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INORGANIC RESPIROCYTES AS MODELS OF RED BLOOD CELLS

O. Gradov and M. Gradova

The present work concerns the creation of artificial red blood cells and blood substitutes based on them. An alternative method of synthesis of erythrocyte models for simulating cellular pathology in clinical hematology is proposed.

INTRODUCTION

At the present moment, the fundamental problem of hematology is the development of biologically compatible non-heme protein-free blood substitutes with the same functional properties as red blood cells. Vesicular synthesis of artificial red blood cells by means of hemoglobin encapsulating is not appropriate, because, as shown by model experiments, the presence of vesicular structures in blood causes immune response of the organism [1]. Hemoglobin is fixed by blood-plasma proteome and transformed into haptoglobin, which is later utilized in the kidneys, bone marrow and spleen, that leads to hemoglobinuria and thrombosis.

There were several attempts to create alternative blood substitutes based on perfluorocarbon emulsions in order to avoid the intoxication by hemoglobin-containing blood substitutes [2-5]. However, the oxygen capacity of perfluorocarbon (liquid F-carbons ≈ 40 vol.%, perftoran ≈ 7 vol.%) does not correspond to the oxygen capacity of native blood and plasma (blood ≈ 20 vol.%, plasma ≈ 2,4 vol.%). Besides, the practical application of perftorans is accompanied by a number of medical problems. Infusion of perfluorocarbon Fluosol-DA can cause anaphylactic reaction [7]. Perfluorocarbons are not stable enough due to their lipophilicity [8, 9] and therefore tend to interact with plasma membrane lipids and receptors. Thus, the clinical introduction of perfluorocarbon-based blood substitutes is rather difficult at the moment.

However, there are original projects of creation of new nanomechanical devices [10, 11] that mimic the functions of blood cells, both erythrocytes and lymphocytes. Respirocytes - artificial analogs of red blood cells, according to [10], should be carbon nanomachines with a diameter of 1 micron, containing mesoscopic tanks - reservoirs of O_2, CO_2, water and glucose for respiration and energy supply. Mechanical equivalents of phagocytes (lymphocytes of the immune system), according to [11], were described as nanomedical microscopic devices, imitating the functions of T-killers. In addition, nanostructured analogs of platelets – klottocytes were proposed to prevent hemorrhage [12]. Finally, vaskuloid - mechanical analogue of the circulatory system, based on the listed nanomechanisms is expected to be implemented by the method of probe assembly only in 2030 [13].

Still it's almost obvious that a construction of a completely functional analogue of hematological systems in this way is impossible because of the systemic character of hematopoietic and respiratory processes. Therefore the only possible method to create adequate functional analogues of biological cells (vaskulocytes of any type) is self-

assembly [14]. For example, a synthesis of functional analogues of cells, based on colloidal micelles is proposed in [15-17]. It should be noted, that such cell models may not correspond to their living prototypes in chemical composition. A similar object on the basis of metal-oxide capsules with selective permeability and capacity for gas exchange is described in [18]. But it is impossible to form a microstructure of the biomorphic objects obtained via vesicular synthesis that inevitably leads to impossibility of a full simulation of cytological systems.

Meanwhile, it's appropriate to use laser forceps for managing the assembly of supramolecular associates, such as colloidal micelles and membrane-vesicular structures [19]. There are similar methods known of manipulating of biological cells and their ultra-structure [20, 21]. Such laser technologies provide for work with both organic and inorganic dispersed systems [22]. That allows producing laser-optical assembly of vaskulocytes, using hematopoietic prototypes. If respirocytes, mikrofagocytes and klottocytes, according to [10-12], represent a kind of nanorobotic devices, it can be assumed that laser-optical synthesis of vaskulocytes can be considered as a biologically inspired self-assembly of robotic systems with a high ultrastructural organization [23, 24].

The work [25] presents a model that mimics haematological and respiratory functions using redox processes on magnetite with impurities adsorbed on it. It is well known that some iron compounds, such as magnetite and an emulsion of iron trichloride, as semiconductors, have photosensitivity. In this connection, they can be used as precursors for laser-optical self-assembly.

MATERIALS AND METHODS

Artificial analogues of blood cells were synthesized via laser-induced self-assembly according to the technique described in [26]. The dissipative structures, isomorphic to the cellular structure of a biological prototype (blood smear), were obtained in the active colloidal medium.

Vasculocytes, as functional models of hemocytes, should simulate reversible gas transfer and other typical blood properties - hemocoagulation, immunohematological functions, etc. Due to participation of the iron atom (in a hemoglobin molecule) in the transport of gases it is advisable to use Fe-containing precursors for hematology modeling. In this work photosensitized emulsions of iron trichloride and desorbed suspensions of magnetite were used as a precursor.

RESULTS

As a result of laser-induced self-assembly inorganic copies of hemocytes were obtained in iron-containing photosensitive medium. Fig. 1a presents micrographs of inorganic analogs of erythrocytes, synthesized on the basis of nanodispersed magnetite, and fig. 1b – the ones synthesized on the basis of hydrolysed iron trichloride. Both structures are completely isomorphic to donor erythrocytes, used as biological prototype.

a	*b*
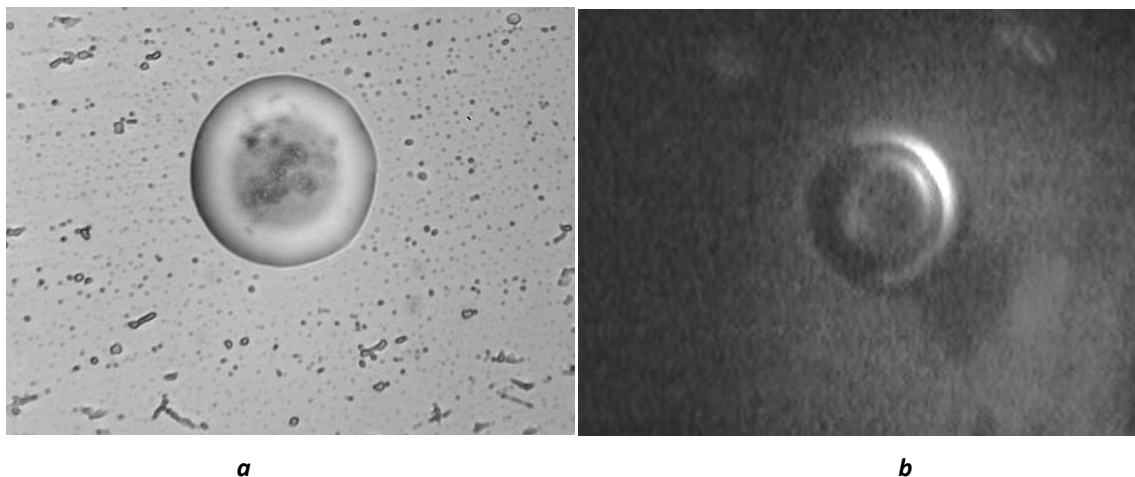
Figure 1. Inorganic cell copies of a peripheral link of erythron

Obviously the structures obtained differ from the initial precursor in chemical composition. According to X-ray diffraction analysis, their composition includes the following compounds:

1. $Fe_8(O, OH)_{16}Cl_{1,5}$,
2. $Fe(OH)_3$,
3. $FeOCl$,
4. Fe_2O_3,
5. minor intermediate compounds.

Inorganic erythrocyte copies were isomorphic with the original erythrocytes. In addition the structures obtained were also found to possess a number of morphofunctional properties, which correlate with the ones of their biological prototypes due to dependence of their chemical composition on spectrochemical parameters of the original erythrocytes.

In this case it is possible to simulate a number of cytochemically caused membranopathies for the purposes of clinical hematology using the obtained models of erythrocytes. Thus the present article shows the results of using inorganic erythrocytes in simulating of such hematological abnormalities as microspherocytosis, elliptocytosis, stomatocytosis, acanthocytosis and some haemoglobinopathies.

It is well known that a change of osmotic resistance of erythrocytes [27] is characteristic of microspherocytosis, because spherocytic erythrocytes become osmotically less resistant. This hemolytic anemia is considered as a molecular defect of the erythrocyte membrane structure and can be reliably diagnosed by the acid erythrogram method at pH 3,0. When microspherocytosis acid erythrogram shows a sharply elongation of the hemolysis.

In inorganic hematological systems acidic pH also leads to microspherocytosis and violation of the osmotic resistance, followed by bursting of erythrocyte membranes. Fig. 2a presents microspherocytic inorganic cells and fig. 2(b, c) demonstrates broken cell membranes under the pH-shift. Over time, the lysed membranes, according to the acoustic microscopy, disintegrate and sediment (fig. 2d) analogous to so-called "shades of red blood cells", obtained under similar conditions.

a   *b*   *c*

d
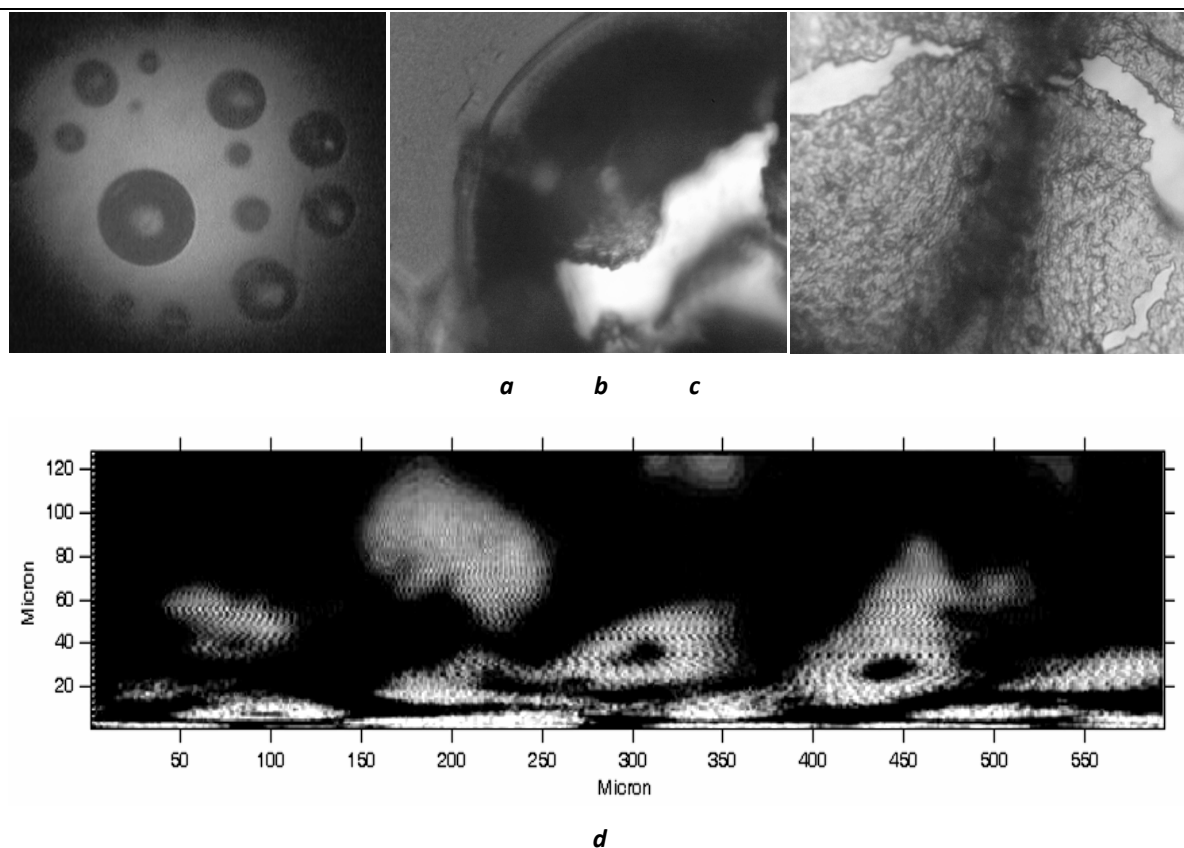
Figure 2.

a - c. Microspherocytic inorganic erythrocytes and their membranes

d. Shades of inorganic red blood cells (acoustic sonogram)

Another membranopathy simulated is elliptocytosis when a content of oval-shaped red blood cells rises from 10% to 25-75% and more. It should be noted that the presence of elliptical erythrocytes in the donated blood is also possible in hematological modeling, although a number of inorganic elliptical erythrocytes were objectively recorded in our experiments. The latter also had broken cell membranes and an increase in autohemolysis accompanied by increase in the osmotic resistance. Photomicrographs of inorganic cells, imitating the following hematological abnormalities, are pictured at fig. 3 (a, b).

The hemolytic anemias described are attributed to membranopathies, so their dependence on the physico-chemical parameters of the membranes is obvious. However, as the morphometric characteristics of inorganic cells are homeomorphic to the ones of normal blood cells (morphometric characteristic of elliptocytosis is an affine transformation of the morphometric characteristic of normal erythrocytes, while when stomatocytosis this transformation takes place only in its central zone), the nature of initiation is not clear.
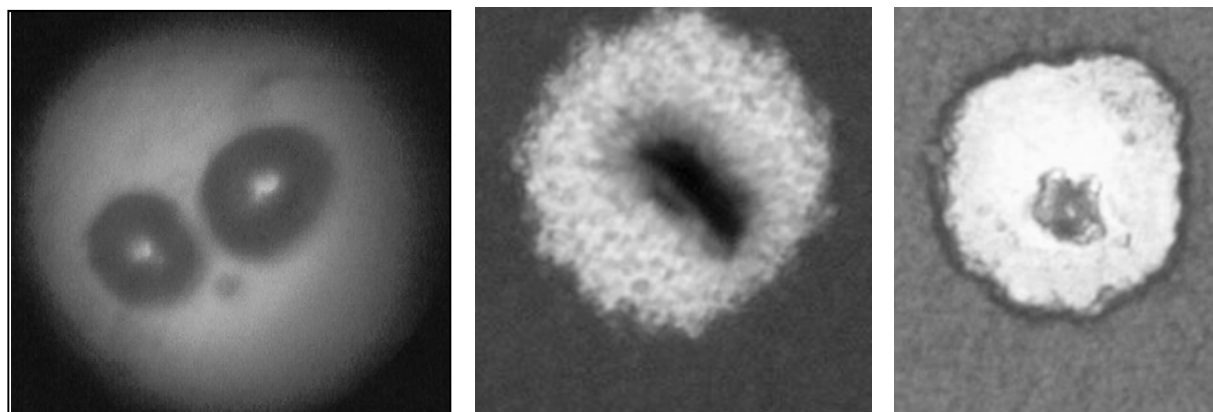
a. Model of ellyptocytosis   b. Model of stomatocytosis   c. Model of echynocytes

Figure 3. Photomicrographs of inorganic erythrocytes, imitating various membranopathies

In order to prove the possibility of the occurrence of hemolytic anemia in inorganic copies of healthy red blood cells under the influence of physico-chemical factors of the medium, hereditary blood diseases were modeled by the method described.

Acanthocytosis or hereditary abetali-poproteinemia is a rare disease, described for 30 cases. Therefore simulating acantho-cytosis on the iron-containing inorganic cell models, we can be almost sure that the effect was caused by physical and chemical conditions of the medium, but not by the form of donor blood cells. Considered pathology in clinical hematology is associated with the defects in the structure of membrane lipids. So it is possible to simulate the morphologic-structural features of acantho-cytosis by changing the membrane Eh and initiating the Fe-deficiency, using the copies of red blood cells from a healthy donor. Ill. 3c shows photomicrographs of inorganic echynocytes - the products of secondary effects on the initial inorganic structures, similar to those given in fig. 1.

The similar echynocyte shapes are observed when homozygous β-(Hb A2)-thalassemia. But, since echynocytosis is also characteristic of iron-deficiency anemias, it is possible to interpret the experiments with the degradation of the inorganic erythrocyte membranes as the induced Fe-deficiency. With the method proposed, it is possible to influence erythropoiesis of the copies of immature erythroblasts by changing the parameters of the medium (pH, dH, Eh, electrical conductivity and ion concentrations, etc). Fig. 4 presents profilograms of inorganic erythropoietic cells, taken in the proximal region. It is obvious that, unlike the erythrocyte, proerythroblast has a ripple profilogram in the central region, due to the presence of heterodispersed polymorphic granules.

The presence of polymorphic granules in organic proerythroblasts indicates the activity of acid phosphatase and a low degree of cell proliferation. Thus, the above principle in cytology can be applied for simulating the processes of metabolic and functional cell specialization.

a. Profilogram of inorganic erythrocyte

b. Profilogram of inorganic proerythroblast
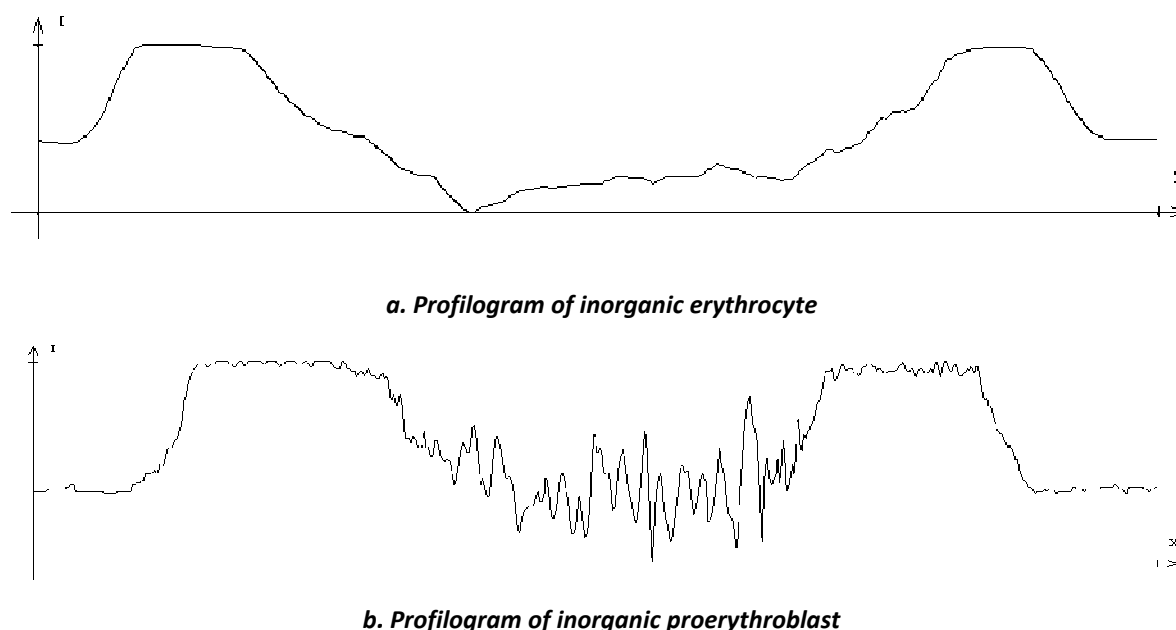
Figure 4.

CONCLUSIONS

Inorganic morpho-functional models of the blood cells were synthesized. The biomimetic structures obtained were found to generate oxygen, in particular, its active forms. The mechanisms of redox processes in inorganic erythrocyte models are rather different from the ones in their biological prototypes. Inorganic copies of the blood cells can be used in clinical hematology for the diagnosis of hemolytic anemia and other pathologies. Also it is possible to create a new type of inorganic blood substitutes based on them. Using the techniques of laser-optical assembly, it is possible to obtain morpho-functional copies of blood cells of every type, in order to create a system of interacting biomimetical structures – vaskuloid [13].

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FAMILY'S WELL-BEING LEVEL AND WOMEN'S HEALTH

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On the basis of complex examination of the women in labor and newborns in the town of Kurgan for the last 20 years it has been revealed, that the majority of values of anthropometric, physiological and psycho-physiological examination increase in case of family's well-being growth up to the level of 2-2.5 values of minimal basket of goods. Further growth of well-being did not influence the dynamics of values or showed the tendency to their decrease.

The negative effect of well-being worsening on children's growth and development, as well on population health status, has been observed [V.A. Shchurov et al., 2008]. It should be logically to put the question, how beneficially the exceeding of well-being prescribed bounds for the lower class influences the health status of women in labor and newborns. In connection with living level worsening the conception of minimal basket of goods has been introduced (**MBG**). The question arises, if the optimal size of basket of goods exists. Such statement of the question is in close connection with the solution of the most important problem concerning society stabilization by creation of its present-day structure, where the middle class preponderates, but not the lower one.

Middle class in the developed countries represents the main social group of populations (60-70%), including minor employers and high-paid hired workers, personal labour of which is a source of revenue. This class acts as a social stabilizer, inclined to support the state order existed, which has allowed to achieve their position [L. Grigori-yev et al., 2001]. In post-soviet Russia an overwhelming majority of people belongs to the lower social strata. Percentage of the population, ranked in the middle class, exceeds 10% a little. There is also a significant interlayer of «idealists», considering themselves among the middle class by their social-and-status orientation, which is not connected with the salary, proper for the middle class.

The base of the population differentiation in our country is a relation to **MBG** size, which changes from year to year, it is not the same in different regions, in different groups of population. The income below 0.5 **MBG** is poverty threshold, the income within the limits of **MBG** is determined as poverty level, families with the income up to 2 **MBG** – families of scanty means, with that of more 2-5 **MBG** – solvent families, with that 6-10-fold exceeding **MBG** – well-to-do families, and families with the income 100-fold exceeding **MBG** – wealthy families [N.D. Kremlev, 2007]. In 2006 the Kurgan region population with the income below 2 000 rubles amounted to 25%, below 4 000 rubles – 26.3%, below 7 000 rubles – 22.7%, and above 7 000 rubles – 30.9%.

The aim of the present study was to reveal the mean optimal level of Kurgan population incomes, which has the most favourable effect on the general condition and

health of adult population, as well as on the health of newborns, and which allows to speak of a regional middle class.

METHOD OF STUDY

The main anthropometric, functional measurements and the welfare status in the families of women in labor (annually – not less than 100 persons at the age of 20-30 years, giving birth in June of every year in MI The Kurgan Town Hospital No. 2) within the period of 1989-2009, has been analyzed, as well as the anthropometric and functional measurements of newborns. Moreover, in 2009 the data of laboratory blood tests and the results of psycho-physiological testing

quality of life have been analyzed using SF-36 questionnaire. The materials of study were analyzed statistically.

RESULTS OF STUDY AND THEIR DISCUSSION

It has been found, that the value of newborn functional maturity according to APGAR-1 scale, which amounted in Kurgan before 1990 to **7.84** ±0.07, by 1997 decreased to **7.21** ±0.10 (p≤0.001). In 2009 this value increased to **7.49** ±0.12. The dependence of the value on the income level of family members was analyzed on the basis of 2009 data (Fig. 1). The analysis has revealed inverse negative relationship between these values.

$$A_1 = -0,108x + 7,93$$
$$R^2 = 0,572$$
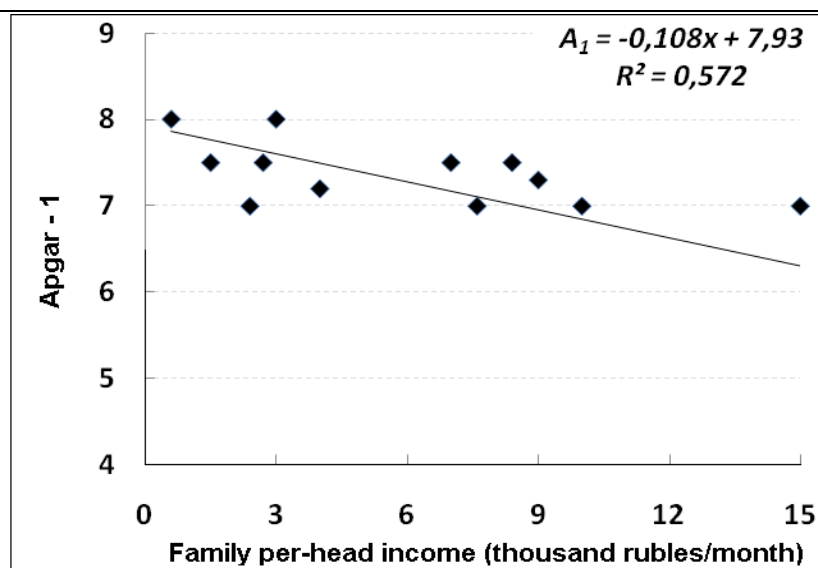
Figure 1. The dependence of the value of newborn functional maturity on the income level of women in labor families in 2009

Such a trend of the dynamics of newborn functional maturity value can be accounted for the known in biology principle of adaptation, according to which the periods of fetal maturation are shorter for more primitive individuals. Previously it was found that in girls, who were 5-9 years old in the

period of Patriotic War, puberty was accelerated subsequently [B.A. Nikitiuk, 1978]. In women, who are going in for sport professionally, newborns have higher Apgar-1 values. This acceleration of fetal maturation does not further lead to the achievement of

appropriate success in intellectual development [N.A. Abramovskikh et al., 2006].

Such conclusion was in part confirmed while analyzing the dynamics of Apgar-2 value. In children from families of scanty means the increment of Apgar-2 value after birth was slight. Nevertheless, the general regularity has been maintained: Apgar-2 value in newborns had a tendency towards decrease with income growth above the level of living wage (Fig. 2).
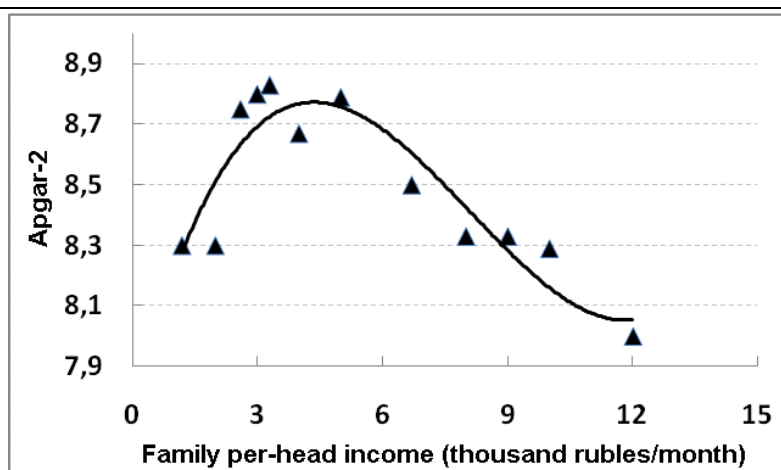
Figure 2. The dependence of Apgar-2 value on the income level of women in labor families

We have made the analysis of other values, which depend on the material well-being of women in labor. Body mass of women in labor has been to be the largest for the incomes, being at the level of minimal basket of goods. This phenomenon can be accounted for the compensatory increase of relatively cheaper products with more carbohydrate content (potatoes, flour and confectionery products) in their ration.

Women with the income at the level of minimal basket of goods (4.0÷0.5 thousand rubles per family member) had relatively smaller families in number and were subjected to induced abortion relatively more often (Table 1). The analysis of fetal palpitation rhythm revealed the higher level of the value in this group of women.

The value of somatic and gynecological diseases in number increased with the family income growth from 3 to 7 thousand rubles (Fig. 3). This value is not connected with the thoroughness of patients' examination, because the matter concerns the women in labor, undergone standard examination. The decrease of chronic disease frequency was observed with further increase of incomes. Hemoglobin level was the highest in women with the income of 6-9 thousand rubles (Fig. 4). Percentage of complete families was the greatest in this group as well.

$$y = 0{,}0008x^4 - 0{,}012x^3 - 0{,}038x^2 + 1x - 0{,}95$$
$$R^2 = 0{,}689$$
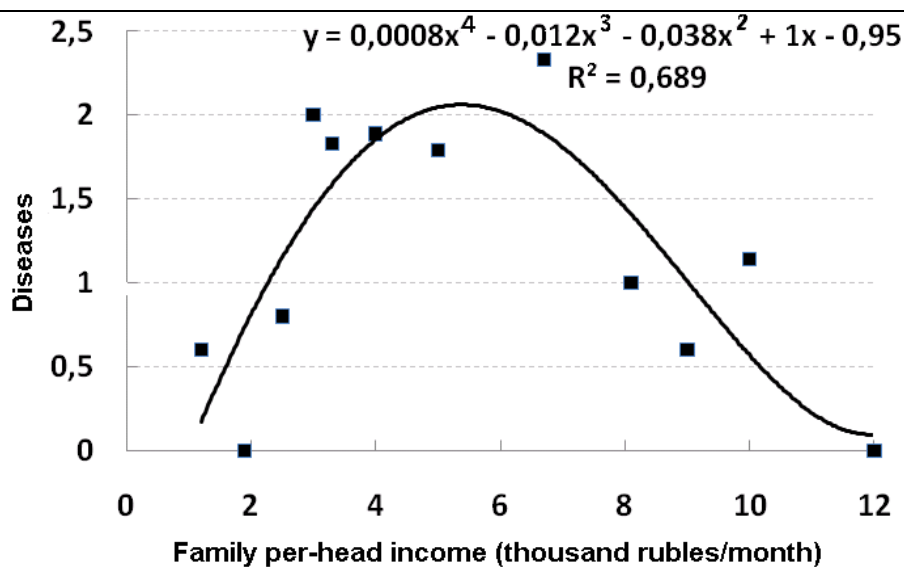
Figure 3. The dependence of diseases in number on the level of women's income

Table 1. Some values of women in labor with different levels of family members' income

Income level (thousand rubles)	Family (members in number)	Morbidity (chronic diseases in number)	Abortions (in number)	Human chorionic gonadotropin (HCG) (points)	Fetal palpitation (points)
1.9÷0.3	3.7 ÷0.4	2.0	0.8÷ 0.3	51 ÷5	8.1 ÷0.3
4.0 ÷0.5	3.0 ÷0.2	2.3	1.9 ÷0.6	51 ÷1	9.1 ÷0.3
7.4÷0.5	3.2 ÷0.1	2.5	1.0 ÷0.3	50 ÷4	8.6 ÷0.3
10.8÷0.8	2.6 ÷0.2	2.2	1.0 ÷0.2	41 ÷6	8.5 ÷0.3

$$y = -0{,}54x^2 + 7{,}65x + 94$$
$$R^2 = 0{,}663$$
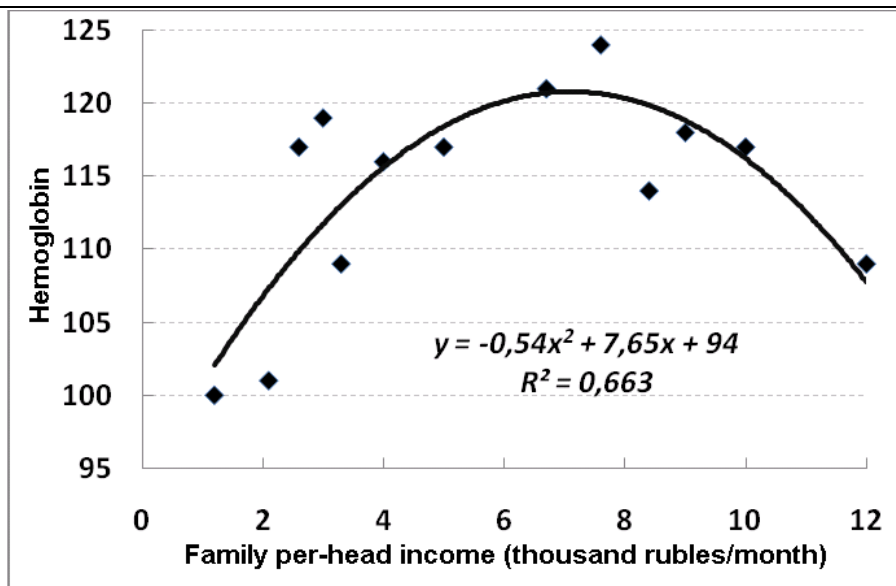
Figure 4. The dependence of mother's blood hemoglobin level on women in labor well-being

The number of complete families decreased steadily for the last 20 years:
$$C = -0{,}0065x + 13{,}789; \quad R^2 = 0{,}358.$$

The level of family well-being influenced this value not well enough, but the level of women's education had a significant positive effect. The level of education was the highest for the incomes of 6-8 thousand rubles.

The size of external conjugate in women amounted to **19.9** ±0.1 cm I n 1990. The general tendency towards anatomic value increase is connected with continuing acceleration process. However, by 1997 this size decreased to **19.4** ±0.14 cm (p≤0.01), and in 2009 only it reached **20.3** ±0.10 cm (p≤0.001). Conjugate values depended on family incomes. They increased with income growth to 4-6 thousand rubles and remained at a stable level for further increase of well-being value (Fig. 5).

$$K = -0,038x^2 + 0,66x + 18$$
$$R^2 = 0,577$$
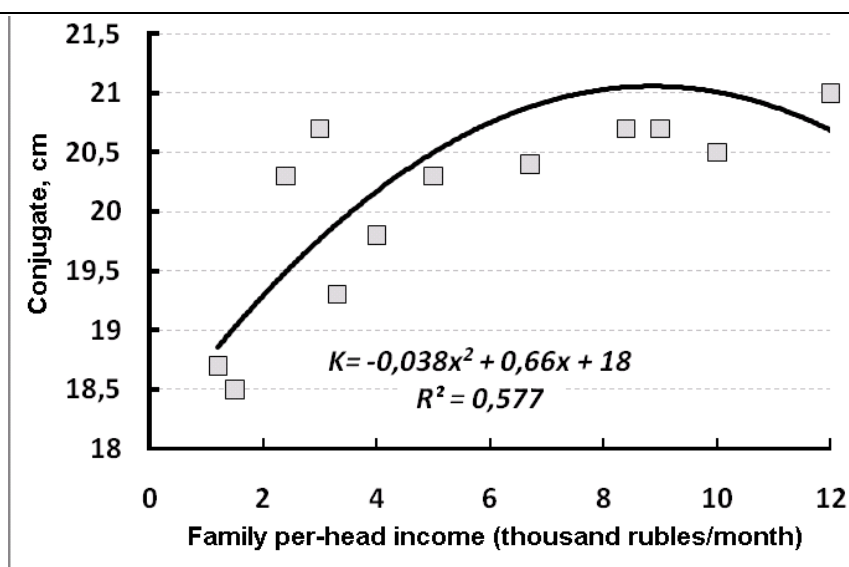
Figure 5. The relationship between external conjugate sizes and women in labor family incomes

The study of quality of life made in women in labor using SF-36 test has revealed that the total value increases rapidly with well-being growth up to the level of 8 thousand rubles per month, and it keeps at this level for further increase of incomes (Fig. 6).

According to Arndt-Schulz law, formulated in the 80s of XIV century, one and the same stimulus is able to have a different effect depending on dosage: weak stimuli excite vital processes, moderate ones increase them, and strong and very strong ones – suppress them. For example, it is known, that quite a number of environmental factors, causing organism growth inhibition, can have a stimulating effect on the organism in case of little degrees of influence [I.A. Arshavsky, 1963; P.G. Svetlov, 1978; F. Imms, 1967; D. Nash, 1968]. Material satisfaction of the most important living needs, in particular those for food, can be considered from the points of view of force relation law, from which it follows that the optimal level of consumption not at all conforms to that maximally possible.
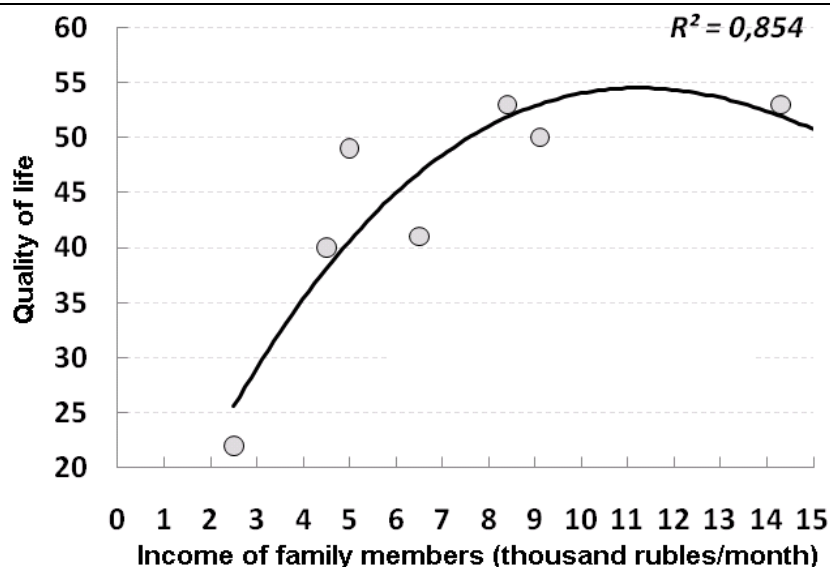
Figure 6. The dependence of the integral value of patients' quality of life on the level of family incomes

It should be mentioned, that it's impossible to define the level of optimal family incomes exactly by any parameter alone. The other thing is important: if unconditional minimum income exists, below which population's quality of life becomes worse, there is a not so clearly designated corridor of well-being optimal values (7-10 thousand rubles per head), by which people may be related to the middle class, because in case of its excess some values have a tendency towards decrease. This optimal level of incomes is a reason to single out a middle class, which by its quantitative criteria is not comparative with the middle class of not only Western Europe countries, but with that of our capital centers. However, such singling out is justified, because it allows to remove an unreal infinity sign from the aim to achieve successful living standards.

This problem may be of practical importance as well. The experience of Western Europe countries in low birth rate stimulation by further improvement of families' well-being level had no effect. Our observations have demonstrated that in families with low incomes the stimulation of generative activity occurs with well-being growth, and the rise of the number of abortions, but not labors, is a consequence of this stimulation. In the 50-th years of the past century the birth rate in the Kurgan region reached 45 per 1000 of population, in 1990 it decreased to 9 children. To find a way with the purpose of returning this value at least up to 1983 level (23 per 1000 of population) – this is the most important task of modern society.

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THEORETICAL AND APPLIED IMPLICATIONS OF DUAL INTERLEUKIN-2 NATURE: SINGLE LOCAL APPLICATION IN A MOUSE BREAST CANCER MODEL

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Immunotherapy is currently emerging mode of breast cancer therapy as efficacy of traditional therapies seems to reach plateau nowadays. First transplanted generation from non-SPF spontaneous BLRB mammary adeno-carcinoma (MAC) were used as appropriate mouse model to examine whether a single local interleukin-2 (IL-2) treatment is efficient against mammary cancer. We showed that survival dynamics of syngeneic recipients with early emerging transplanted mammary cancer (short subclinical period) could be significantly improved by a single IL-2 treatment (2.5×10^6 IU per mouse) applied locally two weeks after MAC cell inoculation. However, the same IL-2 therapy mode applied to later emerging tumors (long subclinical period) of the same average size of 5 mm as late as eighth week after tumor cell inoculation notably shortened the survival of tumor-bearing mice.

Finally, both the fundamental significance and applied implications of biphasic IL-2 effect on mammary cancer growth was shown and discussed.

Keywords: breast cancer, mouse model, prognostic factors, immunotherapy, interleukin-2, roncoleukin

Abbreviations: BC, breast cancer, in women; MC, mammary cancer, in mice; MAC, mammary adenocarcinoma; interleukin-2, IL-2.

INTRODUCTION

Numerous studies presented evidence that breast cancer (BC) patients exhibit T - cell mediated functional immunosuppression, which progresses during tumor growth, so that even the early localized disease shows distinct defects [1]. And high-grade generalized immune dysfunction in advanced disease is characteristic for either tumor-bearing mice [2] or BC patients [3, 4]. Moreover, BC adjuvant therapy (chemotherapy, radiotherapy, or their combination) significantly delayed immune restoration in numerous immune parameters, but especially in interleukin-2 (IL-2) level recovery [5]. Local IL-2 deficiency was demonstrated within breast carcinoma [6]; and IL-2 augmented tumoricidal function of each leukocyte population within tumor infiltrated leukocytes [7]. Thus, wide broad evidence was accumulated more than three decades ago for the *in vivo* IL-2 therapeutic administration to BC patients. Data obtained in experimental research provided rationale to apply IL-2 locally [8].

IL-2 belongs to mediators that are produced by T cells and exert multiple, pleiotropic effects in an autocrine or paracrine fashion [9]. Specific activities of IL-2 as a member of γC cytokine family are nowadays well documented in both natural and therapeutic settings [10]. The stimulation of a tumour-specific T-cell response has several theoretical advantages over other forms of cancer treatment. Namely, T cells can home to antigen-expressing tumor deposits and continue to proliferate in response to immunogenic proteins expressed on cancer

cells until all the tumour cells are eradicated. Moreover, immunological memory can be generated, allowing for eradication of antigen-bearing tumors if they reoccur [11].

The IL-2 therapy alone and/or in combinations with other immunotherapeutical modalities is currently a distinct immunotherapy mode in BC clinic (discussed in [11, 12]) while it's therapeutic potential is still not clear both in mice [13] and human patients [14]. However, clear therapeutic benefit has been achieved in limited cohorts of patients [3, 15]. Indeed, from either theoretical point of view (due to dual nature of this cytokine) or applied implementations (numerous lessons from animal research) one may expect differing IL-2 effects on tumor growth parameters as IL-2 plays quite opposite roles for the T-effector and T-regulatory arms of the immune system (discussed in [16, 17]).

Using IL-2 to enhance T-cell immunity one should keep in mind crucial importance of application time during immune response *in vitro*. At the time of initial T-cell activation IL-2 increased the size of the CD8+ memory pool but reduced the parameter if present during memory maintenance by inhibiting the proliferation of CD8+ memory cells. Thus, IL-2-based immunotherapeutical strategies should take into account the divergent roles of IL-2 in CD8+ T cell immunity [18].

As early as 1969, T-cell mediated local IL-2 therapy was shown to be sensitive to the start and duration time of IL-2 administration in several animal tumor models *in vivo* [19]. Timing of IL-2 administration and T-cell differentiation status were investigated in details in EL-4 tymoma mouse

model [20]. Administration of IL-2 during the initial phase of the response, clonal expansion, and development of effector function, had no effect on the number of cytotoxic T-lymphocytes (CTL) generated or the control of tumor growth. In contrast, a short 2-day time course of low-dose IL-2 at the peak of clonal expansion or at later times resulted in prolonged and expanded responses by the CTL, with concomitant decrease in tumor load and extension of survival. However, when IL-2 administration was more prolonged, as is often the case in clinical trials, the therapeutic benefit was lost due to elimination of the tumor-specific CTL, at least in part through induction of apoptosis [20].

Previously we have shown that on average anti-cancer IL-2 effect may be hardly seen in several transplantable mouse models of BC when tumor growth and survival parameters are estimated for the whole treated and control groups [21]. We showed that distinct therapeutic effect for the whole IL-2 treated group might be hidden as both benefit and non-benefit subgroups exist within treated tumor-bearing mice. Therefore, to reveal masked IL-2 potency tumor parameters should be analyzed separately for short and long survivor, for instance. Using similar subgrouping approach, retrospective research of Characiejus et al. demonstrated that immunotherapy by interferon increased overall survival only in the subgroup of renal cell carcinoma patients who had shorter survival potency, whereas for patients with longer survival potency immunotherapy obviously tended to shorten the survival [22].

Keeping in mind the theoretical importance of timing schedule in the IL-2 immunotherapy protocol and going back to applied implementation of this point in a given mouse model we question whether the time of IL-2 application itself or the initial size of an individual tumor at the therapy start is of a particular value to predict recipient outcome. To address this query specifically we develop mouse model of BC in BLRB males with the first transplantation generation from spontaneous female mammary adenocarcinoma (MAC). We applied IL-2 locally only ones for the tumors of 5 mm in size 2 weeks post transplantation (*p.t.*) for the first subgroup of mice with early emerging MAC (short subclinical period, sub[short]), and 7 weeks *p.t.* for the second subgroup with lately emerging MAC (long subclinical period, sub[long]).

MATERIALS AND METHODS

Mice

We used mice of our inbred strain BLRB- Rb(8.17)1Iem (thereafter called BLRB) with high incidence of naturally arisen mammary adenocarcinoma (MAC) [13]. Animals were maintained in non-SPF thoroughly controlled conditions.

Experimental design

Twenty-six relatively old BLRB males (~12 months of age) were used for MAC cell inoculation to mimic cancer appearing in elderly. Tumor cells were taken from two naturally arisen fast and slowly growing syngeneic female MACs. At day 0, 10^7 cells from this suspension were injected in male mice subcutaneously near right fad pads. At day 14 seven males with early emerging sub[short] tumors of about 5 mm in diameter were treated peritumorally with 2.5×10^6 U Chiron IL-2 suspended in 0.5 ml containing 0.9% NaCl and 0.1% Bovine Serum Albumin (BSA). Six control mice with tumors of the similar size were injected in the same manner with 0.5 ml 0.9% NaCl/0.1% BSA (vehicle) at the same time. Six males with late emerging sub[long] tumors of about 5 mm in diameter were treated by IL-2 in the same manner at day 51; seven control males with the tumors of the same size received vehicle. Mice were inspected each day for survival and health monitoring. The mean tumor diameter was measured once a week as described in [13].

Statistical Analysis

The Mann-Whitney non-parametric U-test was used to compare tumor growth kinetics and survival dynamics.

RESULTS

No differences in average tumor diameter were found after a single IL-2 application at day 14 *p.t.* to sub[short] MACs versus controls. However, the IL-2 treated males survived significantly longer (p<0.05, fig. 1, white figures).

No differences in average tumor diameter were seen after IL-2 application at day 51 *p.t.* to sub[long] MACs versus controls; while IL-2 treated males survived shorter than the controls. The survival dynamics differed significantly from day 35 until day 135 (p<0.05, fig.1, black figures).
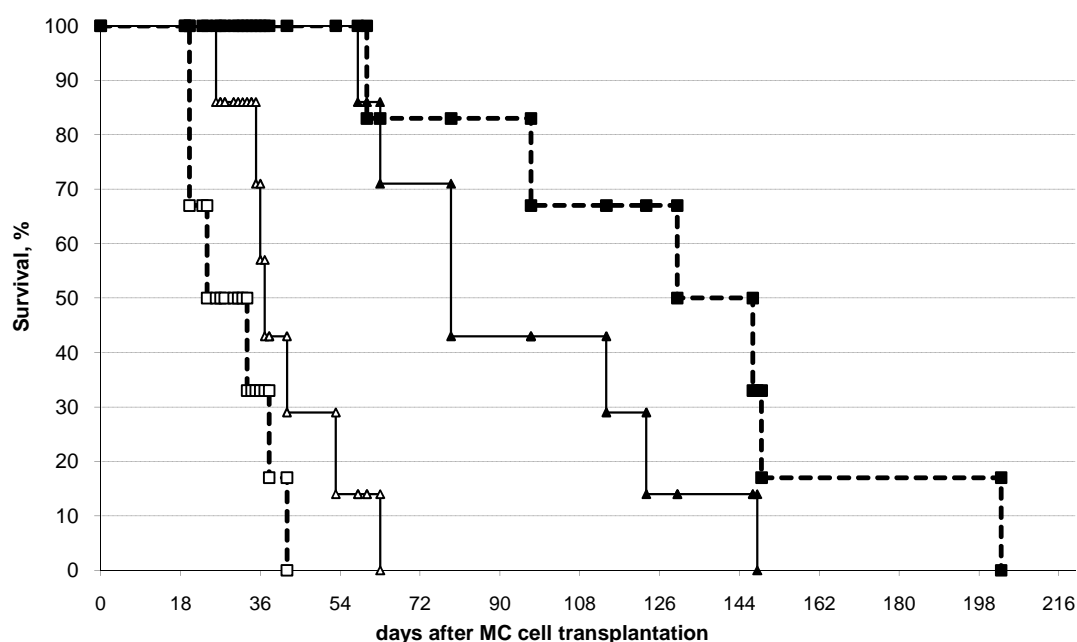
Figure 1. Survival dynamics of IL-2 treated (triangles) and control (cubes, dotted lines) mice with early (white figures) and late (black figures) emerging mammary adenocarcinomas (MAC). Early emerging MACs with short subclinical period (sub^{short}, white triangles) were treated with a single peritumoral IL-2 injection at day 14. Late emerging MACs with long subclinical period (sub^{long}, black triangles) were treated at day 51 after tumor cell inoculation. Controls with sub^{short} tumors (white cubes) and sub^{long} tumors (black cubes) were treated with a vehicle at the same time as corresponding IL-2 treated mice.

DISCUSSION

Early and late emerging transplanted mouse MACs were demonstrated in recipient mice suggesting distinct similarity to human BC where both aggressive and indolent forms occur [23]. Obtained data showed that single peritumoral IL-2 application against early emerging mouse MAC near the second week *p.t.* resulted in significant survival improvement in the BLRB mouse model, similarly to previously published data in A/Sn and BALB/c transplantable MC with the long transplantation history [21]. However, mice that acquired tumors of the same initial size considerably later and were treated at 8th week *p.t.* survived shorter than controls.

These data show clearly that in the model used duration of subclinical period was of particular importance rather then the initial tumor size. This seems to be in discordance with [24], where the benefit of serial intratumoral IL-2 therapy depended on initial low tumor burden and failed in large mesotheliomas. However, tumor burden is a function of *post transplantation* time. Thus, similarly to our research, in [24] anti-cancer IL-2 therapy also failed being applied too late.

Kiessling et al. revealed different effects of fast and slowly growing transplanted murine cancer on the host immune system causing local versus generalized tumor-associated immune suppression, respec-

tively [2]. From this point of view IL-2 immunotherapy might fail in mice bearing late emerging, slowly growing MACs, at least partly due to generalized tumor-associated immunodeficiency.

Furthermore, recently published data support IL-2 essential role in immune tolerance rather than early paradigm in which IL-2 was a central for protective immune system [16]. From one side, based on the IL-2 effect on T-effector arm both IL-2 and it's Russian analog roncoleukin are currently used to augment anticancer response, i.e. boost autoimmune reaction against autologous tumor [25]. Based on the IL-2 effect on T-regulator arm both pharmaceutical forms of cytokine are used to down regulate response in autoimmune patients [17]. Therefore, not only some parts of these newly published data remain controversial, but even cytokine itself paradoxically proposed to augment and suppress generally the same process, i.e. immune response to self-antigens.

We assume that these two sides of the IL-2 effect can be distinguished *in vivo* in tumor-bearing host by means of different application time of cytokine. Probably, during early time (~2weeks *p.t.*) IL-2 application may contribute to protected T-effector arm immunity causing survival benefit. However, being applied too late (~7week *p.t.*) IL-2 may actively supply another arms of it's activity, namely apoptosis of T-effectors and development of memory T-cells and/or T-regulators (Treg), which were shown to suppress effector reactions [16, 17].

Developing subgrouping approach, we disclosed promising anti-cancer potential of a single IL-2 treatment in various types of transplanted BC after therapy efficacy estimation in early and late emerging MAC subsets separately [21]. Survival improvement was found only for recipients bearing tumors with short subclinical periods; whereas survival of animals bearing MACs with long subclinical periods was shortened.

These findings from mouse models of BC may be translated to clinic. Although initial tumor size at BC diagnosis is one of the most used among other prognostic factors in clinic [23] to predict patient's outcome [26]; it may be essential but not sufficient to forecast benefit of the IL-2 immunotherapy. Duration of subclinical period may be of significant independent importance; although this parameter value in BC clinic is hardly estimated as most tumors are several years old at initial presentation [27].

CONCLUSIONS

Taken together, obtained data (1) demonstrate both benefit and non-benefit effects of IL-2 therapy on recipient survival in mouse model of BC used and (2) compel to search for prognostic factors that may predict the therapeutic effect of IL-2 therapy. These findings may facilitate to develop basic principles of a selection procedure for BC patients who may benefit from local IL-2 therapy as was proposed by Kedar and Klein almost three decades ago [28].

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SEVERAL BLOOD PARAMETERS IN INTACT MICE CONNECTED WITH THEIR LONG SURVIVAL AFTER MAMMARY CANCER TRANSPLANTATION AND INTERLEUKIN-2 TREATMENT

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Earlier, we demonstrated the prognostic value of some routine laboratory parameters to determine early or late visible mammary carcinoma manifestation and interleukin-2 (IL-2) efficacy in mouse recipients with only early emerging transplanted mammary cancer. Therefore, 17 hematological parameters were prospectively measured in intact BLRB males before mammary carcinoma inoculation and IL-2 application. Five hematological parameters pointed to anemia and leucopenia *prior* to mammary carcinoma inoculation predicted short survival of tumor-bearing mice treated twice with 2×10^5 ME of IL-2 at days 13 and 22 *post tumor transplantation*. However, in non-treated controls these blood parameter values did not differ among short and long survivors. These results demonstrated that initial poor physical condition of mice before mammary cancer transplantation can limit the efficacy of immunotherapy applied to tumor bearing mice with early mammary carcinoma manifestation.

Keywords: breast cancer, mouse model, prognostic factors, immunotherapy, interleukin-2

INTRODUCTION

The therapeutic potential of interleukin (IL-2) to cure breast cancer (BC) is still not clear both in mice [1] and human patients [2] although distinct therapeutic benefit has been achieved in limited cohorts of patients [3]. We hypothesized that a therapeutic IL-2 potential might be revealed when evaluated for short and long survivors separately, as both benefit and non-benefit subgroups exist in IL-2 treated mice with transplanted mammary carcinoma (MC) [4]. Earlier we have shown promising anti-cancer potential of a single IL-2 treatment in various transplanted MC models for the only recipients with early emerging MC [4, 5]. Moreover, we have found prognostic factors among 30 laboratory hematological and biochemical parameters that predicted early manifestation of transplanted MC [6].

The aim of this paper was to (1) to measure 17 routine hematological parameters in intact males before mammary cancer transplantation, (2) to apply low dose IL-2 therapy twice only to recipients with early appearing tumors, and (3) to disclose differences in initial hematological parameters for short and long control and treated survivors.

MATERIALS AND METHODS

Mice

Mice of BLRB- Rb(8.17)1Iem (BLRB) strain with high incidence of naturally arisen mammary carcinoma (MC) were maintained in non-SPF thoroughly controlled conditions at Mouse Breeding Facility at the Department of biotechnology, Institute of Bioorganic Chemistry, RAS, Moscow [1]. Mice were fed according Institutional guidance and author's supplementation and got water

ad libitum. Each mouse had individual mark and was followed through the whole lifespan as a veterinary patient.

Blood sampling

At day 0 blood samples (0.3-0.5 ml *per* male) were collected from the retroorbital vein sinus of intact BLRB males under ether narcosis (n=64) two weeks before MC cell inoculation.

The individual values of the following seventeen hematological parameters were measured using the hematological analyzer "MICROS OT 18" (Roche, Switzerland): RBC - red blood cell count, 10^{12}/L; HCT- hematocrite, %; HGB - hemoglobin, g/L; MCV - mean corpuscular volume, fl; MCH - mean corpuscular hemoglobin, pg; MCHC – mean corpuscular hemoglobin concentration, g/L; RDW - red blood cells distribution width, %; PLT – platelet count, 10^9/L; PCT - thrombocrite, %; MPV – median platelet volume, fl; PDW – platelets distribution width, %; WBC - white blood cell count, 10^9/L; LY - lymphocytes, %; MO - monocytes, %; EO – eosinophils, %; SN- segmented neutrophils, %; BN - band neutrophils, %. Leukocytes were distinguished by routine microscopic methods.

Experimental design

At day 14 after blood sample collection, 10^7 mammary carcinoma cells from a syngeneic BLRB spontaneous mammary carcinoma were transplanted s.c. into right fat pads near the axillaries of 64 BLRB males according to [6]. At day 13 after MC inoculation 13 males aged 12.1±0.7 months (weight 26.5±0.5g) with early emerging MCs of 5.8±0.3 mm in size were selected. Eight males with tumors of 6.3±0.5 mm in mean diameter were treated at day 13 and day 22

by peritumoral injection of 2.5 x 10^5 U Chiron IL-2 (thereafter called low dose) suspended in 0.5 ml containing 0.9% NaCl and 0.1% Bovine Serum Albumin (BSA). Control mice (n=11) with tumors of 5.4±0.4 mm in mean diameter were injected in the same manner with 0.5 ml 0.9% NaCl/0.1% BSA. Mice were inspected each day for survival and health monitoring, and once a week for tumor size measurement. Tumor growth rate parameters, namely, mean tumor diameter (TD) and relative tumor diameter (RTD) as a measure of tumor growth increase in relation to its initial size before the therapy start were calculated according to [5]. The significance of differences in averages was determined by the parametric Student's t-test. Results are presented as means ± SEM.

RESULTS

1. Therapeutic effect of two low peritumoral IL-2 doses (Figure 1)

Therapeutic efficacy of two low IL-2 doses was tested in the only males with early emerging MCs. Eight males were treated twice with a peritumoral IL-2 treatment (2.5x10^5 IU per mouse per injection) at days 13 and 22 after MC cell inoculation; eleven non-IL-2 treated males constituted the control group. The average tumor diameter dynamics in control and treated groups did not differ significantly (data not shown). However, the relative tumor diameter (RTD) was significantly smaller in the IL-2 treated group (Figure 1A, p<0.05) showing that used therapy modality caused on average inhibition of tumor growth in treated group. The survival of the whole IL-2 treated group was improved only slightly compared

with the survival of controls. However, 100% of the treated animals were alive at day 40 *post tumor transplantation (ptt) versus* only 73% in control group (Figure 1B). The survival curves for both the IL-2 treated and control mice showed two distinct periods, namely before and after day 41 *ptt*. This was the reason for further search of blood parameters that can predict short term (death within 41 *ptt*) and long term (death after day 41) survival in treated and control mice.

Relative Tumor Diameter, mm

Days after mammary carcinoma transplantation

A

Survival, %

Days after mammary carcinoma transplantation

B
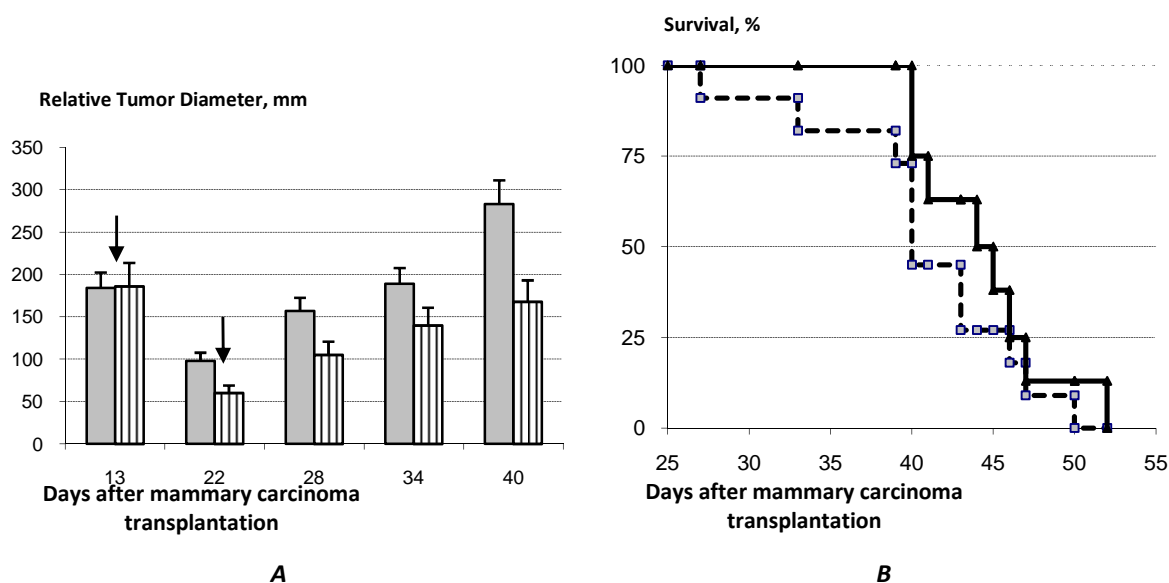
Figure 1. Relative tumor diameter and survival of the whole IL-2 treated and control groups. Two peritumoral 2.5x10^{5} IL-2 treatments (arrows) were applied to early emerging mammary carcinomas at day 13 and day 22 post tumor transplantation. Average relative tumor diameter (RTD, A) and survival (B) for the whole control (grey columns and cubes, respectively) and IL-2 treated (striped columns and triangles, respectively) groups.

2. Tumor growth in short and long survivors (Figure 2)

The average survival time for short survivors in control and IL-2 treated groups did not differ significantly (37±2 and 40±0.3 days, respectively). However, short survivors comprised only 3/8=37% of IL-2 treated group *versus* 6/11=54% of the control group. Two locoregional injections of IL-2 (2x10^{5} IU per mouse per application) at days 13 and 22 resulted in significant tumor diameter increase (Figure 2A, day 34 *ptt*, p<0.05).

The average survival time **for long survivors** in control and treated groups was similar, namely 46±1 and 47±1 days, respectively. However, the proportion of long survivors in IL-2 treated group was higher than in the control one (63% versus 46%, respectively). For these long survivors the same IL-2 therapy mode resulted in a significant tumor growth delay (Figure 2B, day 40 *ptt*, p<0.05).
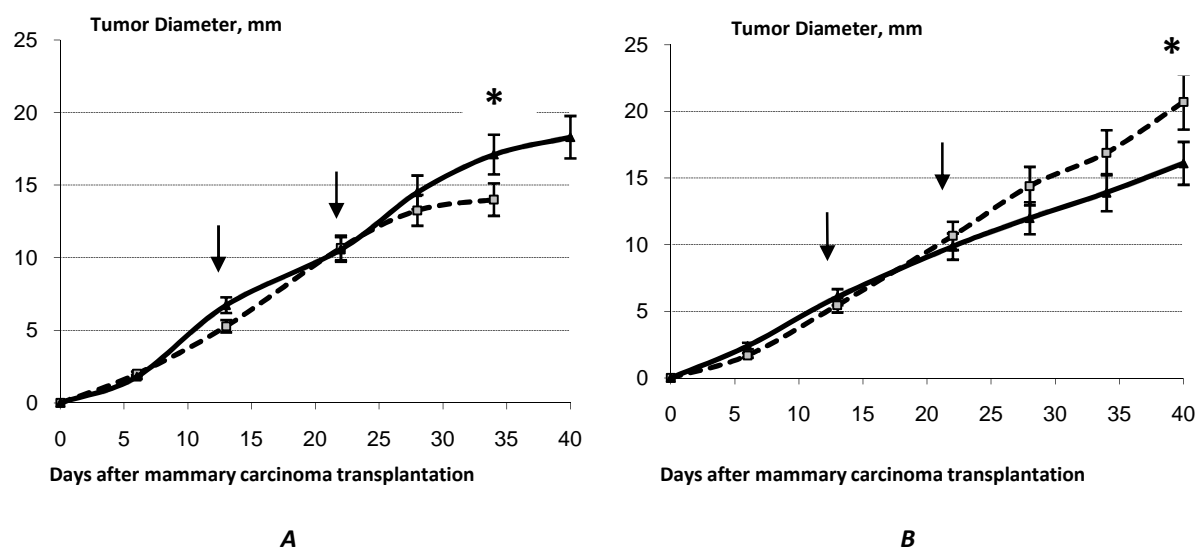
*Figure 2. Average tumor diameter in control (cubes) and treated (triangles) males for short (A) and long (B) survivors after two IL-2 applications (arrows); *- p<0.05*

No differences were observed in the average age and blood sampling for short and long survivors. Lung, spleen, and kidney weight tended to be elevated in long survivors compared with short survivors, and in IL-2 treated mice compared with controls (data not shown). Only liver weight was significantly increased in the IL-2 treated long survivors (1450±103 mg) compared with control long survivors (1110±106 mg, p<0.05). Then we compared hematological parameters within short and long survival subgroups measured in all mice prospectively before mammary carcinoma transplantation in an attempt to predict short or long survival of tumor-bearing mice after IL-2 treatment.

Prognostic factors among 17 hematological parameters measured in intact males before MC inoculation

As anticipated, there were no statistically significant differences in 17 hematological parameter values measured in control and IL-2-treated males prospectively be-fore MC inoculation and IL-2 treatment (data not shown). Moreover, there were no statistically significant differences in average hematological parameter values measured in control short and control long survivors (including Figure 3 A-E, grey columns). However, surprisingly 5 hematological parameter values (SN, Ly, RBC, HGB, and HST) differed significantly for short and long survivors within IL-2 treated group (Figure 3A-E, stripped columns). Both control and IL-2-treated short survivors exhibited noticeably higher leukocytosis than long survivors of both subgroups (data not shown). However, the proportion of segmented neutrophils was in average significantly elevated in IL-2 treated short survivors comparing with treated long survivors (Figure 3A, left and right stripped columns, respectively, p<0.05) being at the similar average level in both short and long control survivors. Furthermore, the proportion of lymphocytes was on average significantly decreased in blood of IL-2 treated short survivors compared with

the proportion in treated long survivors (Figure 3B, left and right stripped columns, respectively, p<0.01) being at the similar average level in both short and long control survivors. The average amount of RBC in blood of IL-2 treated short survivors was diminished comparing with the level of RBC in blood of treated long survivors (Figure 3C, left and right stripped columns, respectively,

p<0.05) being at the similar average level in both short and long control survivors. Average HGB and HCT levels were diminished in males that survived shortly after MC inoculation and two IL-2 applications (Figure 3D and 3E, p<0.05 and p<0.01, respectively) although control short survivors demonstrated the similar tendency.

Figure 3. Hematological parameters for control (grey columns) and IL-2 treated (striped columns) short (left) and long (right) survivors. Significant differences in the parameter values were observed only between short and long treated survivors
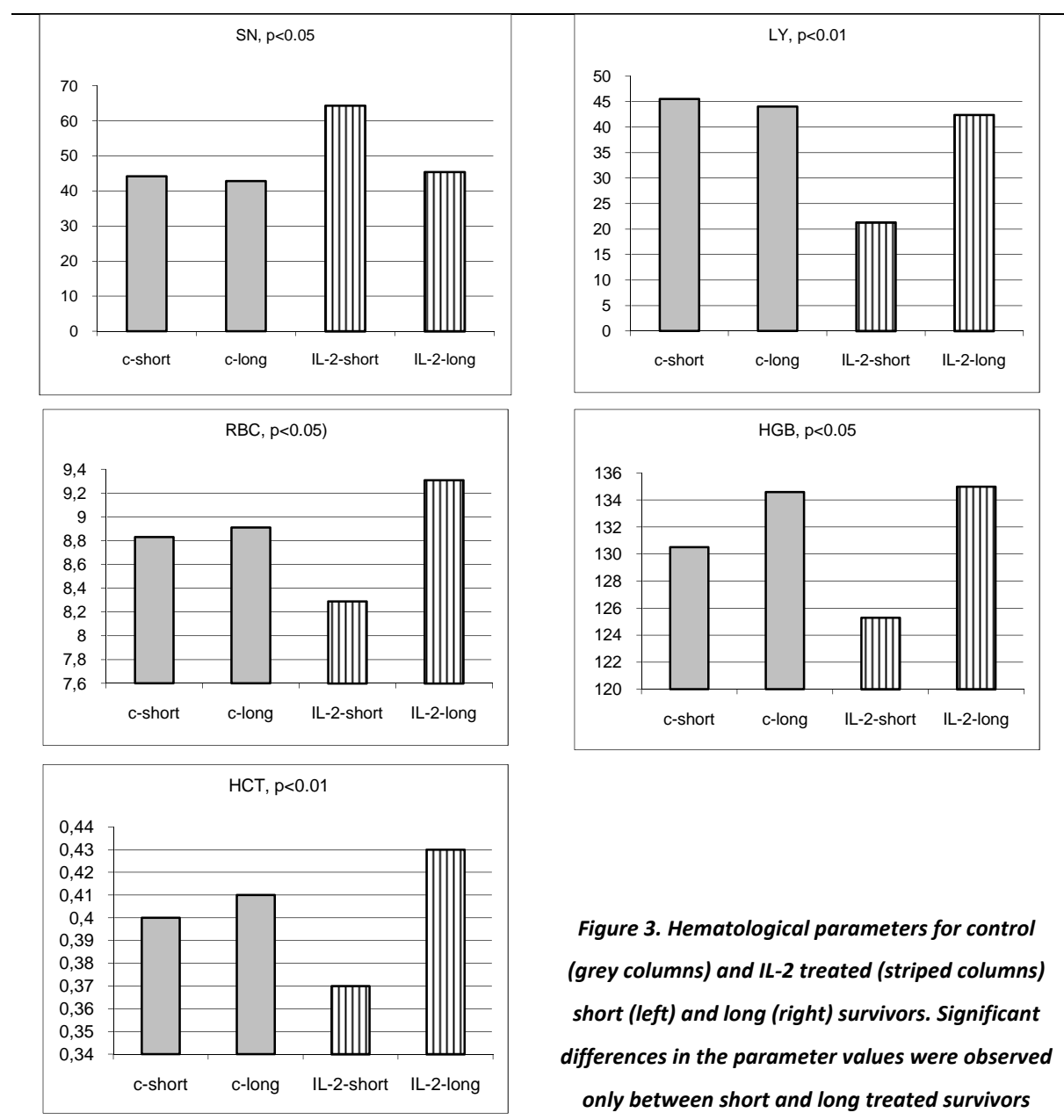
These data pointed to the frequent chronic inflammation, anemia and leucopenia in the IL-2-treated short survivors; whereas non-treated short survivors did not exhibit these disorders significantly more often than control long survivors.

DISCUSSION

Early and late emerging transplanted mouse tumors are always found in recipient mice receiving mammary carcinoma cells from the same donor tumor [5-7]. Previously, we found that (1) some routine blood and serum biochemical parameters do predict early tumor manifestation and (2) only recipients bearing early appeared mammary carcinomas survived better after a single peritumoral IL-2 application two weeks *ptt*. Therefore, we were interested whether some blood parameters measured prospectively in intact mice can predict IL-2 therapy efficacy in a mouse model of breast cancer? To this end, 17 routine clinical hematological parameters were measured in 64 intact BLRB males 2 weeks before MC inoculation. Two weeks after tumor cell inoculation an early emerging tumor subgroup (19 males) was distinguished. Eight males were treated with IL-2, whereas 11 males bearing tumors of the same average size of about 5mm appearing at the same time constituted the control group. No significant differences in both tumor growth rate and survival were found in the IL-2-treated males compared with controls.

Analyzing individual data we proposed that only for distinct recipients IL-2 therapy was beneficial, being non-beneficial for the rest. Therefore, short and long survivors were distinguished in both control and IL-2-treated groups using the same criterion, namely death before and after day 41 *ptt*, respectively. We looked for a possible connection between blood laboratory parameters measured in naive mice and further long or short survival time of tumor-bearing males with or without IL-2 therapy. As anticipated, we found no differences in average initial laboratory parameter values between IL-2-treated and non-treated groups. Moreover, there were no significant differences in all hematological parameter values between short and long survivors in control groups. Surprisingly, we do found significant differences in 5 hematological parameter levels among short and long survivors of the IL-2 treated group.

This analysis shows that a few males with leucopenia and anemia before mammary carcinoma transplantation survived significantly shorter after tumor cell inoculation and IL-2 therapy than healthy animals from treated group. Opposing to the inclined fall of poor condition mice to the short survivor treated subgroup, in non-treated group recipients with poor physical conditions dispersed accidentally to short or long survivors. This interpretation shows that weak physical condition of murine mammary carcinoma recipients might serve as a limitation of IL-2 therapeutical efficacy (at least, for the application mode used). These data are in agreement with the recommendation of Kedar and Klein to select only human cancer patients with good physical condition for immunotherapeutical regimens (e.g., with a Karnofsky performance status of more than 70%) as patients with severe leucopenia, cardiovascular, respiratory, renal or liver

disorders should not receive certain types of treatment [8].

Interestingly, in the untreated group the probability to survive shorter or longer after MC inoculation seems to be more or less similar for males with and without hematological disorders as all prognostic parameter values had the similar average level (SN, LY, RBC) or were only slightly different (HGB, HST)) in control-short and control-long survivors.

CONCLUSIONS

Taken together, these data (1) demonstrated that both benefit (long survivors) and non-benefit (short survivors) murine mammary carcinoma recipients exist after two low dose peritumoral IL-2 applications and (2) demonstrated prognostic value of five hematological parameters to predict the advantage of IL-2 therapy mode used.

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MORPHOLOGICAL INSIGHT INTO NEW OPPORTUNITIES USING BCL-2 AND P53 IN STUDIES OF NEUROTROPHICITY, NEUROPROTECTION AND NEUROPLASTICITY IN BRAIN ISCHEMIA

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Modern medicine is based on essential diagnosis of disease by clinical symptoms. At same time, neuroprotective measures must be started before the appearance of clinical findings, as neuronal death should be terminated in earlier stages of its development. Revealing preclinical and earlier markers by histochemical interactions of Monoclonal Mouse Bcl-2 and P53, which affect ischemic accidents in the Central Nervous System (CNS), at least partially resolves this problem. In our research, we use dynamic analyses of two comparative groups to reveal that protective mechanisms of the CNS are activated and have significant effects on the interaction of natural, pharmacologically-activated actions. They are plexiformed, and together lead to effective complex processes, such as the conservation and reorganisation of nervous tissue.

Keywords: neurotrophicity, neuroprotection, neuroplasticity, Monocloneal Mouse Bcl-2 and P53, brain ischemia, emoxipinum

INTRODUCTION

Neurotrophicity, neuroprotection and neuroplasticity, along with their connection to morphologic and regenerative processes, play a central role in the structural adaptations of organisms to external influences and compensations that adjust for affected functions.

Results in the last decade have lead to a complete restructuring and reorganisation of the current field and to a changed conception of nervous system function [6].

It is crucial to investigate the biochemical and morphological actions by researching the fundamental and biological process of the nervous system that cause cellular death and are the main targets of therapeutic control.

Neurotrophicity, neuroprotection, and neuroplasticity have no clearly expressed limits. They overlap and mix with each other. Each of them has two aspects: absolute and relative. The absolute side corresponds to mechanisms that cause activation of DNA and result in reparative protein synthesis. The relative side predominantly represents the activation of processes in membranes, the cytosol and cytoplasmic organelles that block cellular death and can induce the appearance of reparative molecules. Absolute mechanisms are predominately controlled by neurotropic factors and by the neurotropic-like molecules. Relative mechanisms are connected with ion channels blockers, agonists, and antagonists of certain receptors by free radical scavengers and metal chelators [5, 6].

Pathologic mechanisms drive different etiological factors or biological instances; therefore, many neurological disorders with different evolutions (acute or chronic) are degenerative. In spite of etiological factors that are not considered homogenous, the processes leading to the disturbance and death are coincident. The aim of neuropro-

tective treatments consists of blocking these pathogenic processes.

In recent years, no protein has been studied as intensively as P53. Over the last quarter century, it has been the subject of roughly forty thousand scientific research papers, and that number continuing to steadily rise [1]. The protein P53 is not necessary for normal cell differentiation or formation of an organism: the phenotype of nascent mice devoid of the P53 gene differs in no way from normal. Its biological function consists of providing stability of the genome and genetic homogeneity of cells in the whole organism. Therefore, the P53 gene is frequently characterised as the "genome's guard", "angel-saver", or "gene of cell's conscience", and mutant genes as "fallen angels" [1, 5, 6].

It has been revealed that disturbances of DNA enable accumulation of P53, which, in turn, blocks progression of the cellular cycle in G1 phase, thereby opposing damage. If reparation of damage is impossible, P53 drives the mechanisms of apoptosis. It is now established that the role of disturbances of the P53 gene in development play a role in not only oncological, but also cardiovascular, neurodegenerative, and metabolic diseases. It is argued that the participation of P53 in the development of autoimmune pathology (Oren M., 2003) would be reflected in the associated processes in the CNS. All of these protective mechanisms could be naturally or pharmacologically active. They are intertwined with each other and together cause complex processes, such as saving and regenerating nerve tissue [1-8].

MATERIALS AND METHODS

Reproduction of the model of ischemic stroke

Experiments were done in male Wistar rats weighting 120-130 g (age 2-3 months), being fed standard rations in a vivarium. Disturbance of cerebral blood circulation was reproduced by a temporary clipping of the left trunk of the anonymous artery; clips were released and the wound closed. Interventions were carried out under general anaesthesia. The animals subject to pharmacotherapy were divided into following groups: Emoxipinum (made in Russia), at 0.1 ml/kg; or placebo (0.9% - 200 Ml solution of NaCl). Control animals were uninfluenced. All animals were randomized and systematized for groups. The efficiency of therapeutic actions was estimated morphologically.

For morphological study of ischemia, we used the pattern that is the widespread model for studying morphological changes of nerve cells after oxygen starvation, the classical levinian preparation (Levine S., 1960). For excluding of influences of the diurnal rhythm, decapitation of animals was carried out under anaesthesia at the same time (9-10 am). Afterwards, the tissue was fixed in 12% solution of formalin and after standard histological manipulation, was filled by paraffin. Coloration of preparations was carried out by hematoxylin eosin, using a standard method. Investigation of histochemical reactions was carried out by means of specified sera of Monoclonal Mouse Bcl-2 and P53 in 50 patterns in polyeosin glasses (MENZEL-GLASER). Photo-optical studies of the investigated material was carried out under a light microscope (Zeiss Axiolab) under passive light in corresponding enlarge-

ments; data were saved in a computer database, connected by a special photo and video attachment.

Morphological investigation of temporal lobes after experimental ischemia without treatment

Histological changes in the cortices of the left temporal lobes after experimental ischemia developed over time. Pathological changes in nerve cells after hypoxia were characterised first by polymorphism. Structural changes in nerve cells after hypoxia were detected after 1 hour of chromolysis in different grades in all three investigated groups, to the same degree. Affected neurons start to appear peripherally, centrally or segmentally chromolysed. Comparing patterns in the cortices of the right and left temporal lobes, the primary signs of chromolysis in nerve cells appeared after 60 minutes of restored blood circulation to the left anonymous artery after forcipressure; changes in brains were detected only in some nerve cells and vessels (Fig. 1). The primary signs of brain oedema were characterised by swelling, enlarging in size and bleach-colouring of nerve cells.
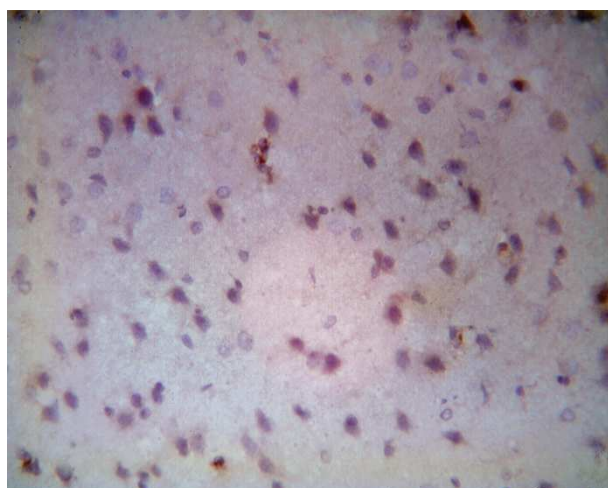
Figure 1A. The cortex of right temporal lobe after 1 hour of ischemic stroke. Colouring by the hematoxylin and eosin. Enlargement: obj x 40, oc x 10
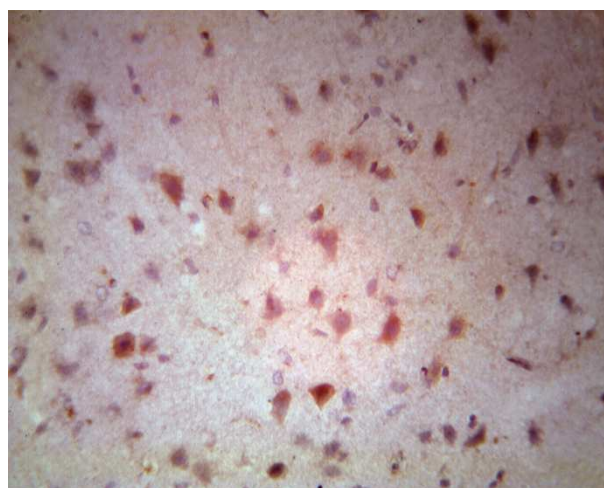
Figure 1B. The cortex of the left temporal lobe after 1 hour of experimental stroke. Reaction of interaction with Bcl-2 cells is not observed. Colouring by the hematoxylin-eosin. Enlargement ob x 40, oc x 10

Manifestation of chromatolysis reached a certain intensity after 3-6 hours of occlusion; morphological changes becomes more widespread and abrupt. Acute swelling of the bodies of several neurons and spraying of tigroid and basophilia of the nucleus characterised the further morphological status of the ischemic brain. Chromatolysis, in turn, indicates reactive changes of nerve cells and reflects disturbances in metabolism of functional proteins. In subsequent chromatolysis, the process includes structural proteins of cell, breakdown of which revealed photo-optical incrustation. Products of breakdown of the cytoplasm, intensely-coloured basophilic lumps, developed within 24-36 hours after experiment and finished

appearing in cells with the picture of neuronophagia.

At the same time, disturbances of structural proteins and lipids in the cells also include changes to lipoproteins, which testify to deep disturbances in the electrolyte and water balance of the cell. As a result, at earlier stages of the process, chromatolysis often occurs with hydropic changes, which are expressed in vacuolisation of different degrees, enlarge cellular size, and round its

cutout. Sometimes it is possible to observe cases of acute or honeycomb swellings of nerve cells.

By investigating the cortex of the temporal lobe with monoclonal tagged Bcl-2 cells over 3-6 hours after ischemia without treatment, light microscopy revealed complex cellular rosetting, in which one neuron was surrounded with multiple Bcl-2 cells (Fig. 2).
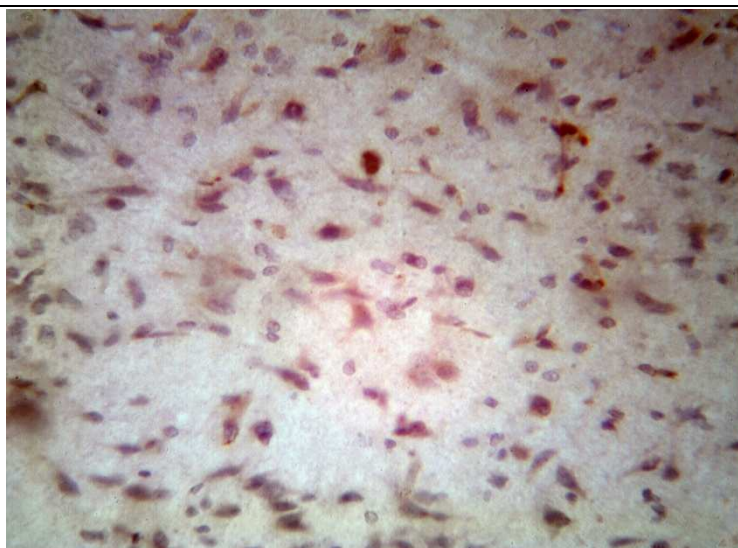
Figure 2. Chaotic allocation Bcl-2 isolated cells around the neurons through 24 hours after ischemia without treatment. Colouring by the hematoxylin-eosin. Enlargement: ob x 40, oc x 10

Chromatolysis and hydropic changes of the cytoplasm at the initial stages, in the first 24-36 hours after adopted hypoxia, is followed by morphological signs of compensating recovery reactions, which are expressed as hypertrophy and hyperchromicity of the ectopic to the nuclear membrane nucleolus (perinuclear hyperchromatosis).

For 24 hours after the experiment, patterns included total hydrolysis and hyperchromatosis of the nucleus in most neurons ("Incrustation" cells, Kariocytolisis, and "Shadow" cells). Some neurons had honey-

combed cytoplasm, while others were completely black in colour, with narrow, elongate bodies. Many neurons had central tincturial acidophilia. We observed dystonia of vascular walls, thickening and roughening of the argyrophilic fibres, perevascular swellings and frequently, small perivascular haemorrhages.

Against the homogenic background, a loose basophilic cytoplasm, which appeared darker than at normal, definitely showed a picnomorphic nucleus. Frequently, cells had triangular or rod-shaped forms. The bodies

of cells extended, but conserved more or less certain configurations; branches were not coloured (Fig. 3A).

Hypoxic neurons with incrustations were characterised by intensely coloured basophile granules along the periphery of cells, which sometimes formed a darker basophilic borderline in the margin of the cytoplasm.

We investigated the cortex by means of monoclonal tagged Bcl-2 cells after 24 hours of ischemia without therapy. Under a light microscope, we observed a chaotic distribution of isolated Bcl-2 cell concentrated around neurons. As a result, we expect further negative dynamics with the appearance of a focal necrosis (Fig. 3).

After 74 hours, the morphological picture changed. On one hand, it was possible to note several signs of restoration: again started colouring powdered to small alpha units - tigroid, and the nuclei of neurons brightened. On the other hand, the pathological proof continued to appear: appearance of vacuolisation, several neurons were darkly coloured, and there was a reduction in sizes of neuronal cells (Fig. 3A).
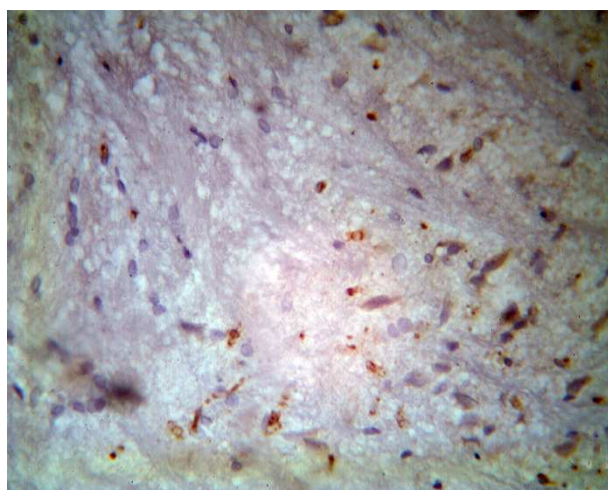
Figure 3A. Depletion by the neuronal cells with the numbers of non-connected Bcl-2 cells of cortex through 3 days after the ischemia without the treatment. Staining by hematoxylin-eosin. Enlarging: ob x 40, oc x 10.
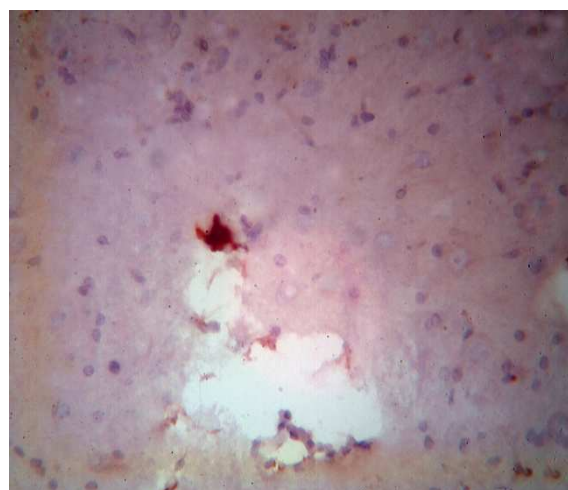
Figure 3B. The zone of necrotic dissolution of the left temporal lobe of the brain of rats at 7th day after the ischemia without treatment. Independent location Bcl-2 cells. Colouring by the hematoxylin-eosin. Enlarging: ob x 40, oc x 10.

Incrustation, frequently followed by the appearance of different granule cells, was observed with the bleaching of cytoplasm. However, picnotic nuclei could still be detected against the background of the cytoplasm, but gradually converted to a shadow, as an irregularly shaped hyperchrome like decayed to small granules and alpha units of angular formations. Amplification of vacuoli-sation, with formation of necrotic caves in zones of maximal ischemia and in zones of emptying, characterised morphological processes at the 7th day (Fig. 3B).

Morphological study of the temporal lobe that was under the influence of emoxipinum following experimental ischemia revealed following peculiarities. We noted, in the populations of nerve cells after

3 hours of emoxipinum exposure, primary cases of chromotolysis that were characterised by a slight brightening of neurons and the appearance of marginal thin bright strips (Fig. 4A). The sizes of cells were relatively stable and were close to normal. Singular neurons were slightly coloured and had round shapes. All current signs were estimated as negligible swellings and persistently demonstrated compensations, appearing as mechanisms of neuroprotection.
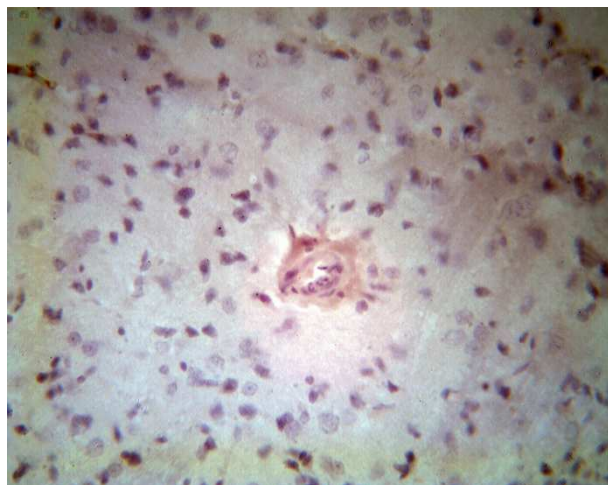
Figure 4A. Influence of emoxipinum on the cortex of the temporal lobe of the brain of rats, after 3 hours of ischemia. The absence of specific reactions with Bcl-2 cells. Colouring by hematoxylin – eosin. Enlargement: ob x 40, ocu x 10
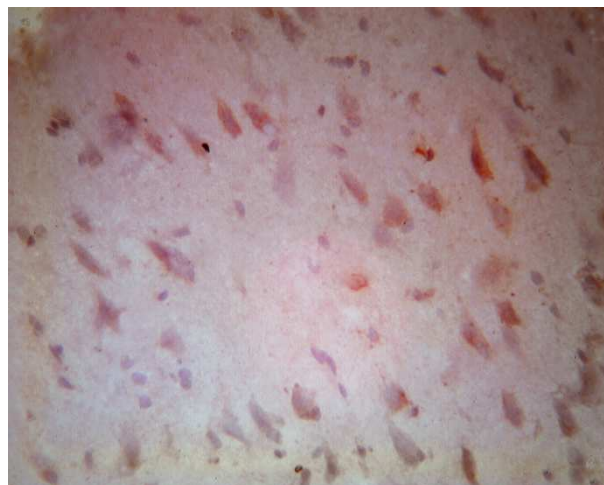
Figure 4B. Singular tags attached to elongated Bcl-2 cells 12 hours after ischemia and treatment by emoxipinum. Colouring with hematoxylin-eosin. Enlargement: ob x 40, oc x 10

At the interaction of mononuclear tagged Bcl-2 cells with the nerve tissue, we saw a diffusely equal distribution at all surfaces outside of their connections with neurons. As an explanation for this, we found compensatory processes that started within the first hours after the ischemia and activated more-general mechanisms of cellular stability following acute ischemia of the brain.

The following viewpoint on the picture of "uncertainty" could testify to the general reactivity of the nerve tissue. Overall, the receptor mechanism is directed towards the affected cell, and does not influence yet-unstarted necrosis or apoptosis. Such assumptions are not contradictory, but could be proven by the initiation of inflammatory processes and cellular disintegration.

At the 6th hour, we start to see singular cellular exhaustion. In addition, only from this moment does a slight tendency appear for the beginning stages of chromotolysis to be noted. Against this background, there are no tendencies for Bcl-2 cells to group with neurons of the cortex. The areas of ischemic penumbra are relatively narrow. The phenomena of ischemia and perifocal inflammation processes are shown with sufficient expression of glial cells, and are observed especially well in expressed margins of ischemia. An insignificant swelling of neurons, beginning with the manifestation of dissolving of the tigroid and stabilising of processes

of chromatolysis, is the distinguishing characteristic after 12 hours of emoxipinum following experimental ischemia (Fig. 4B).

It should be noted that the intensity of chromatolysis is considered to be a neuronal reaction to the metabolism of functionally significant proteins, as the influence of emoxipinum starts to manifest itself directly after the onset of ischemic mechanisms of destruction of brain tissue.

Here, we certify the absence of dissolution of the structural proteins of cells, which manifests under light microscopy as incrustations in the untreated group.

We observed singular tags attached to Bcl-2 cells, against a background of "empty" zones and a tendency for groupings of neuronal cells. The manifestation of such a reaction has been estimated as the primary inclusion of the proliferating mechanisms following processes affecting neuronal cells, which demonstrates not only specific reactions with Bcl-2 cells, but also morphologic manifestations in the structures of brain tissue.

Despite several positive morphologic dynamics at 12th hour following emoxipinum exposure, pathological manifestations of the initial mechanisms of ischemia and hypoxia of the brain also developed further.

In morphological investigations of patterns of the cortex 24 hours after ischemia and treatment with emoxipinum (Fig. 5A), we saw nerve cells areas that were surrounded with enlarged and swollen oxyphil - pyramidal cells with smeared cellular margins, along which there were many polygo-

nal cells. All cells were elongated along the proper axis. Over 3 days after the experiment, changes in the morphological picture of the cortex of the temporal lobe were differentiated by negative dynamics. The pathologic reactions continued to appear: manifestations of empty zones, abruption, and dissolution of neuroglia.

We saw neurons that were elongated, a heavily swollen blurriness of cellular margins, and also observed turned-down and twisted cells. Some cytoplasmic vacuolization hyperchromatosis matched with homogenisations of cytoplasm, and decreed a reduction in sizes of neuronal cells (Fig. 5A). Manifestation of the specific immunohistochemical reactions of Bcl-2 cells were observed in specific surrounds of neurons, where the processes affecting the cells began.

At the 7th day, we observed a relative stabilisation of the processes. Areas that lost nerve cells interchanged with large vacuoles and broad areas of dissolved paths that penetrated the brain tissue (Fig. 5B). Brain cells were less swollen, but hypochromatosis and intracytoplasmic vacuolisation demonstrated a continuing pathological process.

The reaction with tagged Bcl-2 cells begins to manifest its specificity. In the field of view, we saw groupings of tagged Bcl-2 cells directs towards destabilised neurons. There was a tendency for an absence of tagged Bcl-2 cells in some empty areas, around the vacuoles, and along the broad areas of dissolved paths.
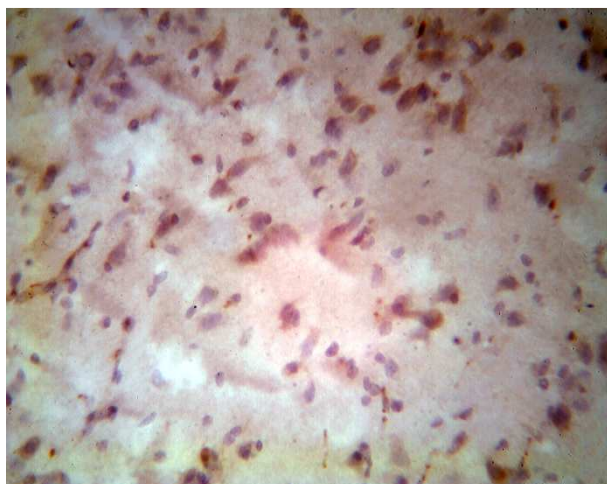
Figure 5A. Influence of emoxipinum on the cortex of temporal lobe 24 hours after ischemia. Colouring with hematoxylin-eosin. Enlargement: ob x 40, oc x 10
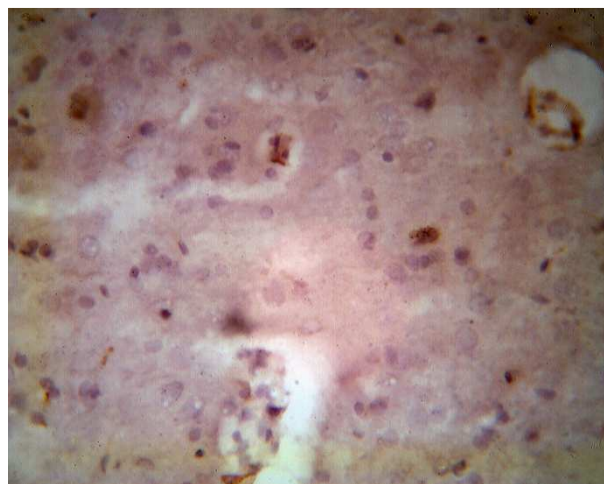
Figure 5B. The tendency for the specific reaction with Bcl-2 cells rosetting. The absence of Bcl-2 cells in zones emptying at the 7th day after the ischemia and influence of emoxipinum. Colouring: hematoxylin-eosin. Enlarging: ob 40, oc 10

SUMMARY

The morphological and histochemical investigation of neurotrophicity and neuroplasticity after ischemic accidents of the CNS, by means of Bcl-2 and P53, must consider the main marker in early manifestations of the dynamics of the pathological processes. The protective mechanism of the CNS more strongly activates and brings major effects by interaction of natural and pharmacological processes. Of course, such complex and expensive morphological approaches are inconceivable in practical and routine clinical use. We consider that in fundamental studies of the peculiarities of CNS during ischemic accidents, and especially for attempting pharmacological protection and treatment, such investigations are impossible for making a decision.

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SORPTION ACTIVITY RATING OF LIGNIN CONTAINING ENTEROSORBENTS AGAINST TO MICROORGANISMS OF INTESTINE

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It is established that for Salmonella typhimorium, Proteus vulgaris and Candida sp the best indicators sorption (32-72 %) are observed at use of a sorbent with a parity activated coal:lignin equal 60-40. There of, the received highly effective sorbents can be recommended for use at correction of bacterial micro flora.

Keywords: enterosorbtion, activated coal, hydrolytic lignin, enter bacteria

INTRODUCTION

Last years a big attention in medical practice is given to phytogenesis enterosorbents to which are belong indigestible in small intestine not starched polysaccharides, such as cellulose, hemicelluloses, pectin, gum, slime and not carbohydrate lignine [1]. Vegetative sorbents are steady against action of enzymes of stomach and small intestine and are exposed to bacterial fermentation in a thick gut. Possibilities of fibers are connected with presence in their molecule hydroxyl and carboxyl groups causing their water-retaining, ion-exchanging and adsorptive properties. Among food fibers there are medical products (for example, polyphepan) and biologically active additives, such as zosterin, detoksal and polisorbit.

Enterosorbtion is based on known in physiology of digestion a phenomenon of maintenance of a constancy of the environment of the intestines which essence consists that irrespective of character of consumed food the chimes remains more or less constant. This constancy is provided by absorption into blood and lymph and excretion in a gleam of a gut of various components (water, electrolytes, carbohydrates, fats, etc.). In recirculation of blood components and chymus participate glands of gastrointestinal tract, liver, bile ducts and pancreas.

MATERIALS AND METHODS

As enterosorbent material in the given work has been used the activated coal and hydrolytic lignine, received on the basis of a waste of sanitary wood cuttings of saxaul. At preparation of enterosorbents, initial components were exposed to mechanical mixing in the ratio activated coal: lignine (100:0, 60:40, 50:50, 0:100) accordingly.

The purpose of the work was studying the efficiency of sorption of cells *Salmonella typhimorium, Proteus vulgaris* and *Candida sp,* obtained with the help of enterosorbent materials. Bacteria grew up in meat infusion broth, yeast in liquid medium Saburo at pH 7,0. Suspension for immobilization was prepared in an isotonic solution with density of cells 10^7 kl/ml. Sorption of cells was studied in a solution of chloride sodium in statistical conditions. Samples were selected in 24 hours of contact of sorbents with microorganisms and after upholding by duration 1 hour was defined number of cells. Number of cells in a liquid was defined by seeding of

cultivations on the medium Endo or Saburo. Efficiency of sorption estimated on a difference of concentration of cells in cultural medium before and after sorption process. Ratio of the mass of sorbents was 1-3 gram on 100 ml of suspension. Sorbents preliminary were exposed to sterilization by autoclaving in duration of 30 mines at pressure 1,5atm. At desorption process sorbents with the cells, adsorbed on them, transferred to 100 ml of an isotonic solution, stirred up in duration of 5 minutes and sowed on Endo medium for definition cells titre [2-4].

Morph physiological characteristic of samples for a visual estimation of quantity of the attached cells of microorganisms to a surface of sorbents was investigated on microscope Leika MRS×1300.

RESULTS AND CONCLUSIONS

Enterobacterium and yeast-like mushrooms of sort *Candida* are a part of microbial association of intestines of the man. However at immunodisfunction of an organism or changing normal microbic cenosis can lead to disease development. It is possible to apply sorbents to correct micro flora of intestines of the person.

About immobilization intensity of the cells *Salmonella typhimorium, Proteus vul-garis* and *Candida sp,* judged by quantity of the attached cells in percentage from initial quantity of cells in the reactionary medium (table 1).

From the data presented in the table, it is visible that all studied sorbents-carriers effectively sorb bacterial cells, but on sorbents of type 50-50 and 60-40 sorption occurs more intensively for cells *Salmonella typhimorium*, than on sorbents of type 0-100 and 100-0. High efficiency of sorption of cells *Proteus vulgaris* and *Candida sp* is noted for sorbent 60-40 and has made 61,1 and 32,8 accordingly. The least number of sorption cells is characteristic for barmy cells in comparison with bacteria.

Efficiency of cells sorption of microorganisms directly depends on time of cultivation and the sorbent nature. Distinctions in degree of cells sorption have been confirmed by the data of light microscopy in the process of cultivation (fig. 1-3).

The active attachment of cells on sorbents was observed after 6 hours of contact. The biggest quantity of sorption's cells on sorbents-carriers of type 60-40 and 50-50 preserved since 10 hours of cultivation till 24 o'clock.

0 hours   *24 hours*

Salmonella typhimorium (sorbent 60-40)
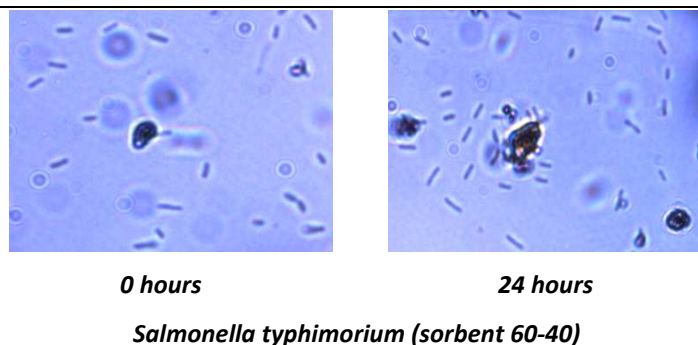
Figure 1. Immobilization of culture Salmonella typhimorium on a surface of enterosorbents.

0 hours   *24 hours*

Proteus vulgaris (sorbent 60-40)
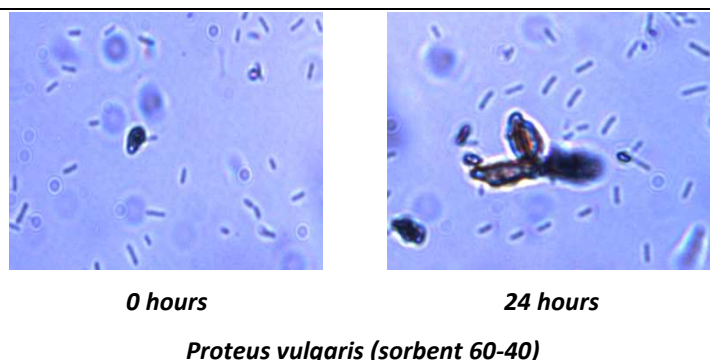
Figure 2. Immobilization of culture Proteus vulgaris on a surface of enterosorbents

0 hours   *24 hours*

Candida sp. (sorbent 60-40)
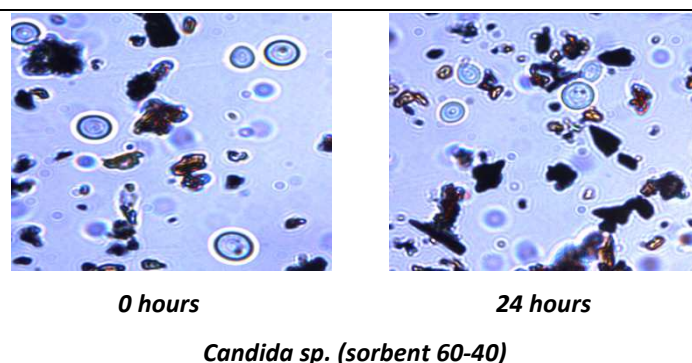
Figure 3. Immobilization of culture Candida sp on a surface of enterosorbents

Table 1. Efficiency of immobilization of the cells Escherichia coli, Salmonella typhimorium, Proteus vulgaris and Candida sp. on lignine containing sorbents

Sorbent types	Cells quantity in suspension (10^8)	Sorption activity, %	Cells desorption, %
Salmonella typhimorium			
50-50	8,2 ±1,3 – 14,5±2,1	58,6±2,3 - 71,9±2,3	8,8±0,1
60-40	15,4 ±0,8 – 18,4±1,6	72,3±2,1 - 90,6±2,1	2,7±0,2
100-0	13,5 ±0,6 – 15,9±2,3	69,9±1,2 - 78,4±1,8	2,9±0,8
0-100	9,4±0,7 – 16,4±0,6	52,5±2,5 - 80,8±1,6	3,4±0,1
Proteus vulgaris			
50-50	15,2 ±0,9 – 15,9±1,2	45,3±2,5 - 86,7±2,4	8,4±0,1
60-40	10,3 ±1,2 – 17,6±0,9	61,1±2,1 - 86,7±2,4	3,5±0,4
100-0	11,3 ±3,2 – 13,5±0,8	55,8±3,2 - 66,4±3,1	2,4±0,5
0-100	10,3 ±1,2 – 17,6±0,9	41,1±2,1 - 86,7±2,4	3,5±0,4
Candida sp.			
50-50	15,3 ±1,4 – 17,9±1,4	28,3±1,7 - 88,6±1,4	6,7±0,5
60-40	14,7 ±1,8 – 16,1±0,5	32,8±1,8 - 78,4±1,2	5,7±0,2
100-0	11,3 ±3,2 – 13,5±0,8	24,8±3,2 - 66,4±3,1	7,4±0,5
0-100	10,3 ±2,1 – 15,3±0,7	30,8±2,2 - 75,4±1,4	8,8±0,2

According to presented the tabular data and drawings 1 - 3, for all species of microorganisms the best values of sorption are observed at use of a sorbent of type 60-40.

Thus, as a result of the done work it has been established that for enterbacteria*: Salmonella typhimorium, Proteus vulgaris* and *Candida sp.* the best indicators of sorption (32-72%) are observed at use of sorbent

with a parity activated coal: lignine equal 60-40. Thereof, the received highly effective sorbents can be recommended for use at correction of bacterial micro flora.

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ANALYSIS OF THE INFORMATION AWARENESS OF SENIOR STUDENTS OF VOLGOGRAD CITY ON THE MATTER OF HEALTHY LIFE-STYLE

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Research of the degree of teenagers' information awareness on the matter of healthy life-style is both actual and quite interesting concerning health saving of Russian schoolchildren nowadays.

The goal of our research work is analysis of the information awareness of senior students of Volgograd city on the matter of healthy way of life and their motivation level for leading healthy life- style.

Prospective questioning of teenagers was lead based on the original questionnaire. The results are the following:

1. The whole level of the information awareness may be considered good: 97% of respondents are aware of the criteria of healthy life- style, the rest 3% are not quite aware of the problem.

2. As a whole, the teenagers assess their life-style critically: 26% consider it as healthy, 67% - a cross between healthy and unhealthy, 7% - unhealthy, according to 10 scale system it was evaluated from 4 to 8 points.

3. Indirect analysis of the accordance of the respondents' way of life with their real life-style showed that the majority of the interrogated teenagers have no harmful habits, they have sufficient dynamic burden. At the same time it gives concern that 46% of the respondents don't manifest their negative attitude to alcohol, 18% of the respondents have already taken alcohol, that isn't over All-Russian index in this age-specific group though.

4. While analyzing the level of validity to leading healthy life-style, it was ascertained, that 40% of the teenagers have strong motivation, 19% - non-persistent, but 41% have no motivation at all. According to the analysis of the structure of stimulating motivation, the first place among senior students takes the following motive – being in love. The final places took stimulating motives like reading of special literature and participation in seminars and lectures on the problem of healthy life-style.

5. According to the analysis of the relationships between "Students - School", it was fixed, that 80% of the respondents think, that a school influences heir health badly, or doesn't influence it at all, on the contrary 20% of the teenagers consider their school to help them keep fit.

Thus, it is necessary to integrate healthy life-style and healthy-developing technologies into the educational process, as it is the greatest humanitarian pedagogical means for saving and strengthening children's health in our country, taking into consideration starting deliberate level of motivation of schoolchildren to leading "Healthy life-style".

THE BIOCHEMICAL BLOOD ANALYSIS AND THE CHRONIC STRESS

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Transport of substances occurs through blood and is carried out gumoral interaction of bodies with each other. Each blood drop contains the information on everything that occurs in soma.

For interpretation of this information the biochemical analysis of blood - laboratory method of research serves which is used in physiology and medicine. It allows to understand, the condition internal bodies and effectively they functions. The received data by the Russian and foreign scientists convincingly testify to negative influence psychological and emotional stresses to the biochemical structure of blood practically on all parameters.

At the chronic stress psychosomatic pathology besides precisely expressed vegetatic infringements the large changes in biochemical parameters of blood are revealed: increase density blood, change hormone balance (increase ACTH, STH, TTH, glucocortycoide, catheholamine, thyroid gland hormones and insulin). The disbalance of glucose, cholesterol, tryglyceryde accrues, the whey ionogramme (Na, K, Ca, Mg, Cl) varies in blood. As a result the influence long kept of psychological and emotional stress occur histamine, catheholamine, serothonine in blood. Cortisol, lactic, pyruvis, alanine aminotransferase, aspartate aminotransferase, antioxidizing activity, alpha-tocopherol, malondialdehyde, dien conjugate parameters change sharply.

On the data of our researches in the biochemical analysis of blood there is no change of parameters leaving for normal intervals at the chronic stress. But their deviation from an average level is an attribute of vegetative balance infringement and threat of occurrence psychosomatic diseases.

The problem demands the further consideration. The acknowledgement of the practical conclusions is estimation criterion of the homeostasis regulation at the chronic stress. It is important for the early diagnostics opportunity of the dysfunction and it is urgent as the method showing efficiency of chosen treatment.

A MELATONIN IMPACT UPON THE PLATELET LINK OF HEMOSTASIS

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Nowadays problems of direct impact of melatonin upon the nervous, endocrine, immune system activity as well as the state of hemostasis either in normal or in pathological condition are being widely discussed. This survey is supposed to study the impact of the melatonin medicine "Melaxen" on the platelet link of hemostasis in the experimental conditions. The test was carried out

within the winter-spring period on 40 white sexually-mature male rats, kept in a standard vivarium conditions with the interchange of natural and artificial light in order to exclude the impact of endogenous melatonin upon the hemostasis through the blocking of its synthesis. Under the affection of maximum and minimum doze of erythrocyte hemolysate the platelet aggregate activity (PAAm and PAAs) and platelet activity index (PAI) were estimated according to the results of the hemolysate-aggregation test. The experimental disfunction of platelets mdelling was carried out via peroral introduction of aspirin in doze of 500 mg/kg to the animals of the second group. Within the third and the fourth group against the background of melaxen that was introduced in the course of a week in doze of 0,1 mg/kg and 10 mg/kg accordingly, the aspirin was introduced 24 hours before the test. The rats of the first group were kept in the standard vivarium conditions without any medical preparations.

The PAAm was 90,9±20,4%, the PAAs was ,4±5,69%, while the PAI was 4,73±1,22 within the check group. Under the affection of acetylsalicinic acid at the expence of full tromboxane system blocking the blood plates aggregation ability was absolutely missed. However, the preliminary introduction of melaxen allowed us to significantly reduce the aspirin effect. The PAAm was raised up to 5,0±17,7%, and the PAAs – up to 146,5±18,9%. The PAI was 3,72±0,63. The AATm within the fourth group animals was about 98,3±8,31%, while the AAPs index significantly exceeded the control point and made 255,7±14,4%, but PAI was close to control point (4,16 ±0,5).

Thus, we can see that melatonin has a direct impact on the platelet link of hemostasis. Against its background blood plates conserve their aggregation process ability under the affection of antiaggregant. This effect is dependent on the doze of melaxen.

PROBLEMS OF ESTIMATION OF INNOVATION POTENTIAL
OF THE HIGHER SCHOOL

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Pressing questions of reforming of the higher school of the Russian Federation are taken up in this article. The basic attention is given to the development and an estimation of innovative potential of high schools. The characteristic of various approaches to an estimation of innovative potential is considered. Author's vision of monitoring and high school management in innovative potential is represented in it.

The innovative way of Russian economy development mentions all the fields of activity, including formation (higher school). Importance of educational sphere is in its ability to create and extend new knowledge that is a basis for innovations. Considering that innovations are the innovations which can accept a commercial form, its high rating among other educational organizations can be result of innovative activity of high school.

Principal reasons for innovative changes in sphere of the higher vocational training are, firstly, the openness of the world space and, as consequence, necessity of alignment of base positions on key questions of training and, secondly, the rapid development in the information sphere and, as consequence, occurrence of new, innovative methods of transfer, accumulation and processing the information in knowledge field.

It should be mentioned that the problem of an estimation of innovative potential of high school is enough new and has not found worthy reflexion neither in theoretical workings out of a pedagogical science, nor in practice.

Thus, objective requirement and undevelopmental of aspects of innovations in the sphere of the higher vocational training allow to speak about an urgency of a considered problem.

The high school is the innovative-focused element of national innovative system. It is caused by character of its production as it creates innovations in all the spheres of the activity. Generally high schools carry out two principal views of activity: educational and research.

The purpose of educational activity is the preparation of new experts for various branches of national economy, reproduction and mental potential development. Thus it is should not be forgotten that in modern conditions formation ought to be focused not so much on transfer of knowledge which constantly become outdated as on mastering base competences allowing in the future to acquire knowledge independently, as it can be required. For this reason such formation should be connected with practice more closely than traditional one. Innovative formation assumes training in the course of creation new knowledge at the expense of integration of scientific activity and directly educational process and manufacture.

Research activity of high schools is focused on working out and creation of scientific and technical production for its use in national economy.

Thus, the high school should possess considerable innovative potential; otherwise it will not be able to carry out its functions in the full value. The innovative potential of high school represents resources of all kinds which can be used for realization of innovative activity both in the field of realization of educational projects and in the scientific sphere. Any change in the organization, connected with revealing of problems of its development and formation of vision of the future of the organization it is impossible to carry out without an estimation of available potential.

The purpose of the estimation of innovative potential of high school is the degree establishment of higher educational institution conformity of innovative activity to the best experts in the sphere. Thus problems of an estimation of innovative potential allocate:

•Reception of the objective information about a condition of innovative activity of high school;

•Revealing of positive and negative tendencies in innovative activity of high school;

•Establishment the reasons for occurrence of problems and complexities during the introduction of innovations into practice of work of high schools and definition of ways of their decision.

There are various techniques for estimation of high school innovative potential. As a rule, they are based on use of the criteria applied at carrying out of certification and accreditation of high school, or for an establishment the possibility of the inclusion of the high schools-leaders applying for reception of grants within the limits of the innovative program of the Russian Federation in its structure.

The official attitude, in particular Minobrnauki of Russia, about methodology and a technique of the analysis and an estimation of innovative potential of high school is displayed in the form of the demand at carrying out the competitive selection of educational institutions of the higher vocational training which introduce innovative educational programs. The structured form high schools-konkursanty should characterise their own innovative potential on following four group indicators:

1) efficiency of scientific and innovative activity (quantity of research, innovative and promotional structures; volume of financing projects in research, innovative and promotional structures; number of students and the post-graduate students involved on the paid basis to researches; the patents received on the workings out of high school; the textbooks with signature stamp prepared by teaching staff of high school, etc.);

2) efficiency of professional training for innovative educational activity (competition at entrance to high school; number of winners of the All-Russia Olympic Games (competitions) enlisted on 1st course; mean score at state exam among enlisted on 1 course; number of winners of the international students' Olympic Games; number of full-time study post-graduate students, number of persons working for doctor's degree, etc.);

3) a mental potential of a higher educational institution (the persons having a scientific degree of the candidate or the doctor of sciences; total number of scientific and pedagogical shots; full members and member-correspondents of the Russian Academy of Sciences and other state academies of Russia; winners of awards of the state level; average wages of teaching staff; a parity of wages of the rector to average wages of the professor);

4) supporting of innovative activity by material and information base (balance cost of cars and the equipment; personal computers and computer workstations; terminals with the access to the Internet; total number of units for storage of library fund of high school).

According to the authors, the similar approach to the analysis and an estimation of innovative potential of high school is possible only for carrying out the express analysis and reception of much aggregated integrated estimation. It does not display:

- Composition and structure of innovative potential that is very important for the analysis strong and weaknesses;

- Sources of innovative potential formation that would show distribution of own efforts and help from the state, etc.;

- Productivity of innovative potential use according to basic components that could show directions of escalating efforts in this or that field of high school activity .

Qualitative criteria of an estimation innovative potential is used in other techniques, this causes the necessity of application of expert estimations. In this case, the estimation of innovative potential is held with the using of binary system, i.e. presence or absence of this or that criterion without definition of level of its performance is fixed. The result of such estimation is the establishment of innovative potential conformity of high school to the best experts in the sphere. Nevertheless, the degree of such conformity that distinguishes high schools from each other can not be defined in this case.

If the estimation of innovative potential is limited with only quantity indicators than there is a question, what indicator should be mentioned as the indicator for comparison. A number of authors suggest using of average indicator, defined on the basis of high school engineering development s of the Russian Federation data, of regional or even world level. In spite of appeal of such approach, it has been represented enough difficult as, firstly, there is necessity in access to corresponding information, and, secondly, the information should be reconsidered regularly for the purpose of supplying with the urgency of the received results. Besides, epy level of innovative activity of high school can be always estimated with the help only quantity indicators.

Besides, such approach allows defining of the high school comparative estimation for the purpose of definition of its rating among other higher educational institutions. And it does not always give the information for an estimation of stability of the innovative development. For this purpose it should be estimated innovative potential of high school in dynamics, at least for last three years that will allow to reveal corresponding tendencies in innovative activity and to de-

fine cause-and-effect relations for formation of innovative activity of high school.

In our opinion the approach to an estimation and high school management in innovative potential should be based on following positions.

First of all, two basic aspects should be allocated:

1) The structure of innovative potential of high school and the ways of its estimating;

2) The structure of a control system of development of innovative potential of high school and, what subsystems can be allocated in it.

Further to this, we consider that two scientific approaches can be applied at the analysis of structure and an estimation of innovative potential of high school.

The resource approach which is based on definition of presence (size) of various resources that the high school uses at all stages of innovative process. For its realization it is necessary to define: the kinds of activity classified as innovative; kinds of resources and expenses that will be considered at estimation.

The resultantly approach which is based on identification of possible effects that high school has already received or will receive from the realization of innovative activity. For realization of the mentioned approach it is necessary to identify effects (economic, scientific and technical, social, ecological) which will be considered at an estimation of innovative activity.

As high school carries out educational and scientific activity the scheme of the analysis of innovative potential structure should reflect each kind of activity.

1. Educational activity.

In the resource approach the innovative potential of high school consists of three components, and each one can be estimated with the certain set of indicators:

- Personnel potential (a share of the teachers having a scientific degree and a status, full-fledged members and member-correspondents of the Russian Academy of Sciences, middle age of the faculty, etc.);

- Material resources (the educational/laboratory areas for one student/teacher, the presence of the modern educational equipment, average quantity of computer hours for one student/teacher, etc.);

- Information-methodical supplying (presence of the interactive information-library centre, total number of storage units of high school library fund, etc.).

In the resultantly approach the innovative potential of high school is defined by its demand:

- Entrants (competition for one budgetary place, number of winners of the All-Russia Olympic Games enlisted on 1 course, mean score of the state exam among enlisted on 1st course, etc.);

- Employers (a share of students trained under target contracts with the enterprises, quantity of contracts with the enterprises on passage of all kinds of practice for students and training for teachers, etc.);

- The state (a share of students trained within the limits of the state order, the state awards of high school, the creative collectives, separate employees, etc.);

- A foreign recognition (a share of foreign students, post-graduate students and the trainees trained under programs of the

international cooperation, foreign teachers and the experts involved in educational process, etc.).

2. Scientific activity.

In the resource approach the innovative potential of high school develops from the following components:

- Personnel component (a share of employees of the high school taking part in research effort and having scientific degree and a status, of quantity of post-graduate students and persons working for doctor's degree, etc.);

- Material component (presence of modern research base such as laboratories, techno parks, business incubators, etc.);

- Information component (presence of the interactive scientific and technical information centre, an access to Internet large libraries, a subscription for authoritative scientific and technical editions and etc.).

In the resultantly approach the innovative potential of high school can be estimated in following directions:

- The number of the candidate and doctor's degrees in relation to the number of employees of high school (and-or to last year);

- Quantity of winners of awards of the state level in the field of science and education;

- The cost of executed research effort and engineering development (including, state budgetary) in relation to number of employees of high school (and-or to last year);

- The balance cost of the equipment for the research purposes;

- The number of publications (including, monographies) in recognized Russian

and foreign publishing houses (including theses of the reports represented at representative conferences and symposiums), etc.

So the control system of innovative potential development of high school should to be capable to realize at least base functions of management.

1. The planning Subsystem should be able to solve following problems:

- The analysis and a substantiation of perspective directions of innovative workings out in the field of science and education;

- Regular planning of innovative activity of high school including working out and realization of strategic and tactical plans for innovative activity;

- Planning of personnel potential development of high school, material base and a supplying with information of innovative activity of high school according to the accepted innovative orientation.

2. The organizational subsystem should be able to solve following problems:

- Distribution of the rights and of organizational responsibility between participants of innovative process in high school;

- A substantiation of necessary and sufficient structure of functional organizational zones (environment research, staff, workings out, etc.) for providing of innovative process;

- Working out and current adaptive organizational structure for realization of innovative process;

- Working out and current support of standard maintenance of functioning of adaptive organizational structure of innovative process.

3. The motivation subsystem should be able to solve following problems:

- A substantiation of principles and approaches for innovative activity in high school;

- A substantiation of motivation levels (for example, for high school it is a financial supplying of innovative process, for creative collective or the separate researcher there must be some system of bonuses);

- Working out of effective financial sources for development of innovative activity;

- Working out of effective models of motivation for employees of the high school participating in innovative activity

4. The analysis and control subsystem should be able to solve following problems:

- The analysis and a substantiation of effective approaches for an estimation of innovative potential and innovative activity of high school;

- System engineering of estimated indicators of innovative activity;

- Current monitoring of innovative activity of high school;

- Working out of the mechanism of development and decision-making on development of innovative potential of high school.

Thus, there is a possibility of purposeful development of innovative potential of high school at continuous monitoring of productivity of all its components.

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PSYCHOLOGICAL AND PEDAGOGICAL GROUNDS FOR APPLYING COMMUNICATIVE METHOD OF TEACHING FOREIGN LANGUAGES IN HIGHER SCHOOL WITH THE PURPOSE OF REALIZATION OF STUDENTS' PROFESSIONAL ORIENTATION

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The article deals with the notion of "professional orientation", its components and levels. The principles of communicative method of teaching foreign languages are analyzed from psychological and pedagogical point of view. Expediency of applying the given method with the purpose of realization of students' professional orientation is substantiated.

Keywords: professional orientation, components of professional orientation, levels of professional orientation, communicative method of teaching foreign languages, activity approach, activity, communicative competence, communication, authentic process of students' socialization.

Professional orientation is the main constituent of any adult personality. Professional orientation is a complex of stable motives, independent of the circumstances, and directing person's behavior and activity towards the acquisition of professional skills, their development and improvement. [1]

The problem of professional orientation levels has been researched by many scientists. [6; 7] We define six components of professional orientation. They are: (1) motivation of professional choice, (2) interest in future profession, (3) goal-setting, (4) professional expectation, (5) degree of self-sufficiency and self-confidence, (6) perception of educational process. Each component is notable for its manifestation degree in the personality of students with different levels of professional orientation development. According to the manifestation degree we define three levels of professional orientation development: the zero level, the first level and the second level.

The zero level is characterized by:
➢ the superficial, uncertain, dependent professional choice;
➢ the episodic, situational interest in future professional activity;
➢ the goal-setting, not connected with future profession;
➢ the vague and inexplicit professional expectations;
➢ the low degree of self-sufficiency and self-confidence;
➢ the unconscious perception of educational process, i.e. without comprehension of its aims and dyadic relationship.

The first level of professional orientation includes:
➢ material incentives and career prospect as the reason of professional choice;
➢ relatively stable interest in future profession;

- the goal-setting, connected only with material aspect of future job;
- mercenary, exploitative expectations of profession;
- the middle degree of self-sufficiency and self-confidence;
- relatively positive perception of educational process, but without any relation with future professional activity.

The second level of professional orientation is notable for:

- deliberate, purposeful professional choice, infatuation for the future profession;
- the firm, stable interest in it;
- the goal-setting, connected with development of the future professional sphere, and professional self-development;
- the expectations of professional self-realization and self-improvement;
- the high level of self-sufficiency and self-confidence;
- professionally motivated perception of educational process.

Hence it is possible to assume that we can correct the level of professional orientation affecting its components. We consider communicative method to be the most appropriate one to fulfill this task. This is the method of teaching foreign communication by means of communication itself. Communicative method of teaching foreign languages is based on the following principles: (1) the principle of activity approach, (2) the principle of communicative competence formation, (3) the principle of authentic process of students' socialization.

Thus the first principle is the one of activity approach. The activity nature of the communicative teaching is put into practice through activity tasks which are called activities. It is necessary to stress that activities are worked out by the teacher and they should contain a communicative purpose and a problem-solving task for students.

Psychological structure of activity has been described by A.N.Leontiyev [3] perfectly and in detail. Integral activity consists of three layers. The first layer includes: wants − motives − goals − conditions of the goal attainment. It is the substantial content of activity. The second layer correlates with the first one and includes: activity − actions − operations. It is a structure of activity, its realization. These two layers compose the psychological structure of activity. The third layer is reciprocal transitions and transformations of its structural components: motive − into goal, activity − into action etc. It is activity dynamics.

Transitions and transformations of activity as an integral system in the process of its realization is a special aspect of our analysis. The reason of such transformations is in the fact that the results of actions composing activity become in some conditions more important than their motives. The most significant changes take place in the students' activity to the end of the first academic year. If to speak about future profession, not all students make the reasonable and the independent choice. It is sometimes parents' or friends' influence or simply randomness. But in the course of study the transformation is possible. Everything depends on the results. If result is negative, a student finds the other motives and activity changes. (It may be the activity of mastering some other profession or it may be the

working activity). If the result is positive, the motive transforms into goal. A student now has a goal to get good marks, to master the subject, to become professional. It is called motive – goal shift [3]. Thus it means that it is possible to correct students' motives in the course of activity, creating situations of success and then gradually complicating activity. We can also modify students' goals, interest in profession, professional expectations by means of their activity. Situations of success undoubtedly can raise students' degree of self-sufficiency and self-confidence.

The second principle of communicative method of teaching foreign languages is communicative competence formation. Communicative competence include: (1) linguistic competence, i.e. readiness to use foreign language as an instrument of intellectual and speaking activity; (2) pragmatic competence, i.e. readiness to reproduce communicative content in communicative situation; (3) cognitive competence, i.e. readiness to the intellectual and communicative activity; (4) informative competence, i.e. grasp of communicative subject. Communicative competence is formed in all kinds of speech activity: in listening, in speaking, in reading and in writing. In other words, communicative competence formation is communication skills training by means of communication itself.

Communication is a complex and many-sided process, which may be a process of people interaction and, at the same time, an informational process, and people relationship, and process of people reciprocal influence, and process of mutual understanding [5]. All the functions mentioned above are realized in total in the communi-

cative foreign language teaching and contribute to the professional orientation development.

It should be mentioned that communication is of great importance not only for a single person, but also for the whole society. In psychology there is a thesis of correlation and cohesion between communication and activity. Communication and activity in the framework of communicative foreign language teaching are also inseparable.

The most important way of communication is a dialogue, i.e. a discussion between two or more people or groups, especially one directed towards exploration of a particular subject or resolution of a problem [9]. The dialogue presupposes: uniqueness and parity of partners; different and original viewpoints; partners' focus on the understanding and active interpretation of their points of view; expectation of the answer and its anticipation in the statement; mutual supplementing of standpoints, which correlation is the goal of the dialogue. It is a dialogue that is the basic activity in communicative method of teaching foreign languages.

The third principle of communicative method is authentic process of students' socialization. We mean not only authentic, original linguistic material for studying, but we also mean creating methodically expedient conditions of natural educational communication. Socialization is formation of the person's social role in conditions of acquisition of the social interaction experience and social values. [4]

Factors of socialization are developmental environment, which is not spontaneous and casual. It should be planned and well organized. Scientific researches disclose

that the better social groups are organized, the more possibilities we have to exert socializing influence on the person. The principal requirement is creating the atmosphere of moral treatment, trust, safety, possibility of personal growth. This atmosphere should provide possibilities for free creativity realization, aesthetic and moral development, and communicative pleasure.

Socialization processes are the necessary "nutrient medium" for the foreign communicative competence formation and the main link in foreign language acquisition. Authentic communicative foreign language teaching employs interactive activities. Interactive activities are impossible to perform without a partner or a group of partners. They presuppose pair or group work. There are three basic types of interactive activities: cooperation to produce a common idea; information combining; message transfer. Authentic communicative foreign language teaching also employs spontaneous communication. It takes place if educational situation transforms into natural one. Then foreign language is used according to its intended purpose.

Thus the communicative foreign language teaching is authentic process of students' socialization, in which they acquire social experience by means of organized communicative activity. This process content is professional orientation of linguistic material and that of students' activity. The principles of communicative teaching themselves are called to form person's professional ori-

entation, to correct motives and goals, to develop interest in future profession, to raise the level of self-sufficiency and self-confidence, to demonstrate significance of every educational subject on the example of the foreign language.

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THE IMPORTANCE OF INDEPENDENT STUDENTS' WORK IN THE PROCESS OF GETTING HIGHER EDUCATION IN TECHNICAL UNIVERSITY

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Nowadays graduating students should have not only academic knowledge but also ability to get knowledge and develop in their sphere. The so-called Bologna process, introduced by the European Union, aims to implement the GATS (General Agreement on Trade in Services) agreement throughout Europe. According to the GATS agreement, all services, including first and foremost education, are to be strictly subject to the dictates of the free market. Thus one of the tasks of higher education is to teach students to work independently, gain and use the necessary knowledge. In the state standard of Russian education it is said that the quality of training future specialists must be obtained through the extension of quantity and quality of independent work.

It should be noticed that scientific knowledge is open-ended, versatile and it is constructed by the learner referring to his/her experience. Accordingly students should be offered independent practical training work using different objective information resources. Practically such kind of independent work can be identified as problem based learning which takes place through critical and creative thinking.

The effectiveness of independent work is defined through a number of conditions.

Firstly, from the first lessons students should be accustomed and taught to approach any task constructively and make up plans.

Secondly, this work should be well-organised. In other words, students ought to be given individual tasks connected with the subjects they are studying. The contents of these tasks must be modern, cognitive and interesting. Moreover, these tasks must systematize stored knowledge.

In addition, the tasks must be followed by questions for comprehension control, contributing to theory understanding and providing independent work. Constituent part of independent tasks is abstract work as it is one of the motives for independent material perception. As a rule, the number of lectures at the majority of universities is not enough for broad elucidation of topics connected with philosophy, history, literature and so on. Therefore a student having written an essay or a report independently gets certain knowledge. Preparation and defence of a report adds considerable number of marks to the rating of a student and can be taken into account at the exam. Besides the fulfilment of individual tasks is a good training for passing any exams.

Thirdly, students should be taught to look at problems analytically, argue and carry their points. This approach not only makes students think, but also orient them at tolerant attitude to other views and opinions, favours the forming of tolerance and "democratic personality".

Fourthly, students should be taught to analyse advantages and drawbacks of their work. The ability to see the merits and demerits of the solution is one of the abilities that should be constantly developed be-

cause it will help students to solve problem tasks in their future professional work.

It is important to note that individual students' work should be checked regularly as it helps to see the results and furthers the subsequent creative work. Lessons should be planned so that students could have the chance to demonstrate their individual work and discuss it. In some cases teachers might have hours for individual consultation for those students who need and want them.

Additionally, oral communication should occupy the main part of any lesson. If written work prevails over oral one, the process of teaching deteriorates. It goes without saying, that written work gives a certain idea about the level of students' knowledge, their ability to reason. But practice shows that sometimes students who have got quite good written work, turn out to be helpless when they have to do oral statements and presentations.

It should be said that computer program PowerPoint gives a great potential as a teaching tool at foreign language lessons. It helps to acquaint students with interesting information and serves as visual support while speaking teaching.

The use of PowerPoint at lessons has the following advantages:
- ➢ it combines various use of visual methods;
- ➢ it combines independent classroom with out-of-classroom activities;
- ➢ it helps to save study hours;
- ➢ it forms teacher-and-student computer competence;
- ➢ it develops students' creative abilities.

The practice of PowerPoint presentation helps students learn to make their presentation focused on a particular type of audience, learn what information to include in the presentation, understand how to keep the audience interested, and learn how to deal with questions.

As students make their presentation, the teacher should assess their performance. The following criteria can be used for assessment:
- ➢ material structure;
- ➢ logicality and succession;
- ➢ adequacy of visual means;
- ➢ slide accordance with a stated problem;
- ➢ information novelty and originality;
- ➢ language accuracy;
- ➢ phonetic and intonation accuracy;
- ➢ ability to keep the audience interested;
- ➢ ability to deal with questions.

Systematical individual work makes for the development of logical thinking substantially. Furthermore, ability and habit of individual work will undoubtedly help students in their future professional activity.

A certain potential for the solution of educational problems has the introduction of computer-aided teaching, the use of the Internet. Its basic purpose is to make teaching and learning more efficient and productive. With the help of computer programs students can check their knowledge, do different exercises and communicate in a written form. With access to the Internet students can communicate with native speakers (or other language learners) all over the world, search through millions of files around the world and access authentic material that answer their personal and professional interests.

Using a computer program a teacher can easily notice the mistakes which a student does. On the top of that, the work with a computer provides the following opportunities, it can:

➢ give a student the ability to work in an individual way;

➢ give a chance to return to any task which was left or omitted and correct the answer;

➢ give several exercises in which a certain structure, rule is trained;

➢ provide a chance to involve every student of the class in a studying process;

➢ show the results of the work as soon as the task is done;

➢ give the possibility to organise a self-dependent work.

But in spite of all these advantages the role of a teacher in the educational process is still important. We should remember that a computer program, like any other tool used in teaching (e.g. authentic books, DVD and CD players, television, resource packs, computer classes where students do laboratory work, projectors, etc.), does not bring improvements in learning itself. Moreover, there is no any unique book or computer program that can be suitable for everyone. That is why a teacher must select programs which answer definite requirements and purposes.

To summarize aforesaid, it can be emphasised that independent work is a part and parcel of the study process. Therefore, it is important to remember basic didactic principles of its methodological background: education scientific character, systematic learning, accessibility of learning, aware and active learning, knowledge consolidation, use of learning means, reflexive learning, creative and developing learning. Independent work helps to develop skills of applying theoretic knowledge in practice, train how to solve future problems and make decisions.

SOCIAL-ECOLOGICAL SELF-EDUCATION OF A FUTURE TEACHER
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The researches in the area of social ecology, psychology and pedagogic theory and practice show us that the main term of a rising generation training for the solution of modern social-ecological problems is an orientation of their future tutor to the problems of the interaction between the society and nature. In this connection a great need for his appropriate training arise. One way of such training is a social-ecological self-education. By this we mean the creation by a tutor the conditions for an independent acquiring knowledge in the area of the environment, forming needed in this case skills and abilities (self-reliant targeting and planning, self-organization, self-control, self-regulation, and self-correction), creative activity, not only within the process of self-education, but also in practical creative process in nature; development of emo-

tional volitional and value attitude to the natural environment.

Self-education within the sphere of social-ecological interactions, to our mind, is a complicated process that embrace all the aspects of a tutor's personality, so it has to be considered on three major levels: axiological, activity, and personal-creative (1).

The first level – axiological – provides for bringing all the elements of a tutor's social-ecological self-education system into the line with such pedagogic values as a: psychological-pedagogis knowledge, pedagogic tact, pedagogic thinking, moral world outlook and behavior etc. Via self-education a tutor obtains certain social-ecological values that gradually attain a personal significance for him. Some of these regulations are: "A man is a part of a nature", "A good's measure is a universality of nature "An accordance of social needs with natural abilities (a measure of natural stability)", "Universal (common) value of nature and culture". These and some other statements have a great social significance nowadays and become an imperative for separate systems of pedagogic knowledge, for example, particular methods of humanist science, and they also are enriched and widened by natural science and its methodology.

The second level, the activity level provides for the enrichment of the future tutor's activity by ecologically-targeted actions and separate operations. This is based on foundation of social-ecological and pedagogic values, gradually becoming a personal need. In other words, this aspect suggest a development of the appropriate technologies. The studying of the future tutor's social-ecological self-education process in the context of the solution of pedagogic problems that stand for the self-management objectives and from the position of a system approach brings us to the outpointing of the following links of a technological chain:

- pedagogic self-analysis within the self-education process;
- targeting and planning of self-education in the area of environment;
- organization of the social-ecological self-education process;
- the process of self-education control;
- regulation and correction of self-impact within this process.

All the links mentioned above includes a system of corresponding skills. Thus, a group of skills, that make up the basis for pedagogic self-analysis would probably contain:

- an ability to define the actual level of your own education level in the environmental area (social-ecological education level);
- an ability to reveal the difficulties, linked to the social-ecological self-education process;
- an ability to estimate an environmental education level of your colleagues and learn their positive experience in this area;
- an ability to identify your own capabilities for the solution of the problems of social-ecological self-education.

The third level – personal-creative level – exposes social-ecological self-education of a future tutor from the position of his inclusion into the creative activity of mastering a social-ecological knowledge and skills, aimed for studying, restoration, and protection of the environment, propaganda

of social-ecological ideas. Creative activity in the considered context starts with an algorithmic stage and ends with a creative stage (outlined by I.F. Isaev). The first stage provides for the strict list of actions, aimed for the environmental self-education. This list correlates with the complex of skills of all the technological links mentioned above. If the developed algorithm is not sufficient then the creative stage begins. In this case a new, nonstandard plan of the outlined objectives arises. New ways, new optimal composition of methods, means and form of the social-ecological experience mastering appear. As a result a possibility of a creative self-realization of a person in the area of social-ecological self-education; the development of a need for studying the natural surroundings, finding way of optimization of social and natural relations; reveal of the corresponding abilities, social-ecological intuition, independence and responsibility in the environmental relations. Defining the process of social-ecological self-education, its complicated content as one of the self-development sources, the subject (a future tutor) obtains the additional possibility to influence the others, first of all his pupils, define their orientation in the environmental interaction, direct them for the careful attitude toward the nature, and saving the nature for future generations.

Personal-creative aspect besides the creative component also includes a personal one. It has been defined, that social-ecological self-education is a area of a future tutor activity that has different ways of the realization of his essential strengths and acts as a social activity measure. Within the process of self-education the corresponding interests, needs start forming in the mind of a tutor, gradually a habit of ecologically-aimed behavior and activity arises. A tutor starts to convince the necessity of carrying out the activity of the environment improvement. Studying the history of social-ecological relations, a tutor learns to find the reasons of the contradictions that arise within these relations; analyze their contemporary condition, perform a prognosis. The social-ecological experience, mastered by a tutor becomes a part and a content of his essential strengths, the basis of his future activity aimed for saving and restoration of nature, people, and himself.

To sum up, we will once again outline the potential of self-education in the area of social-ecological environment, that not only conductive for the development of a tutors personal qualities but also rising an overall level of his social-ecological culture.

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THE HUMAN LIVE SPACE AS HARACTERISTIC OF PSHYCOLOGICAL SISTEM: ADAPTATION, SELF-REGULATION, SELF-ORGANIZATION

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In paper the general psychological aspects of studying of the human live space phenomenon are submitted. The concept of "the human live space" from a position of adaptation, self-regulation and self-organization context is differentiated. Approaches to research of the human live space as to display of psychological system self-organization are designated.

Key words: human live space, adaptation, self-regulation, self-organization.

Such terms as the "opportunities extension", "personal potential actualization", and "self-evolution" describing merge in uniform backgrounds of human development, its present in which the future is already submitted, act as synonyms of the human live space. That is why the term "human live space" implies the continuity of the process, establishment of various human manifestations in his life activity or a human being on the whole.

All opinions existing in psychology at present regarding human live space being as a problem of psychological systems self-organization can be divided into three groups in the course of the analysis.

The first group includes psychological theories of the so-called adaptive type. Despite of the fact that the representatives of this group define a human being as a self-organizing system, they constrict its development to adaptation or conformity to the external environment. Human self-evolution is connected to the improvement of psychological mechanisms of life activity regulation and is consciously grounded on individual abilities of a human being to adopt to changing environmental conditions during regulation process, on personal qualities guiding

one's social behavior and on the ability to assign universal human values, social standards and attitudes that "organize human life" [7].

Psychological theories belonging to the first group pay attention to the stability as a characteristic of personality. Numerous studies of this type are devoted to the stress resistance, emotional stability, tolerance as conflicts resistance etc. as characteristic features of a personality. The representatives of this opinion point out that a personality can resist negative influence and perform reasonable constructive changes in the environment due to psychological stability, thus, providing for the efficiency of life and activity, development and improvement of a personality as well as preservation of psychic health.

Scientists define the following levels of psychic adaptation: social and psychological; psychological (characteristic features of a personality, activities, and psychic states); psycho-physiological (integration of cerebral systems); peripheral (vegetative and humoral mechanisms). With account to numerous levels of psychic adaptation, it is considered to be an integral characteristic of a personality characterizing its stability and

capability to resist break-downs in psychic adaptation.

Thus, a self-organizing origin of psychological systems is considered by the representatives of the first group to be connected to the system's ability to adapt to environmental conditions which guarantees the system's stability at all its levels under changing external conditions. Education of a human being in the context of the research held by this group of researches is a developing process of person's adaptation to constantly changing environmental condition at all levels of psychological system organization. Here one may speak about unilateral "adaptation" of a person: adaptation of internal to external which determines if a person's life activity is a success, that is why education here means "adaptation" and "conformity".

The second group includes psychological theories considering self-evolution and self—organization of a human being as a process happening due to innovations that are "at the same time conditional and conditioning" for human development [13]. The representatives of this group believe that innovations are formed on the basis of a number of personal characteristics such as ability to keep and preserve all positive in one's history, accumulate the results of the development, keep up to date one's potential mental content, create something new in the world and in oneself extending the sphere of the potential [15].

V.G. Budanov points out that ideas developed in A.I. Bogdanov's tectology, L. von Bertalaffy's systems theory, N. Viner's cybernetics allowed to form a general idea about systems and their configuration, mechanisms for systems' integrity maintenance and homeostasis and ways of self-organizing systems management [4; 7]. In this respect, the key concept of the theories belonging to this group is "self-regulation" representing the ability to be a subject of one's own conscious activity and the process of realization of this ability [10; 13].

In case of self-regulation the system functions in the following way: regulation effect is formed by collaboration of all system's components and due to this requires no constant control, thus being more reasonable as far as resources are concerned. Researches sharing this approach define self-regulation as a systematic process including dynamic actions of a person (here these theories are superior to the theories of the first group) aimed at adaptation to constantly changing environmental conditions. The scientist underlines the cyclical pattern of this process.

Ideas about self-regulation developed in the laboratory for self-regulation of Psychological Institute of the Russian Academy of Education (O.A. Konopkin, V.I. Morosanova) are characterized by its complexity regarding the internal structure of the defined self-regulation components due to the original personal orientation of the studies. At present the researches' focus is transferred from general issues of self-regulation structure to the development of its cognitive and personal aspects, to the understanding of the fact that various personal and cognitive structures are backed by specific structures of individual subjective activity organization.

At the same time Russian studies differ from Western psychology in a way that the former develop from general theory of

structure and functions of conscious self-regulation to the study of personality and individual manifestations and forms of regulation, whereas western theories start from study of personality and separate sides of regulation and moves to an integral self-regulation theory and understanding of the fact that regulation consciousness is a very important personal dimension.

Despite of certain differences in approaches to the study of human self-regulation phenomenon, all scientific works demonstrate a common view of regulation as a most general function of psychic activity specific for a human-being allowing a person to act as a creator, executor, supervisor and judge of one's own activity, deeds, and life in general. Self-regulation is an embodiment of a general human ability to be a subject of one's conscious activity reflecting the abilities of his psychics and realized in a numerous variety of acts providing for the actual relations of the subject with various phenomena and manifestations of reality. Self-regulation is represented by two meanings: as a general ability for organization of activity of a human being acting as a subject of one's own activity and as a process of realization of the abovementioned ability in separate phenomena of activity, behaviour and communication. However, Russian scientist point out that the ability of self-regulation is becoming a general ability only upon completion of formation of an integral conscious self-regulation system, formation of its conscious control and its introduction to the internal plan of actions.

The subjectness of a person is developed and is becoming more sufficient in the process of further improvement of the self-regulation system, thus giving ground to certain personal innovations: confidence, self-sufficiency, responsibility, and initiative in all spheres of personal self-determination.

Therefore, according to the second group representatives' opinion, the self-regulation is one of the innovations considered in the framework of the "human being" psychological system, "regulating" both his relations with the world and formation of other manifestations of *self-* (self-cognition, self-determination, self-evolution, self-realization, self-actualization and etc.) that make grounds for reality formation "where everything is progress and nothing is beyond progress" [5; 171]. Self-organization of the psychological system is grounded on the basis of the human being's movement while performing individual vital activities at different levels aiming to accumulate innovations, of which central is psychic self-regulation.

However, the strategic factor for human being education in its complete sense can be the human being itself, and this is the opinion completely shared by representatives of the third group of psychological theories, according to which the self-organizing system is understood as the system that maintains its tolerance due to interaction with the environment and is able to transform its both its organization and processes within the system independently under impact of the environment. The conditions for the development of self-organizing systems as well as basic regularities and such mechanisms as differentiation, integration, hierarchization of elements, self oscillations and feedbacks are provided by the action of the strategic factor. The repre-

sentatives of this group believe that emerging of any self-organizing system, i.e. cluster of elements is caused by one and only reason: acquiring higher tolerance by these elements. The reason and, therefore, the objective of the elements cluster is the strategic factor (according to the authors of these theories and within the context defined by us it is a human being) due to whom the unity emerges for higher tolerance of its component parts. The developed unity, the system, can perform its main function subject to reaching the identity with the elements that formed it and that represent the self-organizing systems of a smaller size.

Expressing agreement with this characteristic (movement of the system in the direction of complication) we emphasize that in the framework of the evolution our position is close to H. Bergson's considerations that "evolutionary movement was something simple and we could easily define its direction if the life would have the one single trajectory like that of a cannonball fires from a cannon. But here we deal with a shell, which burst into fragments the moment it was fired off; and these fragments being, as it were, themselves shells in their turn burst into other fragments, themselves in their turn destined to burst, and so on throughout the whole process. We perceive only that is closer to us – disperse movements of burst fragments. Starting from them we will have to gradually come to the initial movement. When the shell bursts its crushing is explained by both explosive power of powder it is filled with and metal resistance. The same could be said about the life fragmentation into individuals and species. This fragmentation in our opinion is due

to the following two reasons: resistance experienced by life from the part of non-organized material and explosive force that the life bears in itself and that is caused by unstable balance of the tendencies" (Bergson). In this part we employ a big quotation since a metaphorical comparison of evolutionarity with the effect of the burst shell is most accurately reflecting the unevenness of the system movement. In this respect the chaos acts as a method for organization complications and a method for harmonization of development tempos for different fragments within a complex structure providing nonlinear nature of the systems development.

V.G. Budanov contributing to this opinion writes that "within the processes of self-regulation there is a qualitative compression of information as a result of quickly flowing process of natural self-selection that is difficult to trace; the product of these process being the order parameter able to be observed" [4; 40], this opinion is correlated with H. Bergson's opinion that if it is required for the new specimen occurrence that the change would reach a certain value and commonness then it is imperceptibly and continuously committed in any living being in any moment.

Within the context of the third group theories, the subsystems are interrelated and interdependent; therefore, the peculiarities of the structure as well as the quality of organization of one of the subsystems can depend on the structure and quality of the organization of the other. The transition of quality features from one subsystem to the other depends on the peculiarities of organization of the system correlations and to be

more particular, the quality features of these subsystems. In this respect E. Laslo remarked that "some systems are always requiring the medium of a particular type; it must be a medium consisting flows where the rich and continuous energy source is expanding the system" [11]. This point of view in its essence complies with the opinion expressed by A.G. Asmolov who pointed out that qualities of a human being that characterize one as the system element "open" only in the conditions of interactions within these or those systems [1]. In this respect, Ye.A. Semenova considers that the main strategic factor of a human being development is the human being itself, while the mechanisms of self-development in the authors opinion can be self-planning, self-regulation and self-organization [14].

Special emphasis shall be laid to psychological theories in the third group since these employ the heterostasis principle alongside with the self-regulation principle. The question is the highest level of systematic organization of a human being – "development going beyond the standards through the standard-setting" [9; 54-55]. The representatives of this group point at the universal feature of self-organizing systems of any nature, i.e. self-determining that allows re-addressing the responsibility for the choice from the external causation or necessity to a human being itself. This feature of a human being as a self-organizing system allows to consider the latter as the one able to "set oneself at the "limit" … that symbolizes for him the readiness to part with oneself as one had been before the "event", i.e. to change oneself" [12; 353] acting not as a

simple chain in the evolution but as the one responsible for the evolution.

Thus, having defined a human being as a self-organizing system we can detach the process of the system's production and generation of the new that is immediately implemented into further determination of the system self-organization as a form where its development is performed. Thus, V.Ye. Klochko indicates that through the acts of such generation (the system's generating the new) the self-organized system obtains the possibility to influence itself. According to him, this is "the principle of the system determination without which it is not possible to explain the mechanisms of the system self-organization and self-development as a form where self-organization is revealed" [8; 4].

We pay attention to the fact that the education of a human being as a self-organization is possible in the space defined by the unity of the world and the human being itself since "beyond us the world is mutual propensity without succession, we have succession inside us without external sets-string", and only the unity of these beginnings makes "the process of organization and interpenetration" [2].

Within the context, the education of a human being can be considered as the problem of self-organization of one's living space (according to M.K. Mamardashvili, without a human being "the world shall lack order, truth and beauty"), since the life of a human being itself is like a trajectory of movement of the self-organizing system within the time and space.

We believe that the third group of the research has a direct access to the research of the human being education that is under-

stood as the expansion of the possibilities since it considers the problems of emerging, existing, transformation, development and self-development of a human being in their unity. In the framework of these research, there is a possibility to consider the issues of individual strategies defining the direction vector and content of a human being education that are in their turn are defining in respect of the selected strategy for the living potential realization [6; 248]. In the process of life targets realization that seemed ended, we reveal their "transition", "temporary" nature that reveals the prospects of movement to the next objective. This is why in each single deed, action, act of vital activity and life creation a human being "feels oneself a part of this powerful life impulse" [3; 305], personifying in the process of life the creativity, endless development, unperceivable variety that is the infinite number of freedom degrees that defines unlimited possibilities of a human being. In the coincident point of the human being possibility and reality conditions the "successful life" of a human being starts its development as a guarantee of achieving the objective in performing each separate action. This is why the objective's achieving gives to the human being the largest subjective satisfaction grounding the successfulness in life.

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THE IDEAS OF IMMANENT PUBLIC EDUCATION: SOCIO-PHILOSOPHICAL ANALYSIS

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Modern situation of the society and the person development specifies new characteristics of education. It should become immanent and public in opposition to transcendency and discreteness. Immanent and public character of education is initiated by individual educational trajectory.

The aim of this article is socio-philosophical analysis of the ideas of immanent public education.

Keywords: education-in-life, everyday life, social situation, emotional experience, co-being, formation

The development of the concept of the immanent public education was initiated by the following factors of society and education development as its social institute: 1) necessity of person maintenance in his triune entity: body – soul – individual spirit; 2) rupture between education and practice of a person vital activity; 3) dynamics of society development that arouses the change in educational standards during the life of one generation; 4) uniqueness of a trainee's personality that cannot be limited by the standard; 5) absence of taking into account motives and person needs; 6) absence of conditions in educational process for planning an individual educational trajectory; 7) necessity of formation the pluralistic consciousness of a person.

The concept of the immanent public education is presented by the system of ideas that are correlated with the above mentioned factors and can be considered principles. Let us name these principles: Not to have learned, but to experience. To know means to exist. The outside world and me as its part is the University of Life. Every social situation is educational. The high quality education is "The high quality" person. A word is a manner of a business. Everyone has as much as he can take. Everybody works for everybody. Let us consider the contents of these principles in detail.

1. "Not to have learned, but to experience". Globalization and informatization tendencies open the world to a person and a person to the world. As a result speed relations are provided ("+") and boundaries of personality space are effaced ("-"). Here sets the task – to keep a person as a spiritual creature that can see and realize all fullness of being. We consider "emotional experience" as a mechanism of keeping human in a person.

Firstly, emotional experience – is a display of a person being as it means "emotionally colored *state* and *reality,* a person feels, that is directly represented in his consciousness and acts for him as *an event* of his life" [selected by us, 2, p. 203]. Secondly, it is a kind of social mechanism that includes an individual in being as it fills his life with co-beings. (M. Heidegger, das Ereignis). Thirdly, emotional experience in certain extent provides person vital activity as it has

need-and-notional and operational character. Need-and-notional character of emotional experience is contained in its connection with motives, goal-setting and reflection. Operational character of emotional experience is contained in a function of orientation and choice. The choice is carried out by a person on basis of his importance awareness of what is going on. Thus emotional experience is connected with reflection (the process of a person's self-knowledge of inner mental actions and states) as well as with value analysis (the process of dismemberment whole to the parts from a position of significance of the phenomenon, fact, event for a person).

In the context of our research we distinguish two types of activity according to knowledge mastering – "to learn" and "to experience". The one and the other allow a person to appropriate knowledge, to include it in his experience. However they differ in mechanisms of knowledge appropriation. First of all "to learn" appeals to memory (cognitive process) and is concentrated on content of a thing studied. Thereby the studying process to education is carried out. The emotional experience is more abundant than memorizing. It puts into operation a person self-consciousness. The self-consciousness activity is provided by all processes concerning person Self-concept: cognitive, emotional, and volitional.

Thus emotional experience shows immanent character of education. On the basis of importance of emotional experience we can consider it a mechanism of a person "humanization" in opposition to his "materialization". However the presence of emotional experience in educational process

only, from our point of view, will not solve all problems. There is a rupture between education and practice of a person vital activity.

2. "To know means to exist". (A.F. Losev). This statement means overcoming rupture between education and other spheres of a person social being. The overcoming of rupture is possible, from our point of view, at the expense of restoration of person integrity, his realization of *his* individual educational trajectory. Under individual educational trajectory one can understand the unique, appropriate only to the given person line of self-development in educational space that is realized on basis of *realized choice* of main components of education.

What allows knowledge to provide social being of a person?

1- Person exposure his educational needs and requirements.

2- The formation of educational aims.

3- Receiving education then and so much, when and how much a person needs.

4- Finding sense in educational activity for support of realized needs and revealed requirements. Thus filling the deficit in knowledge and abilities, values, aims, a person appears on the other level of self- development. And with it social being of a separate person of education is a subsystem in systems. There are certain cases when a person "studies" not in social institutes. His own life is teaching him.

3. "The outside world and me as its part is the University of Life". This idea is initiated by dynamics of society development that arouses the change of educational standards during life of one generation.

Therefore not to drop behind the life, one should interweave it in acts of education. It defines immanence of education. "Education-in-life" means that content of education is in life itself. Hence everyday life can be considered educational space. Firstly, everyday life as a display of being is pierced with information (phenomena, events, facts et al.). Secondly, everyday life as a social phenomenon presupposes description of intersubjective reality (A. Schutz and his followers). For people this reality is important with its quality of *integral* world and is interpreted with them subjectively. Thus multiplicity of worlds arises; hence every person is a world. "How many people, so many worlds" – affirms Atisha, the reformer of Tibetan Buddhism. Thirdly, everyday life as a process of life- habitation is always contextual. In everyday life, as a rule, context is taken into account: what was "before", what will be "after". It follows thence, that every person of education is in *his (educational) context*.

Thus, everyday life – is a kind of "field of senses" where a person defines himself, his place in the world, in the society, in the activity. Realizing processes of self-knowledge, self-identification, self-determination a person writes his story, creates his world. Crossing of worlds and discovery for oneself a world of another defines sociability of education.

The idea of education-in-life involves the idea of accounting social situation where a person of education is situated.

4. "Every social situation is educational". Individual educational context of a person is a display of uniqueness of its social being. Thus it is impossible and inadmissible to limit education in standard. Standard is a base for development, not the Procrustean bed where it is necessary to cram a trainee. Whereas education is situated in life, every social situation as a totality of circumstances may be educational, ecological, and test.

The social situation is educational under a person's involvement into being with his actions that have reformatory character int.al. As S.L. Rubinstein notes, these actions "are caused by the situation itself, as well as the correlation with a person's needs" [1, p. 357]. A man creates a situation, situation creates a man, whereas any situation "in its essence is problem. Hence – a person's constant going out the scope of situation, and the situation itself is formation" (ib.). Solving the situation a person studies, gains experience.

The social situation is ecological because a person is always situated in a system of relations (to the world, to people, to business, to himself etc). It follows thence, that it is necessary to consider every social situation ecological where the main commandment – "do no harm" is realized (should be realized). This approach to the social situation may become particularly one of the bases of a person tolerance development and of a society as a whole as conditions of keeping human in a person.

The social situation can be called test according to he following reasons. 1) As it was mentioned above, a person of education is considered a wholistic integrity (subsystem in systems). Therefore, it, as any integrity, is inherent in certain features, characteristics, and qualities. 2) In that case it is possible to consider the concrete activity that is set by social situation, a "test". 3) The

presence of necessary qualities allows a person to be successful in the activity process. 4) Their absence sets the trajectory of a person development. Thus, social situation as educational, ecological, and test provides the development of individual educational trajectory and initiates the process of a person integrity restoration. A person forms new qualities during the process of his integrity restoration. Hence the forth idea follows.

5. "The high quality education is "The high quality" person". The appearance of this idea is provoked by transcendency in relation to a person of education. From our point of view the main purpose of education is provision of person positive changes of his qualities, his self-formation. In the context of the open immanent education the source of education content, except standards, is everyday life as "a field of possible senses". In that case individual educational trajectory of the education person (accounting of needs and requirements) is "a navigator". "Navigator" provides a person with replenishment of his individual educational experience with senses and values - a sort of "educational GPS".

On the one hand, the interests of the society and the state are provided in an educated person that is adequate to modern conditions. On the other hand, the accounting of motives and education person requirements is provided. Realization of his individual educational trajectory, in turn, assists the development of an integral person at the expense of the constant going out of integrity on a new level. The formation of a different oneself is provided by one of the most important mechanisms – self-planning.

6. "A word is a manner of a business". (Solon from Athens). This idea is provoked by the absence of conditions in educational process for planning the individual educational trajectory. It supposes planning and realization a different oneself in the process of a person development as a condition of integrity restoration.

Philosophers affirm that a man is the only living creature that is characterized by a constant necessity of self-development that is set by the very human entity. Thus, V.S. Solovyev emphasizes in his paper "The Ideas of Superhumanity" that "only a man from all living creatures… is capable of self-development, that he always wishes to be greater than himself" [6, p. 348].

In this very context we consider self-planning a process of formation I-ideal (I-possible) from the cognition of his requirements, potential, goal-setting on a choice and dicision-making. Self-planning trajectory requires instrument of its realization. Thus it is logical to present the following idea.

7. "Everyone has as much as he can take". At present acts of education are realized, as a rule, without accounting of trainee person motives and needs. The principle of natureconformity is put in the base of this very idea as "compliance in the track of the very nature" in education (Ya.A. Komenskiy). As every person is situated in his educational context he possesses a set of instruments for cognition that *are peculiar only to him*. And this is realized in his individual activity style. This idea initiates the development of a person subjectness, forms such qualities of a person as self-confidence (a self-confident will attain the aim), self-dependence (a man creates his world himself), activity of his so-

cial position. Besides things above mentioned, the development of cognitive motivation is initiated (is a man wants knowledge, he will acquire it). After all, it provides the success of his activity.

But by virtue of what the abilities develop, skills form, ways determine?

8. "Everybody works for everybody". Globalization tendencies set the process of a person consciousness expansion, the necessity of a person pluralistic consciousness formation that is able to let the world of the Other in his own world. Communication, solidarity, co-authorship, collaboration, and empathy are conditions of it. They can act as means with the help of which individual educational trajectory forms.

If everyone implements his educational trajectory (everyone works for himself), the situation of collaboration, where everybody work together, creates a new type of relations – partnership. As a principle of modern management this idea has certain advantages, among which we can mention: 1) the exchange of experience is more effective while working in a group; 2) it is possible to learn not only from one's mistakes, but from other's either; 3) there is a possibility of supervision because "the onlooker sees most of the game"; 4) personal interest, work spirit; 5) the common aim - one cannot stand aside and be disinterested while working in a team; 6) the status of a trainee is affirmed (improved) because collaboration presupposes delegation of authorities and responsibility; 7) the intellectual background of a group rises, etc.

Everyone individual educational experience is demonstrated in this process. It is unique. Its demonstration enriches every-

body. Pluralistic consciousness that differs with internal consistency is formed. (M.M. Bahtin).

One can define the aim of the immanent public education on the basis of the given system of ideas:

As a sphere of a person sociocultural practice: formation of an integral (self-conscious) personality in the process of his socialization.

As a social institute: the creation of conditions for formation of an integral (self-conscious) personality in the process of his socialization.

3) Formation of an integral (self-conscious) personality in the process of his socialization.

Formation is connected with self-planning and self-development of a person as an "enrichment of active abilities and other personality qualities of a man" [4, p. 250]. The truth to this opinion is attached by the following meaning of the definition "formation"– "acquisition of new signs and forms in the development process, approach to the certain condition" [ib., p. 295].

One can draw the following conclusion on the basis of above-stated:

1) The given ideas are a system, as far as they are interdependent and interrelated.

2) In this system each of the ideas plays its own peculiar role; there is a level hierarchy: methodological and technological.

3) A man, considered a system, is a backbone element in the context of his education.

4) The ideas may play the role of the immanent public education principles, as far as they are the base for its character: immanent because it is inherently appropriate to

the being; public because education considers everyday life as a field of senses, "education-in-life".

5) The ideas are a concept of innovative education, because they contain necessary and sufficient elements in their system integrity: aim, sense, goals, content, and technology (ways, means, and mechanism) of its realization and, thus, cardinally change the content and the structure of the educational process.

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THE ANALYSIS OF PHYSICOCHEMICAL PROPERTIES OF COMPOUNDS OF THE PERIODIC SYSTEM GROUP IIA ELEMENTS WITH SINGLY CHARGED ANIONS

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This paper describes physicochemical properties of compounds of the periodic system group IIA elements with singly charged anions in various reference frames. The obtained correlations may be used as a reference material to calculate the selected properties for every point of correlation. It has been additionally suggested, within the scope of the paper, to predict the properties of compounds of an element bearing the atomic number 120 (E-Ra).

The compounds of Mendeleev's periodic system group IIA elements are essential in terms of industrial application and research activities.

An array of various techniques is presently known to be applied to determine physicochemical properties. These techniques serve to find correlation dependencies between the rows of similar compounds [1, 2]. However many of the existing techniques do not allow to establish mathematical relationship with regard to physicochemical properties in subgroups of the periodic system. They also need a huge array of properties in order to determine a single one.

This paper summarizes the results of an investigation into the relationship between a range of properties [3-5] - formation enthalpy, Gibbs free energy, entropy, specific heat; enthalpy and entropy of transition from one phase to another (melting, evaporation); crystal lattice energy, melting temperature and density – and the charges of atomic nucleuses of the periodic system group IIA elements, as well as the number of energy levels. Halides (chlorides, fluorides,

iodides, and bromides) and hydroxides have been selected as singly charged anions. The analysis involved the plotting in various reference frames, and subsequent analytic description by means of Windows-compatible software packages Table Curve 2.03® produced by Jandle scientific™ and Microsoft Excel.

The relationships on coordinates $F=f(Z)$, $F=f(n)$, where F is a selected physicochemical property, Z is an atomic number (nucleus charge) of an element, and n is a period number (energy levels number) are shown as broken curves, but the applied software allowed for steadily varying smooth curve.

As the nucleus charge of a cation increases in compounds $Me^{2+}(OH)_2^-$ and $Me^{2+}(Hal)_2$, both formation enthalpy and Gibbs free energy reduce, while entropy grows. Besides, $\Delta H^0_{298,15}$ and $\Delta G^0_{298,15}$, and $S^0_{298,15}$ have been noticeably increased, with a halide transiting from one period to another (from fluorine to iodine). The situation with hydroxides is somewhat different. In this case the values of formation enthalpy

and Gibbs free energy increase from beryllium hydroxide to calcium hydroxide, and, naturally, decrease from calcium hydroxide to radium hydroxide. Hence, the plotting for these compounds differs in terms of its graphical view. Apparently, beryllium hydroxide and magnesium hydroxide differ from other elements of the row. These relationships are evidently curvilinear. Therefore, the authors suggest that a specific property - a value of property which refers to a nucleus charge unit - should be used in order to smooth data.

Linear relationships can be obtained if plotted on logarithmic coordinates $\ln(F) = f[\ln(Z)]$, $\ln(F/Z) = f[\ln(Z)]$, $\ln(F) = f[\ln(n)]$, $\ln(F/Z) = f[\ln(n)]$. The analysis of logarithmic correlation dependencies has revealed that nearly every line exhibited a kink for calcium compound. Therefore taking into account a certain difference of the first two elements of beryllium and magnesium from other elements of the principle subgroup of the group II we could cut off the logarithmic data on compounds of beryllium and magnesium, and plot dependencies for other compounds of the row (calcium, strontium, barium, and radium). It has been observed that the correlation coefficient increases at that, whereas the value of relative deviation reduces.

The abovementioned can be used as a ground for a logarithmic rule according to which logarithmic values of a property (specific property) are linearly correlated with logarithmic values of the element's nuclear charges (number of a period).

The derived analytical expressions served to predict the selected properties

with regards to compounds of an element bearing the atomic number 120 (E-Ra). The correlations good in terms of prediction have been selected with regard to high correlation coefficient and following the calculation of root-mean-square deviations based on least square technique [6, 7]. The Table 1 shows the analytical expressions recommended for prediction of thermodynamic properties of hydroxides of the group IIA elements with singly charged anions, with deviations indicated for every point of correlation. Similar equations have been derived for calculation of other properties of halides but they are absent from the diagram.

Correlations between various properties as well as between the halides of the group IIA elements should be plotted in order to evaluate the data obtained. The paper suggests a number of correlations – between formation enthalpy and the sum of the first two electron binding energies (ionization energies), as one of principle energy characteristics of elements; between formation enthalpy and crystal lattice energy; between formation enthalpy and standard electrode potential; between crystal lattice energy and standard electrode potential; between crystal lattice energy and the sum of the first two electron binding energies (ionization energies); between thermodynamic characteristics in the row of halides; between thermodynamic characteristics of chlorides and other halides of the group IIA elements (see Fig. 1).

Prediction analytical expressions have been derived for every correlation. These have been selected in a similar manner – on the basis of maximum correlation coefficient

Table 1. Analytical expressions adequate to determine thermodynamic values of hydroxides and halides of the periodic system group IIA elements

Dependence	Equation	MeHal$_2$ Me(OH)$_2$	Absolute Deviation, Δ	Relative Error, δ%
$\ln(-\Delta H^0_{298,15})=f[\ln(n)]$, for Ca(OH)$_2$, Sr(OH)$_2$, Ba(OH)$_2$, Ra(OH)$_2$	$\ln(-\Delta H^0_{298,15})=7{,}1 -0{,}1[\ln(n)]$	Ca(OH)$_2$ Sr(OH)$_2$ Ba(OH)$_2$ Ra(OH)$_2$	-1,4 2,9 -0,9 -0,4	-0,2 0,3 -0,1 -0,04
$\ln(-\Delta G^0_{298,15})=f[\ln(n)]$, for Ca(OH)$_2$, Sr(OH)$_2$, Ba(OH)$_2$, Ra(OH)$_2$	$\ln(-\Delta G^0_{298,15})=6{,}967-0{,}119 [\ln(n)]$	Ca(OH)$_2$ Sr(OH)$_2$ Ba(OH)$_2$ Ra(OH)$_2$	-0,522 1,112 0,046 -0,063	-0,058 0,127 0,005 -0,008
$\ln(S^0_{298,15})=f[\ln(n)]$, for Ca(OH)$_2$, Sr(OH)$_2$, Ba(OH)$_2$, Ra(OH)$_2$	$\ln(S^0_{298,15})=3{,}55+0{,}63[\ln(n)]$	Ca(OH)$_2$ Sr(OH)$_2$ Ba(OH)$_2$ Ra(OH)$_2$	0,46 -1,67 2,07 -0,79	0,55 -1,79 1,90 -0,68

Note: logarithmic equation should be exponentiated, while an equation for specific property should be multiplied by a corresponding nucleus charge in order to determine the property required.
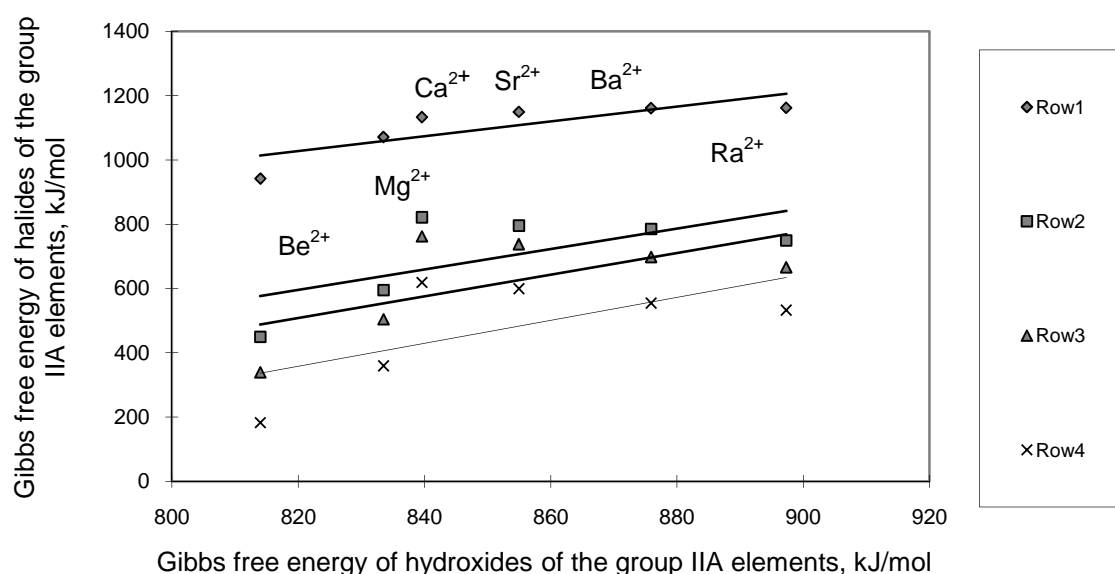
Figure 1. Gibbs free energy correlation between hydroxides and halides of the group IIA elements

Row 1 - fluorides, row 2 - chlorides, row 3 - bromides, row 4 - iodides

and minimum root-mean-square deviation. On the whole, all correlation dependencies are linear. They can be described by the equation y=a+bx, where y and x – properties, a and b – coefficients in equations (Table 2).

The correlations analysis demonstrated maximum deviations for halides and hydroxides of beryllium and magnesium. Hence, more accurate correlations for prediction of selected compounds of E-Ra could be obtained by dividing those correlations

Table 2. Coefficients of correlation dependencies between properties of chlorides of the group IIA elements

Dependence	a	b	R^2
$-\Delta H^0_{298,15}=f(\Sigma E_{i1}+E_{i2})$	1291,696	-0,292	0,9714
$-\Delta H^0_{298,15}=f(-\varphi^0)$	-176,459	346,982	0,9721
$-\Delta H^0_{298,15}=f(E_{latt})$	1630,555	-0 ,386	0,9810
$E_{latt}=f(-\varphi^0)$	4224,723	-726,707	0,8593
$E_{latt}=f(\Sigma E_{i1}+E_{i2})$	1070,308	0,657	0,9907
$-\Delta H^0_{298,15}=f(-\Delta G^0_{298,15})$	-47,184	0,999	0,9999
$-\Delta H^0_{298,15}=f(S^0_{298,15})$	46,448	6,509	0,9233
$-\Delta G^0_{298,15}=f(S^0_{298,15})$	-1,373	6,507	0,9247

into two blocks. Among other things, the division leads to increased correlation coefficients and reduced root-mean-square deviations.

Similar dependencies – with plotted prediction data for halides and hydroxides of an element bearing the atomic number 120 – served to confirm the accuracy of results. Furthermore, correlation coefficients have remained sufficiently high, root-mean-square deviations have not increased, while coefficients of correlation equations have remained almost unchanged.

The Table 3 shows prediction data for fluoride of E-Ra (#120) as well as missing data for radium compounds. The data with regards to the same properties of chlorides, bromides, iodides and hydroxides of radium and E-Ra have been obtained in the course of investigation. However, they are not included into the diagram.

Table 3. Physicochemical properties prediction data

Condition	Element	Value of condition
Fluorides		
$-\Delta H^0_{298,15}$	E-Ra (№120)	1170,63 kJ/mol
$-\Delta G^0_{298,15}$	E-Ra (№120)	1131,542 kJ/mol
$S^0_{298,15}$	E-Ra (№120)	121,778 J/mol*К
ΔH_{melt}	Ra (№88) E-Ra (№120)	16,09 kJ/mol 13,11 kJ/mol
ΔS_{melt}	Ra (№88) E-Ra (№120)	9,22 J/mol*К 7,39 J/mol*К
ΔH_{evap}	Ra (№88) E-Ra (№120)	281 kJ/mol 263 kJ/mol
Cp	E-Ra (№120)	72,53 J/mol*К
E_{latt}	Be (№4) Ra (№88) E-Ra (№120)	3262,49 Joul 2218,39 Joul 2132,28 Joul

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PRIORITY AREAS FOR SCIENCE PROGRESS IN KAZAKHSTAN

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In the period of globalization and the country's deeper integration into global economy, Kazakhstan economy has transferred to the innovative course of development and has become more open which is on the whole an imperative to keep stable economic growth in medium-term and long-term perspective. In the period of world economy globalization, accomplished position of a country, region or a sector of economy is based on the constant renewal aimed at achieving maximum efficiency, competitiveness, and human capital development. These basic principles are the main ones in Kazakhstan Presidential Addresses.

In the Conception of the Kazakhstan's transfer to the stable development for 2007-2024 rather ambitious goals are stated: Kazakhstan citizens' salaries are to become similar to those in developed countries, labor efficiency is to grow multiply, new positions are to be gained on the world market, etc. According to the existing evaluation, 30% to 50% of GDP growth is determined by innovations and technical developments. They can be carried out only in case there is a radical increase of economy competitiveness in our country on the basis of constant technological renewal and qualitative increase of technological development's level of sectors of economy. For that purpose it is necessary for all the participants of Kazakhstan technological development (government, business, science, society) to have a common point of view on the country's technological future. The key role in the process is that of the state which does not only initiates but also guarantees achieved agreements implementation.

Of a special significance in the development of the state scientific and technical and innovative strategy is a new practice of scientific development priorities definition by means of Foresight Method, which is understood as process of systematic definition of new strategic scientific trends and technological achievements that in the long-term perspective can impact economic and social development of the country. Nowadays such a method is widely used in all the industrially-developed countries.

Technological Foresight initiative in Central and Eastern Europe and the CIS has been implemented since 2001. This program includes distribution of the best world experience of Foresight Projects, trainings, regional foresight centers net development.

In order to achieve goals of the science development, the State Program of Science Development until 2012 has been developed which provides new approaches to organization and management of science and development of innovative environment able to promote research activity in the Republic. To continue improvement of the state system of scientific-technical information and to form expert and analytical environment, this Program provides prognostication of research and scientific-technical development. In accordance with this Program, appointed by Ministry of Education and Science of the Republic of Kazakhstan S. Amanzholov EKSU is doing foresight research aimed at definition of priorities of scientific and technical development of the country. The partners

are leading research centers, universities and organizations of Kazakhstan and foreign countries.

Objective of Foresight Research

The Foresight Research (FR) objective is to define priorities of scientific and technical development and working out alternatives of long-term scientific and technical development of the Republic of Kazakhstan in the system of international scientific and technical cooperation based on the development of national innovation system.

To realize the above mentioned objective the following tasks are to be done:

- analysis of the best world foresight research practices;
- definition of prospective sciences and technologies which could be the base for Kazakhstan long-term scientific and innovation development policy;
- evaluation of technical application of the chosen sciences and technologies to increase competitiveness on the world and national markets and to develop sectoral development strategies;
- definition of mechanisms of supplying bodies of state administration and subjects of national innovation system by analytical materials on trends, threats and possibilities in the field of science and technologies.

Kazakhstan has adopted a very ambitious program aimed at long-run increasing its technological competitiveness on the global market. At the same time the government states that success on the international and national level will much depend on effectiveness of modernized science and technology potential of the country in educational and research institutions, design projects, businesses and services. Taking into consideration growing public support of scientific research it is most important to define priorities for public financing. While defining investment priorities it is most significant to consider international competitiveness of Kazakhstan. At present even developed countries with breakthrough technologies are not able to conduct research in all sciences and technologies and have to focus on development of five-seven scientific priorities.

Priorities suggested as a result of the foresight research are based on the priorities defined by High Science and Technology Committee of the Republic of Kazakhstan. Support of a scientific or technical priority is at the same time to enhance a significant growth of national education opportunities, to promote career of promising young scientists and technologists and increasing prestige of Kazakhstan science and technology on the national and international level. It is important to define the policy promoting companies to invest in innovations either into their own laboratories or to research institutions by outsourcing.

Today in the country definition of priorities is done collectively with consideration of proposals of government bodies, scientific and higher educational institutions, scientific community and outstanding scientists, foreign experts. The final approval of research priorities is made at the meeting of High Science and Technology Committee of the Republic of Kazakhstan with consideration of recommendations given by the International Expert Council.

Legal Base for Conducting Foresight Research

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┌──────────────────────────┐      ┌──────────────────────────┐      ┌──────────────────────────┐
│ Kazakhstan President      │      │  Global Competitiveness  │      │ Kazakhstan Law of Science│
│ Address                   │      │  index of 2008           │      │                          │
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   │ Conducting foresight research for defining priorities scientific and           │
   │ technical  development  of 2008-2010                                           │
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│ Development of Kazakhstan │                              │ Kazakhstan 's becoming one of │
│ national Innovation       │                              │ the 50 most competitive world │
│ System Pogram of  2005-2015 │                            │ countries strategy           │
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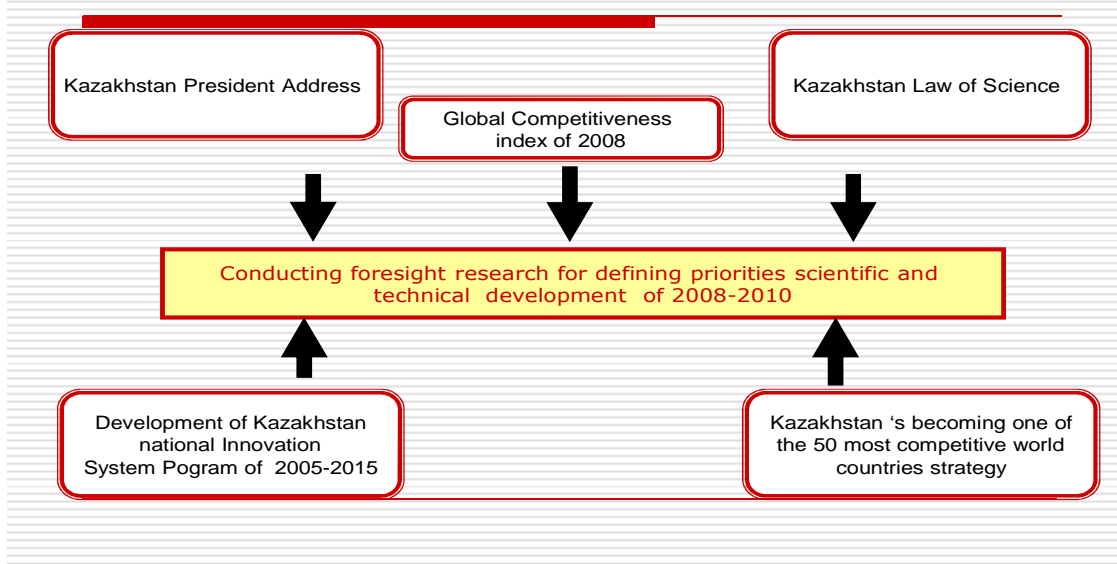
International Expert Council is an advisory consultative body which is every three years to report to the High Science and Technology Committee of the Republic of Kazakhstan about world trends in scientific and technical development and Kazakhstan potential for conducting cutting edge research in certain fields.

Among scientific and technical priorities of the High Science and Technology Committee of the Republic of Kazakhstan for 2007-2010 there are the following sectors of economy:

- nuclear research and technologies;
- IT-technologies;
- biotechnology and bioindustry productions;
- chemical industry;
- environmental protection and nature management technologies;
- agro-industry;
- energy and industry.

The following scientific and technological fields can be defined as priorities for the next 5 years:

1. nuclear research and technologies (radioecology, uranium extraction);

2. biomedicine and biotechnologies (disease diagnostics and prevention, cancer treatment, chemistry of natural products);

3. agricultural sciences and technologies (grain production and processing, increase of meat and milk production, food industry);

4. natural resources (ore deposits review, environmental protection);

5. hydrology and meteorology (irrigation systems, water quality monitoring, automatic air monitoring, non-environmentally friendly weather conditions forecasting).

Research in innovation is the most important component of the world scientific and technical development. So the leading educational centers which combine educa-

tional and research activities increasingly pay their special attention to the latter. Focus on innovations is the key element of the Republic of Kazakhstan Development Strategy until 2020 and the basic principle of the "New Decade – New Economic Growth – New Opportunities for Kazakhstan" address of Head of the State.

Within the framework of Industrial and Innovation Development Strategy until 2015 necessary conditions for innovation implementation have been provided. The institutional system has been formed: the National Investment Fund, Engineering and Technology Transfer Center, Science Fund, Science Committee, financial institutions of development have been founded. The "Innovation Support of Activities" law has been adopted. To upgrade Kazakhstan scientific research infrastructure 5 open national laboratories in priorities of scientific development have been founded, one of which being established at our University in 2009. This year the Accelerated Industrial and Innovation Development Program for 2010-2014 has started. Within the framework of the program the up-to-date national innovation system is to be formed.

To reinforce scientific and technical potential of the country, Head of the State has underlined the necessity of profound modernization of the scientific complex of the country. A new science draft bill which goes with current international practices has been prepared.

Kazakhstan scientific and technological potential should develop rapidly, attracting scientists in breakthrough fields of study. Besides, if Kazakhstan is intended to get profit from expanding global information infrastructure, which enables to export services and evaluate export markets in many fields, it should train talented and mobile workforce which can play a more active part in country priorities' support and on the international level. The main innovation resource of a country is human capital that is why the main aim of the national education system is development of human capital and enhancing its creativity and intellectual level.

Speaking about specific scientific and technological fields which are to be supported, while evaluating their significance it is necessary to consider if Kazakhstan has or is able to get within next 5 years leaders in technology as well as human and material resources essential for realizing research programs and providing scientific and technological services which could contribute much to the social and economic development of the country. In the course of time such a progress could be measured by the following criteria:

1. increase of production profit of Kazakhstan exporters based on scientific achievements or of supplies of scientific and technological services for foreign clients;

2. attraction to Kazakhstan of new national and foreign investments for research or scientific and technological services of national organizations;

3. growth of well-being of the population as a result of implementation pf results of scientific research or scientific and technological services.

Kazakhstan has great resources enabling it to develop and use science and technologies for increasing world competitiveness of the country and economic and social well-being of the population. In general, the

results of the Foresight Research show that at present the country has the necessary preconditions and facilities to put economy to the innovative course of development and thus to achieve strategic aims of the country development.

CONCEPTUAL APPROACHES TO THE ASSESSMENT OF THE ECONOMIC SYSTEMS' SENSITIVITY

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The problem of the interaction between enterprises and external and internal environment, as well as the development of mechanisms that provide the effectiveness of this interaction is of particular significance and relevance.

Consequently, it is necessary to apply more advanced approaches to strategy and planning system of the industrial and economic activity of an enterprise, to create more effective management.

At the present time relevant to the works on economic, managerial problems is a systematic approach, one of the basic concepts of which is the notion of system.

Economic system is determined as a set of interconnected economic elements that form the resistant integrity.

The economic system's functioning represents the set of coordinated actions which are necessary for the carrying out of a definite task.

In the analysis of economic system its sensitivity to the influence of various parameters (or factors): technical, manufacturing, economic, financial, plays an important role.

Consider the influence of the factors of external environment on the economic system and its possible response in connection with the change of main properties, one of which is the stability.

Suppose that the system resides in initial state at the moment of time t_0.

External factors affect the properties of the system and change them with a certain force.

In the process of influence every factor can:

1. intensify the action of the inner property of the system with the endless speed – namely there is a jump, or with definite speed – namely arises the smooth transition of the system in another state;

2. decrease the action of the inner property of system with endless or with definite speed;

3. extinguish acting process in the economic system;

4. does not act on the properties of the system, that is to pass through the system in the same state, as on entrance or to be extinguished in it

The new state of the system – the state, in which she passed changing its properties under the influence of external parameters – can be stable, unstable or the system can reside in the interim area.

For ensuring of the resistant development of economic system or for transition from one state to other on this stage is apply fitting sequence of management tools.

The influence of the management tools can return system to the state, close to the initial one or to transfer it to another area of stability. Following variants are possible here:

1. If the system resided in the resistant area, then arises its further development, or system can lose stability and turn into the interim area;

2. If the system was in the interim area, then influence of the management tools can transfer system to the resistant or unsteady area;

3. If the system resided in unsteady area, then influence of the management tools can transfer system to the interim area or lead to the business failure.

Since the economic system isn't only by influenced control tools but also exterior parameters which change the properties of the system with various force and the behavior of its elements the any reaction of system on the control tools is possible – either positive or negative. That is why it is necessary to research the:

1. the initial state of the system at the moment of time t_0;

2. reactions of the system for the exterior perturbation actions, the research of the sensitivity of the system to the action of various parameters;

3. the behavior of elements and changes of the main properties of the system;

4. also it is necessary to determine the location of the system in one of the region of stability and to forecast the further behavior of the system (the transition in which area and for what time) on the basis of the sensitivity.

5. in order to optimize the behavior of economic system and its development the set of the management tools is chosen.

It is assumed, that the strength of the set of tools to achieve a positive result must exceed the force of the influence of negative factors of exterior environment, namely it means that it is necessary to choose such instruments that: Extinguish the action of one parameters; Enlarge the action of other parameters; Act on economic system by developing its property and optimizing the objective function.

Thus, the sensitivity of the economic system can be determined as property, the reaction of the system to the action of parameters, the speed of the change of system behavior depending on the parameter variations of and exterior perturbation influences.

By analogy with determining of the threshold of sensitivity in physiology and technique, wel determine the absolute and differential thresholds of sensitivity in the economic system.

The absolute threshold of sensitivity in the economic system – is the minimal force of the influence of the parameter (of indignation), capable to cause the system reaction.

Differential threshold – is the minimal value, on which it is necessary to change the influence of parameter, in order to cause the change of the reaction of system.

We can distinguish the main conceptual approaches to the sensitivity assessment.

The first approach is based on determining the sensitivity of automatic control systems, sensitivity functions.

General model of continuous dynamic systems – the vector differential equation of the nonlinear system:

$$\dot{x} = f\big(x(t), p, t\big), \ x(t_0) = x_0 \ (1)$$

where x – is the vector of state; p – is the vector of parameters; f – is the vector function that connects the vector of state and the vector of the parameters of the system.

Since economic system is continuous dynamic system that its behavior maybe described with the help of vector differential equation (1).

For small variations of parameters the additional movement may be described by factorizing expansion terms (1) in Taylor' series. Confining to linear expansion terms, additional movement can be expressed in the following way:

$$\Delta \boldsymbol{x}(t) = \sum_{j=1}^{l} \varepsilon_j \Delta p_j$$

where $\boldsymbol{\varepsilon}_j$ – is the vector of the sensitivity of the vector of state $\mathbf{x}(t)$; $\mathbf{x}_{\varLambda}(t)$ – is the valid motion of system; $\mathbf{x}_H(t)$ – is the nominal motion of system.

Partial derivative, which are determined in the nominal significances of parameters, are named sensitivity index or function of the vector of state υ_j

$$\upsilon_j = \left[\frac{\partial x_1}{\partial p_j}, ..., \frac{\partial x_n}{\partial p_j} \right]^T = \frac{\partial \boldsymbol{x}}{\partial p_j}, \quad j = \overline{1, l}$$

here is component of vector characterizes the rate of change of the element of state vector $\boldsymbol{x}(t)$ if we change the j-th component of the vector of parameters $\boldsymbol{p}$.

The summary systems reaction on the parameter variation is well captured by the norm of the vector which are widely used in the analysis of dynamical systems.

For continuous systems in determining the sensitivity functions there are two cases: changed the parameter variation in time or not ($\Delta p = \varepsilon$ =const or $\Delta p = \varepsilon \upsilon(t)$).

If the variation of the parameter does not depend on time, the function of the sensitivity of the system $\dot{\boldsymbol{x}} = f(\boldsymbol{x}, \boldsymbol{p}, t)$ is determined by the ordinary derivative:

$$u(p_i) = \frac{\partial x}{\partial p_i} = \lim_{\varepsilon \to 0} \frac{x(p_H + \varepsilon) - x(p_H)}{\varepsilon}$$

If the perturbation depends on time, the sensitivity function should be defined as the functional derivative:

$$u(p_i) = \frac{\partial x}{\partial p_i} = \lim_{\varepsilon \to 0} \frac{x(p_H + \varepsilon \upsilon(t)) - x(p_H)}{\varepsilon}$$

where – uniformly limited, integrable function.

The economic system is a continuous system, that is why consideration of the definition of sensitivity to it is applicable.

The second approach is based on determining the sensitivity functions via transfer functions.

$$V_{W_\delta}^K(p) = \frac{dK(p)}{dW_\delta(p)}$$

where $K(p)$ – transfer function of system; $W_\delta(p)$ – transfer function of a variable element.

The lower the sensitivity $S_{W_\delta}^K(p)$ or function of sensitivity $V_{W_\delta}^K(p)$, that less effect of the transfer function $W_\delta(p)$ elements on the properties of the system.

Talking about the change of sensitivity, we mean the change of its modulus, and therefore of great interest are the structures which have a low sensitivity. The lower the sensitivity of the system, the more it is high-quality.

For economic systems as elements can be considered internal departments, and as the connections of elements - the interaction of these units with each other (management industry, business, service, shop and so on down the levels of management).

The third approach, we consider the sensitivity as elasticity.

Since the coefficient of elasticity is the sensitivity, then this feature of the economic

The transfer function of the dynamic system (or element) in the control theory is defined as the function that determines the relationship between input and output values.

Sensitivity $S_{W_\delta}^K(p)$ is the ratio of relative changes in the transfer function of system and transfer function of a variable element:

$$S_{W_\delta}^K(p) = \frac{dK(p)}{K(p)} \bigg/ \frac{dW_\delta(p)}{W_\delta(p)} = V_{W_\delta}^K(p)\frac{W_\delta(p)}{K(p)}$$

system can be determined from this point of view.

The sensitivity of the objective function (profit, work efficiency) of the parameter indicates the percentage change in the function as the parameter change by 1%.

$$\varepsilon = \frac{dF}{dp}$$

The relative change of the function is equal to the change of function to its value. The relative change of the parameter is equal to the change of parameter to its value.

Thus, $\varepsilon = \dfrac{dF}{dp} = \dfrac{\Delta F \cdot p}{F \cdot \Delta p} = \dfrac{\Delta F}{\Delta p} \cdot \dfrac{p}{F}$.

Sensitivity will show the rate of change of the objective function of the system (for example, profit), depending on the external parameters. At any time of the production

process sensitivity is determined as

$$\varepsilon(t) = \frac{dF}{dp}(t).$$

According to the definition of elasticity, we can distinguish three ranges of sensitivity of the economic system (in absolute value):

1. $(0 < \varepsilon < 1)$: at $\varepsilon \to 0$ infinite variation of parameter $\Delta p \to \infty$ does not affect the value of the function, i.e. it will remain constant;

2. $(1 < \varepsilon < \infty)$: at $\varepsilon \to \infty$, any small decrease of parameter $(\Delta p \to 0)$function will increase to infinity (there is a sharp change in the function), and any small increase in the parameter lead to a decrease in function to zero;

3. at $\varepsilon = 1$ and in some neighborhood of «1» can be observed the function change at 1% in the parameter change by 1%.

Concluding the review of basic concepts of the theory of sensitivity, it should be noted that this theory and its methods can't be considered exhausted: the study of the sensitivity of the economic system is in a state of continuous development, supplemented by new theoretical and experimental results.

SCIENTIFIC BASES AND METHODS OF MONITORING OF THE INNOVATIVE DEVELOPMENT OF THE ENTERPRISE

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In article the methods of organization of monitoring of the innovative development of the enterprise are considered, which allow determining the problematic parts of the realization of innovative strategy of development.

Nowadays it is universally recognized that the innovative development of enterprises is precisely the economic forming process. However the regularities of this process are not cleared till the end. From the point of view of the methodological aspects of this problem it is possible to allocate three basic points. Firstly, there are situations when there is no relevant technology (or set of technologies) for some actual problems in a certain interval of time within the framework of the enterprise production system, for the effective solution of contradictions generated by these problems. Secondly, there are situations when the existing scientific-technical and innovation potential cannot ensure an effective realization of available relevant technologies. Thirdly, an attempt to apply the relevant technologies, which are successfully used under the other conditions (regions, branches), don't allow finding out the solution of actual problem under the new situation. Each of three above-mentioned situations is connected first of all with the imperfection of procedure of estimation of innovative potential of enterprises which occupies an important place in the methodological and methodical basis of monitoring. The basis of monitoring consists of three elements: an object of investigation (enterprise), a studied and observed property (characteristic) of this object, an indicator with the help of which the estimation is accomplished.

The monitoring of innovative development represents a flexible dynamic observation system of control over the innovative sphere of enterprise under a certain set of indicators to reveal the tasks in innovation management and to provide different types of innovation.

A complex approach to the study of methodological and methodical bases of monitoring is that the innovative development is considered as an integral object of information observation both in statics and dynamics. The static aspect assumes a calculation and study of all factors exerting influence upon the installing of innovation at the enterprise at a given instant. The dynamic aspect characterizes an advancement of innovations in separate stages of innovative development.

The monitoring of innovative development of enterprise is based on a set of principles, in particular: complexity – is a calculation of different aspects of conducting the monitoring; objectivity – is a calculation and reflection of the specific actual conditions of production and environment; addressing – is a permanent control of the recommended results of the monitoring; efficiency – is a timely representing of actual information; optimality – is an effective relation between quantity of components of

monitoring system and necessary set of assigned functions and others.

The conduction of methods of monitoring of innovative development assumes four stages:

1. Gathering information about the object of investigation using estimation methods.

2. Diagnostics of conditions of the enterprise of investigation according to the set of indicators.

3. Working out the possible variants of innovative development to the short-, middle- and the long-term outlook according to the results of diagnostics of the current conditions of the object.

4. Making the recommendations to provide stable innovative development in accordance with the chosen variant.

The development of a set of instruments for estimation of innovative development forms the methodological base of the monitoring. The estimation of innovative development is the analytical procedure with the help of which the changes of the measured characteristics, determining the innovative development of the object are revealed and studied. The basic methods of estimation include: grouping, the method of dynamics, comparison method, profile method, scale-number estimation, portfolio method, method of interrogation, scientific modeling, cartographic method and others.

For example, the method of interrogation is the operative and dynamic method which operates with qualitative and quantitative estimates and is used for the analysis of weakly-structured problems. For the comparability of data of the examined objects at carrying out the analysis of innovative development using the method of interrogation, a uniform harmonious questionnaire is applied as the way of gathering the desirable information, including changes in production, in stocks, in finance. The comparability of data is being reached by using the standard questionnaire and the standardized estimated scales. This standard solution requires the organization of preliminary preparation and carrying out an experiment to define more precisely and correct the questions. Other standard solutions of this method include: testing and interview.

The variety of methods of estimation of the innovative development of enterprise promotes to obtain precise and reliable estimates by means of a set of indicators giving a representation about the basic properties of the object of investigation to reflect functioning and development of the innovative sphere. The indicator is the estimated characteristic of the object which determines conditions, trend of development and serves as the single element of analysis, prognostication and controlling the object. The following indicators can be carried to the set of indicators of monitoring of the innovative development: wage level of personnel, level of ergonomics of enterprise, age structure of fixed capital, volume-to-capacity ratio, export trade volume of new technology products, profitable growth through innovation, capital structure and others [1, p. 22-23].

For example, the capital structure indicators serve to indicate a share of capital stock, debt and leases, capital invested in the going concern. The external source of funds is characterized by potential possibilities and investment conditions (by size, by cost of debt and leases), the internal source

of funds is characterized by sizes of profit and depreciation charges.

The efficiency of monitoring of innovative development of enterprise is expressed by following criteria: reduction of time to accept administrative decisions, increase in number of innovative ideas, increase in motivation and professionalism of participants of the innovative process, attraction of external sources of funding, shorter-term innovation development, expense reduction [1, p. 21].

The results of monitoring are used both for developing an innovation strategy of enterprise which reflects the maintenance and the basic directions of the innovative development process of enterprise and is directed to support the competitor status of output to the planned prospect and also by regional governments to develop a policy in the sphere of national activity.

The proposed methods of organization of monitoring of the innovative development correspond to requirements of specific-program approach, systems analysis, scientific-technical and economic prognostication in innovation management. The methods allow forming the alternatives of realization of innovative purposes for any enterprise, its subdivisions and completely promote cardinal reconsideration of a role of innovations in the development of enterprise.

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ESTIMATION OF SOLUTION OF EULER-LAGRANGE EQUATION IN THE BOUNDARY LAYER

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Let's define a ratio between extremals an extremal problem for functional (1) ([1], p.34, formula (1.1.1)) and a problem (2) ([1], p.39, formula (1.2.1)) under $t \in \Delta$:

$$\Phi = \int_0^1 L\big(u(t), \dot{u}(t)\big)\, dt \ , \tag{1}$$

$$\psi_\Delta = \min_{\tilde{u} \in \tilde{U}} \int_0^\delta L_\Delta\,(\,t, \tilde{u}(t), \dot{\tilde{u}}(t)\,)\, dt \ , \tag{2}$$

where the set $\tilde{U}$ is defined by next expression:

$$\tilde{U} = \Big\{\tilde{u}\Big|\ \tilde{u} \in C^1(\Delta, IR)\,,\ \ \Delta = [0, \delta]\,,\ \ \delta << 1\,,\ \ \tilde{u} = u - u_0 - \dot{u}_0\, t\Big\}. \tag{3}$$

Let:

- a function $u(t)$ is the solution of the problem for functional (1),

- a function $\tilde{u}(t)$ is the solution of the problem (2).

From expression (3) it follows

$$\Big|\, u - \tilde{u}\,\Big| = \Big|\, u_0 + \dot{u}_0 t\,\Big| \le \Big|\, u_0\,\Big| + \Big|\, \dot{u}_0\,\Big|\,\delta \le \Big|\, u_0\,\Big| + \Big|\, \dot{u}_0\,\Big| \ ,$$

$$\Big|\, \dot{u} - \dot{\tilde{u}}\,\Big| = \Big|\, \dot{u}_0\,\Big| \ .$$

As a result we obtain the estimation

$$\big\|\, u - \tilde{u}\,\big\|_1 \le \Big|\, u_0\,\Big| + \Big|\, \dot{u}_0\,\Big| \ .$$

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THE METHOD OF FORECASTING AND ESTIMATION OF RATIONAL USE OF THE GROWN YIELD OF FODDER CROPS BY THE COEFFICIENT OF EFFECTIVENESS OF FORAGES' PREPARATION'S TECHNOLOGIES (CET)

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It is possible to prepare various voluminous forages, for winter period, from the grown yield of fodder crops, as from new-mown mass, at usual (spontaneous) fermentation or with use of chemical or biological preservatives, and from sun-cured and dried up mass. Thus each basic technology of forages' preparation has set of variants, differing in technological operations. The choice of the most rational variant of resource-saving and energy-saving technology of voluminous forages' preparation with consideration of safety and using of nutritious substances' energy of the grown yield of fodder crops, needs and opportunities of farms, weather conditions and other working factors is essentially important.

Preparation and storage of forages, and further feeding, are parts of one circuit. At the same time their study is frequently carried out separately, it can result to one-sided and even to a biased assessment.

On the basis of facts, received in own researches we've developed an objective index for a complex estimation of methods of preparation, storage and use of voluminous forages, received mathematical expression in the formula of coefficient of effectiveness of forages' preparation's

technologies ("Zootechnics", №9, 2000, Moscow).

The output of dry substance and energy on the stages of preparation and storage of forages, and also metabolism of gross energy in organism of ruminating animals are calculated in the coefficient, on a basis of previously calculated losses of dry substance (DS) and concentration of gross energy (GE) in fresh raw material, in raw material, prepared for a storage (forage-raw material), and ready voluminous forages.

Theoretically the coefficient of effectiveness of technology is based on the recognized systems of the estimation of forages: A.P. Dmitrochenko, 1982, N.G. Grigoryev, 1986 (definition of energy according to the equations of regress), the British system of K.L. Blekster, 1965 (metabolism of energy), the German system of definition of nutritiousness of forages on L. Hofmann and R. Shimann, 1975 (classification of losses of dry substance) and other basic theories of feeding production and feeding of agricultural animals.

The majority of the modern scientists consider the system of an estimation of forages by energy the most perspective, connected, on the one hand, with feeding production, and, on the other hand, - with feeding of animals. The offered coefficient of effectiveness of forages' preparation's technology (by energy) expresses the named connection mathematically and can make a basis of a method of a complex estimation and forecasting of successfulness of voluminous forages' preparation from identity of vegetative mass at a choice of optimum technology with the least loss of energy of

the grown yield of fodder crops. The coefficient of effectiveness of technology (CET) is calculated under the formula:

$$CET = \frac{O_2 * C_2}{O_1 * C_1} * \frac{O_3 * C_3}{O_2 * C_2} * \frac{C_{ME}}{C_3} * 100$$

(Ist stage) (IInd stage) (IIId stage)

CET by energy - the coefficient of effectiveness of technology, %;

O_1 - crop of green mass, kg of dry substance (DS) with 1 ga;

O_2 - output of "forage - raw material" with 1 ga, kg DS *;

O_3 - output of a ready forage with 1 ga, kg DS;

C_1- concentration of gross energy (GE) in green mass, MDj in 1 kg DS;

C_2 - concentration GE in "forage - raw material", MDj in 1 kg DS;

C_3 - concentration GE in ready forage, MDj in 1 kg DS;

C_{ME} - concentration of metabolic energy (ME), MDj in 1 kg DS.

* - the formulation "forage - raw-material" means the weight, ricked into the storehouse or put away for warehousing and suitable, on the contents DS to the given way of preservation.

The closer factor is to 100 %, the greater efficiency of investigated (used, forecasted) technology is. As the same forage has various power nutritiousness for various kinds of animals, it is automatically distributed to the offered coefficient.

The formula changes depending on researched methods of forages' preparation. So, if at the drying of grass the indices O_1 and O_2 differ considerably, at the filling of a silo from corn and other crops by a straight combine, they are almost the same.

The offered way allows to determine *preservation* of GE of the grown yield of fodder crops separately in voluminous forages from the identical green mass, from mowing to filling into the storehouse (stage I), at keeping, taking out and use (stage II), and *efficiency* of assimilation GE by animals, on the basis of calculation of its metabolism (stage III). All kinds of the corresponding losses of DS by starting green mass are counted up on the stages I and II: field, from fermentation, with juice; regional, at taking out - use of forage.

All calculations are carried out according to the international system of units (ISU). The basic indices of the offered method are GE and ME in MDj/kg DS, which meets the standards of the countries of European Economic Community of quality's estimation of silage with employment of standard methods of the analysis, tested and introduced by the international standard organization (ISO).

Under the formula CET, it is possible to analyze the preservation of energy of the grown crop of green mass on the stages of preparation and use of forages. For example, at the mowing of clover-timothy grass mixture, the preservation of energy has made 89% at the first stage, from harvesting to filling into a trench, 86% on the II stage - in the storehouse before use by animals, and the preservation (metabolism) of energy at the

transformation of GE and ME has been 53 % on the III stage. The corresponding quantity has made 68 %, 84 % and 50 %, on the stages of preparation, storage and use of hay, and 98 %, 74 % and 51 % at the silage.

The coefficients of effectiveness of technology are settled down in the following descending order, in a complex, on three stages of preparation, storage and use of forages from clover-timothy grass-mixture:

$$CET = \frac{O_3 * C_{ME}}{O_1 * C_1} * 100$$

The tables of CET have been prepared for six investigated fodder crops, phases of vegetation, methods of preservation to use the offered method of estimation and fore-casting of rational use of fodder crops in feed production and for scientific purposes.

The researches which have been lead in controlled experience in collective farm "Tver" of the Tver area of the Russian Federation on lactational cows of black-motley breed at feed to forages from clover-timothy grass mix have shown, that between sizes CET and an output of milk counting (upon 1 ga) to the fodder area, there is the positive communication, which is coming nearer to high (r = + 0,673; p = 0,01).

Application of regressional analysis has allowed to reveal the following rectilinear dependence: at increase in effectiveness ratio of technologies of preparations of forages on 1% and feed forages to cows, the output of milk counting (upon 1 ga) the fodder area increases on the average for 98 kg. If to apply this regressional dependence to variants of mowing (CET 40,57 %) and preparations of hay (CET 30,87%) on a difference

haying - 40,57 $\pm$1,15 %, silage - 36,26 $\pm$ 1,97 % and preparation of loose hay - 30,87 $\pm$ 1,22 %. The received coefficients are reliable P < 0,001. The difference between CET of separate forages is also reliable at standard P < 0, 05 - 0,001.

It is possible to use the reduced variant of the formula for quick determination of CET:

in factors (9,7%) are possible for predicting that the output of milk counting upon 1 ga at mowing will be higher on 9,5 c., that proves to be true the data of the lead scientific-economic experience in collective farm " Tver ", in which actually use of the oblique grass as mowe in comparison with hay was more effective on 9,2 c. some milk, counting upon 1 ga. The difference between actual and predicted sizes made 3,26% (p <0,01). The given results are checked up in facilities Torzhokskiy, Kaliniskiy and Kimrskiy of the Tver area of the Russian Federation.

Transformation of the base formula of CET by energy makes it possible to determine efficiency of use of separate nutritious components of starting vegetative mass.

It is desirable the help of leading scientific centers with the problems of technology of preparation of forages and feeding of agricultural animals for expansion of CET's data bank and possible recommendation of its definition in feed-production.

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INTRODUCTION INTO THE NEW METHODS OF NATURAL STONE BREAKING

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Nowadays the demand for the natural stone construction materials is very high and continues its increase in most countries. In connection with that the output of its kinds, from which various wares are produced, is being carried out. The production of natural stone is conducted in the most countries with certain differences in output volume and its nomenclature, as well as the purpose of the initial and repeated production. In the meanwhile new means of its destruction, aimed for the efficiency increase and preservation of the natural quality of output resources are have been invented, approved and launched into the production line within the last ten years. According to a new trend, all means of the natural stone destruction, including wedge-operated that are typical for the solid stone production pits, are used and improved. One of the ways of this improvement is the introduction of the plastic substances into the breaking process and the supply of the proper technical facilities and mining technologies.

The typical attribute of all natural stone production facilities is the technical complication and high value of their inner reorganization in order to use new technologies. In most cases cardinal alterations are needed within the going opening methods and the resources taking out preparation system. Because of that mining operations within the most natural stone production facilities are being carried out regardless to the possibilities that are linked to the appearance of new effective ways of rock destruction. Some of those mining technologies that are highly adapted to the existing mining-geological and mining-technical conditions of minerals production are the technologies of natural stone breaking using the plastic substances. With the right characteristic calculation the can be used for the natural stone production of any solidity, are effective with the system of natural and artificial fissure and do not need any unique and expensive equipment for their application. They can be easily adapted to negative external environment conditions and also have high safety and harmlessness index.

The nature stone breaking technologies that are linked with ousting the plastic substances from blast holes is based on the direct rock destruction method that has its basis from the new principles of fissure advance in fragile environment. Its static are dynamic type of forming demands the application of specific technological set, devices and materials that are need for its practical

usage. The most significant direction of the natural stone production is its breaking from the massive as a number of monoliths and blocks that makes possible the production of wares of any forms, sizes, and for any purpose while saving the maximum of the raw materials natural attributes. Though the suggested method aimed for achieving the mentioned goal, it is not used in production today. That allows us to mark the development and substantiation of natural stone breaking technology using different plastic substances out as a separate scientific area that has its own goals, problems and prospects. Equally with that we should consider that the circle of scientific and practical researches on studied problem is quite narrow and usually defined by the basis, created by The Mining Institute of the Siberian department of Russian science academy.

It is reasonable to start work with clarification of problems, defining the prospects for block stone production in the world, analysis of used technics and technologies of its breaking and carrying out their comparison. Then it is necessary to validate the basic parameters of block stone breaking technologies using the plastic substances in the conditions of their intensified ousting from the blast holes into the formed fissure and also their comparison with the technologies based on other ways of rock destruction. After that the experimental inspection of the new mining technologies parameters in the laboratory conditions is needed. Then the main attention must be devoted to the block stone breaking technologies development and their experimental check in the conditions of open means of mineral deposit processing. Besides, the additional areas of

the method of direct destruction of fragile materials using plastic substances effective application validation is highly needed. In this case we would need the development of the corresponding mining and construction technologies as well as the results of their natural conditions tests. This cycle of works is concluded by the validation of the accepted technical and technological solutions in the area of block stone breaking using plastic substances according to the factors of the environment and labour protection for the conditions of open means of mineral deposits processing.

The following objectives are considered as the most important:

- regularities of the crash-origin fissure advance, blast holes forming within fragile materials depending on their spatial location, from which the plastic substances ousting happens, identification, and also development and experimental check of their major geometric parameters calculation methods;

- identification of the correlations between the energetic indexes of the crashing system and the rheological and volume characteristics of plastic substances, physical and mathematic qualities of destructed fragile material, and geometric parameters of applied blast holes;

- verification of the fragile materials crash destruction technologies with plastic substances depending on their effective application area;

- verification of the block stone crash breaking with plastic substances according to its impact on the environment and labour conditions for the open mineral deposit processing method;

The novelty of the performed work in this area so far is showed by the following:

- identification of the forming of the fissure configuration, that is formed along and across the blast hole axis, regularities and the evidence of the possibility of its control by definition of its internal orientation comparative to the blast hole axis, from which the plastic substances ousting happens;

- identification of the single tool strike necessary power, that is designed for the block stone breaking with plastic substances, that serves as its choice foundation;

- the evidence of the possibility of using crash destruction of fragile materials using plastic substances for the breaking of stone of any known solidity and mineralogical composition provided by the choice of needed combination of plastic substance's liquidity, geometrical parameters, pressurization, blast hole walls voltage concentrators, wedge configuration, and used breaking system energetic indexes;

- the evidence that the mechanized versions of block stone crash breaking technologies, based on plastic substances usage, have minimum impact on the aerial environment and are save and harmless.

IRKUTSK REGION WATER RESOURCES EVALUATION

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The problem of harmonious exploitation basing on economical-ecological compromises is not new but still actual. Competent housekeeping (at any economic level) that was recommended in the ancient time by Aristotle wouldn't lead to the ecological crisis of nowadays. The mankind must understand that we all live on the same planet, and we are guilty in our problems but not those people of another nation or country origin. Conformism, indifference, laziness and simply unwillingness to think or to blame ourselves are the reasons of our current lawless position. Living on the territory that includes unique natural resources we couldn't defend the largest lake in the world – Baikal, we allowed to locate one of the largest pollution source on its shore, the Baikal pulp and paper mill.

The Irkutsk region water resources are one of the most valuable natural wealth. The aquatory square of the world-famous lake Baikal is 31,5 ths km^2, the extent from North to South is 636 km, max width is 79,5 km. With the average depth of 730 m and max depth of 1637 m, the potable water supply is 23,6 ths km^3, which is 20% of the world potable water supply. Besides, there are 229 more lakes in Irkutsk region, their total aquatory square is 7732,5 km^2.

The fluvial net is represented by the drainages of large rivers (such as Angara, Lena, Nizhnaya Tunguska) and their numerous inflows. The density of fluvial net is 400 m on 1 km^2. The main water artery is Angara River; its water regime is mainly defined by the lake Baikal that gives it 60 km^3 of pure water annually. On the 55th km from the origin the river is blocked by the Irkutsk hydroelectric dam and forms Irkutsk dam lake. The square of the dam lake is 154 km^2, the shore length is 300 km, the water volume is 2,1 km^3. The regime of the Angara flow from Irkutsk to Bratsk dam lake depends on the Irkutsk hydroelectric station mode.

Bratsk dam lake is 605 km down the river. Its square is 5470 km^2, volume – 169,3 km^3, shore length – 6000 km. And the last hydroelectric dam on Angara forms Ust-Ilimsk dam lake 1026 km down the river. Its square is 1922 km^2, volume – 58,93 km^3, shore length – 2500 km.

For the period of Angara's hydroelectric stations exploitation two problems appeared (according to the governmental report "About the conditions and protection of the Irkutsk region's environment in 2003"): stream-bank erosion (Ust-Ilimsk water storage – 70 m, Irkutsk and Bratsk water storages – 200 m) and Baikal and Angara shallow that appeared in 1996 and led to the water storage discharge.

Besides, there is a systematical and inadmissible for harmonious exploitation water pollution, in particular, the pollution of Baikal Lake that led to the substantial negative changes in the lake's ecosystem. Anthropogenic influence on the Baikal is increasing since 1950. The logging on the rivers increased and there were started the rafting on the Baikal. Constantly growing amount of tourists doesn't promote the improving of ecological situation too. There is also sewage disposal from the Baikal pulp

and paper mill (BPPM), Slyudyanka city, Angasolka station, the quarry Pereval and the South-Baikal fish factory. There is the Baikal-Amur railway along the Northern bank, and there are about 90 units of private and departmental vessels. A portion of pollution is also brought in the lake by the ice crossings.

The observation of Baikal Lake pollution for the period 1993-2005 according to the data of the Irkutsk regional office on hydrometeorology and environment monitoring shows that disposal of not enough cleared sewage into the Baikal is performed by the BPPM (since 1966). It is located right on the bank and disposes the sewage right into the lake. In addition, there is a dump of not enough cleared sewage from Slyudyanka city (1463 ths m^3), Angasolka station (41,4 ths m^3), quarry Pereval (242 ths m^3) according to the data of 1993. Besides, there are economic-domestic sewages from vessels (0,7 ths m^3) that are not enough cleared because of the synthetic surfactants. Since 2005 the analysis of pollution by fluorides is held, the amount of fluorides in sewages is about 2,312 tones. In addition, the water is polluted by industrial releases, numerous boiler houses' and railway stations' releases. In general, the water quality is qualified by category II (conditionally clear), excluding the Maritui river mouth where the quality of water is III (moderately polluted) because of high concentrations of mineral oil and copper.

According to the data of 2003, the total sewage disposal in Irkutsk region is 1225,35 bln m^3, 1203,7 bln m^3 were dumped in the surface water that is 33,61 bln m^3 more than the previous year. Among the total sewage 639,4 bln m^3 are not enough cleared, 183,04 bln m^3 – not cleared, 360,3 bln m^3 – standard clear, 20,95 bln m^3 – standard cleared. In the surface waters of Angara basin 1124,4 bln m^3 of sewage were dumped, in the Baikal basin – 45,6 bln m^3, in the Lena basin – 33,7 bln m^3. The main pollution sources are pulp and paper industry enterprises (BPPM, BratskComplexHolding, Ust-Ilimsk timber industry concern), chemical, petrochemical and fuel industry enterprises (HimPromUsolye, SayanskHimPlast, Angarsk petrochemical enterprise), and housing and communal services.

The detailed description of all Irkutsk region water resources pollution exceeds the paper restrictions. It is absolutely obvious that the Irkutsk region ecosystem is already affected by the environmental impact. The river Angara is influenced even more in the area between Irkutsk and Angarsk cities. The main pollution sources close to Irkutsk are the sewages of left and right bank sewage treatment plants, Irkut enterprise, city storm flows. According to the pollution index the water of Angara near Irkutsk is qualified as category II. Near the Angarsk city the main pollution sources are the sewages of thermal power stations number 9 and 10, Angara-reactive factory and Angarsk petrochemical enterprise. The water here is qualified as categories III-IV.

Hydro-chemical observations of Bratsk dam lake are held at 13 points. Before the Bratsk dam lake the water of Angara is polluted by the Irkutsk and Angarsk enterprises. In addition, the sources of further pollution are HimPromUsolye, Usolye HimFarmCombinat, and pig-rearing complex. The concentration of chlorides is significantly increased (14 times), as well as the concentration of

sulfates (2 times). The water is qualified as category III. By the complex of parameters the water of the upper part of Bratsk dam lake is qualified as categories III-IV in general.

In the area of Balagansk settlement the water is qualified as category IV (polluted). In view of high mineral oil concentration the point is included in the Priority list of water objects, where immediate water-control practices are needed. The water near the dam in the area of Bratsk city is also highly polluted and is qualified as category III. In the Suhoi Log gulf of the Bratsk dam lake the water quality is impaired and is qualified as category V (dirty water). At the point of Dondir gulf the average annual concentrations are high and the water is qualified as category VII (extremely dirty).

Hydro-chemical observations of Ust-Ilimsk dam lake are held at 13 points. Its feature is in its non-uniform hydro-geological mode in different areas. The volume of the water is regulated by the Bratsk hydroelectric station's water dump. Accordingly, the water quality in the upper part of Ust-Ilimsk dam lake is defined by the pollution level of the Bratsk dam lake waters. The most polluted is the gulf of the Vihoreva river where the sewages of the following pollution sources are dumped: BratskComplexHolding, Bratsk housing and communal service engineering communications, city sewages. At the point of Sedanovo settlement the water quality is qualified as category VII.

Dam lakes are the reasons of many hydro-biological, hydro-chemical and biological modes changes. The flow rate of the rivers slows down, the depth of waters is changing, as a consequence, the fish fauna is radically changed. Instead of the valuable and numerous fish species the low-grade ones are widely spread: roach, darter, crucian and bream. The negative influence on the fishery product reservoirs is caused by the sewages and the huge amount of drowned timber.

At present the ecological situation in general is very difficult, especially in the areas close to the highways where anthropogenic influence is extremely high. Taiga territory, significant in the past, is crossed with clear cutting by 25-50%. The increase of cutting areas breaches the hydrological mode of the territory (floods happen more often, the water level in rivers and lakes decreases), changes the climate (sand storms appear and happen more often), negatively influences on the region's biodiversity. Moreover, the areas of intensive cutting are characterized with high flammability. Anthropogenic influence, including forming and expanding the urban territories, building dams and highways, developing the chemical industry, expanding the cutting areas and burned-out forests, leads to the significant changes in the space structure of separate populations and general assemblage of plants and animals. The diversity and total estimate of indigenous species continues to decrease at all ecological complexes. Dark coniferous taiga landscapes succumb their place to forest-steppe ones. In the agricultural areas there is a degradation of grass stand together with vegetation changes and, as a consequence, soil erosion.

Such changes are the direct consequences of environmental impact caused by mankind. Of course, we can connect this all with global climate changes which is con-

cerned with the global heating and century cycles. But what if the global climate changes are also connected with anthropogenic influence?

There is a necessity for the special activities targeted to stabilize the region's natural system. In particular, the development and working of ecological systems based on the technology of complex territory's ecological volume evaluation, with different exploitation modes that allow to preserve the natural homeostasis, targeted to preserve landscape and biological diversity.

Suggested technology is based on the space-time method of ecological-economical damage evaluation:

$$Ev = \frac{C_{dam} \cdot S_{dam}}{100 \cdot S_{gen}^{n}} \cdot R_{com} \cdot T_{max} \cdot \left(\frac{1}{Sc}\right)^{n-1},$$

where S_{dam} – breached area; C_{dam} – breach rate; S_{gen} – total area of a level; R_{com} – the number of breached relations in natural system, in this case is equal to 3 (soils, waters and atmosphere); T_{max} – component's life time; S_c – scaling factor, takes value from 2,3 to 3,6; n – level number from 1 to the number of levels. The ratio $\dfrac{S_{dam}}{S_{gen}^{n}}$ is a space parameter, whereas $T_{max} \cdot \left(\dfrac{1}{Sc}\right)^{n-1}$ is the parameter of natural system levels' interface changing time.

Replacing the *Cdam* by HPC and the areas by the volumes, we obtain the formula for water resources damage evaluation:

$$Ev = \frac{HPC \cdot V_{dam}}{V_{gen}^{n}} \cdot R_{com} \cdot T_{max} \cdot \left(\frac{1}{Sc}\right)^{n-1}$$

But in this case we must take into account the spreading of pollutants in the water. In the stationary basins we can neglect the dynamics as the formula itself takes into account the spreading of damage on surrounding areas. As for the rivers, we can estimate the limits of pollution by adding the following formula: $L = v \cdot t$, where L – a distance that the pollutant will get over going down the river; t – the time of pollutant's dissolution; v – the average speed of the river.

The significant data amount, processing complexity, departmental interests etc. lead to the necessity to develop special technical (software) means. To facilitate the data processing and to visualize the ecological-economical damage caused to natural system by anthropogenic influence, the program product "WaterRisk" is developed.

A man lives in the natural system which is a system with limited energy resource defined by the known methods of obtaining the energy. Nowadays the mankind population's supply exceeded the possibility of natural system self-restoration. The further mankind development is impossible without ecological-economical com-

promises. Thus the complex analysis of territory's ecological volume is a necessary attribute of harmonious exploitation.

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KING FRIEDRIC WILHELM III AND THE ELECTIVE RIGHTS OF THE PRUSSIAN CITIZENS IN THE EARLY XIX CENTURY

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The representative assemblies which appeared in Prussia after 1808 can be characterized as "dragging out a miserable existence and powerless". Most people believed that the representative assemblies were not enough so the King failed to fulfill his promise about All-Prussian people's representation, nevertheless the political organizations made no complaints [9, p. XXII]. And "the people refrained from violence waiting patiently for the King to die; they were grateful to him for the reforms which he had implemented in the early days of his reign".

The liberal ideas set forth by the Great French Revolution were in no way accepted in absolute monarchical Prussia for many years unlike in some other German states. But as time passed more and more citizens demanded a constitution and people's representative bodies formed by elections.

In 1807 the Prussian king Friedric Wilhelm III, in order to boost the consolidation of the country after the devastating French invasion and humiliating peace treaty, promised to establish representative bodies which could be formed by all the citizens. The king was forced to promise so under the pressure of the situation but he broke his word as soon as an opportunity came because he feared lest the representative bodies limited his power.

On the eve of the battle of Waterloo the Prussian king in his address to the people said again about his intention to grant a constitution, liberty and voting rights to decide on the German affairs. Later he again refused to fulfill his promise, and in order to calm the public opinion he started to appoint commissions for discussing the reforms. As B. Burdes remarked to the point, "generous with extravagant promises at hard times the German authorities called on the people to fight against Napoleon but they were hard to keep the word and often took away with one hand what they gave with the other" [7, p. 6].

Friedric-Wilhelm III in his decree of 22 May 1815 again declared about his intention to form representative bodies on the basis of universal suffrage though he added that he would do it "in due time". This promise was made against a background of a ban on liberal books and newspapers and persecution of liberal-minded individuals. It was a kind of gratitude to the Prussians who bravely fought against Napoleon for freedom of Prussia.

The election of All-Prussian people's representation should have been a conclusion to all the Prussian reforms which had been implemented by L. Stein and W. Humboldt [4, p. 290].

Less than three years later, on 21 March 1818, the Prussian king in a new decree duplicated his promise but no date was again appointed.

In October 1819 Baron von Hardenberg submitted to the commission a project "On the class constitution of Prussia" in which he proposed that deputies of the All-Prussian landtag should be elected by the provincial assemblies. W. Humboldt in a memorandum "On the class constitution of Prussia" insisted on direct elections. But the commission made an utterly conservative

decision that Prussia did not need people's representation at all.

The royal act of 1820 ordered the government to lend or borrow or impose new taxes only with the prior consent of the people's representatives. Constitutional commissions were again formed. The commissions on working out a project of the people's representation finished their work in 1823. According to the project by the 5th commission in which the chairman was the Crown Prince (opposed to any extensive reforms and to people's representation in particular), the King promulgated a law "On organization of the provincial class representation" on 5 June 1823 and a law "On organization of the representative bodies in some provinces" on 1 July 1823.

The class representative bodies were to be formed by regular elections taking place every two years. The provincial class representatives had the right for consultative votes in local and partly national legislation, also they could address the provincial requests to the King on behalf of the province (the landtags could only express their wishes but not issue decrees).

If one tries to characterize these newly formed bodies (the landtags or "land assemblies") one has to note that they were "quite different from constitutional bodies" [8, p. 20].

According to the suffrage of the Prussian provincial towns of 5 June 1823 and 2 June 1824 in the town of Solingen only 511 of its 7934 citizens had the voting right (6.4 percent), in Dusseldorf only 246 of 31 596 (0.7 percent). Nevertheless even this limited suffrage was rather progressive in that time. Owing to it, less than 50 years later almost

universal suffrage was temporarily enacted in Germany.

On 5 June 1825 the Friedric Wilhelm III's government implemented a law "On the regional class assemblies" that were to be gradually introduced in several provinces.

We can get a general notion of these assemblies by analyzing, for instance, the provincial landtag of Brandenburg. A. Bebel points out that "the noble landowners and 4 representatives of the ancestral nobility had 35 votes, the towns had 23 votes while the peasantry had only 12 votes. Besides, the peasant and town representatives were not elected by all the peasantry and town citizens but by certain groups of voters" [6, p. 13]. O. Buch points out that some 2000 noble estate owners elected a half of the landtag deputies while the other half were elected by 1 335 000 citizens [3, p. 113].

It was established that the ratio of class representation should be 3:2:1 but the actual ratio was different. The noblemen elected slightly more than a half of the deputies, the townspeople – about 1/3 and the peasantry – no more than a quarter.

The age qualification to elect was set at 25 and the age qualification to be elected was set at 30. It was only the nobility who had the right of direct voting. The citizens aged above 25 constituted 20-23 percent of all the Prussia's population [5, p. 31].

The representative assemblies which appeared in Prussia after 1808 can be characterized as "dragging out a miserable existence and powerless" [2, p. 223]. Most people believed that the representative assemblies were not enough so the King failed to fulfill his promise about All-Prussian people's representation, nevertheless the political

organizations made no complaints [9, p. XXII]. And "the people refrained from violence waiting patiently for the King to die; they were grateful to him for the reforms which he had implemented in the early days of his reign" [10, p. 6].

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FROM THE ESTABLISHMENT OF INTERNATIONAL PROGRAMS FOR THE INTEGRATION OF NATIONAL STANDARDS

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International integration in education - is the result of the development and deepening of the relationship and complementarily of the various national educational systems, to form a single educational space. However, this process can begin only if the goal of education policy will provide modern quality education based on the preservation of its fundamental nature and compliance with relevant and future needs of the individual, society and state.

That is the modern post-industrial society necessitates the revision not only of technology education, but most of its content, refine the optimal structure of knowledge.

Educational activities pervades modern society and is closely linked with virtually every sphere of human activity, with one or another sector of the economy. In this connection it is necessary to fill the internal components of national education standards with new, relevant, research in various fields.

Any educational standard can be divided into "base" (a list of fundamental disciplines that form the worldview of students and ability to analyze the subsequent subjects on the basis of modern methods) and "superstructure" (areas of specialization graduate).

Problems of international integration of national educational standards is very complex and include both objective and subjective evaluation. In this regard, we see that the process of integration is possible, especially in the establishment of international programs in the so-called "add". One such program brings to the discussion.

Currently, gaining an increasing number of supporters of a sustainable development model of the world allows the state, regions, sectors to establish mechanisms for sustainable development of economic systems.

In a market economy need to expand the scope of stability. Use it not only financial, but also in the management areas of the enterprise, allowing quickly take the necessary management decisions.

Based on the definition of the economic system, under the soundness should be understood as the ability of economic system to implement its own target function. The measure of sustainability is the unity of quantitative and qualitative characteristics of the system in which quantitative change inside or outside of it does not lead to qualitative transformations.

Thus, the study of sustainable development of economic system (for example, fishing industry) should be directed to:

a) the direction of scientific development, characterizing the external environment of the complex (section 1).

b) the scientific problem of increasing the stability of economic systems - enterprise Fishing Fleet (main section).

c) related (providing) problems of solving the stability of economic systems (section 3).

Consider the content of each block.

SECTION 1

1. The study of macroeconomic processes in modern national and world economy, development of methodological basis and methodological apparatus of analysis and forecasting of economic development in general and fisheries sector in particular.

2. Supply and demand, market segmentation, positioning products and companies, competitiveness and competition in the domestic and foreign markets in a globalizing world.

3. Innovation management and investment activities, which deals with a problem of current conditions and forecasingt investment in the light of the investment climate, the parameters of existing and proposed macroeconomic and microeconomic policies, the productive capacity of fishing industry.

4. The problems of economic evaluation of the current situation and projections of water resources, improved environmental management and environmental protection.

5. Rationale for prioritization and sequencing of "secondary" development of fishing areas of the world ocean, the development of the basic principles of the production process (extraction, processing, transportation and sales) in the fishery, areas of naval bases, the establishment of repair and technical and marketing bases in foreign ports.

6. The technical condition of ships, moral and physical deterioration, the program, funding for construction of techno-economic characteristics, infrastructure development of credit relations and credit instruments and modern methods of corporate lending fishing fleet.

7. Development of optimal industrial - technological regime that allows courts to operate effectively in the face of deteriorating resource base, quota restrictions and price increases for fuel and petroleum products. It includes the optimum value of the catch per trawling, the optimal interval between the volume of supply on board the regular catches, the minimum hourly costs, the optimal variant of optimal processing of the catch. Given these limitations is determined to obtain the maximum revenue from the sale of products or the maximum amount of profit.

SECTION 2 (MAIN)

8. The systems approach to the study of the complexation. The main directions of the systems approach (system-elementary, systematic and structural, systemic-functional, system and communications, system-integrative and others). The principles of the systems approach (unity, development, functionality, decentralization, hierarchy, uncertainty, organization). The relationship of the system and environment.

9. The company's fishing fleet as an economic system, its properties (efficiency, reliability, adaptability, stability, sensitivity, safety, competitiveness, value, handling, agility, self-organization, etc.). Their relationship and the degree of influence.

10. The theory of the behavior of economic systems, their qualitative changes and the impact on the stability of enterprises. The relationship between the concepts of steady state and its effectiveness. Consideration of sustainability in the long and short time periods. Rationale admissible domains of stability. Moving the economic system

within each region of stability. Factors contributing to the process of moving the economic system.

11. Methodology for assessing the stability of the company's fishing fleet as the economic system. Changing financial flows needed for the internal needs of enterprises for fixed changes in the external environment. Changing financial flows as a result of changes in quantitative parameters that characterize the impact on the enterprise market. Speed and acceleration parameter changes as a result of the impact of market factors.

12. Regulation of the company's fishing fleet is in an unstable condition. Boundaries of the regions of unstable states, quantified. Phase portraits for each area (the area of return, the transition region and the area of irreversible bankruptcy). Managerial decisions of the first and second level, that allow to ensure the restoration of the system's ability to fulfill its objective function. The inference engine companies from the area of unstable states.

13. Regulation of the fishing industry fleet companies, that are in a stable condition. The choice of indicators for sustainable management of economic systems based on analysis of their sensitivity to changes in the external factors. Calculation of critical values of parameters corresponding to the boundaries of the steady state and the definition of buffer zones for each indicator.

14. Impact of investment policies on the dynamics of economic development enterprise fishing industry fleet. Specifics of formation of the investment potential of the company fleet fishing industry in the concept of sustainable fisheries. Priorities, the

main directions of modernization and innovation of the fishing fleet, government regulation of investment activity in industrial fishing.

15. The tools and methods of management for businesses of the industrial fleet. Development of management tools. The matrix of possible states of the industrial fishing companies through the use of management tools. The evaluation of the total group of management tools for enterprises of industrial fishing (the sequence of groups of instruments, changes in return on equity, getting a synergistic effect).

SECTION 3

16. Mechanisms and instruments of formation of transnational clusters on the basis of existing production facilities. The presence of three constituents of the transnational Russian-Norwegian fishing industry cluster in the North Basin (the presence of similar industrial complexes, cooperation and dialogue, political will). Creating a functional model of a transnational cluster involves the creation of common sectors of shipbuilding and ship repair, port services, fishing, fish processing sector of technological and fishing equipment, educational and research sector.

17. Assessment of risk insurance and business entities. Classification of economic risks of the enterprise according to the criterion of the object of insurance protection (financial, commercial, climatic risks, environmental, transport, social and political, information and innovation risks). Analysis of the actual state of risk in industrial fisheries. Evaluation of the total amount of risk. The model of economic risk management in

the enterprises of the industrial fisheries through the use of insurance companies and Indemnity Clubs. Types of Clubs marine insurance.

18. Organizational-economic conditions of the optimal size of the enterprise fishing industry fleet. The method of determining the optimal size of the company, consisting of three phases: the first one - justification of the market structure (the choice of data on costs per unit of output, the number of products consumed by the market, the economic analysis of the efficiency of enterprises in the market), the second one - the adjustment of optimal size of enterprises, taking into account the costs of transnational and costs associated with entering the market, and the third one – delimitation of the optimal size of enterprises taking into account strategic facts of their growth.

19. Controlling in the management system of enterprise fishing industry fleet. The structure of the controlling system. Controlling as information-analytical management subsystem. Contents stages of the process of information provision. Effect of scale of business and organizational goals on the system controlling.

Based on this conceptual approach may be considered the formation mechanism for sustainable development of any industrial complex, which will help to expand expertise in business analysis organization. Since, in the information post-industrial society and a significant increase in the role of the educational complex of the education system should be considered as a single polyfunctional complex caring out many important functions: providing various industries with qualified personnel, the creation of new technologies, research.

Unity of Education and Science will significantly increase the scientific potential of a specialist in a particular area.

It is thus developed in-depth courses on current trends in the economy, which will integrate this knowledge on a global level.