of a scientist and the life of a person will depend on the competence of the translator.

In order to improve the quality of postgraduate education, a wider use of English medical literature is necessary. In this connection, there is a need for an adequate translation, which is possible only with special knowledge. The introduction of the elective discipline "Fundamentals of Medical Translation" will contribute to a more accurate understanding of the modern medical data by young specialists, and simplify their practical application. The course is focused on the learning and development of practical skills of translation from English into a mother tongue and vice versa. The main selection principle of educational material is the development of systemic concept of methods, means and strategies of lexical, grammar and stylistic units' transformations during bilingual translation. Types of translation transformations are also considered.

The following issues will contribute to acquiring of in-depth knowledge in the elective discipline "Fundamentals of Medical Translation":

A) The forms of medical translation. Full translation, abstract, annotation. Translation of medical records and patents.

B) Grammatical features of medical translation of scientific literature.

C) Medical abbreviations and acronyms. Graphic, lexical and syntactic abbreviations. The most commonly used abbreviations.

D) Medical terminology. Variants of translation of medical terms.

E) Translation of proper nouns. Transcription, transliteration.

F) Headlines of medical articles. Types and features of translation of English headlines.

G) Equivalence of the translation. Types of transformations in the translation process.

Thus, it should be noted the need to find options for expanding the teaching of a foreign language in the system of postgraduate professional education. The creation and inclusion of additional disciplines, such as "Fundamentals of medical translation", can contribute to this task.

Our results are correlated with earlier studies and developmental principles not only of the university, but also of the state as a whole. For example, the emphasis on the in-depth

study of the English language was made in the last message of the President of the Republic of Kazakhstan N. Nazarbayev to the people of Kazakhstan, January 10, 2018: "It is necessary to accelerate the creation of our own advanced educational system covering citizens of all ages. The key priority of educational programs should be the development of the capacity for constantly adaptation to changes and assimilation of new knowledge. The future of Kazakhstani is the deep knowledge of the Kazakh, Russian and English languages. It is necessary to update the training programs in technical and vocational education taking into account international requirements and digital skills ... Universities need to actively implement joint projects with leading foreign universities and research centers. It is required to attract foreign managers to universities, open campuses of world universities" [5].

In conclusion, we would like to express gratitude to our scientific advisor – the Head of Foreign Languages Department, c.p.s., associate professor V.A. Burmistrova.

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# OPTIMIZATION OF SCHOOLCHILDREN'S NUTRITION IN METABOLIC SYNDROME AND DISORDERS OF CARBOHYDRATE METABOLISM IN CHILDREN

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Food is dear to those who want to increase their life duration, purify their existence and have strength, health, happiness and satisfaction. Such foods are juicy, fatty, wholesome and pleasing. Food is too bitter, too sour, salty, spicy, sharp, dry and hot for those under the influence of passion. Such foods cause distress, misery and disease. The paper discusses metabolic syndrome, violation of carbohydrate metabolism as well as causes of obesity in children, adolescents and schoolchildren in the Chuvash Republic. "Bhagavad-Gita" According to WHO findings, about 30% of the world's population suffers from overweight. Of these, 16.8 per cent are female and 14.9 per cent male. The number of obese people is increasing progressively by 10% every 10 years.

Keywords: metabolic syndrome, insulin resistance, hyperinsulinemia and violation of carbohydrate metabolism

Studying physiological parametric characteristics of carbohydrate, protein and lipid metabolism, detection of frequency and developmental patterns of their disorders are especially important in childhood and adolescence, when all metabolic processes, like the organism in general, undergo significant changes: regulatory and transport systems are restructured, and an adult type of metabolism forms. An important role belongs to lipid metabolism in the processes of vital activity of a human body; being one of the components of biological membranes, they affect their permeability, regulation of intercellular interaction and intracellular processes, participate in energy metabolism, and are also used in synthesis of hormones and enzyme systems [6, 7]. A factor for the development of violations of carbohydrate and lipid metabolism is obesity, and for people with a high risk of diabetes heredity is important, as well as early detection of major metabolic disorders and development of metabolic syndrome (MS). In modern world, a complex of hormonal, clinical and metabolic disorders is implied by metabolic syndrome that is associated with type 2 diabetes mellitus and is a risk factor for the development of cardiovascular diseases, which is based on compensatory hyperinsulinemia (HI) and insulin resistance (IR) [7, 10]. Diabetes mellitus is an endocrine disease associated with impaired glucose uptake as well as insulin hormone insufficiency, resulting in hyperglycemia – a persistent increase of glucose in blood. There are  $\alpha$ -cells and  $\beta$ -cells that are found in the cells of pancreatic Langerhans islets, producing glucagon and insulin, to increase and lower blood glucose levels [1, 2, 4]. The disease manifests a chronic course as well as violation of all types of metabolism: carbohydrate, fat, protein, mineral and water-salt. Most often, pathology of carbohydrate metabolism is hereditarily transmitted,

it manifests at an early age in children, at least one parent of whom is diagnosed with "diabetes mellitus". A child whose mother was diagnosed with gestational diabetes during pregnancy may also be in risk group [9]. In excessive weight, there is violation of carbohydrate metabolism, that is a change in tolerance to carbohydrates and proven hyperinsulinemia. With increasing duration and obesity degree, these disorders can increase. The pathology of carbohydrate metabolism is diagnosed in obese children and adolescents and represents as glycemia and impaired glucose tolerance [2, 3]. The prevalence of impaired tolerance to carbohydrates among obese children and adolescents aged 4-10 years is 25%, among children 11-18 years old -21%and 4% in adolescents with obesity having diabetes mellitus. When glucose intake is excessive, it is utilized in the form of glycogen in hepatocytes. And regulation of glycogen formation and decomposition is under hormonal control. The main ones are glucagon and adrenaline. Fatty hepatosis is a chronic disease where hepatocytes degenerate into adipose tissue. It is abdominal accumulation of fat that is associated with the development of hormonal and metabolic disorders. Excessive consumption of fatty foods rich in lipids without rational physical activity leads to deposition of "excess lipid energy" in the form of triglycerides in the subcutaneous fat [5, 7]. Gradually obesity develops. When a child has excessive weight, this disease is influenced primarily by genetic factors and environmental factors. An important role in the metabolic syndrome is played by digestive organs. Chronic stress is a factor in the development of metabolic syndrome as well as diseases of the digestive tract, which are formed with prolonged and excessive exposure to internal and external stress factors, hypothalamus dysfunction, vegetative department of the central nervous system, which

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disrupts the peristalsis and tone of smooth muscles in the digestive tract, hyperproduction of gastrin and hydrochloric acid. Progression of these disorders is hypersecretion of catecholamines, glucagon, cortisol, which is manifested by a decrease in the resistance of gastric and intestinal mucosa, damage to the liver parenchyma and the pancreas. Emotional-personal and psycho-vegetative disorders lead to various forms of eating disorders. When there is a change in diet, intake of large amounts of food disrupts the biological rhythm of the digestive tract functioning. This contributes to maintenance and formation of motor-evacuation disorders and, as a consequence, development of inflammatory changes. The role of chronic inflammation is not ruled out, in the genesis of which cytokines of adipose tissue and activation of lipid peroxidation play an important role. Thus, the metabolic syndrome as well as disorders of carbohydrate metabolism in children and adolescents remain a complex and currently completely unexplored problem [7, 8]. An important pediatric problem allows us to consider this symptomatic complex of thrombogenic, atherogenic, diabetic complications in adolescence. To fully study the pathogenetic mechanisms of metabolic syndrome in children, only joint activity of pediatricians with endocrinologists, gastroenterologists and cardiologists will make it possible to identify the spectrum of clinical manifestations, focusing on earlier symptoms that are its predictors. This will allow to develop methods of targeted prevention of cardiovascular pathology and type 2 diabetes mellitus. Diseases of the digestive and reproductive system contribute to reducing the risk of early disability and premature death [10].

### **Practical work**

Recommended daily average food sets for children 7-11 and 11-18 years are developed by pediatricians, dietitians and institutions of Federal service for supervision of consumer rights' protection and human welfare, directors and deputy directors on social issues of educational institutions, specialists organizing meals for students at schools and other educational institutions [9, 10].

Healthy ratio of proteins, carbohydrates, fats is the following: proteins 10-15%, fats 30%, carbohydrates 55-60%.

Proteins are the main components of cells in all organs.

Carbohydrates are complex organic compounds that are a source of energy.

Fats are complex organic compounds that contain molecules of 3-atom alcohol, fatty acids and glycerin.

The basic principles for organization of rational nutrition remain relevant for people of all ages [9].

1. For a child's energy consumption, an adequate energy value of the diet is needed.

2. A balanced diet for all substitute and irreplaceable nutritional factors is necessary.

3. The main condition for ensuring balance is maximum variety of diet.

4. A child should follow an optimal dietary regime.

5. Adequate culinary and technological processing of food and products should ensure their high taste values and preservation of their original nutritional value.

6. Individual characteristics of children should be taken into account.

7. Compliance with all sanitary requirements for the state of a food unit, food supplied, transportation, preparation, storage and distribution of food – ensures food safety.

Organization of food intake for schoolchildren aged 10-17 years has its own peculiarities: they are to take into account all those changes that occur in a child's organism at this age. During this period, special attention should be paid to the following points:

• The organism in general is intensively growing at a rate which is comparable to development rate of person in the first year of life.

Chemical composition of a product set							
Nutrition	Age of children, content in the diet, % satisfaction of daily needs						
	7-10 years old		11-17 years old				
	Content	%	Content	%			
Protein, g	Proteins-80 g	119,6	Proteins-100 g	124,0			
	(30-35 of animal origin) (50-55 of animal origin)						
Fat, g	Fats-80g (65g-fats of animal	114,0	Fats-95g (75g-fats of animal origin,	115,6			
	origin, 15g-vegetable origin)		25g-vegetable origin)				
Carbohydrates, g	315,7	94,2	381,9	97,9			
Energy value, kcal	2451,0	104,3	2951,0	107,3			

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• Development of all basic systems – musculoskeletal (especially the skeleton), cardiovascular, nervous, muscle mass – increases (taking into account sexual characteristics) and radical hormonal changes in the body, associated with puberty teenager, take place.

• Workload on the psychoemotional sphere increases against the backdrop of all physical adjustments.

• Not only do school loads increase, but tension caused by adolescent's social adaptation as well.

• Proper nutrition of schoolchildren can help in solving many problems that arise during adolescence. It is especially important at this time to provide the body with all the resources not only for growth and development, but for all increasing loads at school and puberty as well.

• It is in these years – in fact, starting from 10 years – that a child becomes an adult. This concerns his physical, psycho-emotional and intellectual development. The child learns new rules of adult life. He learns independence and responsibility, builds up his relations with people in a new way.

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# **REGULATION OF ANGIOGENESIS IN THE WOMEN GONADE**

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A review of the literature is devoted to angiogenesis in the female sex gland. Some cellular mechanisms of regulation and participation in this process of endothelial progenitor cells are described. We consider molecular stimulators (growth factors: vascular endothelial, nervous, transforming, fibroblast) and inhibitors of angiogenesis, their participation in the creation of the ovarian reserve, the development of follicles and the yellow body. The aberrant activity of most angiogenic factors can be the cause of widespread female diseases: polycystic ovary syndrome, endometriosis and neoplasia, hence the study of the role of these substances in neoplasm of ovarian vessels is necessary.

Keywords: ovarian, factors of angiogenesis regulation

The vascular system provides a fullfledged operation of any organ, including the ovaries, in which even a short-term disturbance of the blood supply leads to persistent changes in reproductive and endocrine functions [7, 24, 42, 43, 44]. All the main processes of the reproductive cycle in women are closely related to the formation of new vessels, angiogenesis, which is tightly regulated, especially during pregnancy [3, 6, 41, 42]. Regulation of angiogenesis presupposes the presence of mechanisms that induce the development and integration of vessels that accelerate or inhibit their growth [6, 40, 44]. Unlike most other organs, the formation of new blood vessels in the female reproductive system is a natural physiological process that takes place in the sexually mature age. With the development of pathology, this process is disrupted, resulting in destructive changes in the ovaries [6, 7]. Disturbances of angiogenesis are accompanied by a variety of ovarian diseases (benign and malignant tumors, polycystic ovaries, endometriosis, follicular cysts) [8, 12, 41, 44]. Today it has become clear that the cellular and molecular mechanisms regulating the growth, development and regression of blood vessels are also key factors that ensure reproduction processes, which is one of the reasons for interest in this problem.

Regulation of angiogenesis is carried out by cellular and molecular mechanisms that promote the formation of vascular networks of follicles and the yellow body and their remodeling in different phases of the cycle. In adults under physiological conditions, the process of angiogenesis is under strict control of the body's regulatory systems, which provide a delicate balance between stimulants and angiogenesis inhibitors [14].

A special role in the process of angiogenesis is played by **cellular mechanisms**, namely, endothelial progenitor cells. Endothelial pro-

genitor cells represent a fraction of cells that, like embryonic angioblasts, proliferate and migrate in response to angiogenic growth factors and differentiate into mature endothelial cells in situ. They contribute to the formation of vessels in the adult body, and an increase in their number leads to neovascularization and recovery of ischemic tissues [27]. Sources of endothelial progenitor cells, along with bone marrow, are mesenchymal stromal cells, tissue resident cells, as well as spleen mononuclear cells, tissue-resident progenitor cells of the intestine and liver. Even in adipose tissue, stem cells secreting a large spectrum of proangiogenic factors and differentiating into endothelial cells in vitro, which promote neovascularization in vivo are found in adipose tissue [16]. Thus, endothelial progenitor cells are a heterogeneous population.

Equally important role is assigned to molecular mechanisms, the main role in which is performed by various growth factors - stimulants and angiogenesis inhibitors. Stimulants of angiogenesis are: peptide growth factors (VEGF, FRT, FRF); cyto- and chemokines (TNF-a, IL-8); enzymes (angiogenin; platelet FR); hormones (estrogens, prostaglandins E, follistatin, proliferin); oligosaccharides (hyaluronan, gangliosides); hematopoietic growth factors (erythropoietin, granulocyte and granulocyte-macrophage colony-stimulating factors). Inhibitors of angiogenesis should be considered: proteolytic peptides (angiotensin, endostatin, a fragment of prolactin, laminin, fibronectin); inhibitors of enzyme activity (MMP-1 inhibitors, -2, -3, -4, -9); cyto- and chemokines (TNF-a in high doses, interferons, IL-12, platelet factor 4); molecules of the extracellular matrix (thrombospondin); hormones / metabolites (2-methoxyestradiol, protein associated with proliferin); oligosaccharides (hyaluronan, high-molecular fractions) [4, 27, 30, 31]. The most important regulators of angio-
genesis are members of the family of vascular endothelial growth factors: VEGF, FGF, TGF, NGF, angiopoietins [35, 44].

The effect of vascular endothelial growth factor (VEGF) on angiogenesis in the ovaries is a proven fact. Expression of this factor was found even in egg cords and developing follicles, ovarian stroma in perinatal ontogenesis [9, 13, 23]. Immunohistochemically, expression of proteins and mRNA for various VEGF isoforms and in the definitive female gonad, namely in ovules, granulosa cells and ovarian stroma of girls and women at different ontogenesis periods, has been observed [14, 22]. According to the authors, the presence of receptors for VEGF-a, especially granulosis, suggests that this factor participates in folliculogenesis, arousing primordial follicles and continues its action in the preantral [1, 2, 22]. Several studies have shown that the vascular system has a significant influence on the early development of egg balls, primordial follicles and some other ovarian formations [22]. The main factor of vasculogenesis is endothelial growth factor, which plays an important role in endothelial cell differentiation and development of the vascular bed of the organ. VEGF is also part of a system that restores the supply of oxygen to tissues when blood circulation is inadequate. Treatment with VEGF promotes the activation of primordial follicles, providing an alternative approach to stimulating the early development of follicles [1, 3, 13].

The growth factor of fibroblasts (FGF) is a promising angiogenic molecule that modulates the growth of blood vessels during their neoplasm. FRF (both acidic and basic) is a potential mitogen. It is believed that FGF stimulates angiogenesis by directly affecting endothelial cells, while the transforming growth factor (TGF- $\beta$ ) exerts indirect influence, "inducing" other cellular types to isolate factors that stimulate endothelial cells [17]. It is likely that FGF can be released from cells as a result of their damage [19]. Other members of the family FRF, for example, the proto-oncogene int-2 (FRF-3), freely secreted in embryogenesis, can serve as initiators of angiogenesis in the development process [44].

**Transforming growth factor-\beta (TGF-\beta)** – is important in many cell types as a regulator of cell proliferation, angiogenesis, cellular remodeling and other cellular processes. TRF is necessary for normal growth of the follicle and luteinization of the latter. An increase in the expression of the transforming growth factor in the preovulatory follicle has been demonstrated, reaching a maximum during ovulation [19,

39]. TRF- $\beta$ 1 is essential in the stabilization and differentiation of pericytes, hence, the integrity of the vascular wall is compromised in TRP- $\beta$ 1-deficient mice [21]. Follicular ovary cells expressing TRP-\beta1 contribute to the proliferation and differentiation of granulosa cells, which certainly helps in the growth of the dominant follicle. Most researchers believe that the transforming growth factor- $\beta$  indirectly, through the VEGF, and in conjunction with the fibroblast growth factor participates in the formation of the vascular ovulatory cascade [19, 20, 21, 39]. TPP $\beta$  (primarily TRP $\beta$ -1) is considered a potent inhibitor of endothelial cell proliferation in vitro, but it is also able to induce angiogenesis in vivo [25, 38].

The nerve growth factor (NGF) is one of the most important in the physiology of the ovaries. Already in newborn rats, FSH receptor expression is detected, which is stimulated by a nerve growth factor. The lack of action of this factor contributes to the delay of folliculogenesis at the stage of small antral follicles, delayed puberty and disruption of estrual cyclicity. Along with previous factors, this is involved in the preovulatory pulsation of gonadotropins and promotes ovulation [21, 28]. NGF probably stimulates and angiogenesis, induces the expression of angiogenic molecules in many tissues, including the ovary, but can be neutralized by the neurotrophin, which reduces neovascularization. According to some authors, NGF for several hours before ovulation increases and enhances the cascade of expression of other growth factors, increasing the area of blood vessels and their rupture. This study reliably shows that NGF promotes the enhancement of angiogenesis-dependent parameters: the expression of proangiogenic molecules and the number of ovarian blood vessels [21, 35]. It is also reported that NGF is capable of activating the proliferation of endothelial cells, regardless of the content of the VEGF, is capable of increasing the area of the ovarian vessels, which is fundamental in the cyclic physiology of the female gonad. In addition to NGF, the neurotrophic factors bdnf, HT3 and NT4 in the neonatal ovary [21] have been described, some of which are associated with the development of the early follicular stage. NGF and neurotrophin receptors have been implicated in such processes as steroidogenesis, FSH receptor expression and proliferation of somatic cells in rodents and human ovaries [28, 35]. These results are the first and confirm the angiogenic effects of NGF in the ovary of rats, giving a new look at its role in the function of mammalian ovaries.

Vascularization of the ovary during the reproductive period of ontogenesis is regulated by factors such as delta-like ligand 4, thrombospondin-1, prokineticin-1 and prostaglandin E2 [12]. All these factors contribute to the survival and functioning of the ovarian reserve in different ways and prevent abnormal angiogenesis [12]. The role of acid cysteine-rich secreted proteins in key angiogenesis processes in the luteinization phase are elucidated. The role of these proteins in the regulation of proangiogenic factors and components of the extracellular matrix of the follicle during luteinization is shown [44].

The role of cytokines, in particular tumor necrosis factor, interferon gamma, Fas ligand for angiogenic activity and VEGF mRNA level, as well as its receptors throughout the luteal stage has been determined [15]. The dependence of angiogenesis in the development of the yellow body, luteolysis from the action of these cytokines is shown [15]. Especially important is the effect of the action during pregnancy, due to the active secretion of progesterone. Vazoinhibin-1 was found in the yellow body endothelium, acting as a negative feedback regulator of angiogenesis and lymphogenesis in the yellow body of ovaries of cows [30]. Evidence of leptin involvement in the angiogenic process at an early stage of formation of the yellow body is presented [37]. This involvement is associated with growth factors that are expressed in response to an increase in leptin content in ovarian tissue, namely, fibroblast growth factor, angiopoietin-1 and vascular endothelial growth factor.

Ovary is an important organ for studying angiogenesis and vascular function. In one study, a model for the expression of elements of the Notch signaling pathway in the ovary and the key roles of the regulatory pathways of Notch transmission in angiogenesis in pathological conditions were determined. This pathway is a promising target for the treatment of angiogenesis disorders in the treatment of ovarian diseases. A series of Notch pathway inhibitors has been developed, including monoclonal antibodies aimed at blocking Notch ligands / receptors, gamma-secretase inhibitors, peptides aimed at blocking the transcriptional complex. Thus, components of the Notch signaling pathway are targets for regulating abnormal angiogenesis and other pathological processes in the ovary. In addition, the role of the Notch signaling pathway for anovulation, ovarian production of androgens, and polycystic morphology, which are closely related to ovarian angiogenesis, have not been fully elucidated [34].

### Angiogenesis in ovarian pathology

Defects in the regulation of angiogenesis can be associated with a variety of pathologies. such as polycystic ovary syndrome (PCOS), endometriosis and most neoplastic processes [18, 44]. Polycystic ovary syndrome is one of the most frequent endocrine pathologies among women of reproductive age. Women with polycystic ovary have an increased ovarian blood flow, which is probably due to a higher serum VEGF level found in these patients [22, 26, 33, 44]. Ovarian enlargement is observed in rats with steroid-induced polycystosis and intraovariant neutralization of the nerve growth factor. This mechanism cannot be excluded in cases of some forms of polycystic ovary, infertility and other processes associated with disorders of angiogenesis, due to the fact that there is a disruption of the NGF release and, therefore, aberrant products of the VEGF [5, 10]. It has been found that an increased level of VEGF in serum and follicular fluid contributes to all clinical manifestations of this syndrome, such as anovulation, oligomenoreya, giperandrogeniya, obesity and insulin resistance [2, 11, 31, 32]. Some authors on the model of dehydroepiandrosteroneinduced PCOS show the effect on the VEGF level, leading to a partial restoration of folliculogenesis, improvement of ovulation, and the development of follicles. Therefore, inhibition of angiogenesis in the ovaries can be considered in the treatment of such patients with the purpose of restoring the function of the ovaries [2, 36].

Another acute problem is endometriosis, including endometriosis of the ovaries. Since the implantation of endometrial fragments on foreign sites requires neovascularization, angiogenesis plays a key role in the growth of these ectopic implants. In one study, it was determined that the areas of the ovarian endometrioma exhibit an aberrant blood vessel formation indicative of angiogenesis in these ectopic tissues [29]. To confirm neovascularization, an immunofluorescence study was carried out with an antibody against von Willebrand factor in the early and late stages of ovarian endometriosis. It was found that this factor is specific for blood vessels and exhibits increased expression in the late stages of the disease. Also, an important regulator of the angiogenic environment, cyclooxygenase-2, was determined at different stages of the disease. Expression of cyclooxygenase-2 was significantly increased and was found to be localized both in the glandular epithelium and in the stromal cells. VEGF is an indispensable factor of angiogenesis, as it regulates proliferation of endothelial cells, germination, assembly, lumen development,

permeability and vascular distribution. In this experiment, the main factor of angiogenesis was significantly increased with the course of the disease, which confirmed the involvement of angiogenesis in the progression of ovarian endometriosis [29].

And finally, ovarian cancer, one of the most common, life-threatening, gynecological neoplasms, is a heterogeneous, rapidly progressing and very dangerous disease. Angiogenesis is a sign of ovarian cancer, and it is a key process that promotes tumor growth and metastases. The increased vascular density in ovarian cancer was positively associated with an increase in the incidence of metastases, as well as a decrease in patient survival [35, 44].

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## COMPARATIVE ANALYSIS OF HUMAN BEHAVIOR IN THE PROCESS OF ACTIVITY AND QUANTUM OBJECT BEHAVIOR

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Determinism of human behavior in the process of certain activity, for example of a student in the process of acquiring knowledge, as well as of quantum microparticle behavior is realized through randomness. In this respect behavior of such objects could be described with non-classical probabilistic-statistical method. It is shown that this method enables to take into account distinctive features of human and microparticle behavior, conditioned by the fact that every human has personality factors, while microparticles of the same grade are identical. Besides, the fact is considered, that random nature of human behavior is realized not only in coordinate space, as for microparticle, but also in space of velocities and accelerations of various orders.

Keywords: student, microparticle, randomness, determinism, probabilistic-statistical method, distribution function, probability density, continuity equation

The success of any human activity fully depends on its consciousness development level. It is known that determinism of consciousness of an individuum is realized through randomness, caused by inherent random character of its psychic and somatic states [7]. And this reflects in random character of behavior of an individuum in performing certain activity. In this regard non-classical probabilistic-statistical method is used to model behavior of an individuum. This method is also widely used to model behavior of quantum objects (f.e. electrons, atoms, molecules etc.) [2]. In contrast to classic (mass) probabilistic-statistical method this one allows to describe random character of behavior of a large quantity of objects as well as behavior of an individual object, in this regard sometimes it is called individual method [8]. Let us consider the aspects of this method applied to analysis of human and quantum object behavior.

## Human behavior modeling

Aspects of random character of behavior of an individuum in the process of an activity would be considered in the context of acquiring knowledge, due to the fact that now study of probabilistic-statistical character of human behavior succeed mostly in this area of activity. In paper [6] probabilistic-statistical student model is proposed, according to which student is identified with distribution function (probability density), moving within information space of coordinates, velocities and accelerations of various orders. This is based on the fact, that human knowledge is a product of consciousness, which determinism is realized through randomness. Hence, it is impossible to define exact position of student in information space, one could only define probability to find him in a targeted area of information space. It is worth noting, that collective result of human semantic activity is understood under the term "information space". In terms of informatics and technical sciences it is customary to measure information in "bits", while in pedagogics "mark" (grade) is used to estimate fullness of knowledge. One can always establish necessary quantitative relationship between bits of information and marks.

Using probability conservation law, a system of differential equations has been received – their solutions represent distribution functions, which identify students. Actually, these equations are continuity equations, which link probability density change per time unit in a space of coordinates, velocities and accelerations of various orders with divergency of probability density flow [9]:

$$\frac{\partial \Psi(\sigma;t)}{\partial t} + div_{\sigma}[\langle \dot{\sigma} \rangle \Psi(\sigma;t)] = 0,$$

$$\frac{\partial \Psi(\sigma, \dot{\sigma};t)}{\partial t} + div_{\sigma}[\dot{\sigma}\Psi(\sigma, \dot{\sigma};t)] + div_{\dot{\sigma}}[\langle \ddot{\sigma} \rangle \Psi(\sigma, \dot{\sigma};t)] = 0,$$

$$\frac{\partial \Psi(\sigma, \dot{\sigma}; t)}{\partial t} + div_{\sigma}[\dot{\sigma}\Psi(\sigma, \dot{\sigma}; \sigma;t)] + div_{\dot{\sigma}}[\ddot{\sigma}\Psi(\sigma, \dot{\sigma}; \sigma;t)] + div_{\dot{\sigma}}[\langle \ddot{\sigma} \rangle \Psi(\sigma, \dot{\sigma}; \sigma;t)] = 0,$$

$$(1)$$

where  $\Psi(\sigma;t)$ ,  $\Psi(\sigma, \dot{\sigma}; t)$  and  $\Psi(\sigma, \dot{\sigma}, \ddot{\sigma}; t)$ are distribution functions, which identify student in information space;  $\sigma$ ,  $\dot{\sigma}$ ,  $\langle \dot{\sigma} \rangle$ ,  $\ddot{\sigma}$ ,  $\langle \ddot{\sigma} \rangle$ ,  $\langle \ddot{\sigma} \rangle$  are coordinate, velocity, average velocity, acceleration of the first order, average acceleration of the first order and average acceleration of the second order of an individuum respectively; *t* is time.

System (1) involves infinite set of differential equations. First equation account for random character of behavior of an individuum in coordinate space, second equation describes random character of behavior of an individuum in space of coordinates and velocities etc. Which equation one should apply depends on capability to obtain empirical values of average velocity and accelerations of various orders, however a part of information about random character of student behavior is being certainly lost. In [7] the results of theoretic and experimental researches have been systematized concerning distribution functions, which describe behavior of a student in the process of learning as well as behavior of a student batch.

The solutions of the first and the second equations from system (1) allowed to receive analytic expressions of student individual distribution functions, that represent superposition of waves, spreading within information space of coordinates, coordinates and velocities respectively. Using probabilistic-statistical scaling, experimental distribution functions have been received, related to specific students and student batch in all. Fig. 1 presents experimental distribution functions of a student batch, calculated as a sum of student individual distribution functions divided by total number of students within a batch [7]. This implies, that this distribution functions are actually averaged individual distribution functions, that define density of probability to find a student within information space. High achieving students of a batch contribute to the head end of an averaged distribution function, while low achieving ones - to its tail. Analysis of these distribution functions shows, that as distribution functions move within information space their dispersion grows. This fact reflects increase in extend of heterogeneity of student body by level of knowledge, obviously it adversely affects the competence of future graduates of higher education institutions.

System of equations (1) allows to describe human behavior in performing any activity, if space metric is known, where the activity takes place. Wave functions demonstrate similar behavior and describe behavior of quantum objects.

### Modeling of quantum object behavior

One of the most efficient ways to describe behavior of a quantum object is based on use of Schrödinger equation [10]:

$$-\frac{\hbar^2}{2m}\nabla^2\Phi + U\Phi = i\hbar\frac{\partial\Phi}{\partial t},\qquad(2)$$

where  $\Phi = \Phi(x, y, z; t)$  is wave function, which represents solution of Schrödinger equation; U = U(x, y, z) is potential energy operator; *m* is mass of a microparticle;  $\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{\partial z^2}$  is Laplace operator, which action reduces to the finding of second partial derivative of the function;  $\hbar = h/2\pi$ , where *h* is Planck constant;  $i = \sqrt{-1}$  is imaginary unit; *x*, *y*, *z* are coordinates.

The wave function itself has no physical sense, while its squared absolute value has [3]. Squared absolute value of normed wave function defines density of probability, i.e. probability to detect a microparticle in a unit space volume:

$$w = \left|\Phi\right|^2 = \Phi\Phi^*,$$

where w is probability density;  $\Phi^*$  is complex conjugated wave function.

This implies, that integral of probability density, taken over the whole volume, should be equal to unity:

$$\int_{\infty} w \, dv = \int_{\infty} \Phi \Phi^* dv = 1 \, ,$$

where *v* is volume.

The use of probability conservation law helps to write down continuity equation relating to the probability density:

$$\frac{\partial w}{\partial t} + div \vec{J} = 0, \qquad (2)$$

where  $\vec{J}$  is probability density flow.

We could also deduce equation (2) using joint transformation of Schrödinger equations for wave function  $\Phi$  and complex conjugated wave function  $\Phi^*$ , moreover in this case we could find an explicit expression for probability density flow [2]:

$$\vec{J} = \frac{i\hbar}{2m} (\Phi \nabla \Phi^* - \Phi^* \nabla \Phi),$$

where  $\nabla = \frac{\partial}{\partial x}\vec{i} + \frac{\partial}{\partial y}\vec{j} + \frac{\partial}{\partial z}\vec{k}$  is Hamiltonian

operator;  $\vec{i}$ ,  $\vec{j}$  and  $\vec{k}$  are unit vectors along x, y and z axes respectively.



Fig. 1. Density of probability to find a student within information space: 1 – after first year of education; 2 – after third year of education; 3 – after fifth year of education



Fig. 2. Radial density of probability to find an electron within an atom of hydrogen in its basic state

In itself equation (2) is identical to the first equation from system (1). The difference just lies in the forms of expressions for probability density flow, which reflect specifics of study subjects (student and quantum microparticle). These equations describe random character of behavior of study subjects in coordinate space. It worth noting, that random character of human behavior in the process of an activity is obvious and direct observation substantiate it [7], whereas random character of microparticle behavior has been experimentally proved 23 years after Schrödinger quantum theory had been established [1].

Today mathematical apparatus for solving Schrödinger equation is highly developed and allows to obtain solutions, which describe behavior of single microparticles as well as behavior of quantum systems. Fig. 2 shows radial density  $w_r$  of probability to find an electron within an atom of hydrogen [2], where *r* is radius;  $r_b = 0.529 \cdot 10^{-10}$  m is Bohr radius.

Compatible analysis of behavior of an individuum in information space (Fig. 1) and microparticle in common space (Fig. 2) shows their equivalence in qualitative terms.

### **Discussion of the results**

From the above it follows, that determinism of human behavior as well as behavior of microparticles is realized through randomness. This reflects the unity of the world at large, and hence, generality of its fundamental laws. However, study objects have natural specifics, that affect their behavior. Let us consider them in more details.

Every human in the context of psychic and somatic processes, occurring inside, is individual, so, as mentioned above, its consciousness development level will differ from one another.

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These differences affect human behavior, and hence, in this case so-called discriminability principle works. According to this principle we could theoretically, by solving the required equations from system (1), and experimentally observe the behavior of every single human being. In quantum mechanics indistinguishability principle works for microparticles of the same grade, according to it all microparticles are identical and couldn't be distinguished from one another.

Equation system (1) allows to describe random character of behavior of an individuum not only within coordinate space, but also within information space of velocities and accelerations of various orders, while Schrödinger equation allows to describe random character of quantum object behavior only within coordinate space. This points to the fact, that in science terms human behavior in performing certain activity turns out to be more interesting and rich, than that of quantum microparticles.

Human consciousness directly affects the process of pedagogical measurement, as well as quantum measurement [5]. According to "many-world" interpretation of quantum mechanics [4] measurer is not an outside observer, it is a component of unified quantum system "measurement object, measuring device and observer". When solving Schrödinger equation for such systems, the solutions may be found, representing possible classic states (alternatives) of measurement object. In paper [5] observer's consciousness is identified with selection of alternatives of a measurement object ("...we suppose, that selection of the alternative must be identified with consciousness"). Author of this paper also states, that "...the assumption is noncontradictory, that consciousness can make some event likely, even if under the laws of physics (quantum mechanics) it has low probability. It is important to clarify the wording: consciousness of this observer can make likely the fact, that he will see this event". From these statements explicitly follows confirmation of the fact, that determinism of human consciousness is realized through randomness. Further advances in developing measurement basics in pedagogics, quantum mechanics and science at large would

depend on the achievements being made in human consciousness theory development.

### **Summary**

1. Determinism of human behavior in the process of acquiring knowledge, moving within information space, as well as behavior of a microparticle, moving within common space, is realized through randomness. In this regard non-classical probabilistic-statistical method is used to describe behavior of such objects.

2. Random character of human behavior in the process of its activity is realized not only within coordinate space, as it occurs for microparticle, but also within information space of velocities and accelerations of various orders.

3. While describing human behavior in the process of any activity its individual characteristics are taken into account, i.e. "discriminability" principle works, whereas when we describe behavior of quantum microparticles of the same grade "indistinguishability" principle works, due to the fact that these microparticles have identical characteristics, and this simplifies solution of practical problems.

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# THEORY AND PRACTICE OF DESIGNING AND DEVELOPING MODULAR TYPE EDUCATIONAL PROGRAMS IN MEDICAL EDUCATION (LITERATURE REVIEW)

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The article offers an overview of modular training as described in scientific literature. It discusses the main theoretical and methodological aspects of modular training pertaining to the Russian system of higher education, and in particular to medical education. The transition to modular training requires the creation of a methodological base, accounting and adaptation of the principles of modular training to the existing standards of higher education, the creation of adequate means of assessing the competencies that are being formed. The absence of a systematic approach to the methodological basis for documenting and assessing qualifications in accordance with existing federal standards. The article presents our own experience in applying intra- and inter-departmental modules of training qualified medical staff.

Keywords: medical education, modular training, design and implementation of modular programs, overview

Currently, the wide application of innovative learning technologies allows instructors to individualize the educational process and to enhance the cognitive activity of students. Learning technologies create conditions for easier assimilation of the educational material as well as encourage the creative development and selfexpression of the individual. Such modern technologies include modular training [8].

Modular training in various forms is widely used by numerous educational institutions. It arose in the 1960s, and quickly spread throughout English-speaking countries such as the USA, England, Canada. The essence of this method was that the student was able to work with a proposed individual educational program which included a goal-oriented lesson plan, a bank of information, and guidance books targeting the achievement of educational goals. The role of the educators varied from being informative-regulatory to being consultative-coordinating. Initially, the modular format was proposed for individual study, but eventually ended up being applied as a new approach in the classroom. At the UNESCO world conference on adult education held in 1972 in Tokyo, modular training was rendered most suitable for continuing education. Subsequently, the significance of this technology was extended to training youth and high school students [30].

Currently, modular training is actively applied to school and university education, including postgraduate professional training [5, 9, 35, 38].

The module is a self-contained part of an educational discipline. It includes cognitive and professional aspects the mastering of which is tested with the appropriate form of knowledge, skills and abilities tests. The use of modular training allows educators to differentiate the content of the educational material, to individualize the educational activities, and to encourage the development of independent study. It also stimulates goaloriented work and a sense of personal achievement. The method allows instructors to develop an effective system of grading. It offers students the opportunity to learn at their own pace within the module.

The above criteria determine the advantages of modular technology compared to the conventional teaching model, which currently remains most commonly used in medical schools. Attempts to introduce elements of modular education at the level of medical school undoubtedly exist and are based on the analysis of the advantages and disadvantages of the traditional system [10, 33]. According to N. Oh. Bartosz, N. S. Podchernyaeva (2007), the indisputable advantages of the traditional system include integration and continuity in the study of fundamental (basic) and clinical (applied) disciplines within the framework of a logically structured clear system, the presence of highly qualified teaching staff engaged in scientific research and medical work, the cooperation between specialized departments with the purpose of mutual enrichment, creative growth and improvement, in-depth preparation in individual disciplines with the purpose of training student-scientists. In addition, the authors note that the essential advantage of the Russian medical education system is the focus on deep clinical training of students. A great amount of time is traditionally devoted to the development of practical skills and their systematization including training "at the bedside", demonstration and analysis of clinical observations. All of these aspects contribute to

the creation of a system of effective learning as well as establish the foundations of clinical thinking, and the ability to solve professional problems.

However, along with the obvious advantages of the traditional subject based system, there are also certain problems in the current state of medical education. These include excessive fundamentalization with low motivation of students related to the study of basic disciplines, overcrowded classes, difficulties associated with the design, development and implementation of interdisciplinary programs reflecting the current condition of various medical fields [6]. It is obvious that there is a need to solve these problems in light of increasing demands on the part of employers in terms of the quality of training of graduates.

It is known that in order to increase the competitiveness of specialists, it is necessary to create adequate educational programs that ensure on one hand the formation of a system of professional knowledge, skills, and habits, and on the other hand the development of creative, innovative abilities [23]. The practical orientation of modern medical education and the need for implementing a competence approach, actualize the problem of modernization of the traditional system of education and raise the question of the need for deeper integration of subjects and the creation of modular educational programs.

The modular approach is relevant, first of all, in the design of continuing professional education programs. The implementation of such programs, according to S.R. Filonovich, requires fundamental institutional changes in the organizational structure of the university, and the formation of a new type of a teacher. One way of achieving this goal can be the individualization of learning, and the creation of individual educational trajectories. The fact that the technology of modular training is based on the theories of personality and motivation of activity, the theory of subjectivity and activity of the individual, the concept of cognitive ergonomics makes this approach most applicable to the design and implementation of the personality-oriented model of education.

It should be noted that the principle of "lifelong learning" (or "continuous lifelong learning") has always been inherent in the medical education system. Due to the specifics of their work, medical doctors are obliged to validate their practice license once every five years. They are also required to improve their qualifications, to constantly participate in conferences and seminars, and to continue taking professional courses. In this regard, the development of programs that are relevant to the modern requirements of the health care system and the student's personal requirements, creates a competitive advantage for the university. In the age of rapid development of medical technologies, educational programs need to be flexible and dynamic. They need to contain variable elements but at the same time they must include the necessary amount of fundamental knowledge that builds essential professional skills. It is these features that distinguish modular training from other modern educational technologies.

The analysis of foreign literature based on this subject showed that most often, the module is represented by several courses, during which a coherent system of knowledge and skills in a particular discipline is built. Within the modules, fundamental and applied disciplines can be combined both thematically and methodologically in the process of learning. They range from simple to complex, gradually forming students' basic knowledge and practical skills – the final result of training [22, 41]. More often, this technology of training is used in the system of educating surgical specialists and doctors of emergency medical care, which is probably a result of the need for effective knowledge and ability to quickly make optimal professional decisions [11, 14, 20, 25, 31, 40]. Practical orientation of learning, students feedback, improved academic achievement and satisfaction with the educational process (confirmed by numerous studies) allows us to use this approach in teaching pre-clinical disciplines like anatomy, physiology, pathology [26], as well as clinical disciplines at the interface of different fields [1, 15, 28, 42].

The experience of foreign colleagues in the application of modular interactive training of medical specialties within electronic learning environments with online testing is appealing in the context of our domestic practice. The majority of authors note higher results of training in comparison with traditional educational programs [3, 7, 16, 17, 18, 19, 32, 36, 39].

For the purposes of successful planning and implementation of modules, foreign researchers recommend focusing on the main stages of training: knowledge, understanding, application, analysis, synthesis, development. At each stage of training, it is necessary to take into account three main domains of training: cognitive, affective and psychomotor. Thus, the assimilation of cognitive (informative) strategies is aimed at developing the ability to solve a new problem (to rebuild the known, to

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discover, to invent the solution to the problem). Affective training forms the ability and readiness to make choices with regard to people, phenomena, events. This concerns not only feelings and emotional experiences, but also personal value orientations. Psychomotor training is important in the formation of practical skills, which is especially relevant nowadays in the development of effective knowledge [27].

From the point of view of foreign authors, it is especially important to plan training, taking into account the existing traditional experience and the use of modern training technologies. The formula for PIE-R3 (Prepare – Input – Explore - Retain - Reconfirm - Reflect) is important for the successful design of modules and description of the steps of the design [13]. Taking into account these stages, specific instructions for the development of modules are offered. First, the results of the student should be documented (a list of abilities acquired by the student during the educational process within the module is needed). Second, the preliminary steps for acquiring practical skills should be explained to the students (the educator should prepare the students, teach relevant vocabulary, define the expected situations and the results). Third, practical activities promoting the acquisition of skills by students should be conducted (it is necessary to help students in learning and acquiring knowledge in a certain field). Fourth, activities which aim at building a solid base of knowledge should be organized (the creation of conditions for demonstration of knowledge and skills acquired during the module is needed). Finally, basic skills required for training in the module should be offered [2].

The credit-based modular system is traditionally used to evaluate the results of learning at foreign universities. Existing models of credit-based modular systems (UMAP Credit Transfer Scheme, United States Credit System, Credit Accumulation and Transfer System, European Credit Transfer and Accumulation system) are focused on the accumulation and transfer of points to ensure academic mobility of students and academic recognition of the specific university, facilitating the interaction of universities from different countries. Currently, in Europe (France, Spain, Germany, Italy, UK) the most common credit-based system is ECTS (European Credit Transfer and Accumulation System). ECTS allows these countries to evaluate the curricula of their universities on a common scale, which stimulates the convergence and integration of national educational systems. The Russian higher education system is included in the common European

educational space in accordance with the Bologna Declaration. Hence, the transition of Russian universities to ECTS and the implementation of modular technology seems promising. As for medical universities, at this stage it is necessary to create a powerful methodological base for the introduction of modular training and methods of evaluating its results. The system of assessment of qualification skills needs to be changed from a traditional discrete-insession system to a rating system, the different methods and advantages of which are widely covered in specialized literature [4, 24, 34].

In the process of transitioning to modular learning technology and the implementation of new educational standards, there may be certain difficulties. These difficulties are due to the disciplinary-cyclic (horizontal) structure of the Federal Standards for Higher Education, presented by the units of grading in various disciplines and semesters (these values are not always multiples of three, which makes it difficult to divide the curriculum into modules). There are difficulties in calculating the credit value of each academic year in the process of developing large modules (more than one year) [21]. A solution for this problem, according to E. V. Karavaeva (2012), is the introduction of amendments to the Federal Standards of Higher Education, the abolition of the disciplinary structure of the Basic Educational Programs (BEP), the calculation of the credit values of the sections of the BEP in multiples of three, the division of large modules into course units. However, in our opinion, these difficulties should be overcome, since it is the use of modular technology that will make it possible to more effectively create and implement interdisciplinary programs, both within and outside of the faculty departments.

The methodology of creating modular programs was tested and is being used at Samara State Medical University (SSMU). Traditionally, the teaching of pathological anatomy and pathological physiology in medical universities is carried out within the framework of individual subjects by different departments. At Samara State Medical University, a modular program of teaching pathological anatomy and pathological physiology has been introduced at the Department of General and Clinical Pathology. This approach is implemented in the educational process with the purpose of integrating pathological anatomy and pathological physiology as interdisciplinary areas of medicine encompassing the pathochemical, morphological and pathophysiological processes of vital activity of the body within the

normal and pathological ranges. The use of the modular program makes it possible to focus its content on specific problems, to form well defined outcomes of the learning process, namely interdisciplinary fundamental and effective knowledge. In order to implement the modular approach, changes were made in the curriculum, in the lecture schedules and in the practical courses. Considering that the cyclic principle of training in medical universities is applied starting with the third year, the program provides three basic modules consisting of two consecutive sub-modules – pathological anatomy and pathological physiology. Each sub-module is divided into basic and variable parts.

The total credit value of the discipline is 16 credits (576 hours), the credit value of the modules in accordance with the schedule is based on 4, 2 and 10 credits accordingly. The first module is aimed at familiarizing the students with the content of the subjects offered and with the process of inflammation. The second module is devoted to the problems of oncology. The third module deals with the issues of specialized pathological anatomy and pathological physiology, clinical pathological anatomy, clinical pathophysiology.

The structure of each module includes lectures, practical classes in a group format, classroom and extracurricular independent work, ongoing tests (including oral exams based on situational problems), chapter-based tests and final exam.

The experience of designing and implementing modular training is undertaken at the department of advanced training and retraining of teachers at SSMU. The content of the modular cycle "Modern educational technologies" is represented by four modules: a basic module ("organization of the educational process"), and three variable modules of advanced level ("Design and development of educational programs", "Organization of independent work of students", "Control and documenting outcomes in medical education"). The structure of each module includes lectures, workshops, both in an individual and group formats, classroom and extracurricular independent work, ongoing tests, chapter based tests (in sections) and final exam which is a final paper based on the subject of interest of the attending student. During the training, there is ongoing communication with the audience the purpose of which is to determine the success of learning, to analyze errors, etc.

The modular format of the cycle provides teachers with the opportunity to choose topics depending on the educational needs, their work experience, the need to design and develop educational and methodological support of the learning process for a particular discipline.

Thus, the analysis of literary sources and our own experience of applying modular type programs, allows us to conclude that currently there is no system approach to the methodology of creating, designing and developing modular educational programs at the level of higher medical education [5, 6, 9, 10, 12, 29, 37]. The transition to modular training requires the creation of a methodological framework of documenting and adapting the principles of modular training to existing federal standards as well as the creation of adequate methods of evaluation of acquired qualifications.

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# SIGNIFICANCE OF THE STUDY OF THE LINGUISTIC NATURE OF ETHNOGRAPHIES, RELATED TO WOMEN

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At all times the theme of a girl and a woman is relevant in any society. From the most ancient times up today there are enough works on this subject that become the best treasure of spirituality. The job purpose – determination of cultural wealth necessary for modern society by systematization of the ethnographism relating to the girl at Turkic peoples. Identification of similarities and distinctions of ethnographism relating to the girl at Turkic peoples. Identification of similarities and distinctions of features, methods and ways of national views' marker. Defining of motivated characteristics of the language units determining the concept "girl", consideration in artistic and precedent texts the mythology of a conceptual image of "Turkic girls", its value in sacral, toponymy, anthroponym systems, their evolutions to symbolical level will be realized through comparisons of the concepts "girl" and definition of their place in national outlooks, identification of features, methods and ways of national views' marker.

Keywords: ethnographies, girls, linguistic and cultural characteristics, Turkic peoples

The main prerequisite for the development of this work is the fact that it is directly related to the tasks of the article of N. Nazarbayev, has in "Orientation to the future: Modernization of social consiousness." In this article, the president says: "It is a spiritual code that can be deeply rooted in the history of a society that has been revived. The most important condition for a new type of renewal is to maintain that national code. Without it, it is easily become an echo. The essence of the revival is to avoid the historical experience and national traditions as before. On the contrary, it is necessary to make the most important prerequisites for successful modernization of the past traditions. If the country is not able to get the nourishment from its national-spiritual roots it will start to err."[1, 1]. Therefore, in choosing the subject of the project it is planned to direct the main direction of our state to our profession. In connection with this, the question of determining the national code in training and educatinng future specialists is certainly important. Certainly this problem is not only of linguistic scientists, it should be noted that the solution of such problems will be realized through the integration of several sciences.

Undoubtedly, after gaining independence the horizons of Kazakh science have expanded. Especially in connection with the spirit of the national language, literature, history, cultural science, philosophy, etc. Creation of new paradigms of research in the fields is a natural phenomenon. V.Humboldt noted: "The nation is characterized by a spirit of self-indulgence, the ability to exudge and preserve the spirit of that spirit and to extend from generation to generation" [2, 349]. In the spoken language, the national consciousness, the way of thinking, the behavior of every nation will remain. These peculiarities of the people change from generation to generation through the culture, tradition, literary heritage. Scientist Zh.Mankeyeva wrote: "Language is a key to recognition of culture, a great force that participates in the formation of spiritual and material culture. It defines the general nature of culture, collects, maintains and supplies basic information [3, 154].

"The lexical layers of the Turkic languages are in the focus of Turkic studies since M.Kashchary, and today lexicology is the sphere of linguistics which is sensible for all the phenomena and changes in people's lives. N.K. Dmitriev, J.K. Kiekbaev, E.F. Ishberdin, E.V. Sevorthyan, K.M. Musaev, A.A. Yuldashev, A.I. Kononov, N.A. Baskakov, A. Kajdar and others. The problems of lexicology of Turkic languages were studied in the works of scientists in the Soviet period and in the first years of the present century Ethnographic lexicon in particular Turkic languages has been studied in detail on the vocabulary of the Turkic languages by K. Musayev, A. Kaidar (Kazakh, Uighur) and Y. Zhanpeisov, J. Mankeeva, R. Shoibekov, G. Smagulova, S. Satenova (Kazakh), R.G. Ahmetyanov, R.C. Rakhimova, F.F. Gaffarova, F.S. Bayazitova, N.B. Burganova (Tatar), A.K. Appaev (Karachai-balkar) etc. In the Kazakh language ethnographies occupy a special place among the lexical units. Ethnographies are words and practices that reflect a wide variety of household and householdrelated items, products, concepts and phenomena created by the mind and work of the people. In other words, "ethnographies mean that many ethnographers have lived in our past life, many of which are still in use in household appliances, in particular in business, economy, traditions, customs, beliefs, housing, clothing, special names and phrases reflecting the peculiarity of the country's domestic and linguistic identity used in connection with the

peculiarities of the rule of the country, the rule of law"[4, 18].

With national code and spiritual refinement, there is now a need to gather, redefine and re-evaluate many of the cognitive, aesthetic, educational values, including the most important values related to ethnographies. The main object of our research is a symbol of femininity, beauty, creativity and wisdom, which has its own place in the world for all nations. The creation of a comprehensive encyclopedia of linguistic culture in the Turkic linguistics, the collection of its vocabulary, and presentation of the Kazakh State Women's Teacher Training University, which brings together nuture and upbringing of future mothers, which will be the basis of national identity, will increase the relevance of the research project. Determining the cumulative meaning, motivational nature, usage, dictionary arrangement, traditions and customs of other Turkic people is one of the topical issues of modern Turkic linguistics.

The vocabulary of our language is rich in information related to the history of the Turkic peoples, mentality, material and spiritual culture of the Turkic people. In this regard, the analysis of etymological, linguistic-cultural, ethno-linguistic and other aspects of female nomadic names in the Turkic languages is based on the extra-linguistic factors of their semantics, aesthetic taste of the Turkic ethnos and ideological mentality. There are works that directly or indirectly have a methodological basis for such issues that determine the direction of our research, as well as researches in the Kazakh language and in other nations.

Defining of motivated characteristics of the language units determining the concept "girl", consideration in artistic and precedent texts the mythology of a conceptual image of "Turkic girls", its value in sacral, toponymy, anthroponym systems, their evolutions to symbolical level will be realized through comparisons of the concepts "girl" and definition of their place in national outlooks, identification of features, methods and ways of national views' marker.

In K.Aronov's works "Ethno-linguistic nature of people's cosmonyms in the Kazakh language", "Stable phrases related to persuasion and faith in the Kazakh language" by K. Gabithanuly, "Lexicon of the spiritual culture of the Kazakh language" by S. Zhampeysova, "Ethno-linguistic issues of studying the means of spatial expression orientation in the Kazakh epic" by R. manalieva,"Phraseologisms in the Kazakh epic" by G. Kusimova,"Lexicon of the ware culture of the Kazakh language" by Zh. Mankeeva,"Language picture of the world in the national cultural context" by A. Islam, "Ethnic linguistic characteristics of the names of Kazakh national musical instruments" by T. Zhaubasova, "Ethno-cultural foundations of the vocabulary of the works of Mashhur Jusip" by A. Turyshev, "Linguistic cognitive bases of the Kazakh language" R.Shoybekov, "Lexic of the ritual folklore: idio-ethnic semantics" by A. Aitmukasheva, K.Rysbergen,"Ethnolinguistic foundations of the dialectal vocabulary of the Kazakh language "by M. Atabaeva, "Ethno-linguistic study of the lexics of the Kazakh language" by A. Mukataeva,"Language of Kazakh riddles" by N. Ongarbaevoy "Figuratively, a backdrop of stable expression based on ranching vocabulary in Kazakh language" by S. Satenova, "Ethno-linguistic somatic foundations of phraseology verbs of the Ka-zakh language" by B. Uyzbaeva, etc. the spiritual and cultural heritage of the Kazakh people is considered in the ethno-linguistic aspect.

In the following studies the question of a girl, a woman is discussed in various aspects. A.Baigutova performs a thorough analysis of the concept of "Kazakh Wife" at the Candidate's Dissertation "Ethno-cultural Characteristics of the Kazakh Woman's Concept". Together with the semantic, conceptual, ethno-linguistic, psycholinguistic analysis of the concept of "Kazakh Woman" the words, artistic and precedent texts, phraseological texts, proverbs and sayings that are included in this concept as well as their ethno-language image of the world are defined. Another peculiarity of the work is the use of associative experimental methods to define concepts and national stereotypes about the "Kazakh Wife" in the consciousness of the present generation. This work has a worthy contribution in the field of Kazakh linguistics, ethno-linguistics and cognitive research [5].

A. Alimzhanova's dissertation "Ethnolinguistic character of folk lexicon in Kazakh language" defines the ethno-linguistic nature of names, their place in their linguistic system, and the identity of woman's crafts, based on women's crafts, on the basis of the onomaciological system which reflects the continuity of material and spiritual culture. The woman studies the lexical-semantic, thematic groups of names, and the place she takes in crafting the national culture in the context of her craft, with a comprehensive study of the materials on crafts and spiritual culture [6].

In his doctoral dissertation "The Scientific basis of gender classification" G. Shokym analyzes the manifestation of gender classification in the language and speech, analyzes male, female concepts, features of verbal, non-verbal actions of men and women. The gender peculiarities of women's language is defined in the research, and gender relations of women in the history of our people are taught by the ideas of national and nationalist ideas of Tomiris, Aisha Bibi, Domalak Ana, Begiman, Kizay, Bopay queen. The key aspect of gender linguistics is the lack of gender and language differences between men and women in the context of linguistic communication, in the context of figurative, paramio-graphic fund, as well as comparative gender and language differences in the current language study [7].

M. Bigeldieva's "Kazakh and Turkish women's anthroponyms" defines typological similarities and national peculiarities of Turkish and Kazakh female anthroponyms. The place of female names in anthroponyms of both languages is noted and the linguistic compound of the modern Kazakh and Turkish women's anthroponyms was analyzed. More than half of the anthroponic fund of the two languages have been identified as Turkicspeaking names and anthroponyms of their percentage of foreign languages are analyzed and the lexical classification and semantic system of the Kazakh and Turkish women's anthroponyms, the peculiarities and similarities of the rite principle "to give a name to newly born" are analyzed [8].

In the monograph "The Ethno-cultural characteristics of linguistic units concerning girls" by T. Yermekova, A. Yusup, the linguistic units related to a girl which take a significant portion of our national language and spiritual values are analyzed. As a result of recent achievements in ethno-linguistics, cognitive linguistics and linguistic-culture, which is closely related to one another, the linguistic units of a number of linguistic units show the ethnos nature and spiritual culture, their contribution to enriching the vocabulary of our language. The fields that define the concept of "Girl" in the linguistic sense of the Kazakh people are identified and analyzed in its component structure and information content [9].

There is a research on the concept of women in the Russian language. In this regard, L.B. Adonina, Liu Bo, G. Apuxtina, O.A. Chibysheva, A.B. Kirillin and others works can be named.

L.V. Adonina's monograph "The Concept of the Woman in the Linguistic and Cognitive Consciousness of the Russian People" provides a semantic-cognitive analysis of this concept. A comparative analysis of cognitive signs is based on gender and age features [10]. L.H. Dzassezheva's semantic analysis of women's names in the Russian and English-Kabardian and Chercess languages is based on the work "Women's lexical and semantic field in various cultural communities". Common universal and national peculiarities are distinguished for languages [11].

The following works on women's issues in the world space can be named: Ibrahim Hasan's "Language, Gender, and Power: Analysis of theme and topic management in Arabic conversational discourse" examines the Arabic language spoken in the issue of language, gender and power, the nature of women, their linguistic discourse, and analysis of place in society [12].

In the project work done by Nadia Furlan in the period of 2008-2010 the problem of women in society is also touched upon. Here is a comparative analysis of the social and religious issues of women in Jewish-Christian cultures [13].

In the study of Julia S. Falk the object of research was taken from the beginning of the twentieth century. Here is the role of women in the preservation of the vital part of language (viability), the activity of women-scientist in history and language science. [14]

Although there is a general study of the ethnographies of separate languages in Turkic studies, there is no study of ethnographies related to girls, comparing several Turkic languages with linguo-cultural character. This, in its turn, makes it difficult for the Turkic peoples to change their common spiritual values and intercultural communication. By collecting ethnographies, certain data on ethnic history of Turkic-speaking peoples are based on past lifestyles and economic peculiarities. The relevance of the research is determined by the fact that the ethnographic lexicon of the Turkic peoples is limited to the study of small, though individual, lexical groups of individualized Turkic languages. The lack of fundamental research on this topic, including lack of a complete classification of ethnographies related to girls, and lack of full coverage of ethnographies in dictionaries – increase the relevance of this work. The accumulation of this part of people's rich lexicon, which accumulated for centuries, can accumulate valuable data from the development of Turkic peoples, languages and social, economic and everyday life of the population, and not only define their cultural and spiritual connection with the peoples of the neighboring and other linguistic groups but also contribute to the development of linguistic-cultural science.

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In addition, the linguistic units of the linguistic unit are divided into two groups: spiritual and material; not only their etymology, use in oral literature and poems, proverbs and phrases are analyzed but linguistic units telling us about historical, cultural, aesthetic and civilizational values of our people will be determined.

The findings and conclusions of the research contribute to a certain extent to the reflection of the scientific and theoretical foundations of ethno-linguistics, linguistic culturology, and cognitive studies in Turkic (Kazakh) linguistics. In the course of the research, the analyzed language data can be used to compile explicit, phraseological, associative dictionaries of the Kazakh language.

Women's linguistic culture reflect manycentured collective spiritual and material creativity of the Turkic peoples connected with mineral resources, household products, their relationship with the natural wealth, society, and the environment, as well as phraseological units, equations, proverbs and sayings, folklore and epos. Modern use reflects the personality and peculiarity of the spiritual heritage of our people living in the integration society.

The essence of the concept of "girl" is a distinctive feature of the people. The beauty of the girl since the ancient times in the Kazakh people has been measured by her character, mind, vision, and relationships with people around her. The Kazakh people recognized the word "girl" as a sign of beauty, elegance, and beauty. In the folk folklore of our people, many poets gave many beautiful illustrations to the girl. She also appreciated the child's attentiveness, skill, tenderness, tenderness, and tendency toward art, education, and personality that he used to portray these qualities in figurative language.

When it comes to the Kazakh girls, especially when talking about their inner beauty and harmony, their riches and their intelligence, you will most certainly come to see the characters of heroes in heroes' eyes. The Kurt is a symbol of wisdom and intelligence inherent in the Kazakh woman, Silk – beauty and elegance, the indispensable qualities of Ayman and Akjunus – the deception, the cunning, the wit and the Bayan – the symbol of loyalty to love and affection.

In the lyric epic poems of the national literature, the beauty of the Kazakh girl is evident. Outside beauty is characterized by the inner soul of that character. In regular expressions about a girl in the Kazakh language, there are a lot of linguistic units that describe the beauty, beauty, elegance, and beauty of a girl. Among the linguistic units created with the word "girl" are traditions that are subject to nomination process. The main event in the life of a girl in Kazakh customs is to marry a goodlooking girl. Our wise people were not indifferent to this problem. It is clearly reflected in the heritage of the Kazakh woman, her value and character, her dignity, her outlook on her marriage, her life, her life, heritage and her age, reflecting her by her wise words, proverbs and sayings, her constant companions.

It is highly probable that the linguistic unity of the girl is of great importance to the education and upbringing of the Kazakh people, and that the older daughter will be a good mother and a good mother in the future.

The linguistic and cultural meaning of the concept of "marrying a girl" in the Kazakh identity is also reflected in Kazakh phraseology.

In the Kazakh society, the girl values the qualities of a child, and of women as a whole, not as inferior, immoral, shyness, and more. It is clear that the Kazakh girls, such as fortune-teller, haughtiness, pride, wisdom and wisdom, have come from the legendary tales of the country, tales of tales, tales of princesses, Zarina, Doma-lak Ene, Aisha bibi, Kurtka and Gulbarshyn for centuries. The woman's character, her male character, is, first of all, the girl's beauty.

The concept of "girl" in the Kazakh language has a linguistic and cultural value. From the phraseology to the girl, we pay special attention to the upbringing of our girls, the environment, the origin, the beauty of the girl. Our wise people firmly adhered to the principle of "upbringing of a girl – generation, national education".

The people of Kazakhstan, who say, "Be a good girl for me – be a stupid woman", adhere to the wisdom of the people, and when girls start to grow up, they will be able to make friends with noble, noble, educated, , who were willing to go with them, and were officially educated. From the childhood he was brought up from the childhood, not to say the least, to laugh, to laugh, to keep his mouth clean.

The main object in the article is that the girl is a symbol of femininity, beauty, creativity and wisdom, which has its own place in the world for all nations. Determining the cumulative meaning, motivational nature, usage, dictionary arrangement, traditions and customs of other Turkic people is one of the topical issues of modern Turkic linguistics. As we mentioned above, it is quite possible that in the case of complex research for this topic and in the light of new language areas it is possible to write important works for linguistics, Turkic studies.

# Pedagogical sciences

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# METHOD OF TEACHING INFORMATICS FOR SCIENCES-MATHEMATICAL DIRECTION IN THREE LANGUAGES

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For today huge events on modernization of education system, which includes secondary education are held in the Republic of Kazakhstan. Learning appeared in the result of increased demands on level of foreign language proficiency at limited time which is built in for its study. Method of teaching informatics for sciences-mathematical direction in three languages Informatics students will go to classes in three languages easily. At the same time, the lesson for the passage of light Kazakh, Russian and English word. Each topic included in the short-term plans and visual aids. This approach allows to carry out training in two subjects simultaneously, though the main attention may be paid either to language, or to non –language subject.

Keywords: national culture, great literature, great culture, future teachers, Method, sciences-mathematical direction, three languages, informatics

The relevance Nazarbayev emphasized that all the Kazakhstan citizens should strive to know their national language. "Lifting of one nation through humiliation of other nation is unacceptable. That is why I am talking about three lingual's," he said. "Kazakhstan has to know its official language - the Kazakh language. The Russian language is the language of our big neighbor and one of the six languages. This language enabled us to access the great literature, the great culture. That is why we should not forget it, or put it aside, every language is wealth for a person," the President said. "We need the English language to enter the global arena. Out of 10 million books published in the world 85% are in English. The science, all the new developments and information – they are all in English nowadays,' said the President. He added that there were 3500 foreign companies in Kazakhstan and the local citizens needed English to communicate with them and use the equipment they bring into the country.

Management and Control. Taking into account the changes in the program in the ministry of education, language teaching changes and additions to the program of learning. Russian language schools by the Department of Education in Kazakh "History of Kazakhstan", Kazakh language taught in schools "World" in Russian history; "Informatics", "Physics", "Chemistry", "Biology", in preparation for the introduction of English language training courses period.

Methodological and instructional support. Integration courses (computer science, physics, chemistry, biology and English language) to learn step-by-step methodical introduction of integrated. English early learning preschool classes offer additional paid services. Explanatory dictionaries and purchase of foreign, domestic, methodical, educational literature

Method of teaching informatics for sciences-mathematical direction in three languages Informatics students will go to classes in three languages easily. At the same time, the lesson for the passage of light Kazakh, Russian and English word. Each topic included in the shortterm plans and visual aids.

Therefore, the future teachers of computer science "in three languages – Kazakh, Russian and English languages" as a method of improving the level of students' knowledge of modern electronic teaching the necessity of forming a complex topic "Method of teaching informatics for sciences-mathematical direction in three languages" computer science teaching he then became the basis for the preparation of the complex.

The aim of the thesis: "Method of teaching informatics for sciences-mathematical direction in three languages " preparing information center.

Objectives of the degree work:

- Information medium and definition of requirements.- the implementation of the threelanguages education.

– In the middle of the Dreamweaver "Method of teaching informatics for sciencesmathematical direction in three languages " create the information medium.

The practical value of the degree work:

"Method of teaching informatics for sciences-mathematical direction in three languages" on the efficient use of information medium in the educational process.

The scientific novelty of the thesis:

"Method of teaching informatics for sciences-mathematical direction in three languages " creation of information medium. **The object of the research:** "Method of teaching informatics for sciences-mathematical direction in three languages ".

State language and the country's independence important . He is an independent national culture and national consciousness, the support of our spiritual being. Language of the population differs from that of other nations. Language is a sign of other things, determining the portion of the individuality of the nation. "Which only be the language of the nation and other related and unrelated nature of the nations of the population, can show its traditional natural" [1].

Kazakhstan is a multinational state. More than 135 people live in unity and peace. Representatives of every nation to preserve their languages, customs and traditions of all the conditions are being created. All nations and nationalities living in Kazakhstan, language, culture and traditions will continue at the same time to create the best conditions for the development of the previous "[2, 3].

Each features will be an independent state. They are: coat of arms, anthem, flag and language.

Were provided to sit it out the status of the state language, Kazakh language, the Russian language is equally considered. There has been a priority in recent years, it comes to existing languages. State institutions, local self-government bodies and settlement of securities in Russian. Now, who was doing business in Russian state institutions.

Russian language than the language of the state for many years was going to be printed. 90 percent of the population speaks fluent Russian. Kazakh language is different from the address. It was only on paper. Existing condition worse. In this regard, the various programs in order to increase the activity of the state language, the design began to be accepted. One of them is the "trinity" of the state program.

President Nursultan Nazarbayev, which was built to start a program that provides a significant advantage in the Kazakh language. Since 2011, the project is firmly taken today started its work and has given a positive result. President XVII session of the Assembly of People of Kazakhstan Kazakh language that unites the peoples living in the territory of Kazakhstan noted that language must be clear:

"Kazakhstan, a Kazakh family friendship holy balanced, various ethnic groups like the golden lion rays. At the same time, vast areas have common values that unite all of us. It is the core of our vast cultural heritage and solid state language "[3, 4]. In his messages for specific purposes. He drew attention to the increase of the state language, Kazakh language in 2025 should be 95% of the total population, who says:

"Language should be a unifying the people of Kazakhstan. This is a healthy and consistent language policy, no one should be without prejudice to the language spoken by Kazakhstan. By 2025, 95 percent of Kazakh citizens must learn the language.

The future of Kazakhstan – Kazakh language.

Kazakh as the dominant language in all spheres of life by 2025, has become a day-today language of communication in any environment. So the independence of the nation's most important asset – organized by the native language will become "[2, 5].

"Three-languages" on the basis of the program

1. Kazakh language

2. Russian language

3. English language

Russian language – a historical advantage. Kazakhstan via the Russian language for several centuries, additional education and within the country and abroad to expand and communications environments.

English language proficiency – will be the key to understand the youth of the world. Fluency in English opens up unlimited opportunities for our young people. He is the guarantor of globalization.

Kazakh language – the state language. A symbol of the independence of the country. The future of Kazakhstan – Kazakh language, Kazakh language – the language of the future.

The study of the languages of other ethnic groups, each know the specifics of the language by creating conditions for learning, will be familiar with the traditions and customs.

"One of the programs aimed at improving the function of languages in the state program of functioning and development of languages for 2011-2020". The project prepared by the Minister of Culture of the Republic of Kazakhstan Mukhtar Kul-Muhammed.

The main objective of the program:

• The improvement of the status of the Kazakh language;

• clerical Kazakh language in state institutions;

• mastering the English language;

• Excellent knowledge of Russian language;

• The development of languages in every nation, to preserve them;

• languages open the way to the unity of harmony.

The period of implementation of the project: The first stage of the year: 2011-2013

The second stage: 2014-2016 years

The third stage: 2017-2020 years

The project will result in:

• 100% of public high school graduates who have mastered the language;

• 95% of the total population – have mastered the state language;

• State institutions of the Kazakh language paper in -100%;

• The share of citizens who speak Russian in the country -90%;

• 20% share of the population is fluent in English;

• languages other nationalities – 30%.

• fluent in three languages should be headed 20% of the total population;

As you can see, the Kazakh language is more and more attention. It is difficult to be a priority. This is caused by the lack of knowledge of the language of Kazakh citizens.

State language – the main route. 100% of the next ten years, the school graduates were required to learn the Kazakh language. Its implementation task of the family and the school. If taught by the parents of children in family education and science and education, the school will absorb. They are compatible with the development of Kazakh language. Then the only Kazakh-speaking, think of the Kazakh society. Such education system in the formation of a special place in society.

Nearly every try the basis of knowledge will be able to start a family, parks and gardens. Child put it, see what the box "flight", the first words, learn how to learn what language is close to that language. Therefore, Kazakh kindergartens in the family must pay attention to the speech. Primary class complements any child's vocabulary, knowledge, systematize, seeks new knowledge and education. Children who learn the Kazakh language, wants to continue to further the knowledge of this language. In other words, at the age of kindergarten, the child must speak the language of Kazakh routing. In this way we are educating the citizens 100% fluent in Kazakh. She wanted ten, twelve years later, will be the guarantor of the Kazakh-speaking society.

Russian language and English language school age to start training. In addition, not only taught only grammar, teachers, students speak freely able to express their opinion, should close attention to the extent trained them to come. This event, to be effective implementation of all the conditions required. Fluent in English and Russian citizens abroad, education, economy, political situation in the country, will be able to learn about the traditions, nature. It can be achieved using different areas of the country. This is the feature of the language. Therefore, youth training, free to speak the language training in kindergarten, school, educational institutions, need to be taken.

The three walls of the school were taken to a different first started teaching the language. For example, in the city of Astana NIS trilingual education is underway. With regard to the specifics of this process:

1. the program is taught in different languages;

2. if necessary, to ensure that the material in the native language team training;

3. the optional extracurricular events: (drama club, choir, clubs, sports clubs, readers club, languages, etc.), integration;

4. the original training to allow the school to provide trilingual library resources;

5. all relevant documentation (policies, relations, web sites) in three languages;

6. The organization, which promotes the development of language competence language courses;

7. encourage foreign countries through training;

8. In accordance with the requirements of international standards for the development of international students, thinking that experience of language, culture, literature, etc. will be supported by considering as a path to "[6].

As you can see, in addition to teaching the language as a subject, and a variety of other subjects, Russian and English languages, is expected to be available in three languages by learning platform. In addition, the school library trilingual provide resources for students to read any text, for example, the original knowledge opens up the opportunity to store and create conditions for foreign writer's work, will feel a deep aesthetic pleasure.

Optional extracurricular events, use the same language, the three clubs, the securities requires the use of three languages and knowledge of the language. These measures will create conditions for the development and use of the languages and the introduction of secondary schools in the trinity of this work will be the way of the implementation of the program [7].

As a result, the Kazakh languages policy priority – Trinity of languages.

### Terms of the implementation of the three-languages education

The purpose of the program: Kazakhstan all the people and preserving the languages

of national unity important factor in strengthening as the state language fully functioning which provides language policy.

Objectives:

• improve the professional skills of teachers;

• Foreign Languages disciplines of educational material connecting to prepare give;

• foreign students Languages, as well the cultural and increase the level of education.

Expected result:

• Together with the students in the 2015-2016 academic language teachers, language analysis, comprehensive development program Elementary conversation to a discussion Skill is carried out.

• 2016-2017 academic year – language, history teachers and the cycle of natural science Together with teachers application integration course preparation, relationship remove all obstacles to the language of the program take an active part.

• 2017-2018 academic year, language teachers, teachers of history and natural science cycle joint training, courses will be held, a trilingual education subjects at school learn the specifics of.

• 2018-2019 academic year – language teachers and teachers of history, natural science

cycle trilingual education research program in the field of Practical learn how to enter periods.

• 2019-2020 academic year, Language teachers and history, natural science cycle teachers, their experience According to learn a trilingual various video issues classes, online classes, and master classes on site share information tools and publications, miss [10].

The content of computer science in grades 9 through training complex in three languages:

I. Name of the theme in three languages II. computer science in grades 9 through 34

lessons designed for short-term plans.

1. Introduction Safety rules of computer classroom.

Means of Algorithm. Features of Algorithm.
 Methods if imaging algorithm. Block diagrams. Means of executive.

4. Types of Algorithm.

5. Auxiliary Algorithm .

6. Methods of solving tasks. Structure algorithms, mathematical model of the task.

7. Control work.

8. Revision . Independent work.

9. Languages of programming. Program and its structure.

10. Orders and operators.

11. Expressions. Claim. Numeric functions.



Method of teaching informatics for sciences-mathematical direction in three languages

12. Types of data. Means of variable.

13. Practical work.

14. Control work.

15. Revision.

16. Independent work.

17. Input and output databases. Programming of linear algorithms.

18. Organization of the choice. Choosing operator.

19. Conditional operators.

20. Programming of cyclic operators. While, repeat, for cyclic operators.

21. Repeat cyclic operators.

22. For cyclic operators.

23. Programming of graphical objects. Coordinate plane.

24. Practical work.

25. Control work.

26. Revision.

27. Working with symbolic databases.

28. Massive. One-dimensional massive.

29. Models and meaning of modeling. Types of models.

30. Statistical and dynamical models.

31. Internet – World Wide definition. World Wide educational medium. Worlds informational society.

32. Surfing information in the internet. Sending and receiving information. Through email address.

33. Control work.

34. Revision.

III. drawings, presentations and how to work with the Pascal programming language in compliance with the themes of the video lesson.

IV. words in three languages depending on the term discipline. Located in alphabetical order.

V. Instruction tests for grades 5 to 9.

VI. Information about 6 people create electronic textbooks.

In conclusion, the results of the degree work using at the school and secondary school environment, "Method of teaching informatics for sciences - mathematical direction in three languages" information environment is created. Computer lessons Kazakh, Russian and English languages, prepared to go easy. Students in the English language was clear and perfect knowledge of three languages for word. In addition, videos and presentations. This theme "Method of teaching informatics for sciences – mathematical direction in three languages" protection of computer information systems and networks of the information through a secondary offer, thinking that students learn the lesson easily.

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# THE RELEVANCE OF TRANSDISCIPLINARY AND SYSTEMIC RESEARCH OF EFFICIENCY OF INTERPERSONAL INTERACTIONS IN EDUCATIONAL PROCESS

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The article discusses the urgency of conducting transdisciplinary and systemic research in the field of education, in particular, the need to analyze the coherence of interacting subjects of the educational process. These questions relate to many areas ranging from the fundamental concepts of Vygotsky and Piaget to the modern neuropsychophysiological methods of hyperscanning and neurosocioetology. The need for psychophysiological studies of the role of individual-typological features of subjects of the educational process in providing effective joint activities in groups of students, including educators, is emphasized. It is suggested to take into account the coherence of perception and activity of subjects at different hierarchical levels: socio-cultural, behavioral, linguistic, psychological, cognitive and emotional, including psychoneurophysiological. Such approaches, taking into account interpersonal coherence in a broad sense, are important for the development of methods that facilitate the training of young people with emotional and behavioral difficulties. In addition, transdisciplinary research can also be successfully applied to the study of more specific activities, for example, joint thought, joint creative activity, group gaming activities including virtual, as well as social networking in the Internet and in joint networked education.

Keywords: transdisciplinary research, interpersonal interactions, educational process, coherence, neurosocioetology

A large number of scientific research, publications and reviews are devoted to studies of educational processes in the school, including the higher school, and the identification of patterns and mechanisms of optimal interaction of subjects in the field of pedagogy. Most of these scientific works are based on psychological methods of research and are theoretical or applied nature. Most of the works in the field of pedagogy are based on the cognitive development theory of Piaget [18], in which he describes a series of stages: sensory-motor (birth to 2 years), preoperative (from 2 to 7 years), stage of concrete operations (7 to 11 years), stage of formal operations (it begins in adolescence and covers the entire human adulthood) in development of intellectual sphere of children, which includes changes that affect cognition and cognitive abilities of the child. According to Piaget, firstly cognitive development involves processes based on actions, and just then appears in the form of changes in thinking processes.

At the heart of many domestic and foreign works is the cultural-historical theory of L.S. Vygotsky [32], showed the role of cultural and social development and development of the human personality. Both the theory itself and its main provisions are analyzed depending on the object of attention of the authors. Vygotsky L.S. emphasized the social dimension of intelligence that is developed through joint activities and the creation of its products, such as culture, through cooperation, communication and learning, both in phylogenetic and ontogenetic sense. Vygotsky L.S. claimed and presented evidence that cognitive skills of a person are formed by their interaction with the other people in a culture with artifacts and symbols created by the human community. This theory finds followers among the leading foreign researchers, who criticize the development of the theory of intelligence, based only on the processes of social competition [15].

In foreign psychology the most widely used concepts such as: the law of development of higher psychological function, the zone of proximal development, often considered, compared together with the concept of scaffolding, the triangle of meditation, the idea of the importance and the role of adult and peer in a joint activity of the child. In the west, the cultural-historical theory of Vygotsky and Leontiev's theory of activity connected, even in the title, in the cultural-historical activity theory (Cultural-Historical Activity Theory). Meditation triangle of Vygotsky and Leontiev's ideas were recycled by Engestrem, and on that basis he developed a model for the structure of activity. This model is widely known abroad [30].

The greatest interest in Engestrem model is the effectiveness of its application to the analysis of joint activities in the group, the community, and between organizations. This model also allows to examine the systems of activities mainly on the macro-level of the staff and the community compared to micro-level of the individual, acting with the tools. The model allows to design, organize and conduct examination of activities. In practice, the formation of cultural-historical activity theory allows to organize work for young people with emotional and behavioral difficulties, joint activities of teachers in schools, create new cultural forms by human activity [7]; organize joint leisuremediated activity of children – the author's project "The Fifth Dimension" by M. Cole and his colleagues [12]. In this article the authors examine the application to the research of the problem of training and development approaches of Vygotsky and Leontiev, in which the basic unit of study of human thinking in the cultural-historical activity theory – a joint mediated activity.

Data from a study of the "Fifth Dimension", specially organized activities for children after school to support cognitive and social development of children and adults are analyzed. Applied practically-oriented nature of the theoretical model should be noted. Representations of L.S. Vygotsky were developed in the domestic psychological school and pedagogy [33].

A large number of works are devoted to the subjectivity of small social groups, carrying out joint activities, their consistency and integrity, the presence of independent qualities in macro systems of this level: the group aims and motivation, norms and values, cohesion, compatibility and harmony, efficiency, orderliness and reliability groups, group installation, group self-esteem, and others. [5, 26, 33]. Also some authors in psychosocioethology draw attention to the conditions of life of the group subject and the dynamic features of group subjectivity, in particular the levels of development, actualization and self-determination.

Many questions remain regarding the selection processes of different tactics of social behavior of individual subjects depending on their source of individually-typological features, including cognitive ability, general and research activity, as well as the hierarchical status in the subpopulations.

A significant proportion of publications are devoted to the study of the features of work, play or sports joint activities. Among them, most of all works associated with the production joint activities and labor groups, especially with the brigade form of labor organization. Researchers also show interest in the joint activity of preschool children, co-curricular activities of students, teachers, and pupils. In the first case similar in content issues are considered, such as predictors of emergence of collective action and its subject children have got [29], the development of the gaming joint activities and relations of preschool children [3], the establishment of a joint plot-role-playing and initial forms of joint labor, the degree of formation of labor and gaming activities and their influence on the formation of children's readiness for cooperation, joint actions [10]. In the second case, the interest is caused by problems of maturing in joint educational activities of children, including those in the age context, models of group learning task, co-operative and collective distributive forms of solution of educational tasks, the organization of group work as a new paradigm of learning – problems connected, by and large, to the formation and organization of cocurricular activities of students [20, 21]. A number of studies focuses on constructive, effective educational cooperation teachers with students [13, 28], their joint thinking activity [4].

It should also be noted that research aimed at studying more specific activities, such as the collective thinking activity [24] the joint creative activity [14], group gaming activity include game in the virtual environment [25].

Another direction of the application of the ideas of the importance of social organization of cooperation in solving the problem is an area of the "culture" of interaction on the internet and during joint network education [31]. Researchers refer to the concepts of the zone of proximal development and cooperation in the team of adult and peers for design and creating a variety of tools for working of children in the online environment, and to create these environments in the educational process. For example, the E.D. Patarakin [17] presents the general principles of pedagogical design of collaborative networking, according to which the activities of the subjects of education is built around the creation of various types of educational products which can be generally described as "digital story". Due to the fact that the network activity is associated with changes in digital objects, its organizers and participants have the opportunity to observe and analyze the situation of working together. The methodology of presentation diagrams of joint activities on the board with alphanumeric notation that allows discussion and analysis of qualitative data on participants in groups, which are formed in the course of educational or socio-educational projects is offered. Technology and methodology of static and dynamic diagrams helps to analyze and discuss the situation arising in the course of joint network activity.

Influence of culturological features of the subjects of social groups, especially emerging in the educational process on the effectiveness of the quality and features of their operation remains poorly studied. It is not enough studied also backbone factor and the cognitive component of joint activities.

Also, physiological processes, such as neurophysiological and somatic-vegetative

mechanisms ensuring human integration into a joint group activities, which in modern terminology refers to the new neuroscience "neurosocio-ethology." remain poorly studied. These processes are increasingly investigated at zoosocial interactions of mammals and birds [6, 11, 22]. Differences zoo-social forms of behavior, their severity depending on the sex, and in subjects with depleted social and cognitive experiences are shown. Some neurophysiological and neurochemical mechanisms of formation of various forms of their social relationships are found out. Part of the front regions of the cortex in the regulation of zoo-social behavior, and hemispheric asymmetry are revealed. Differences neurotransmitter systems of the brain, in particular the dopaminergic, serotonergic, and endogenous opiate are shown [19, 23].

In recent years, some groups of authors began the study of synchronous changes in the activity of different brain regions of people working together, by registering the spectralcoherent characteristics of their electroencephalograms and fMRI mapping. As far as we know, Duane and Behrendt [8] were the first who carried out simultaneous recording of EEG brain activity of several subjects. They were trying to calculate correlations between electroencephalographic characteristics of two people. This multi-subjective EEG analysis technique then for a long period of time has not been claimed, but has been revived in recent years and was named "method of hyperscanning" [16]. Since then, researchers have begun to use hyperscanning for analysis of correlations of activities of the brain structures of the two people in the process of inter-subjective social interactions [2]. At the moment the coherence of the activity of brain structures in civil aviation pilots while working together at the gym is shown [27]. It is proposed by using hyperscanning to explore the emotional component of the interaction of several subjects in the process of listening to music [1]. Other authors using hyperscanning of magneto encephalograms show the dependence of synchronous activation and correlation of brain activity of 2 subjects in the kinematic problems, depending on their role in the process of interaction: leadership or statements of subjects during the joint activity.

Some authors [9] believe that if neural mechanisms of inter-subjective coherence of brain activity were accurately identified, it would be quite acceptable to use them as neuro-markers of quality of social interactions in everyday life, and as neuromarkers of quality of processes of learning and could be a measure of the success of the learning process in educational environments.

The analysis of the data of domestic and foreign scientific literature shows that there were practically no such transdisciplinary research of educational processes: with a comparative analysis of the general cultural development, cognitive abilities, psychophysiological and neurophysiological provision of individual and joint activities of human subjects. There are scientific works tackling only fragments of the whole problem and solving just its solitary tasks. For the first time ever the intersubjective interactions are proposed to be considered and examine holistically and at different levels as follows:

1. The culturological coherence.

2. The behavioral coherence:

2.1 in the educational process;

2.2 in the test model of joint activities;

3. The linguistic coherence: a comparison of the space-time structure of sentences in writing by the subjects of the educational process, including teachers.

4. The psychological and emotional coherence.

5. The physiological coherence of the subjects of joint activities:

5.1 in terms of EEG activity of different brain structures,

5.2 in terms of heart rate variability, reflecting the processes of vegetative regulation of cardiac activity and psycho-emotional tension.

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# Philological sciences

## INTONATION AND DISCOURSE

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This article is aimed at discussing one of the most expressive non-verbal means of social intercourse and oral discourse known as intonation. The form and function of suprasegmental characteristics of oral discourse have not yet been described in detail despite the wide use of modern technologies in the field of acoustic phonetics in the XXI century. Intonation conveys information in speech independent of its words and sounds in long stretches of speech. The time is ripe for summing up the data in the study of intonation based on the thorough scientific analysis of all the components of intonation constituting a dynamic complex of suprasegmental (prosodic) features accompanying speech production and affecting the listener(s) in social interaction. Language contact resulting into language interference and foreign (non-native) accent is also a factor to be thoroughly researched both in theory of intonation and intonation practice in EFL classroom.

Keywords: intonation, intonology, suprasegmental, oral discourse, intonation discourse, foreign accent, cross-cultural communication

One can define a department of modern linguistic science concerned with the study of intonation as intonology (Antipova, 1979). Intonation (Lat. 'intonare' – 'to pronounce') is a complex of expressive phonetic qualities of speech. Intonation is very obviously suprasegmental, "...since an intonation pattern extends over a whole utterance or a sizable piece of utterance" (Trask, 2007, 283). Intonation is the 'soul' of a language (Kingdon, 1958). It is its 'voice mimics' (Bally, 1951). It is a complex phenomenon in both form and function. Intensive intonation studies began not so long ago - in the 1950s of the XXth century, due to overwhelming achievements in the field of linguistics and the accumulation of many experimental data deduced from the study of many world languages. The implementation of modern precise methods of phonetic analysis have brought about astounding results that made it possible to pronounce intonology an independent department of linguistics having its own object of research and its own methods of analysis. Intonation began to be explored from different angles: linguistic, paralinguistic, sociolinguistic, didactic, esthetic, etc. As a complex phenomenon of oral speech, it attracts much attention on the part of specialists from different spheres of knowledge: philologists, linguists, literary critics, art critics, theatrical experts, sociologists, psychologists, acoustic engineers, etc. The study of intonation is of prime importance for the practice of teaching and learning foreign languages. When one listens to the sound flow of speech in a foreign tongue it is firstly intonation that catches one's ear. The concrete meaning of an utterance may not be quite clear but the overall prosodic pattern of speech can help the non-native speaker decode the general emotional state of the speaker and his attitude towards the partner in communication. It is common knowledge already that intonation is most difficult to master in the foreign language learning process. Wrong intonation does not only betray a speaker's foreign origin and jar upon a native speaker's ear - it can convey distorted meanings resulting in a serious misunderstanding in the process of communication. In this sense, as many phoneticians point out, intonation is much more important than accurately pronounced sounds of a foreign tongue: "English speakers are able to make a good deal of allowance for imperfect sound-making, but being for the most part aware of the far-reaching effect of intonation in their own language, they are much less able to make the same allowance for mistakenly used tunes" (O'Connor, Arnold, 1973, 2).

Intonation is capable of transmitting a whole range of language meanings. The remarkable role of intonation is manifested in the emotional and expressive power of utterances, intonation is the music of speech, its non-verbial means of communication. The individual intonation characteristics of speech are very much diversified. Does it mean that intonation is subjective and can't be given any objective description? Certainly, not. People would stop understanding each other if they couldn't decode what meanings and speakers' attitudes stood behind the tonal inflections of speech (Zinder, 1979). There are definite intonation patterns of oral speech that are recognizable by all the speakers of a given language community. On the other hand, foreign speakers often misinterpret the intonational nuances of native speech being guided by their own native language intonation meanings. Such intonation mismatch causes communication hazards between native and non-native speakers of the concrete common language.

The purpose of this research is to examine the theory of discourse intonation and to discuss issues related to intonation pedagogy. The basic argument here will be in favor of teaching certain elements of discourse intonation after taking into account governing conditions such as learner needs, teaching programme aims, and the learning context. The issues of important and peripheral in intonation for non-native speakers interacting with each other in EFL situations are brought into focus. It should be noted that certain intonation parameters, such as distribution of sentence stress in oral discourse, nuclear sress prominence, rhythm and melody patterns, etc. may be marked by phonological errors in non-native speech, causing breakdowns in communication.

The beginning of the XXIst century is witnessing renewd interest in intonation research. The goal of intonology nowadays is to give a description of intonation as a linguistic category possessing its own phonetic features and functions, its universal and specific characteristics in oral speech. What is more, the studies of intonation nowadays are concentrated on various types of oral discourse. Discourse Intonation seems to be the most sensible approach to the teaching and analysis of everyday speech. Discourse Intonation (DI) theory was developed at The University of Birmingham (UK) in the late 1970s and early 1980s. The originator of this approach was David Brazil (1925-1995), working with Professors John Sinclair and Malcolm Coulthard (Brazil et al., 1980). It became influential in English Language Teaching (ELT) in the mid-1980s and 1990s, both for teacher training (language awareness) and classroom practice (pronunciation). This influence continues to grow, and DI is increasingly used in academic research (Hewings, 1990; Cauldwell, 2013).

Certain established practices in foreign language teaching, especially in the development of communicative skills that demand the production of language, assume that written and spoken discourse are identical in form, structure and use. Similarly, it follows that the acquisition of one leads to the acquisition of the other. However, these two versions of discourse are not identical and they diverge from that suggested by foreign language textbook authors with communicative aims in mind (Tocatlidou, 2016).

The recent discourse intonation research focuses on the stylistic peculiarities of oral discourse (Velikaya 2010; Freidina 2005 et al.). Intonation stylistics (Antipova, 1979) is concerned with a description of suprasegmentally different styles of speech (prose reading, stage speech, recitation, oratory style, conversational style, etc.). Text and discourse intonation research was initiated in Russia at the end of the XXth century (Doubovski, 1978). The term 'discourse' refers to the larger context of the whole conversational interaction between speakers. Intonational meaning cannot be separated from discoursal meaning. The discourse approach views the function of intonation as the speaker's way of organizing and relating together meanings throughout the discourse. Intonation reveals the information structure of the discourse, the relationship between utterances. Descriptions of intonation differ in the way they account for its meaning. One description links intonation meaning to attitude, another looks at grammar, and a third to discourse. All the functions of intonation work together and help to express the rich character of oral speech discourse, the so called 'speech in action', or 'streaming speech' (Cauldwell, 2013).

Intonation is a linguistic universal: all languages appear to have it, though its form and function will inevitably differ from case to case (Kingdon, 1958; Crystal, 1969; Bolinger ,1986; Cruttenden, 1997; Crystal, 1969; Fox, 1995). The attempt to determine the limits of such differences leads to a concern with the establishment of an intonational typology, and an attempt to identify possible parameters of typological differentiation, and of the criteria that are appropriate for identifying them. In intonation, there is still a lack of data about the permitted range of inter-language variation, and where descriptions of intonation of different languages are available it is difficult to relate them to one another because of the differing modes of description adopted. However, the description of intonation patterns of languages coming into contact in the speech of a bilingual is particularly imperative in view of the practical difficulties the learners of the target language inevitably face (Vishnevskaya, 2002). The low level of phonetic proficiency stems primarily from the learner's failure to adequately perform intonation (in spoken communication) or interpret it (on the level of perception) in discourse. Intonation presents both phonetic and communication hazards to the learner of English and deserves particular attention from EFL pronunciation instructors, both practically and theoretically.

Of late, most theoreticians and teachers of English pronunciation are focused on oral discourse prosodic and intonation characteristics of different varieties of English in the era of language globalization with English as *a lingua franca* in cross-cultural communication. In extended speech utterances, they have to deal with a lot of intonation istakes (both in form and function) in English speech of 102

classroom bilingual learners, betraying their foreign accent, mostly on the suprasegmental level. The social communicative effect of accented speech in oral discourse needs further research in view of the necessity of successful intercultural communication. The development of corpus-driven studies in linguistics over the past few decades resulted in thought-provoking research findings worthy of linguists working in the field of phonetic studies with a focus on prosody and intonation in oral discourse (Cheng, 2015; Kazakova, 2017).

Research in the teaching of English pronunciation as a second and foreign language (ESL/ EFL) over the last decade or so has proved the significance of intonation features (i.e., melody, stress, rhythm, pausation, timbre) in the comprehension and production of the language (Bolinger, 1986; Fox, 1995, Cruttenden 1997, Atoye, 2005). However, the teaching of intonation remains to be less effective and more hazardous than the teaching of segmental phonetic characteristics of a non-native tongue (Vishnevskaya 2002; Cheng, 2015; Rannali, 2016). Besides, there is still no adequate and learnable description of English intonation for language learners coming from different language backgrounds. The discourse intonation approach gives real chances for language learners to improve their intonation skills in oral speech and avoid serious communication breakdown with native speakers.

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# FEATURES OF THE AGE CRISIS IN THE TRANSITION FROM PRESCHOOL TO PRIMARY SCHOOL AGE IN CHILDREN WITH MENTAL DEVELOPMENT DELAY

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The article presents an analytical review of psychological studies devoted to the study of peculiarities of the age crisis in the transition from preschool to primary school age in children with mental development delay. The main scientific concepts of the age crisis as a psychological phenomenon in Russian psychology are discussed. Understanding of the age crisis in L.S. Vygotsky's cultural-historical paradigm, in D.B. Elkonin's concept of key activity, in K.N. Polivanova's theory of age crises is presented. Scientific works devoted to the age crisis of 7 years are especially considered. The author describes age-related formations, which appear during the critical period, and touches upon the mechanisms of their formation. The article analyzes the psychological works dedicated to the problem of children experiencing mental development delay of the age crisis in the transition from preschool to primary school. Special attention is paid to the scientific works carried out within the Nizhny Novgorod school of special psychology. This is a study of different aspects of the formation of self-regulation as a general ability to learn in children with mental development delay. This phenomenon is considered as one of the key indicators of normative age development in the transition from preschool to primary school. The given review allows to draw a conclusion about absence of special researches on this issue.

Keywords: age crisis, the age crisis of 7 years, mental development delay (MDD)

Basic researches on the problem of age crises in Russian psychology are scientific works of P.P. Blonsky, L.S. Vygotsky, K.N. Polivanova, D.B. Elkonin and other researchers. L.S. Vygotsky emphasized that crises are a prerequisite for normal, consistent development of the individual. His developmental periodization is based on the alternation of stable and critical ages. Thus, during stable periods, development occurs through microscopic changes in the child's personality, which are subsequently reflected in a new age-related formation. On the other hand, during a relatively short critical period, child's personality undergoes sharp, dramatic changes. L.S. Vygotsky associates this crisis with the change in current social situation of development and the emergence of a new one [12].

L.S. Vygotsky designates as the main features of critical periods the following:

- firstly, the absence of clear borders of the crisis, i.e. the difficulty to determine the exact moment of the beginning and end of the crisis;

- secondly, the difficulty of education, conflicts with others and internal conflicts, decrease of performance and learning difficulties;

- the third feature consists in the negative nature of child's development during the critical period: the period of stability presupposes that the development is based on the principle of creation, while the critical period implies that the child tends to lose what was obtained at the previous stage.

L.S. Vygotsky divides each critical age into three phases: pre-critical, critical and post-crit-

ical. In the pre-critical phase, there is a contradiction between the objective and subjective components of the social situation of development. In the critical phase this contradiction escalates even more and reaches its culmination. In the post-critical phase, the contradiction is resolved by creating a new social situation of development and establishing harmony between the components.

D.B. Elkonin associates the crises with key activities. Transitions between the so-called age-related epochs are considered as great crises, each epoch starts with the period of development of the need-motivational sphere. Transition between the periods within the same epoch is considered as a small crisis and is associated with the formation of intellectual and cognitive forces of children, their operational and technical capabilities [3]. At the present stage of development of psychological science crises are claimed to be normative, natural and necessary conditions of personal development. They are perceived as transitional phases that separate one stable period from the other.

According to K.N. Polivanova, crisis is not just a period of change in the social situation of development or key activities. Crisis is a very specific psychological space in which the act of development is committed. The psychological space of the crisis is the condition that is necessary for the transformation of a new formation into the ability of a child. Besides that, K.N. Polivanova points out that the destructive and constructive components of crises constitute a single whole, while the destructive component is a prerequisite for the transition. Attempts form the mechanism of the age crisis [9].

Thus, we see that, in the opinion of the above mentioned authors, every age crisis of childhood is a sign of the child's psychological maturation, its transition to a higher, qualitatively new level of development.

We shall consider in more detail the symptoms of the crisis of seven years, which puts an end to the preschool period. In the periodization of D.B. Elkonin this crisis is regarded as a small one and is thought to separate two periods of the same epoch – preschool childhood and primary school age. L.S. Vygotsky discovered two main symptoms of this crisis: grimacing and putting on airs. In his opinion, the loss of childish naivety and spontaneity are especially characteristic of the children aged of seven.

K.N. Polivanova divides the symptoms of the crisis of seven years into three categories. Symptoms of the first category concern some established family relations and rules and manifest themselves in the direct violation of these regulations. K.N. Polivanova subsumes under this category dispute, disobedience, pauses, exactingness, stubbornness, cunning, whims and reaction to criticism. In the seventh year of life it becomes possible to distinguish the attitude to rules set by parents in holistic relations to a close adult. The child understands that rules are set not by himself, and the primary attitude towards the rules is negative, hence the appropriate response – violation of these rules. The child tries to oppose the position of his parents with his own position. Symptoms of the second category, which are neutral, comprise adult behavior and appearance. Thus, the child tries to assume the role of an adult, seeking to show his increased independence. The last category of symptoms of the crisis includes positive acquisitions of the child: independence, self-education, emergence of common issues and interest in school. The child tries to play the role of an adult [9]. Thus, all of the above listed categories of symptoms help the child on his way of growing up.

During the transition to school age the child changes dramatically, he is no longer a preschooler, but not a student yet. He moves to a new stage of development, which marks a new stage of socialization. The main factor in the successful adaptation of the child at school is his psychological readiness to learn.

School readiness is a multicomponent concept. Different authors distinguish the following components of this concept: personal, motivational, intellectual, emotional-volitional and communicative readiness. D.B. Elkonin, speaking about the problem of school readiness, puts an emphasis on the formation of prerequisites for learning activities. The most important prerequisites, in his opinion, are the ability to focus on the system of rules, the ability to listen to instructions and follow them, the ability to work in conformity with the model.

In the works of L.I. Bozhovich the main criterion of school readiness is the central new formation of the personality, called "internal position of the schoolchild", which is closely connected with cognitive need and the need to communicate with adults at a new level. According to L.I. Bozhovich, the source of the crisis is the discrepancy of the new personal formation with the old system of relations inherent in preschool childhood [2]. It is worthwhile noting that the internal position of the schoolchild does not appear immediately and goes through several stages on the way of its formation. Thus, in the seventh year of life children have a positive attitude to school in the absence of orientation to the substantive points, and by the end of the eighth year the actual position of the schoolchild, which combines social orientation and orientation to the educational components of school life, takes shape.

Other important age-related formations that have an impact on the learning success include the development of motivational sphere, namely the development of cognitive motivation associated with cognitive need; social motives based on the understanding of learning need; "positional" motive that characterizes the desire to take a new position in relation to others, etc.

Futhermore, at the turn of preschool and primary school age there is a change in the self-esteem of the child. D.B. Elkonin points out that while the child has an unconditional positive attitude towards himself / herself at the age of six, when the real state and the desired state are not differentiated, there is a division of I-real and I-ideal and more adequate self-assessment at the age of seven [4].

Another important new formation in the transition from preschool to primary school age, which occupies a special place in the structure of psychological readiness for learning, is arbitrariness. Preconditions of its formation appear prior to senior preschool age in role-playing games. And by the end of preschool age children have the arbitrariness of behavior and the arbitrariness of mental activity.

Creation of new formations is associated with the emergence of a number of dissections in the consciousness of the child. All these skills do not appear simultaneously and pass through several stages of formation. K.N. Polivanova introduces the concept of behavioural instability of children in a critical period, when in some situations the symptoms of crises manifest themselves, while in others they do not.

Speaking about the peculiarities of the age crisis development in the transition from preschool to primary school age in children with mental development delay, it should be noted that regrettably, there are no special studies on the issue.

We can point out that, by the end of the preschool period, children with mental development delay are not ready for school. They do not reach the optimal level of personal, social, motivational, intellectual, communicative, emotional and volitional readiness for learning. There is a lack of cognitive interest, self-regulation and control, critical attitude to the results of activities, emotional instability, predominance of playing interests, inadequate self-assessment in children with mental development delay.

As noted above, normally developing peers have the ability to regulate cognitive activity formed by the end of the preschool period. On the contrary, children with mental development delay are characterized by a lack of ability to subordinate their activities to a specific task and focus on a specific action, as well as by a lack of mental planning and self-control skills.

U.V. Ulyenkova in her studies identified the following peculiarities of self-regulation in children with mental development delay:

- performance of tasks in accordance with the instructions (rules) doesn't arouse any interest or any positive attitude in children, they are ready to stop it at any time;

- -at the stage of orientation in the task, children verbalize only a common goal, the rules are not fully understood by them even in practice;

- during the execution of a task, children are better able to accept simple rules, establishing logical connections presents a real challenge for them;

- as a general rule, children are satisfied with their work even if they do not achieve the desired result, they do not try to correct mistakes or improve their work [10].

In like manner, various aspects of the features of formation of self-regulation in children with mental development delay were studied in the works of E.B. Aksenova [1], V.V. Kisova [5, 6, 11], T.N. Knyazeva [7], etc.

As already noted, children with mental development delay have unformed motivational sphere by the end of the preschool period. While their normally developing peers acquire the internal position of the schoolchild as a new formation connected with the emergence of cognitive motive, children with mental development delay retain the playing motive and it remains predominant till the end of the preschool period. Generally, children have no desire to go to school, their cognitive need is unformed. Negative experiences, difficulties in learning and establishing contacts with peers, lack of educational motivation – all this leads to school disadaptation and consolidation of this phenomenon even in the early stages of schooling.

Self-esteem of children with mental development delay also has a number of features. It often turns out to be inadequately inflated in comparison with the self-esteem of normally developing peers. According to V.V. Kisova, this is due to the absence of children's ideas about the actual evaluation criteria, as well as to the fact that children consider as absolute value any result of their activities. Children can not adequately assess themselves and their activities, do not compare themselves with peers. At the beginning of school, a child with mental development delay does not take a lagging position, trying to maintain a high self-esteem. However, in the higher classes of primary school, overestimated self-esteem plummets, resulting in a sense of inferiority and hopelessness. Children have a desire to avoid the situation of school education, communication with peers. In addition, it is worthwhile to say that self-assessment of children with mental development delay usually depends on the opinions of others. Partially differentiated self-assessment appears in children with mental development delay only in primary school and tends to reflect the attitude of the adult to the child [5].

A similar point of view can be found in I.V. Korotenko's concept. She explains the overestimated self-esteem in children with mental development delay by less developed compensatory and psychosocial abilities as compared to normally developing peers. She notes that the feeling of underestimation, selfundervaluation in children with mental development delay is compensated by artificial reevaluation of their personality, which is most likely not to be realized by the child [8].

Thus, we see that the main age-related new formations of children with mental development delay turn out to remain unformed by the end of the preschool period, namely, they have an unformed internal position of the schoolchild, an insufficient level of self-regulation and arbitrariness, inadequate self-assessment, predominance of the playing motive instead of the cognitive one. Timely performance of psychological and pedagogical correctional work is necessary for full-fledged crisis development and prevention of its negative consequences.

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# **RESONANT TUNNELING OF ELECTROMAGNETIC** WAVE THROUGH INHOMOGENEOUS IONOSPHERE

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There are plenty of approaches but the most constructive one is using exactly soluble models of inhomogeneous environment waves' interactions. Using these models makes it possible to examine wave processes in cases when approximate methods are obsolete or useful, because of inhomogeneities of high amplitudes. For example, waves' reflectionless tunneling through plasm is important for radiation yield from sources that are in dense plasma in astrophysics, it is also interesting for powerful electromagnetic radiation absorption effectiveness intensification, when plasma is heated to thermonuclear temperatures as the result of wave penetration to dense plasma, and also for gases.

#### Keywords: electromagnetic wave, ionosphere

Lately there has been a high demand for researches of wave resonant tunneling through micro-scale inhomogeneities effectiveness. In particular for reflectionless waves (of different nature) passage through significantly thick layers of inhomogeneous environment [1-4].

There are plenty of approaches but the most constructive one is using exactly soluble models of inhomogeneous environment waves' interactions. Using these models makes it possible to examine wave processes in cases when approximate methods are obsolete or useful. because of inhomogeneities of high amplitudes. For example, waves' reflectionless tunneling through plasm is important for radiation yield from sources that are in dense plasma in astrophysics, it is also interesting for powerful electromagnetic radiation absorption effectiveness intensification, when plasma is heated to thermonuclear temperatures as the result of wave penetration to dense plasma, and also for gases [5].

In this work we examined accurate solutions for Helmholtz equation, that describes reflectionless tunneling of electromagnetic wave through a wide inhomogeneous gas layer of ionosphere with micro-scale structures of its high-density amplitude.

Analysis of exactly soluble models of electromagnetic waves and inhomogeneous environments interactions appeals for many applications, for example, development of radiotransparent materials for aerials, searching for effective electromagnetic signal transmission through dense plasma layer [6].

This work presents research results based on linear reflectionless drop of electromagnetic wave to gas layer of final thickness containing micro-scale inhomogeneities of gas density (at scale of vacuum wave length).

Analysis of waves with inhomogeneous environments interactions was carried out based on Helmholtz equation for monochromatic electromagnetic wave field  $E(x,t) = F(x) \exp(i\omega t)$  which is written by

$$\frac{d^2F}{dx^2} + k_0^2 \varepsilon ef(x)F = 0.$$
(1)

Here  $k_0 = \frac{\omega}{c}$  is a vacuum wave number,

 $\varepsilon ef(x)$  is effective dielectric permittivity of inhomogeneous environment.

In case of gases it is determined with directional concentration distribution and without external magnetic field for electron modes we have  $\varepsilon ef(x) \equiv N^2(x) = \varepsilon_{\perp} - (\varepsilon c^2 / \varepsilon_{\perp})$ , where *N* is a refraction index,  $\varepsilon_{\perp}$  and  $\varepsilon c$  are components of dielectric tensor at upper hybrid resonance frequencies.

Analogously to [2, 3] the accurate solution to equation (1) is defined with formula

$$F(\xi) = Eexp\left[i\psi(\xi)\right] \left[\frac{1}{p(\xi)}\right]^{1/2}$$
$$\frac{d\psi}{d\xi} = p(\xi),$$

here E = const [2, 3], defined with wave power flow. Wave number is defined with formula

$$q(\xi) = 1 + \chi], p(\xi) = [q(\xi)]^2$$

In that case dielectric permittivity of gases is determined with formula

$$\operatorname{\varepsilonef}(\xi) = [p(\xi)]^2 - p(\xi)0.5d^2[1/p(\xi)0.5]/d\xi^2$$

with parameters  $\chi$ , *b*, *a* =  $2\pi n$ .

For the dimensionless wave amplitude we have formula  $A(\xi) = 1/[p(\xi)]^{1/2}$ . In inhomogeneous layer  $0 \le \xi \le b$  it follows that  $p^2 > 0$  is constraint. As the most simple analytical model, which at the borders of gas layer  $\xi = 0$ ,

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 $\xi = 3b$  automatically provides conditions of reflectionless cross-linking of incident electromagnetic wave from vacuum ( $\xi < 0$ ) and electromagnetic wave outgoing to the right from plasma layer  $(\xi > 3b)$ , we use the following formula for dimensionless vector  $p(\xi) = 1 - \mu \left[ 1 - \cos(\gamma \xi) \right]$ , where  $\mu$  task option  $(0 < \mu < 0.5)$ ,  $\gamma = 2\pi/b$  gas layer density option, below it is determined as b = 20.

For example, let's examine the following function selection  $f(\xi)$ .

$$f(\xi) = [1 + \cos(2\gamma\xi) - \cos(3\gamma\xi) - 0.5\cos(4\gamma\xi) + 0.5\cos(5\gamma\xi)], \quad (2)$$

Reflectionless interaction of electromagnetic wave and inhomogeneous gas layer when choosing more complicated function than (2) formula,

$$f(\xi) = 0.125\mu[1 - 0.25\cos(\gamma\xi) - 0.5\cos(2\gamma\xi) - 0.5\cos(2\gamma\xi)$$

 $-1.25\cos(3\gamma\xi) - \cos(4\gamma\xi) - 0.25\cos(5\gamma\xi) -$ 

$$-0.5\cos(6\gamma\xi) - 0.5\cos(7\gamma\xi) - 0.25(9\gamma\xi)],$$

Let's introduce the following notations:  $a_1 = -0.25$ ,  $a_2 = -0.4$ ,  $a_3 = 0.71$ ,  $a_4 = 0.91$ ,  $\gamma_1 = 3.11\gamma$ ,  $\gamma_2 = 2.77\gamma$ ,  $\gamma_3 = 1.67\gamma$ ,  $\gamma_4 = 4.17\gamma$ , and some functions are as follows

$$f(\xi) = [1 + \sum a_n \cos(\gamma_n \xi)],$$
  

$$P(\xi) = 1 - \mu f(\xi) [1 - \cos(\gamma \xi)]$$
  

$$g(\xi) = \frac{dp}{d\xi}, \ h(\xi) = \frac{d^2 p}{d\xi^2},$$

it will allow to rewrite the equation more convenient and consider far more summands in it.

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$$g(\xi) = -\mu\gamma f(\xi) \sin(\gamma\xi) +$$
  
+  $\mu[1 - \cos(\gamma\xi)]\sum a_n\gamma_n\sin(\gamma_n\xi),$   
h( $\xi$ ) = 2  $\mu\gamma\sin(\gamma\xi)\Sigma a_n\gamma_n\sin(\gamma_n\xi) -$   
- $\mu\gamma^2 f(\xi)\cos(\gamma\xi) + \mu[1 - \cos(\gamma\xi)]\Sigma a_n\gamma_n^2\cos(\gamma_n\xi)],$   
 $\gamma = 2\pi / b,$  where  $b = 25$ 

First of all, when  $\mu = 0.18$  and computing results  $\varepsilon_{t}(\xi)$  an effective dielectrical plasma permittivity will be

$$\begin{split} \epsilon_{f}(\xi) &= [p(\xi)]^{2} + [h(\xi)/2p(\xi)] - 0.75 \ [g(\xi)/p(\xi)]^{2} \\ f(\xi) &= 2,599, \ g(\xi) = 0,0959, \\ h(\xi) &= -0,0462, \ p(\xi) = 1. \end{split}$$

Choosing these parameters we obtain option for gases without external magnetic field, and also dielectric permittivity  $\varepsilon_{f}(\xi)$  spatial profile diagram, character  $p(\xi)$  and other parameters.

As we see at the picture 1, wave vector profile includes opacity layers, where  $\varepsilon(\xi) < 0$ .

Therefore, in this work we have examined reflectionless electromagnetic waves' interaction with inhomogeneous micro-scale structures of gas layers using exactly soluble equations. There are some independent parameters, particularly, inhomogeneous layer thickness, modulation depth of dielectrical permittivity etc. Parameters changing makes it possible to obtain a lot of fully-clarified inhomogeneous layers with micro-scale gas layer structures.


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It's important that inhomogeneity could be represented as arbitrary number of different layers, with a number of independent parameters stratification.

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## THE RESEARCH OF PHASE COMPOSITION AND MORPHOLOGY OF THE PRODUCT DISPERSION OF CADMIUM IN MICROEMULSION (WATER-TOLUENE), USING THE ENERGY PULSED PLASMA

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Cadmium nanostructures in microemulsion (water-toluene) were synthesized and investigated using pulsed plasma energy in liquid (PPL). To compare the results of the study, parallel synthesized cadmium nanostructures in pure toluene and distilled water, using the PPL energy. X-ray phase and electron microscopic analysis for the obtained samples was carried out. Particle size was calculated from half-width of diffraction lines using the Scherrer formula. When nanostructuring metal cadmium, changing the composition of the medium is very important. Metal cadmium, cadmium oxide and cadmium hydroxide nanowires are formed only at the boundary of two immiscible toluene and water liquids. Spherical nanoparticles of metallic cadmium and cadmium oxide formed in toluene.

Keyword: pulsed plasma in liquid (PPL), nanolayers, nanorods, nanowire, interfacial surface, microemulsion, nanostructures

The specific properties of materials of ultradispersed (nano) open up broad opportunities for creation of new effective catalysts, sensor, semiconductor, superconducting systems, drugs with high biological activity for use in the electronics, alternative energy, ecology, medicine and agriculture [1].

Nanomaterials derived from metal cadmium is poorly understood, mainly devoted to the preparation and study of ZnO nanorods, nanotubes of cadmium chalcogenides. For example, in [2], metallic cadmium nanowire obtained by thermal decomposition of cadmium sulfide powder in argon atmosphere. There is a hydrothermal method for producing cadmium hydroxide nanowires by processing 0.01 molar solution of cadmium dehydrate acetate with 0.015 molar solution of hexamethylentetramine for 16 hours at a temperature of 95 °C with the formation of cadmium hydroxide nanowires, which, when further calcined in the air for three hours at a temperature of 350°C, turn into cadmium oxide nanowires [3, 4].

The disadvantages of the above described methods for producing nanowires of metal cadmium, cadmium hydroxide is the use of high temperatures for decomposition of cadmium sulfide powder, the need for an inert atmosphere, refrigeration and anti-explosion devices, which complicates the hardware design of the process, requires significant energy and material costs. To obtain cadmium hydroxide, it is necessary to maintain long-term high volumes of aqueous solutions in explosive autoclaves. Indeed, currently, the synthesis of nanomaterials requires the use of expensive and sometimes dangerous tools (laser technology, high-frequency ultrasonic devices, explosive technology, hydrothermal synthesis at high temperatures and pressures), or bulk for the use of liquid solutions "wet" chemistry. All known technologies of obtaining nanostructures of cadmium along with its advantages there are also some certain drawbacks in this regard, the search for promising methods of obtaining is actual.

Recently, very interesting are the regularities of the formation of nanoscale objects on the border of two phases, which open the possibility of creating a fundamentally new generation of nanoustroysty, multi-level architecture which is based on the unique property of nanoparticles spontaneously unite into ordered ensembles, both in the volume of dispersion and on interphase surfaces [5]. There are different approaches to the creation of ordered nanostructures at interfaces. Of the microemulsion type "water in oil" (or reverse micelles) have recently attracted increasing attention as microreactors for synthesis of nanoparticles. As is known, highly dispersed water droplets are also ideal micro-reactors for producing microparticles, and the size of droplets is a natural limiter of the sizes of grown nanoparticles [6].

The properties of microemulsions are largely determined by the size and shape of the particles of the dispersed phase, as well as rheological properties of the interphase adsorption layers formed by surfactants. Since microemulsions have a high mobility and a large surface area between the phases, they can serve as a universal medium for many chemical syntheses, including for the production of solid nanoparticles. It is known that phase interface surfaces often have unique properties. Studies on the boundaries of the phases have already made great strides in a wide variety of areas of expertise.

### **Experimental part**

To obtain nanostructures, we have proposed pulsed plasma in the liquid (PPL) [7] and microemulsion, which is created with the help of a high-speed magnetic stirrer.

Low-voltage pulsed plasma in liquids occurs as a result of an electric breakdown of the interelectrode space at a relatively low power source, insufficient to excite the arc plasma. Unit impulse localized in time and has duration of the order of 10<sup>-3</sup>-10<sup>-5</sup> s. In the zone of influence of a single pulse  $(10^{-3}-10^{-4} \text{ cm}^3)$  develop high temperatures  $(10^4-10^5 \text{ K})$  due to the high current density (106-108 A/cm2) and pressure (3-10 Kbar), resulting from the transience of the process. The energy of a single pulse is sufficient to turn into a steam and gas state of any conductive material. Undoubtedly, the formation of particles of the evaporated material and their energy saturation proceed from the steam or gas state [8].

Obtaining self-organized nanostructures using pulsed plasma has its advantages: the ability to regulate the energy of a single pulse allows to increase the proportion of particles with nanoparticles, the use as a reaction medium – dielectrics helps to stabilize the emerging nanoparticles components of the medium. In turn, the surface tension energy at the interface between two immiscible liquids is an additional energy to the pulse plasma energy.

For nanostructuring on the interfacial areas of the electrodes were taken cadmium metal 98,90% purity. Dispersion of cadmium proceeded faster in comparison with other metals. Cadmium nanostructuring was carried out in water – toluene microemulsion, using a highspeed magnetic stirrer, as a result of which two fractions were obtained-heavy (sediment) and light (which surfaced on the emulsion surface). In the obtained samples, the light fraction was carefully separated from the emulsion surface, and the sediment was filtered and dried well.

The dispersed powders obtained in the microemulsion were analyzed on the Rigaku Geigerflex X-Ray Diffraktometer with Cu<sub>va</sub> radiation. Sediment diffractogram, cadmium dispersion product contained reflexes (002), (100), (101), (102), (103) and (112) (Fig. 1) relating to metal cadmium. The crystal lattice of cadmium is hexagonal, with options  $a_{lit} = 2,9793$  Å,  $c_{lit} = 5,6181$  Å literature data. The experimental lattice parameters of the particles of the cadmium precipitated emulsion (water-toluene):  $a_{exp} = 3,176757$  Å,  $c_{exp} = 5,46586$  Å). Was also discovered the diffraction lines of the cadmium oxide CdO reflexes (220) (311) cubic lattice parameter,  $a_{exp} = 4,73477$ Å, (a  $_{\text{lit}} = 5,273$  Å). Defined diffraction lines CdCO<sub>3</sub> with reflexes (012), (104), (202), (024), (115), (102) having a trigonal crystal lattice with the parameters of  $a_{exp} = 4,76469$  Å and  $c_{exp} = 13,84346$  Å, literature data  $(a_{lit} = 4,930$  Å,  $c_{lit} = 16,27$  Å) and the crystal lattice of Cd(OH), hexagonal reflexes (001), (100), (102) and (110), where  $a_{exp} = 3,51904$  Å,  $c_{exp} = 5,18070$  Å ( $a_{lit} = 3,496$  Å,  $c_{lit} = 4,702$  Å). The half-width of the reflexes identified by using the Scherrer formula, for each phase, the calculated particle sizes: D(Cd) = 15.7 nm; D(CdO) = 17 nm; D(CdCO3) = 17,64 nm; D(Cd(OH)2) = 16 nm.



Fig. 1. Diffractogram of cadmium nanoparticles precipitated, in the system (toluene-water)

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Fig. 2. Diffractogram of cadmium nanoparticles that floated to the surface emulsion (toluene-water)

40

20

60

80

20



Fig. 3. Diffractogram of cadmium nanoparticles obtained in water

0

For a light fraction of the cadmium sample, the same reflexes as for the heavy fraction were found, but here the diffraction lines are less pronounced. The parameters of the crystal lattice of light fraction for cadmium metal is equal to and  $a_{exp} = 2,89963$  Å, with  $c_{exp} = 5,65593$  Å. The crystalline lattice of CdO cubic parameter,  $a_{exp} = 4,5786$  Å. Cadmium carbonate CdCO3 has a trigonal crystal lattice settings,  $a_{exp} = 4,08286$  Å,  $c_{exp} = 16,7953$  Å. The parameters of the crystalline lattice Cd(OH)<sub>2</sub>,  $a_{exp} = 3,74282$  Å,  $c_{exp} = 4,71737$  Å ( $a_{lit} = 3,496$  Å,  $c_{lit} = 4,702$  Å) hexagonal structure. The particle size was: D(Cd) = 19,64 nm; D(CdO) = 22,3 nm; D(CdCO<sub>3</sub>) = 21,5 nm; D(Cd(OH)<sub>2</sub>) = 16,3 nm.

Processing of diffraction patterns of the synthesized nanoparticles of cadmium in water show that cadmium particles have a hexagonal crystal lattice with the lattice parameters:  $a_{exp} = 3,01199$  Å,  $c_{exp} = 5,73735$  Å (Fig. 3). Crystalline lattice nanostructures Cd(OH)<sub>2</sub> is monoclinic with the parameters of  $a_{exp} = 5,93525$  Å,  $b_{exp} = 10,38348$  Å,  $c_{exp} = 3,51046$  Å, and literature data  $\gamma$ Cd(OH)<sub>2</sub> a fint = of 5.63 Å,  $b_{lit} = 10,18$  Å,  $c_{lit} = 3,40$  Å. The particle size of which amounted to: D(Cd) = 15,14 nm; D(Cd(OH)<sub>2</sub>) = 18,25 nm. Processing of diffraction patterns of nanoparticles of cadmium synthesized in pure toluene show that the particles of cadmium are hexagonal crystal lattice settings,  $a_{exp} = 2,9927$  Å,

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 $c_{exp} = 1,6352$  Å, where literature data  $a_{lit} = 2,9793$  Å,  $c_{lit} = 5,6181$  Å. The crystal lattice cubic CdO, option,  $a_{exp} = 4,7273$  Å (Fig. 4). The size of the particles is: D(Cd) = 20,8 nm; D(CdO) = 12 nm.

The results of processing the diffractogram show changes in the parameters of crystal lattices in comparison with the literature data, which are due to the conditions of pulsed plasma [8] and the processes occurring on the interphase surface in microemulsion (water-toluene).

Cadmium dispersion products in toluene and in microemulsion (water-toluene), using energy and coolant, in the form of dispersed powders are subjected to electron microscopic analysis using a translucent electron microscope TEM JEOL-2000FX. In fig. 5. TEM images of cadmium nanostructures obtained a) in pure toluene, b) in microemulsion (watertoluene) using the energy of PPL are presented. The results of the analysis of TEM image, in the case of nanostructuring cadmium in pure toluene, showed the formation of two phasespherical nanoparticles of metal cadmium and cadmium oxide (Fig. 5. a) When cadmium nanostructuring in microemulsion (water-benzene), cadmium nanowires, cadmium oxide and cadmium hydroxide are formed (Fig. 5. b).

Thus, when nanostructuring metal cadmium, changing the composition of the medium is very important. Metal cadmium, cadmium oxide and cadmium hydroxide nanowires are formed only at the boundary of two immiscible toluene and water liquids. Nanoparticles of cadmium metal, cadmium oxide and cadmium hydroxide are formed in pure water and toluene.



Fig. 4. Diffractogram of a sample of cadmium nanoparticles obtained in pure toluene



Fig. 5. TEM images of cadmium nanostructures obtained a) in pure toluene b) in a microemulsion (water-toluene), using of energy PPL

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## Conclusion

Was first carried out work on the dispersion of metallic cadmium, with the use of energy PPL in the environment of toluene in water and in microemulsion (water-toluene), where we have used the total energy PPL and the energy of surface tension on the interfacial surface. The phase composition of the obtained compounds is studied and determined their size.

The results of processing diffractograms show changes in the parameters of crystal lattices of synthesized compounds. For products obtained in microemulsion, the particle size of metallic cadmium, cadmium oxide, cadmium carbonate and cadmium hydroxide is much smaller than the particle size obtained in pure toluene, using the energy of PPL. Thus, the dispersion of cadmium in the microemulsion under the influence of the total energy of pulsed plasma and the energy of surface tension is a significant reduction in the particle size.

Formation of cadmium nanowires, cadmium oxide and cadmium hydroxide occur due to the presence of an interphase surface, which plays the role of a flat substrate on which twodimensional layers of cadmium are formed, as well as its oxide and hydroxide with further folding them into nanowires. In the known methods of synthesis of cadmium-based nanowires, it is required to use auxiliary precursors in the form of pores, layered compounds, etc., which contaminate the target products. In our case,  $\sim 90\%$  of the energy supplied to the electrodes is spent on nanostructuring the material of the electrodes with encapsulation of its resulting nanostructures.

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### INFORMATION WARFARE AND INFORMATION SECURITY IN THE 21<sup>st</sup> CENTURY

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The present paper is dedicated to studying theoretical and practical aspects of information warfare and information security maintenance. The authors analyzed and integrated different approaches to definition of "information warfare" and "information confrontation". The article contains data related to the typology of information warfare and its structural elements. The authors underscore the relevance and role of the information security both for states and individuals. The work contains information on the main aspects and issues related to information security, it resumes common principles and techniques of information-psychological warfare. The authors made an attempt to analyze and evaluate main issues that Kazakhstan faces providing information security.

Keywords: information warfare, information

With the development of new information technologies and global informatization, modern society has become an "informational", creating worldwide information space. It is becoming increasingly evident that social progress, as well as every person are largely determined by the development of their information sphere, that contributes to the formation of new national interests and brings up new controversial issues. Many of these problems relate to the pursuit of dominance in the global information space. The information space has become another field of confrontation between international actors, it implies such issues as formation of the concept of information warfare by a number of states, violation of the normal functioning of information and telecommunications systems, security of the information resources, as well as unauthorized access to them.

Information is reasonably considered as a strategic national resource. The political weight of the country, its ability to influence world events depend not only on real-power factors, but increasingly on information factors. It involves an ability to exploit the intellectual potential of other countries, spread and impose their values, and also impede spiritual and cultural expansion of other nations, transform and even undermine their spiritual and moral foundations.

There is an urgent need for a definition of such important notion as "information confrontation" and "information warfare". Thus, I.N. Panarin defines information confrontation as a form of struggle of the parties with the use of special (political, economic, diplomatic, military, etc.) methods and means of influencing the information sphere of the opposing side, as well as for self-defense [1, p.245].

An "information warfare" is a term that was introduced in the USA in 1967, but attracted the experts attention in 1991 during the Gulf

War. The phenomenon of information warfare originated in the West during the Cold War. The term was firstly used by Allen Dulles, the main organizer of the information war against the Soviet Union, in his book "The Secret Capitulation" [2]. It introduced as a special intelligence operation. Given the militaristic origin of this concept, the American definition was oriented towards military objectives and the emphasis on the need to influence the enemy in a threatened period. "Information warfare" is a term of publicists, it is not used in a professional environment, where it was substituted by information or psychological operations. One of the reasons is that a war can not be waged in a peace period, but operations can.

S.N. Grinyaev, a Russian researcher, proposed the shortest and most adequate definition of information warfare that is a use of means of information influence on the enemy in the interests of achieving the objectives of the influencing party [3, p.98].

The majority of Russian researchers distinguish two main directions of the information warfare (confrontation): information and technical (systems communications and management, computer and telecommunication systems, radio electronic means, etc., as the objects of influence), information and psychological (public consciousness as the object of influence).

The detailed list of information warfare dimensions, according to the American sources, includes Electronic Warfare (EW), Psychological Operations (PSYOP), Computer Network Operations (CNO), Military Deception (MIL-DEC), Operations Security (OPSEC) [4].

There are following important subjects of information (psychological) warfare:

- national military units of psychological operations;

- state foreign policy;

- special state services;

 bodies of military and political propaganda of international organizations;

- international non-governmental organizations;

- national and international research and educational institutions;

 international religious extremist organizations;

- the media;

- individual network activists and their associations.

A.V. Bedritsky, referring to the authoritative American expert M. Libicki, singles out four categories of information-psychological operations conducted within the framework of the psychological struggle: operations against the structures of public administration, operations against military command structures, operations to demoralize the armed forces, the war of cultures ("kulturkampf") [5, p.97]. The first three areas perfectly fit into the basic concept, but the latter one is very specific. It is addressed to society as a whole and associated with the influence on the culture of the country or its individual elements. The war of cultures is a specific spiritual action directed against the public consciousness with the aim of changing the attitudes and orientations.

The existence of the cultural-ideological direction of the psychological warfare is also recognized at the highest political level. It was very clearly described by Vladimir Putin in 2012. As the historical experience shows, cultural identity, spiritual and moral values, value codes are a sphere of fierce competition, sometimes the object of open information confrontation is for sure, and certainly well-directed propaganda attack. And these are not phobias, it is real. This is at least one of the forms of competition. Attempts to influence the world view of whole nations, the desire to subordinate them to own will, to impose own system of values and concepts are an absolute reality, just as the struggle for mineral resources, which is faced by many countries, including Russia [6].

There are several common principles and techniques of information-psychological warfare.

1. The main and most effective method of information and psychological warfare is the systematic imposition of one's own point of view, one's own picture of the world, one's view of things. It is effective no matter whether the opponent is trying to consciously resist. If a person does not 100% realize that the opponent's imposed ideas are wrong, he can begin to give in and perceive things from the position of the enemy. At the same time, the opponent can impose a correct point of view, as well as partially correct and false ones.

2. There is a hidden imposition in addition to explicit imposition. The influence is carried out in such manner that the person does not realize this, therefore it is very effective. This method is very convenient, because nothing needs to be proved. The effective reception of the hidden imposition of representations is to present them through some information that looks neutral, formulate certain ideas, and look at things as something natural, non-alternative, self-evident.

3 The firmness and consistency in defending own position, confident behavior as a keystone.

<sup>4</sup> Counter-propaganda in order to dissuade, make doubt, purposefully influence the key moments in the enemy's views on which he bases his behavior. When choosing an object, we must choose, first, the weakest points in terms of their reliability, correctness and persuasiveness, and secondly, those points that are the most sensitive.

5. Any information-psychological impact is useless, if it is not supported by real intentions, actions and willingness to commit them. Dissonance between what a person says and what he does, ruins the effectiveness of any propaganda.

The traditional rational direct method of influencing consciousness is based on persuading people to change their minds with the use of rational arguments and logic. Along with rational ways of influencing consciousness, there are ways that can be called irrational. They can have a destructive influence, suppress the rational principle and force people to serve their goals. It implies appealing to irrational arguments, lies, intimidation, suppression, disorientation, shocking and zombieing.

One of the most important problems associated with information warfare is the society's misunderstanding of the fact that a threat can be born by modern communicative processes. Also society is not ready to oppose attempts to manipulate public consciousness.

Information security in today's information warfare is relevant for Kazakhstan. There are no information wars against Kazakhstan, we are not the object of an information war, but our deep immersion in the foreign information space determines our involvement in the information confrontation. Therefore, the problem of information security is very urgent for the Republic of Kazakhstan. **Technical sciences** 

The dynamics of the development of information technologies that reflect on socio-economic and cultural development stress the need of regulation of information security issues.

In accordance with the openness of national information space and popularity of foreign media, television and Internet resources, there is a real threat of information impact on public consciousness. Information impact can be expressed both in the form of direct imposition of the ideas that contradict national interests and creating a certain information background artificially maintained by information manipulation. To counteract this manipulation of public consciousness, it is required to seriously improve the effectiveness of the state information policy, increase the openness of the state bodies, and increase security of citizens' right to information.

Another serious problem is a non-competitiveness of the domestic content that forms national information space. Its quality remains insufficient for full-fledged competition with a foreign information and entertainment product. In conditions of the national information space openness it leads to unpopularity of the local information product. Consequently, low popularity does not allow to attract significant investments that causes scarcity of the domestic content.

A lack of the appropriate domestic information technologies for the state, business and society leads to the forced use of foreign equipment and information systems. As a result, it increases a probability of an unauthorized access to databases and data banks, as well as country's dependence on foreign manufacturers of computer and telecommunications equipment and software.

A specific threat is a low level of people's general legal and information competence including skills of the safe use of cyberspace.

A legal support of the information sphere is significantly insufficient for the current needs. Legal mechanisms regulating production, transmission, dissemination of information, information resources, information products and information services need to be constantly improved and updated.

Thus, the current state of information security is characterized by such threats as an underdeveloped information security system and disruption of the functioning of the important information objects; the low level of production and application of the relevant information and communication technologies that do not meet the objective needs of society; dependence on the import of information technology and information protection facilities, the use of which can damage national interests; the information warfare between confronting great powers; development of information manipulation technologies; a possibility of the destructive information impact on the public consciousness and state institutions damaging the national interests of any country; a misinformation or purposely distorted information capable of causing damage to the national interests of the Republic of Kazakhstan; the insufficient effectiveness of information support for public policy; weak security and low competitiveness of the national information space; a low quality of the national content that do not meet the objective needs of society; the growth of crimes, including transnational, extremist and terrorist activities that make use of the information and communication technologies; the insufficient development of the system of legal regulation of the information sphere; illegal actions of state structures resulting in violation of rights and interests of individuals and entities.

An effectiveness of the state policy related to ensuring information security depends on the national concept. Often, such concepts are not fully developed and do not meet the everchanging global challenges and threats. For example, the Concept of information security of the Republic of Kazakhstan was adopted by the Decree of the President of the Republic of Kazakhstan on November 14, 2011 and was implemented during the next five years [7]. The purpose of the concept of information security is to create a national information security system that guarantees protection of the national interests of the Republic of Kazakhstan in information sphere. To achieve this goal, it is necessary to complete the following set of tasks:

1) to develop an information security management system that allows to ensure the security of the country's national information infrastructure and a single national information space;

2) to develop and implement a unified technical state policy in order to ensure information security, including development and strengthening of the national information protection system;

3) to protect the rights of the individuals and the interests of society;

4) to develop the national information space;

5) to improve legislation that regulates the information sphere;

6) to provide state's active participation in the processes of creating and applying global information networks and systems. Despite of all, Kazakhstan's information security system is characterized by the low effectiveness of information management of the state policy, due to the shortage of the qualified personnel, lack of a system for the formation and implementation of the state information policy, insufficient coordination of the governmental bodies' activities. The situation is also aggravated by the fact that sometimes the official media is unable to fulfill its main function of conducting the state information and ideological policy because of unpopularity and low level of population's trust.

The information transfer has an extremely high speed, therefore it is practically impossible to completely restrict the dissemination of any information, except for private situations, so information is the most important social resource of the information society. As a consequence, control over information flows provides an opportunity for significant influence on various spheres of society, social institutions and the entire system.

Another important point relating to information is an information security of the person. Given the fact that in addition to the physical and mental characteristics peculiar to any individual, the latter gets a virtual dimension, representing a diverse array of information about the person, handling of the personal information becomes socially important requirement for participants of the information society.

If information security on a global scale and at the level of individual states is the subject of professional work of specialized departments, personal information security is an another growing issue.

In modern society information security is an essential component of national security. The level of economic, defense, social, political and other types of security largely depends on it.

Thus, information security creates conditions for the mental health of the individual and population in general, proper functioning of the state and public institutions, as well as formation of the individual and mass consciousness aimed at the progressive and sustainable development of societies and states.

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## MOBILE HOUSING AS A FUNCTIONALLY-TYPOLOGICAL DIFFERENCE OF THE INDUSTRY OF MODERN HOUSE BUILDING

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The article is devoted to the current socio-demographic conditions and the level of providing the population with housing of various types and quality, suggest the possibility of active development of mobile housing construction. The practical advantages of mobile homes in different regions of the world are reflected in the popularity of their use, especially as a temporary, recreational, holiday and tourist accommodation. The use of mobile housing currently has a limited functional and typological composition.

Keywords: mobile housing, modularity of mobile housing, transformation, adaptation, ecological compatibility, use of renewable energy sources, energy-saving houses, "smart house"

The main purpose of the article is to identify the features of designing and erecting mobile housing on the basis of studying the world and domestic experience, taking into account a comprehensive assessment of the shaping factors (environmental and fire safety requirements, energy conservation, reliability and sustainability, etc.).

Throughout the course of historical development, the use of a mobile home was the optimal response of a person to harsh, unfavorable external living conditions or was related to the characteristics of life and economy. Two main types of mobile homes (land and water based) have received different vectors and the degree of their development, depending on the habitat habitual for a person. After a considerable pause in its development, the mobile home received a new round only after the first scientific and technological revolution, which is associated with the emergence of new zones of attraction of human resources and the availability of technical means for their movement. An analysis of the subsequent stages of development, both of the mobile home itself and of its position in the general structure of settlement, indicates that such dependence (the place of residence / zone of attention - the means of transportation - the mobile dwelling) is preserved, leading to the fact that the area of application of the mobile dwelling has constantly expanded in the direction of increasing extremes of the external environment. The range of factors (natural and climatic, technical, economic and ecological) that determine the use of a mobile dwelling depending on the conditions and the complex of problems solved with its help is widening. At the same time, the range of its potential consumers is widening, which can be conditionally divided into the following groups: public, social, private and special. It is worth noting that for each period of mobile

home development, the prevalence of certain groups of influence factors and groups of potential consumers over others is characteristic, taking place against the background of their increasing differentiation. The basic principles that predetermine the transition to the use of mobile homes remain unchanged: "the principle of limited resources" – the limited territory, living space, time, resources, labor, etc., and "the principle of changing conditions" - the variability of the place, external and internal conditions. The first principle is responsible for the conditions for the transition to the application and selection of typological varieties of the mobile home (scope, type, species and its varieties). The second relates to the characteristics of the mobile home itself, determining accordingly its transportability, adaptability and interactivity [1.12-13].

Modern socio-demographic conditions and the level of providing the population with housing of various types and qualities suggest the possibility of active development of mobile housing construction. The practical advantages of mobile homes in different regions of the world are reflected in the popularity of their use, especially as a temporary, recreational, holiday and tourist accommodation. The use of mobile housing currently has a limited functional and typological composition. The development of the mobile construction industry has a wide range of practical applications [2].

In studies on mobility and transformability of residential buildings, the following issues were considered: the experience of adapting housing to changes in the livelihoods of their inhabitants in the form of transforming the internal space and ensuring its multifunctionality; method and design of structures that differ in moving, collapsible or folding parts and the features of the formation of a mobile recreational dwelling; the evolution of the human 120

dwelling and the predicted futuristic view of the structure of the residential environment. In the scientific development of modern authors in the field of construction and architecture, the topics related to energy conservation are of great relevance: the study of the historical preconditions for the development of energyefficient housing, the development of basic requirements and solutions for their formation, and the creation of an engineering-effective method for designing low-rise architecture; analysis of the use of non-traditional energy sources, identification of the main ways to save energy and the development of the architecture of energy-saving residential buildings of small and medium-level storeys; development of an integrated approach to the environmental and economic justification for the creation of energy-efficient residential houses using alternative energy sources; the urgency of energy saving in construction in the context of energy savings for future generations, the use of renewable energy sources (RES) and the creation of energyefficient houses with the use of "smart" housing in the form of autonomous control systems; use of RES and secondary energy resources and construction of experimental houses; creation and formation of energy-active agro-life on low-productive areas degraded due to technogenic factors; creation of new standards for designing a home based on real experience in research, design, construction and operation of energy-efficient engineering systems [3]. It seems reasonable to study the problem of mobile modular housing in the context of energy conservation and energy efficiency requirements.

To start, I would like to stop on the historical foundations of the evolution of mobile housing. The history of the development of a residential house, the evolution of its formation in the environment is associated with the allocation of two basic forms - mobile housing (land and water) and a capital structure (real estate). The mobile form of habitation was characteristic of all ancient nomadic tribes inhabiting vast steppe open spaces from the Carpathians to East Asia (Cimmerians, Sarmatians, Huns, Turks, Tatars, Mongols, etc.). Among the peoples of the semi-settled way of life, portable houses were used along with the construction of permanent housing (Persians, Hittites, Scythians, Bulgarians, Magyars, Khazars, Pechenegs, etc.) [4].

The principle of the construction of a mobile home has not undergone significant changes since ancient times to the present day. The main types of portable dwellings: yurt, yaranga, plague, tipi – are frame structures, round in plan with a center located in the center, differing in size and coverage. A feature of the device of the Central Asian yurt – the most complex of primitive nomadic dwellings – is the presence of lattice folding walls, poles making up the dome, holes at the top of the dome for daylighting and ventilation and felt cover [5].

At the same time, the yurts of different peoples have characteristic features in the details of the structures and organization of the internal space. The diameter of the average yurta is 5-7 m, the height is 3-3.5 m. So, instead of a felt canopy replacing the door, two-leaf wooden doors (in Kazakh and Turkmen yurts) can be arranged. Yurts have zoning on the male and female halves and mandatory allocation of places for honorary guests in the altar part, located opposite the entrance.

Traditional dwellings of the indigenous peoples of the North America, North and North-Eastern Europe and Siberia are the yaranga among the Chukchi, Eskimos, Koryaks and Yukagirs, and others; the plague of the Saami, Nenets, Evenks, Mansi, and others; and tipi (among the Indians of the Great Plains), consisting of poles covered with reindeer skins, birch bark, mats or bark [6,289].

The installation of the nomadic dwelling was usually carried out by women, the assembly took several hours, and the dwelling was also quickly disassembled and loaded onto camels, deer, lamas, and dog sleds. In modern conditions, traditional mobile, fast-gathering, seismic-proof housing is still in demand and is most common among residents of the North, Mongolia, Kazakhstan, Kyrgyzstan, Turkmenistan, etc., engaged in pasture-pasture livestock.

Since ancient times to the present day, various marquees and tents (simple frame structures, covered with cloth or leather, basically not providing the process of preparing food in the room with the help of the hearth and designed for moderate or hot climatic conditions) serve as a camp light lodging. To the prototype of campers – mobile housing, which has a wheel base, you can include indoor gypsy wagons, wagons and wagons of wandering artists and other residential "trailers", the application of which is also associated with seasonal and climatic conditions.

Mobile form of housing in the modern view has been actively used in many countries since the early 1950s. In the beginning, these were inexpensive, often temporary houses; in some cases, the factory-made house was transported and installed on the prepared foundation in the chosen place. The first houses had a width of Technical sciences

2.5 m, then the sizes increased and as a result, the border separating camper-caravans (motorhomes), dimensions, weight and engineering capabilities of which were severely restricted, and mobile homes (full-fledged housing from 1 to 3 floors from bulk or flat elements) [7].

Currently, the field of application of mobile prefabricated low-rise housing construction (land and water) is extensive and diverse:

- temporary housing for shift work, including in construction conditions, as well as in underdeveloped and hard-to-reach areas remote from the industrial centers of the prirulous zone, in areas with unfavorable natural and climatic conditions;

- in the conditions of the increased migration of the population connected with problems of employment;

- for placement of internally displaced persons from regions with unstable military and political situation;

- in the context of emergencies caused by natural or man-made factors;

- temporary garrison housing for servicemen (soldiers' barracks and houses for officers);

scientific-expeditionary activity;

– urban, suburban, suburban manor and dacha housing;

- housing for rural areas;

- recreational housing;

- tourist and hotel accommodation.

The development of the mobile housing market and the use of certain typological types of mobile housing have significant regional differences. Among the countries – the main producers of mobile housing, as well as in which the advantages of mobile homes in the form of suburbs, cottages, tourist campsites, hotels are used to the greatest extent are the USA, Great Britain, Germany, Spain, etc. A popular phenomenon was the adaptation of vehicles for residential needs: housing in buses, in the bodies of trucks, in freight containers.

In Central Asian countries, mobile homes have traditionally been used mainly as temporary working housing (wagons-trolley cars). Light mobile constructions of economic and commercial purpose (kiosks, booths, small hangars, etc.) and garages are quite in demand. An insignificant percentage is the use by citizens of automobile residential trailers.

In recent years, the use of prefabricated (mainly skeleton-panel and container) mobile homes for temporary, alternative living and recreation in the form of country and suburban housing (less often for the organization of tourism business) has increased noticeably. The production and erection of mobile residential buildings meets the general building codes and requirements (town-planning, architectural and constructive, sanitary-hygienic, fire-fighting, socio-economic, ecological, energy-saving, etc.) imposed on residential buildings.

However, in some parameters there are specific features:

1) considering the urban factor, when placing mobile housing in the city system, the choice of the territory outside the historical development zone is of primary importance. Taking into account the principle of conceptuality, architectural formations from mobile homes are difficult to fit into the historical environment in which buildings of the period of construction until the middle of the 1910s are present. Preferable allocation of sites on the outskirts of residential areas; The most appropriate may be a neighborhood with a manor or multi-store building.

2) mobility: mobile homes belong to the so-called types of non-traditional housing and have the main difference – the types of mobile housing are different: a) by type of transportation:

- self-propelled - with a non-removable undercarriage and an engine similar to a car;

– with the possibility of towing;

- wheelless, transported by means of vehicles.

On structural and technological features: from bulk elements (container and superblock) and from flat and linear elements.

- container and super block houses consist of a house consisting of block-containers of increased factory readiness, often with a complete set of engineering equipment and furniture. The house is put into operation immediately after delivery to the destination. House-containers are transported by vehicles or towed on own undercarriage, which can be fixed or removable (automobile chassis, rolledin cart, sled, etc.). Containers have a strict limitation of dimensions (super-block houses have considerably larger dimensions), planning capabilities and high cost.

Mobile houses of flat and linear elements are assembled from the structures of increased factory readiness (frames, racks, panels) into a single system directly at the site of operation. Compared with container houses, they have more diverse planning solutions, the possibility of creating cottages of various sizes and storeys. Installation and dismantling are carried out by cranes of small carrying capacity, the process of redeployment is more complex, primarily because of the need for on-site installation of engineering equipment and connection to centralized networks [8, 442-444]. 3) turnover of a mobile home – the number of redeployments for a certain calendar period.

4) the structural and spatial system of an apartment house can be modular; Nowadays modern technologies allow creating a new type of housing – modular mobile homes.

Modular units can be module-containers, individual volume blocks, as a rule, full or maximum factory readiness. In this case, it is possible to use the transformation of modular structures and change the exploited area, construction volume and other technical and economic indicators of the house. There are such basic types of transformation:

a) with the change of external parameters – in the case of erecting the house in stages, by adding additional volumes to the main module by means of special docking elements;

b) with the change in the internal parameters of the house by re-planning the internal space with the help of transformable partitions. At the same time, the areas and proportions of the rooms, functional zoning and inter-room connections are changing;

c) combined, in which the principles of external and internal adaptation are applied.

Mobile mobile housing (including modular) is a kind of dynamic adaptable house and has already become widespread in economically developed countries (USA, Japan, Great Britain, etc.).

Depending on the method and nature of adaptation, the following main types of transforming houses are distinguished:

folding – with the help of special folding structures;

 pneumatic – houses with flexible fabric inflatable fences, supported by excessive air pressure;

sliding – with special sliding elements of walls and ceilings;

- cassette - characterized by a high-density interposition of structural elements.

5) Limitation of the number of storeys – up to three floors (with rare exceptions) and durability.

6) Certain difficulties of application in conditions of rough terrain and large slopes of the terrain. Preferably, the choice of flat sites with the purpose of reducing the preparation of the territory.

7) Certain specificity in the use of structural systems and methods of construction (or installation): as a rule, a frame or frame is used as a supporting system, and technologies of monolithic and finely assembled erection are not applied.

The main requirements for choosing a constructive solution should be reliability, stability and safety. Before the installation of mobile housing (in most cases), earthworks of the zero cycle (excavations and trenches) are not carried out, foundations and basements are not being constructed (in some cases, collapsible lightweight foundations are used). The installation of a mobile home (not equipped with a wheelbase) can be made directly to a pre-prepared territory (the site is leveled, often with a bulk of rubble, sand or using special slabs).

Self-propelled mobile homes can be lifted by jacks before installation (lodges are put on special concrete or metal supports), while the wheelbase can be removed or covered, leaving the wheels in a hanging position.

8) In order to fulfill the requirements for energy saving and environmental friendliness, when creating energy-efficient mobile homes, it is necessary to take into account their design features. The construction of energy-efficient housing (including mobile), more technically more complex than the traditional one, requires an integrated approach based on close cooperation between architects and engineers.

In many countries that have adopted the Law on Renewable Energy Sources (REE), energy-efficient houses with the use of hybrid systems (using solar radiation, geothermal heat as an additional source of energy, etc.) become quite common. For example, in Germany, according to the Law on Renewable Energy, owners of houses using alternative renewable energy sources (solar, wind, geothermal energy) in the system of autonomous heating of housing receive state subsidies both in the arrangement of autonomous heating and in the operation of the heating system.

The use of energy-saving hybrid systems in mobile housing construction is also quite realistic. Taking into account the characteristic differences in the construction and operation of mobile housing (functional-typological and design features, the estimated time of use in one place, turnover, etc.), it is possible to work out various energy-efficient engineering and technological schemes that are acceptable for each specific case. When designing mobile homes for seasonal use (in the warm season) with low energy consumption, it is possible to provide energy only with autonomous installations operating on RES (recreational, dacha, tourist accommodation, etc.).

Experimental developments in the creation of a "smart house" (or a home-car) – an energy-efficient and equipped with an integrated automatic control system – are becoming increasingly popular. An example is an office green house with a roof used as a garden, built in Israel. Inside the building, several thousand sensors continuously record data (temperaturehumidity regime, air composition, etc.). The water from the sewer system is cleaned and used a second time for technical needs (watering plants on the roof, etc.). Thanks to the green plantations on the roof, the building receives additional thermal insulation. Thermal energy released by cooling plants is used to heat water. The control panel of the entire engineering system is located in the basement [9, 76-78].

The use of mobile housing construction of various typologies has real prospects for development. Along with the traditional capital housing, which constitutes the priority share of the construction industry, mobile homes can serve as a quick and good help (primarily for summer residents and tourists). A necessary condition for this is the general growth of the economic well-being of our country, the intensification of international cooperation in various sectors.

The design of mobile housing should be viewed from the standpoint of the processes of people's livelihood, carried out in this dwelling, and the processes of its creation. It is necessary to provide a comfortable living for a person in a small area, to place in the internal space all necessary equipment. But, most importantly, it's the world in our common home and the confidence of people in the future – their own and their children.

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### BEHAVIOR IN THE CREDIT SPHERE: ON THE EXAMPLE OF STUDENTS

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The authors analyze models of behavior in the credit sphere among students. It is established that a credit for a significant part of students is not a daily practice, but merely an instrument of solving a certain problem (to pay for education, to purchase something, etc.). Female students are more likely go for informal lending than young men who prefer to use formal lending. A significant number of students, regardless to their gender differences, plan to use formal lending to solve the housing problem after finishing their education. Formal lending is not the lifestyle for most of the students due to a number of circumstances: high bank requirements when requesting a large monetary loan, financial illiteracy, high risks, etc. In addition, it is established that the higher the level of well-being of the student's family, the more often and more willingly he or she goes for formal lending. In conclusion, the authors consider the prospects for the development of formal lending among students.

Key words: loans, credit cards, credit products, formal and informal lending

### **Relevance of the study**

Positional experts note that in the past decade, the number of people with paternalistic positions has increased, most of the population has 7-8 credits and microloans. [6] The number of citizens who are unable to pay off loans is increasing. As a result, in order to somehow rectify the situation, the Law on Personal Bankruptcy of Individuals entered into force on October 1, 2015.

#### Empirical basis of the study

In 2015-2016, we carried out a survey of students of:

- Yaroslavl State Pedagogical University named after K.D. Ushinsky (YSPU);

- Yaroslavl State University named after P.G. Demidov (YSU);

 Orel branch of the Russian Academy of National Economy and Public Administration under the President of the Russian Federation (RANEPA);

– Yaroslavl branch of the Emperor Nicholas II Moscow State University of Railway Engineering (After all merges the branch of the Russian University of Transport (MIIT)).

Quota sample. Sample frame n=954. Quota variables: gender, age, university.

The survey of the teaching staff of universities with the purpose of studying the situation in universities in terms of economic socialization and education of students n=14.

In addition, the study of opinion of positional experts (Client managers) n=12.

A secondary analysis of the data of:

- Russian Federal State Statistics Service;

– Results of sociological researches conducted by VTsIOM (Russian Public Opinion Research Center), employees of the Federal Research Sociological Center (FNISC RAS).

### Methodological basis of the study

The methodological basis of the study was the concept of "post-materialist values" (R.F. Inglehart), as well as the works of the authors of V. Zelizer, J.M. Keynes, S.A. Baburkin, V.N. Kudashov, A.V. Lymarev, S.L. Talanov. [3, 4, 5, 6, 7].

### Author's hypotheses

1. A credit for a significant part of students is not a daily practice, but merely an instrument of solving a certain problem (to pay for education, to purchase something, etc.).

2. Female students are more likely go for informal lending than young men who prefer to use formal lending.

3. A significant number of students, regardless to their gender differences, plan to use formal lending to solve the housing problem after finishing their education.

4. Formal lending is not the lifestyle for most of the students due to a number of circumstances: high bank requirements when requesting a large monetary loan, financial illiteracy, high risks, etc.

5. The higher the level of well-being of the student's family, the more often and more will-ingly he or she goes for formal lending.

#### **Results of the study**

In the beginning of the study, we analyzed how it is common among students in everyday practice to go for formal lending?

Only 27% of respondents have credit cards. 11% had experience in using loans and credit cards. 62% of respondents noted that they do not use credits and credit cards.

It was established that all interviewed students have debit cards, since the scholarship can be paid on a bank card only.

Then, we looked at the benefits from the point of view of students, for the formal lending (respondents could specify several answers). As a result, 78% of respondents noted that a bank loan allows to inform no one about their financial problems. Absolutely all female students explained that they do not want to borrow money from friends, especially young men, not to be indebted to them. Therefore, girls prefer to borrow money either from their parents or from the bank. In addition, girls who are in relationships with men (live together) indicated that they are borrowing money from their men. At the same time, it was explained that most men, when requested for a loan, simply give (as a gift) money without demanding them back. 67% of students noted that there is an opportunity for them to receive a large cash loan. 58% of the respondents explained that it is possible to take a loan for a long period and, accordingly, to pay off the debts in installments over a long period, which significantly reduces the financial burden on the already small student budget.

54% of respondents indicated that formal lending trains to lead long-term planning, to be responsible and disciplined.

54% of students explained that the loan could now be taken without any difficulties, but unfortunately not as for the amounts that would be desirable. You can apply for a loan without leaving home. The bank is giving its decision on your request very quickly.

Then, we looked at the disadvantages from the point of view of students, for the formal lending (respondents could specify several answers). 89% of respondents noted that, due to their low incomes (scholarships) and age, banks prefer not to provide them loans, or give, but small amounts of money

65% of respondents indicated that the main disadvantage of the credit loan is high interest rate.

43% of students admitted that they did not read all the terms of the contract when taking the credit. In general, they requested for the credit as to the last opportunity to solve their difficult financial situation. It means they were ready to take a loan under any terms. The same group of respondents explained that they do not have enough knowledge in the sphere of lending. That would be logical to teach a special course on economic behavior in universities.

Then, we looked at the benefits from the point of view of students, in informal lending (respondents could specify several answers). It was found that 64% of students see the advantage of borrowing from friends in the speed of financial support. In a bank with all the latest

technologies, to get a loan, it takes some time. In addition, 57% of the respondents noted that friends are ready to wait with the return of the debt, which is very important for most of the students, considering their small incomes. You can borrow the money from friends many times and even in case when the previous debt is not returned.

Then, we looked at the disadvantages from the point of view of students, for the informal lending (respondents could specify several answers). It was found out that 37% of respondents believe that it is risky to give loans to acquaintances and even friends, since there is a possibility of not returning the debt. Accordingly, there is a possibility of loss of trust and spiritual intimacy between friends.

As it is pointed out by American sociologist Ronald Inglehart, the main values in postmodern conditions are: a decent level and quality of life, health, friendship, self-development. [2] The media is promoting these values. In conditions when a person acquires cultural capital (education), meaning most of his time receives and trains knowledge, skills and abilities, and sometimes works, as a rule, to the detriment of the main goal, it is very difficult to maintain a decent standard and quality of life without the resources of wealthy parents.

For many young people, formal lending allows to improve their quality of life. But if a person's reference group is very wealthy (rich), or if everyone in the student group is very wealthy, then in order not to "stand out" the existing consumption standard, it is necessary to spend large amounts of money and lead an idle (expensive) way of life (night clubs, restaurants etc.).

The Ministry of Education and Science of the Russian Federation notes that in recent years up to 60% of applicants from other cities have entered the universities of big cities. In Moscow, St. Petersburg, the life of student is difficult enough, especially without the support of wealthy parents to maintain a decent quality of life.

The stratification of society is very visible in big cities; there are many temptations. In fact, those applicants who came to study in Yaroslavl from small towns of the Yaroslavl region, found themselves in the same difficult situation as the applicants who came to Moscow or St. Petersburg from the province.

The survey showed that there are a lot of students from other towns (nonresidents) in Yaroslavl universities.

Most of them live in dormitories, in rooms for 4-5 people. In this regard, in our research,

we studied how often nonresident students are going for formal and informal lending.

It was established that 16% of nonresident students resorted to the help of microfinance institutions. 24% have credit cards (limited up to 30 thousand rubles). However, most of the nonresident students prefer the informal lending in a difficult life situation

An interesting fact is that 8% of respondents periodically seek help from a pawnshop. Mostly, when pledging gold products, the students are able to buy them back later on.

Things are going better for the nonresident students who are in a relationship (here we are mostly talking about cohabit). In such couples, the financial component is more stable.

The survey of the teaching staff of universities showed that within the teaching process, students are being taught very few disciplines, within which one could create the necessary economic skills. Such discipline as economic sociology is mainly given only to those who study at the "Social studies" department. Only a small number of students is inherent for the resource planning and rationality. As a result, many students are not capable of long-term planning, and the ability to take risks and be responsible for their choice.

The university teachers noted that they had repeatedly faced situations when several students applied to the trade union asking for material support, providing all the necessary substantiations, but when receiving the money, passed all the cash to a student who urgently needed it, but could not get the money from a bank or trade union, due to various reasons.

65% of students note that they have difficulties in understanding economic disciplines. In addition, 24% of students believe that they do not need any economic training.

Positional experts (client managers of the bank) explained that students, as a rule, do not receive loans. The bank seeks to receive the maximum profit, and for this reason, the borrower's solvency is important. Students have to study, and in their spare time or at the expense of their studies, they try to improve their well-being. In other words, their income is not stable. The current situation is that the credit is usually given to students over the age of 21. It is more difficult if a borrower is a male student (liable for military service), since he will probably serve in the army in a year, thus there is a risk of not returning the loan.

Female students also find it difficult to get a loan, because banks require at least six months of work experience, the availability of a record in labor book, an income reference. The problem is that even if the student finds a well-paid job then, unfortunately, he or she is usually paid in an envelope (not officially). These kinds of time-to-time job mainly happens in summer and lasts for not more than 2-3 months.

Sometimes banks are asking for pledge, but the student has rarely got a car or an apartment in its property.

If students apply to the bank for a credit, they prefer to take a consumer loan, less often a loan for education.

Experts explained that the average size of a retail loan in Russia is about 160 thousand rubles.

Young people want to look successfully, meaning to dress fashionably, to wear expensive watches, to use modern phones, to drive cars, etc. Sometimes these goals are completely inaccessible. Banks are afraid to take risk and to give large sums of money to young people, because according to the National Bureau of Credit History, a lot of loans given to people aged 21-25 years remain non-return.

Experts also explained that some young people behave frivolously when facing the difficult situations, and they do not have the opportunity to pay the installment in time, instead of informing the bank they simply cease to make payments under the loan agreement. As a result, they are charged with fines and penalties. However, it would be possible to act differently. Namely, to come to the bank, where they could have been supported with an individual repayment schedule for the loan, or could have been provided a two-month credit holiday.

According to positional experts, most students go for microloans, as there are no strict requirements for borrowers. There are 2412 microfinance institutions in Russia. Microloans are easier to get, usually at 3 % daily rate. However, the amounts are not large, up to 40 thousand rubles. Not every student is able to overpay so much.

Since August 14, 2017, the Bank of Russia has established the increased reserve requirements for microfinance institutions (MFIs) in case of loans to individuals. In other words, it will be more difficult to obtain a "pay when salary comes" loan.

We as researchers were interested in how many students plan to be engaged in small or medium-sized businesses; and to find out in general whether among respondents there are ones who are already engaged in business.

It was established that among the respondents there was not a single person who had his own business. It was found out that 27% of students would like to do business, but they do not want to associate themselves with formal lending. They expect to receive subsidies or grants for business development, in the framework of special programs.

47% of respondents noted that they are aware that there are 10 institutions for supporting entrepreneurship in the Yaroslavl region.

#### Conclusion

Within the framework of the conducted research, it was established that for the most part of the respondents could still be characterized as financially illiterate.

When deciding to take a credit, students are often guided not by their profit, but by immediate interests. Financial problems arise because of low financial incomes, disability to build long-term planning. They spend their incomes on the things based on their subjective interest and impulsive actions.

Banks need to revise their position on loans for students. In particular, to reduce the number of documents needed to obtain a loan, to reduce the interest rate on the loan; and as a guarantee, to provide mandatory insurance for the credit taken. Obviously, these proposals will not change the fundamental state of affairs in the formal lending market. It is important to form certain skills, abilities and knowledge of students in the university. For this reason, the development of formal lending will depend not only on the Government of the Russian Federation, but also on the success of economic socialization (mastering the economic roles, readiness for economic activity, etc.) in the university.

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