CONTENTS

HYPOTHESIS ABOUT ROLE OF PURINES IN THE DEVELOPMENT OF RENAL DISEASE ASSOSIATED WITH ARTERIAL HYPERTENSION

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The concentrations of intermediates of purine metabolism in blood at patients glomerulopathy and tubulopathy associated with arterial hypertension were tested. At patients with chronic glomerulonephritis and chronic tubulointerstitial nephritis two stable trends of purine metabolites concentrations were observed (normal and very high). Hypertensive patients also were recorded two stable trends of purine metabolites concentrations, but in opposite direction (normal and reduced). The hypothesis of adenosine reduction in the mechanism of renal disease in hypertension was discussed. Excessive accumulation of purine nucleotides in blood at patients glomerulopathy and tubulopathy was supposed to take part in promotion of the progression of chronic renal diseases.

Keywords: purine metabolism, chronic diseases of kidneys, arterial hypertension

One of the promising directions in biomedical research is the study of intermediates of purine metabolism. It is determinated their diverse metabolic functions, including its participation in the regulation of renal function, vascular tone, coagulation, etc.

The aim of our study was to examine the content of intermediates of purine metabolism in patients' blood with glomerulopathy and tubulopathy associated with arterial hypertension.

Materials and methods of research

The groups of patients with chronic glomerulonephritis (GN) and chronic tubulointerstitial nephritis (IN) were formed. In addition, the patients with arterial hypertension (AH) without renal pathology also tested . A separate group comprised patients with a combination of AH and IN (AH + IN).The diagnosis were based on a complex survey, which included standard methods of patients examination. In some cases, morphological verification of renal pathology carried out. It was estimated the glomerular filtration rate, which all patients reached normal values. Hypertension did not exceed the second degree level. The content of intermediates of purine metabolism (guanine (G), hypoxanthine (HXn), adenine (A), xanthine (Xn) and uric acid (UA) was determined in the blood plasma of patients of investigated groups. Metabolites of purine metabolism were studied by the method of E.V. Oreshnikov and collaborators [1]. The concentration of purine bases was expressed in units of extinction (un. ekst.). Statistical analysis of the data was performed using STATISTICA software package version 7.0, a version recommended for biology and medicine.

Results of research and their discussion

Analysis of changes of purine metabolism indicators at patients with GN and IN revealed two trends, and on this basis two clusters were formed (tab. 1).

Table 1

Content of purine metabolites in blood plasma of patients with glomerulonephritis and interstitial nephritis ($M + m$)

Indicator	Control ($n = 25$) (The reference values)	GN cluster 1 ($n = 25$)	GN cluster 2 ($n = 13$)	IN cluster 1 ($n = 11$)	IN cluster 2 ($n = 6$)
Guanine	146,85 ± 8,4 130–260	616,5 ± 106,2*	245,6 ± 89,9	628,0 ± 74,3*	184,5 ± 74,3
Hypoxanthine	164,71 ± 27,06 110–224	548,5 ± 97,4*	209,6 ± 77,87	594,0 ± 70,67*	155,0 ± 70,67
Adenine	122,86 ± 19,33 90–180	453,2 ± 114,2*	167,4 ± 64,12	563,0 ± 56,17*	124,0 ± 56,17
Xanthine	142,93 ± 23,39 90–190	478,7 ± 122,7*	213,1 ± 68,4	586,0 ± 61,5*	174,0 ± 61,5
Uric acid	286,57 ± 28,35 213–372	439,9 ± 128,8*	233,6 ± 69,2	572,5 ± 72,9*	198,5 ± 72,9

N o t e : * – accuracy compared with the control group $p < 0,05$.

As can be seen from table 1, the content of all the intermediates of purine metabolism in patients with GN of 1 cluster is much higher than the upper limit of the physiological norm in patients with GN, combined in a second cluster. The content of guanine, hypoxanthine and adenine was nearing the upper limit of the physiological norm in GN patients, combined in

the 2 cluster. The only exception was xanthine, which level was higher than control. A similar trend is observed for IN patients. Two trends was also showed on analysis of changes of purine indicators in patients with AH and AH + IN; and on this basis it was formed two clusters (tab. 2).

Table 2

Content of purine metabolites in blood plasma of patients with AH and AH + IN ($M + m$)

Indicators	Control ($n = 25$) (The reference values)	AH cluster 1 ($n = 18$)	AH cluster 2 ($n = 7$)	AH + IN cluster 1 ($n = 7$)	AH + IN cluster 2 ($n = 20$)
Guanine	146,85 ± 8,4 130–260	222,6 ± 43,51	122,0 ± 33,8	505,1 ± 74,96*	170,9 ± 62,46
Hypoxanthine	164,71 ± 27,06 110–224	188,2 ± 42,5	98,6 ± 26,91	459,7 ± 69,37*	143,0 ± 56,13
Adenine	122,86 ± 19,33 90–180	147,4 ± 35,98	76,6 ± 22,7*	408,9 ± 97,86*	114,8 ± 49,11
Xanthine	142,93 ± 23,39 90–190	199,7 ± 36,6	114,1 ± 34,7	450,6 ± 91,16*	157,8 ± 60,94
Uric acid	286,57 ± 28,35 213–372	233,3 ± 62,9	137,3 ± 42,4*	402,4 ± 24,62*	189,0 ± 75,93

N o t e : * – accuracy compared with the control group $p < 0,05$.

The content of intermediates of purine metabolism is no excessive of the physiological norm in blood plasma at patients with AH combined in the 1 cluster. It was fixed the decrease of guanine, hypoxanthine, adenine and uric acid content relatively the upper limit of the physiological norm in blood plasma at patients with AH united in the 2 cluster.

The intensive decrease of intermediates which were accuracy higher of the physiological norm was fixed in blood plasma at patients with AH + IN united in the 1 cluster In the blood plasma of patients with AH + IN combined in a second cluster, was fixed a sharp increase of intermediates, which significantly were exceeded those of the physiological norm.

Consequently, we have the opposite changes the content of metabolites of purine metabolism. In patients with GN and IN, and AH + IN was revealed two stable trend: the fluctuations in the concentration of purine metabolites within the physiological norm, and a sharp increase in the concentration of some metabolites in plasma. Increasing the concentration of adenine in plasma of patients with chronic renal failure on hemodialysis, and patients with renal transplant has been shown previously Slominska EM et al [2]. Hypertensive patients also was recorded two stable trend, but with a different direction. The first trend was the changes of the studied metabolites concentration in the range of physiological norm. The second trend was reducing the concentration of different metabolites in blood plasma lower than the control data.

In order to pathogenetic interpretation of the detected phenomenon, we propose the following working hypothesis. The increase of catabolic content of purine metabolism can be due to breakage of their capture and transport to the cells, or due to increase their emergency (for example, the destruction of cells). Purine nucleotides accumulate in the extracellular environment in response to metabolic stress and cellular damage, in particular, during hypoxia, ischemia and inflammation. The general sources of adenosine are neutrophils, endothelial cells and microphages [3, 4]. Increasing concentrations of purine bases has an ambiguous effect on metabolic processes in the organisms of patients. Foe example, guanosine has protectional effect against apoptosis of tubules and renal dysfunction. This effect is manifested in the activation of small GTP-ase involved in the function of the cytoskeleton and intracellular transport. Likely, another mechanism as stimulation of the synthesis of nucleic acids also can used [5, 6].

Extracellular adenosine causes a cascade of cellular and tissue responses, which are considered as defensive, to maintaining homeostasis [6]. At the same time, adenosine demonstrates a variety of detrimental properties as induction of cytokine synthesis and modulation function of neutrophils and formation of active oxygen agents[7, 8]. Extracellular adenosine is considered as important mediator of renal function [9, 10] and it influences on regulation of renine secretion. In turn, the dysfunction of the renin-angiotensinogen-angiotensin

relationship determines the development of prothrombotic state [11]. Finally, adenosine promotes the initiation of procoagulant phase, induces platelet activation, and it has a vasoconstriction effect [12]. Xanthine and hypoxanthine induce vasoconstriction and damage of the endothelial barrier [13, 14].

Consequently, the excess accumulation of purine nucleotides can be regarded as an independent pathogenic factor of blood cells damage, the development of procoagulant phase, endothelial damage, disruption of metabolic processes in the kidneys, which can be regarded as a condition for the progression of chronic kidney disease (CKD). Currently it was proposed to consider two groups of mechanisms of CKD: nonmodified and modified. The first group includes factors such as age, sex, genetic factors, etc. The second group includes the bases disease activity, hypertension, metabolic disorders and hemocoagulation [15]. Imbalance of purine nucleotides should be considered as a new metabolic «agent of influence», as factor which determines the mechanisms of development and progression of chronic kidney disease. Hypertensive patients observed a decrease of some metabolites content of purine metabolism in blood plasma lower the reference data. In our opinion, this is a key moment determining one of the mechanisms of renal disease in hypertension.

According to modern concepts extracellular adenosine regards the strong regulatory effect on renal function. Thus, in particular, it was shows the role of adenosine in enhancing the glomerular filtration rate in hypoxic conditions [16]. Extracellular adenosine inhibits the activity of matrix metalloproteinase, which are now considered as one of the leading factors of the renal disease formation [17].

As mentioned earlier, in some hypertensive patients was fixed decrease concentration of adenine and uric acid in blood plasma below the physiological norm. Reducing the number of adenine in blood plasma may be due to several mechanisms: a decrease in its formation of nucleotides, increasing the capture cells, recycling through the catabolism or excretion, etc. As previously in all patients with hypertension documented increase of acid-soluble precursors of nucleic acids [18], which are subsequently catabolised to nucleosidmonophosphats, then we can talk about reducing the rate of formation of nucleosides from nucleotides. As already mentioned, our data demonstrate a decrease of extracellular adenosine in the blood of some patients with hypertension. Decrease in the concentration of extracellular adenosine against hypoxic renal tissue (eg, due to increase of blood pressure and compensatory vasoconstriction of glomerular arterioles) reduces GFR, which, in turn, may be one of the triggers of an inflammatory or toxic lesions of the kidneys. Low concentrations of adenosine and other purine catabolits in plasma under rules supported by a system of enzymes that are present both in soluble form and localized to the membranes [16]. Such systems are characterized by strong polymorphism. Therefore, the change of adenosine and purine catabolits in blood plasma of patients with hypertension is determined by individual characteristics of active components of these enzyme systems, catalyzing the formation and further damage. This explains the development of kidney lesions in some patients with arterial hypertension.

Thus, we propose a new predictor of renal disease in hypertension: reduction of adenosine. Excessive accumulation of purine nucleotides can also be regarded as an independent pathogenic factor determines blood cells damage, the development of procoagulant phase, endothelial damage, disruption of metabolic processes in the kidney that promotes the progression of chronic renal diseases.

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Materials of Conferences

ANLAGE OF LYMPH NODES OF COELIAC ARTERY IN RAT

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I study initial development of lymph nodes (LN) in basin of coeliac artery of white rat. In the fetuses of 18–19 days cranial mesenteric artery (CMA) and its branches invaginate into lumen of neighbouring mesenteric lymphatic vessels with formation common anlage of mesenteric LN as stromal tape. It becomes lymphoid tape in the fetuses of 19–20 days. Initial segment of CMA is surrounded by lymphoid tissue likely horseshoe on right, left and caudal sides from the artery, behind pancreas. This «horseshoe» has two branches: the right is short, extends to pancreaticoduodenal artery, the left is long, extends into common root of mesentery and mesocolon. The right branch turns and continues in cranial direct, on the right side of hepatic portal vein – anlage of hepatic LN. This lympoid tape displaces on the dorsal surface of portal vein and to midline, on the right side and cranially from initial segment of coeliac artery, where the tape surrounds hepatic artery. Similar anlage of splenic LN is determined in lumen of lymphatic vessels, along tributaries of hepatic portal vein, on the dorsal surface of tail and on the left side from body of pancreas, at the level of CMA. The dorsal projection of tail of pancreas separates anlage of splenic LN from thick root of dorsal mesentery. The cranially this projection disappears and lymphoid tape passes on the dorsal side of body of pancreas, where it widens and surrounds splenic artery (anlage of pancreatic LN). Then this anlage reaches the midline and gastrosplenic artery, on the dorsal side from the mouth of splenic vein (anlage of gastrosplenic LN). The left, pancreatic lymphoid tape don´t passes into the right, hepatic lymphoid tape and into the left, but more caudal mesenteric lymphoid tape.

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LYMPH NODES IN BASIN OF COELIAC ARTERY IN RAT

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I prepared 20 white rats of first and second months with the purpose to study shape and topography of lymph nodes (LN) in the basin of coeliac artery. Usually it divides into two end branches: the right – hepatic artery, the left – gastrosplenic artery. I found one small LN with oval shape on caudal side of gastrosplenic artery, near end of splenic vein and two LN with such shape and sizes along hepatic artery, in different position about hepatic portal vein. Sometimes hepatic LN was unpaired and large as ileocaecal LN. I found two groups of LN along splenic artery and vein, near dorsal border of pancreas:

1) the dexter two LN, large, with shape of bean or «coffee bean» – pancreatic LN. They lie on dorsal side of greater curvature of stomach, near pylorus («caudal gastric» LN). After withdrawal of stomach these LN remain on the dorsal border of pancreas, about splenic vein. The body of pancreas separates pancreatic LN (at cranial side of pancreas) and central mesenteric LN (at the caudal side);

2) the left two LN, oval, in 2–3 times lesser, than the dexter, – splenic LN. They lie on the place of curve or bifurcation of body of pancreas (crossing into tail), about splenic hilum, between its two cranial veins.

Tail of pancreas ajoins to visceral surface of caudal part of spleen, and between splenic LN and cranial part of spleen is determined gastrosplenic ligamentum. Thus, 6–7 LN are situated in basin of coeliac artery of white rat, mainly in connection with hepatic portal (1–2) vein and splenic vein (5). Pancreatic and splenic LN enter in complement of gastrosplenic lymphatic circle. Two bundles of lymphatic vessels unite these LN: dorsal bundle passes onto greater curvature of stomach and ventral bundle acrosses pancreas.

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THE BEHAVIOUR OF AQUATIC ORGANISMS AS A QUALITATIVE INDEX OF THE ECOLOGICAL STATE OF WATER BODIES

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The article touches upon the questions of the possibility of the usage of behavioral reactions of living organisms for identification of the toxicity of aquatic environment. We demonstrate that behavioral reactions serve as well-marked indices of the influence of small concentrations of pollutants and represent the first and the quickest responses to the change in the aquatic environment.

Keywords: aquatic organisms, ecological state, water bodies

Solving problems of environmental management we have to acknowledge the impossibility of complete prevention of the anthropogenic impact on aquatic environment in present or in the nearest future even if the industrial conditions become better. That's why the forehanded obtaining of the information about environmental pollution must be a constitutive stage of an ecological expertise, as these data enable to adequately evaluate the degree of technogenic pressure on aquatic objects and the probability of the risk of negative impact on its inhabitants.

In order to evaluate the degree of negative changes it is necessary to carry out an ecological monitoring, the system of observations and control of the changes in composition and functions of various ecological systems. Levels of the organization of the monitoring are different; it may be carried out in global, national, regional or local scope. Different chemical, physical and biological methods of analysis are being actively applied in ecological monitoring. The data of the monitoring are used for the comprehensive analysis of the environmental state and for the determination of the strategy of its management, for the regulation of its quality and for the qualification of the permissible ecological pressure on the environmental systems.

Despite the availability of effective efficient physical and chemical methods analytical procedure of detecting pollutants in aquatic environment has certain restrictions. Firstly, all stages of the procedure, from the stage of taking samples to the stage of identification and metrological evaluation of results of measuring take much time and are quite expensive, moreover, there is necessity in well equipped chemical laboratories and modern analytical facility. Secondly, a trustworthy identification of purposeful components in complex compounds of pollutants of different nature and toxicity is possible only in case of big sum-total of measurements and simultaneous application of three or four independent methods. A thorough and argumentative analysis in all cases of the situation threatening people's health or environmental hazard is completely essential.

The basic defect of physical and chemical methods is the disability to detect small concentrations of toxicants in aquatic environment in most of the cases.

Meanwhile, entering of even small concentrations of pollutants in a water body may cause change in the correlation of species, the change of the qualitative contents of the community may result in catastrophic decrease of the abundance of commercial species or decline of their quality. Organisms are able to live in a toxic environment for quite a long period of time, that's why one can get an impression of their full biological well-being.

A potential danger of small concentrations of pollutants consists in the fact that many substances are accumulated in organisms and are concentrated in considerable quantities in each of the following trophic link. As a result, the highest link may accumulate a substance many times more than it is present in the water of the same volume. Correspondingly, we can't deny the possibility of entering of pollutants into human body not only through waters but also through food.

In contradistinction to chemical and physical methods, the biological methods of analysis that use living organisms as analytic indicators make it possible to get an integral evaluation of an ecological situation. The principle of biological methods is based on the fact that all living organisms in active state interact with the environment and need the environment of a strictly defined composition for the optimal life-support. If you change the chemical composition by adding an additional component or deleting it, an indicating organism will give a reverse reaction. The reverse reaction of an indicating organism is transformed in an analytical signal that serves as a measure of qualitative evaluation or quantitative determination of the chemical composition of water.

Human beings have always treated living organisms as indicators of the quality of the environment. That's why recently scientists have started to pay more attention to behavioral reactions of living organisms with the help of which they can detect a pathology caused by chemical substances long before the integral responses of an organism are disordered.

The analysis of Russian and foreign literature devoted to the behavioral reactions of hidrobionts let us make the following conclusions:

1. As a basic criterion of the toxicity of chemical substance for hidrobionts we must consider the biological criterion that characterizes the danger represented by this or that toxicant for a reproduction of mass species, playing role in production and self-clarifying processes, or commercial species. When we study the toxic effect of different substances using hydrobionts, we need to define not only lethal but also critical concentrations of substances, i.e. such concentrations that evidence the least considerable disturbances in the processes of organisms' life activity.

2. The biological methods have become conventional and widely-spread for determining the toxicity of different chemical products as well as the quality of the aquatic environment as a whole. The reaction of living organisms to an integrated influence of any toxicants is approved and fully evidences the aggression of the studied environment.

3. The behavior of organisms is the most delicate and sensitive indicator of the toxicity. Organisms respond to any outer influence, including a toxic one, by their behavior long before the moment of irreversible pathological changes or death. Changes in behavior occur much earlier and in cases of smaller concentrations of toxic substances than vivid features of intoxication or animals' death.

4. The behavioral reactions of aquatic organisms on the influence of a toxicant are various and depend on a large number of factors: chemical and physical nature of a substance, concentration and the duration of influence, mechanism of influence, specious membership of systematic groups of animals, stage of ontogenesis, sex, size and other factors.

5. Behavioral manifestations of toxicosis may be observed at an individual level as well as at a group one. The degree of an audibility of the behavioral effect depends on the concentration and the duration of the pollutants' influence.

6. When studying the behavioral reactions of aquatic organisms to different toxic substances the following test objects are most commonly used: infusorians, crustaceans, leeches, mollusks, amphibians and fish. The choice of the biological objects is determined by the possibility of hydrobionts' cultivating in laboratory conditions or the maintenance of the normal life activity for the individuals cached in the natural habitat. The choice of functional indices of hydrobionts is determined by the regard of a possibility of receiving the quick reverse reaction in conditions of minimal changes of the water quality.

7. The complex of behavioral reactions is greatly varied. The following behavioral reactions are being recorded: change in the movement activity, change of phototaxis or chemotaxis, change of the preferred areas of the habitat, reactions of avoidance or attraction, change in the daily rhythms of the animals' behavior. The most reliable index of toxicity in this sense is the disorder in the complex of the fixed activities, directed at the achievement of the biologically relevant aims – nutrition, defense, reproduction.

8. In some cases the use of behavioral reactions makes it possible to state the fact of the toxicity of water as well as to assume the character of intoxication and the chemical nature of the toxicant. If one toxicant during an exposure causes different reactions in a definite sequence, while under the influence of another toxicant this sequence changes, there appears a possibility to identify the toxicants by the behavioral response. Studies in this direction are quite topical, as they may help to understand mechanisms of the peculiar influence of this or that toxicant on aquatic organisms.

Summing up, we would like to make the following conclusion.

The scientific ground of the permissible limits of the anthropogenic impact on aquatic ecosystems that guarantees their well-being as well as the economic efficiency of the nature-protecting activities brings to the forefront the purpose of an ecological regulation of the anthropogenic pressure.

The ecological regulation must be based not only on the data about the survival rate of the hydrobionts but also on the changes in the processes of their life activity. If we use lethal outcome as the only index of toxicity we don't pay attention to the numerous fore pathologic reactions of an organism in the period between the first contact of hydrobionts with polluting agents and the following manifestation of intoxication. In our case, behavioral reactions serve as well-marked indices of the influence of small concentrations of pollutants and can be treated as the first and the quickest reactions on the change of the aquatic environment.

There are no grounds to contradict one level to another one, or to treat one of them as the main one, and the others as subordinate ones. Studies of the toxicants' influence must be carried out at all levels of the organization of a living system. The information obtained at one level helps to understand processes taking place at another level.

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NOVEL PHOTOCHROMIC SPIROPYRANS DERIVED FROM 6-HYDROXY-4-METHYL-5-FORMYLCOUMARIN

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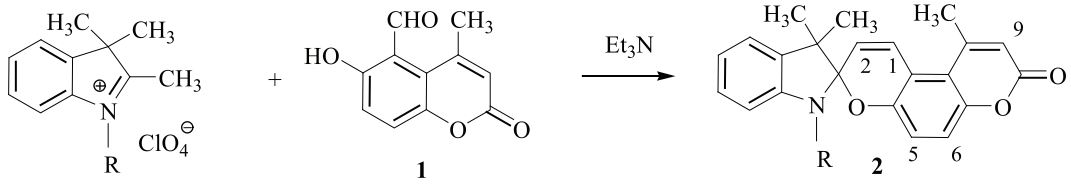
Novel indoline, isobenzofuran and naphtopyran spiropyrans (SPPs) containing in 2H-chromene part of the molecules fused coumarin moiety were synthesized. According to ^{1}H NMR, IR and UV/Vis spectral data these compounds exist in cyclic spiroform SP. Under irradiation of their solutions in isopentane-isopropanole (4:1) mixture at $T < 250$ K the formation of merocyanine (MC) isomer was observed. The back reaction MC ® SP is thermally reversible.

Keywords: spiropyrans, merocyanine, coumarine, photochromism

Photochromic spiropyrans (SPPs) are widely used for data recording, as photocontrolled organic molecular switches, in devices of molecular electronics and as chemosensors for metal cations [1–4]. Some representatives of coumarin-containing SPPs were synthesized earlier [5–9]. In order to study influence of annelation manner of coumarin moiety to 2H-chromene part of the molecule on photochromic and spectral properties of SPPs novel indoline, isobenzofuran and naphtopyran spiropyrans were synthesized.

6-Hydroxy-4-methyl-5-formylcoumarin **1** as aldehyde component was used for the synthesis of above mentioned SPPs. Perchlorates of N-substituted 3*H*-indolium, isobenzofuranium and benzo[f]chromenium were employed to form hetaryl part of the molecules. Spiropyrans **2** were obtained by condensation of corresponding 3*H*-indolium perchlorates with aldehyde **1** in isopropanol in the presence of triethylamine (scheme 1).

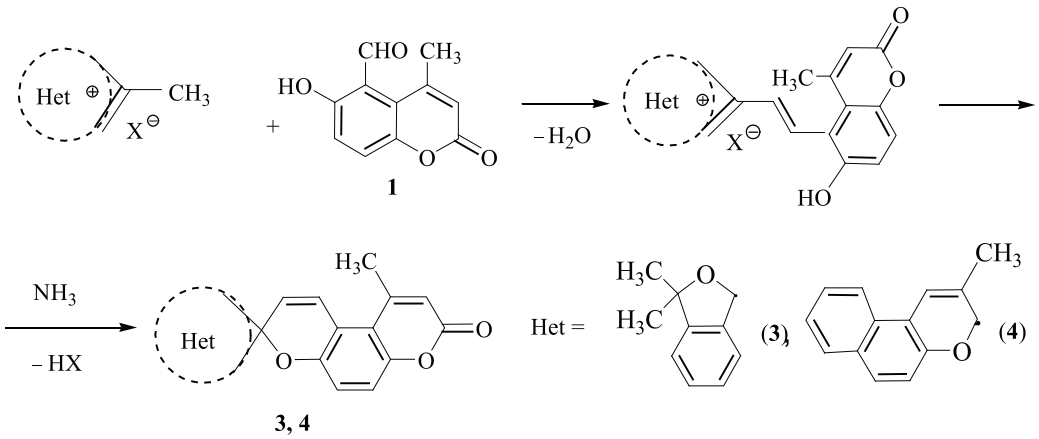
Scheme 1



R = $CH_2C_6H_5$(**a**), C_3H_7(**b**), C_6H_{13}(**c**), C_8H_{17}(**d**)

Spiropyrans **3,4** were synthesized in two steps (scheme 2). The first one represented condensation of isobenzofuranium and benzo[f]chromenium perchlorates with aldehyde **1** in acetic acid. The second step consisted in treatment of intermediate product by dry ammonia in benzene solution.

Scheme 2



In upfield region of ^{1}H NMR spectra of spiropyrans **2-4** are present two signals of magnetic unequivalent *gem*-methyl groups. Signals of diastereotopic methylen group protons of N-benzyl substituent in SPP **2a** are observed as two doublets at 4,20–4,30 ppm. Signal of H-2 proton in double bond of pyran cycle of compounds **2-4** are registered as doublet at 5,32–5,85 ppm. Doublet of H-1 proton is closed by aromatic proton signals at 7,00–8,50 ppm. However for molecules **2b,c,d** and **4** this doublet is seen at 7,40–7,60 ppm. These data confirm that SPPs **2-4** exist in cyclic SP form.

Singlet signal of H-9 proton in coumarin moiety is registered in the region 6,15–6,19 ppm. The location of H-5 and H-6 protons is very specific: doublet at 6,56–6,90 ppm. The second doublet of these protons is closed by aromatic proton signals at 7,00–8,50 ppm, however for **2d** it is seen at 7,32–7,36 ppm.

Table 1

^{1}H NMR spectra of spiropyrans **2-4** in $CDCl_3$

Comp,	Chemical shift, ppm (*J*/Гц)	
	Hetarene fragment	Pyran fragment $C^1H = C^2H$ (1H, d)*
2a**	1,10 s, 1,25 s (6H, 2 *gem*–CH_3); 4,00 d, 4,50 d (2H, NCH_2)	5,40–5,55
2b	0,86 t (3H, CH_3); 1,19 s, 1,55 s (6H, 2 *gem*–CH_3); 1,28 s (2H, CH_2); 3,08 m (2H, NCH_2)	5,83–5,85; 7,56–7,60
2c	0,86 t (3H, CH_3); 1,18–1,28 m (12H, $2CH_3$, $3CH_2$); 1,55 s (2H, CH_2);3,05–3,26 m (2H, N–CH_2)	5,80–5,84; 7,56–7,60
2d	0,86 t (3H, CH_3); 1,18–1,28 m (16H, gem– $2CH_3$, $5CH_2$); 1,56 s (2H, CH_2); 3,05–3,26 m (2H, NCH_2)	5,80–5,84; 7,56–7,60
3**	1,30 s, 1,45 s (3H, 2 *gem*–$2CH_3$)	5,65–5,75
4**	1,82 s (3H, CH_3)	5,60–5,80; 7,40–7,50

Notes:
* Signal of the second proton is in the region of aromatic proton signals;
** In C_6D_6.

Electronic absorption spectra of SPPs **2-4** in isopentane-isopropanol mixture (4:1) show long-wavelength bands with maxima centered around 364–402 nm with strongly marked vibration structure which are indicative for cyclic forms SP [2, 10, 11]. The irradiation of compounds **2-4 SP** in above mentioned solution (λ_{irr} 365 nm, $T < 250$ K) leads to formation of merocyanine isomers **2-4 MC**. In dark conditions these isomers thermally convert into the initial spiroforms (table 2).

Scheme 3

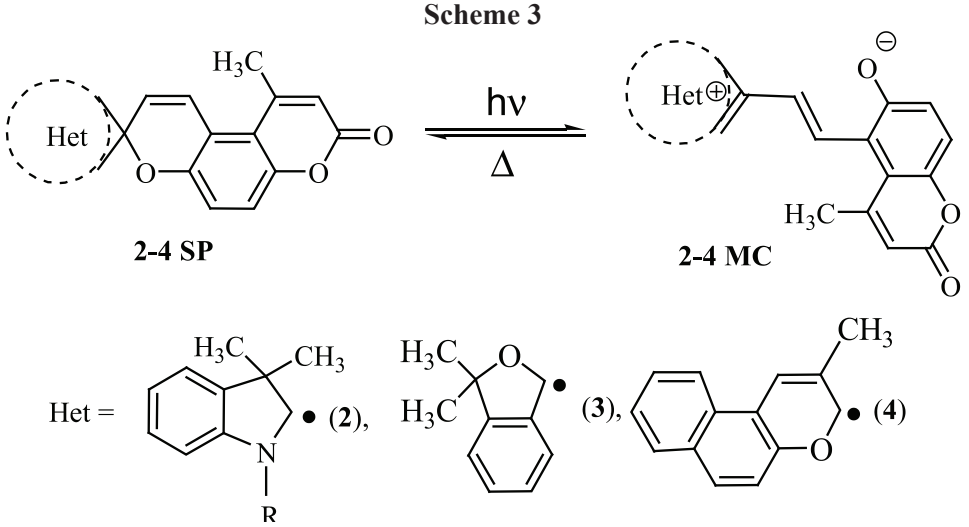


Table 2

Spectral characteristics of isomers **SP** and **MC** for **2-4** in isopentane-isopropanol mixture (4:1) at 203 K

Comp.	Spiroform **SP,** l_{max}, nm	Photoinduced form **MC**, l_{max}, nm
2a	382	609
2b	380	606
2c	384	609
2d	383	606
3	364	550
4	402	602

According to these data a new type of photochromic coumarin-containing SPPs was synthesized.

Acknowledgments

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STABLE LAWS AND THE NUMBER OF ORDINARY

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Power total number of primes from the discharge of the decimal system is identified by the law of exponential growth with 14 fundamental physical constants. Model obtained on the parameters of the physical constants, proved less of the error and it gives more accurate predictions of the relative power of the set of prime numbers. The maximum absolute error of power (the number of primes), the traditional number is three times higher than suggested by us complete a number of prime numbers. Therefore, the traditional number 2, 3, 5, 7, ... is only a special case. The transformation ln = 2,302585 ... it was a rough rounded, leading to false identification of physico-mathematical regularities of different series of prime numbers. Model derived from physical constants, proved more accurate than the relative accuracy, and it gives more accurate predictions of the relative power of the set of prime numbers with increasing discharge the decimal number system.

Keywords: primes, total number, physical constants, the relationship

Prime number – is a natural number $N = \{0, 1, 2, 3, 4, 5, 6, ...\}$ that has two positive divisors: one and itself.

There are several variants of distribution or **a series of prime numbers (SPN):**

1) finite number of critical primes $P = \{0, 1, 2\}$;

2) non-critical prime numbers $P = \{3, 5, 7, 11, 13, 17, ...\}$;

3) the traditional [1] number of primes $a(n) = \{2, 3, 5, 7, 11, 13, 17, ...\}$ with order (serial number) $n = \{1, 2, 3\}$, which was considered by many scientists and by Riemann;

4) part series of prime numbers [2] $P = \{1, 2, 3, 5, 7, 11, 13, 17, ...\}$;

5) the total number of prime numbers $P = \{0, 1, 2, 3, 5, 7, 11, 13, 17, ...\}$ that are equivalent row N.

The literature focuses on SPN_3, and we did not find sufficient publications on the analysis of SPN_4 and other ranks have been proposed by us. In this reader a series of five articles examined SPN_1, SPN_2 SPN_5 and compared with evidence SPN_3.

In the analysis of stable laws have been applied [3] to the distribution of prime numbers.

Biotechnical law and its fragments. Under the scheme «from the simple to the complex structure» in table 1 are all stable laws are used to construct formulas biotech laws. Generalizing formula is biotech law [3]. Most often, the sum of two biotech laws constitutes a deterministic allocation model. Formula, together with a finite set SPN runs in a software environment CurveExpert for parameter identification of a stable law and wave patterns.

Table 1

Mathematical constructs in the form of stable laws to build a statistical model

Fragments without previous history of the phenomenon or process	Fragments from the prehistory of the phenomenon or process
$y = ax$ – law of linear growth or decline (with a negative sign in front of the right side of this formula)	$y = a$ – the law does not impact adopted by the variable on the indicator, which has a prehistory of up period (interval) measurements
$y = ax^b$ – **exponential growth law** (law of exponential death) $y = ax^{-b}$ is not stable because of the appearance of infinity at zero explanatory variable	$y = a\exp(\pm cx)$ – law of Laplace in mathematics (Zipf in biology, Pareto in economics, Mandelbrot in physics) exponential growth or loss respect to which the Laplace created a method of operator calculus
$y = ax^b\exp(-cx)$ – biotech law (law of life skills) in a simplified form	$y = a\exp(\pm cx^d)$ – **law of exponential growth or death** (P.M. Mazurkin)
$y = ax^b\exp(-cx^d)$ – **biotech law**, proposed by professor P.M. Mazurkin	

For the processes of behavior of living and/or inert substances (according to V.I. Vernadsky) parameters a, b, c, d biotech law and its fragments may approach to the fundamental physical constants, and it has been shown in the distribution of chemical elements [4].

Power series of prime numbers. According to [1] SPN_3 and our calculations on SPN_5 in table 2 shows the cardinal numbers and their relationships SPN_5/SPN_3.

In the first digit decimal numbers the difference between a full and traditional rows of simple number is equal to 150%. The relative cardinal number is the maximum 100,31 at $i_{10} = 6$ and minimum 66,67 at $i_{10} = 1$. What SPN better? In advance, we say that SPN_5.

Table 2

The relative cardinal number the increase in the capacity (quantity) of prime numbers

Discharge i_{10}	The power of numbers x	Traditional SPN_3 [1]		Full SPN_5		SPN_5/ SPN_3, %	
		Power $\pi(x)$	$x/\pi(x)$	Power $\pi(x)$	$x/\pi(x)$	$\pi(x)$	$x/\pi(x)$
1	10	4	2,5	6	1,6667	**150,00**	66,67
2	100	25	4,0	27	3,7037	108,00	92,59
3	1 000	168	6,0	170	5,8824	101,19	98.04
4	10 000	1 229	8,1	1 231	8.1235	100,16	100,29
5	100 000	9 592	10,4	9 594	10,4232	100,02	100,22
6	1 000 000	78 498	12,7	78 500	12,7389	100,00	**100,31**
7	10 000 000	664 579	15,0	664 581	15,0471	100,00	100,31
8	100 000 000	5 761 455	17,4	5 761 457	17,3567	100,00	99,75
9	1 000 000 000	50 847 534	19,7	50 847 536	19,6666	100,00	99,83
10	10 000 000 000	455 052 512	22,0	455 052 514	21,9755	100,00	99,89

Traditional SPN. With the increase in decimal place of natural numbers the increase in the relative cardinal number of the set of prime numbers with a capacity of more than 455 million occurs (fig. 1) by a deterministic model of the law of exponential growth.

$$x / \pi(x) = 0,00066575 \exp\,(8,10285\, i_{10}^{0,10893}). \quad (1)$$

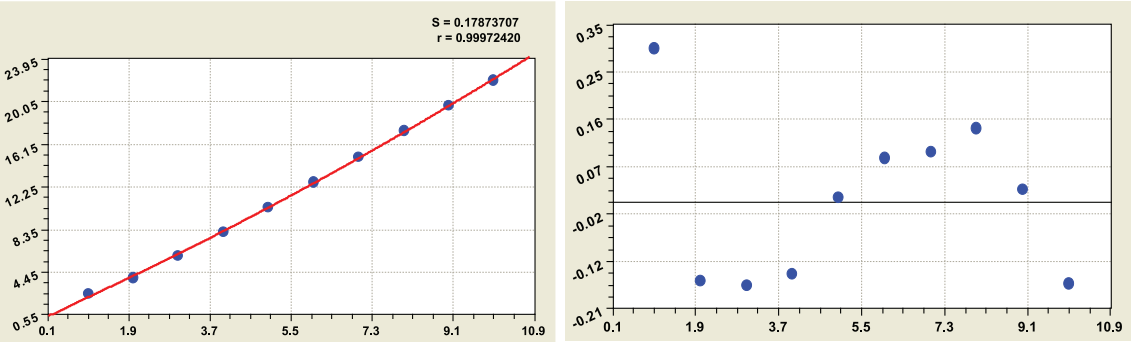

Fig. 1. The schedule of the law of exponential growth (1) the relative power and remains after it: S – Dispersion; r – correlation coefficient

On the balances was obtained of the wavelet function (described in the second article)

$$\varepsilon = 88,26937 \exp\,(-5,36239\, i_{10}^{0,098706}) \cos\left(\frac{\pi i_{10}}{0,59537 + 1,47125\; i_{10}^{0,27860}} - 0,67755\right). \quad (2)$$

The law of exponential death before the cosine function shows half of the amplitude of the oscillatory perturbations of power SPN_3. Because of the high value of the remainder for $i_{10} = 1$, we have that zero discharge is theoretically possible number of prime numbers must be 88. Combining formulas (1) and (2) gives the binomial model with the wave function of the form

$$x / \pi(x) = 0,00074272 \exp\,(8,15289\, i_{10}^{0,10111}) +$$

$$+956,514 \exp\,(-5,28998\, i_{10}^{0,21896}) \cos\left(\frac{\pi i_{10}}{-0,14154 + 15,52749\; i_{10}^{-0,33681}} + 1,38397\right). \quad (3)$$

Top of the wave has moved up to 957 prime numbers with zero discharge of the decimal system. In addition, under the function of the cosine of half-cycle fluctuations has changed: the beginning shifted to the first digit of the negative numbers. Half-life increases sharply, and the intensity parameter of death −0,33681 shows anomalous behavior of the model (3).

Full range. This SPN_5 received a deterministic pattern (fig. 2) the type of

$$x / \pi(x) = 1,50030 \cdot 10^{-24} \exp\,(55,46724\, i_{10}^{0,019036}). \quad (4)$$

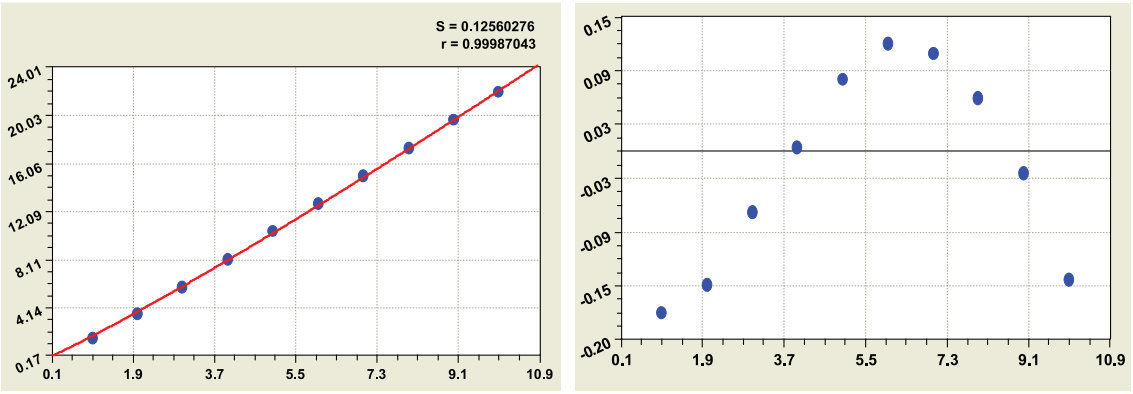

Fig. 2. Schedule of the law of exponential growth (4) and residues from himt

Residues have a relatively smooth swing and determined by the formula:

$$\varepsilon = -0,20751 \exp\,(-0,16759\, i_{10}^{0,48624}) \cos\left(\frac{\pi i_{10}}{8,19322 - 0,31718\; i_{10}^{0,99304}} - 0,22080\right). \quad (5)$$

In formula (5), half of the amplitude of the perturbations of the power SPN_5 has the numerical value of all 0,20751. The initial half-life 8,19322 damped oscillations approaching 8.

The general equation is characterized by binomial formula

$$x / \pi(x) = 1,49766 \cdot 10^{-24} \exp\,(55,46556\, i_{10}^{0,019025}) -$$

$$-0,18905 \exp\,(-0,0032736\, i_{10}^{1,00713}) \cos\left(\frac{\pi i_{10}}{7,40869 - 0,23358\; i_{10}^{0,61848}} - 0,028862\right). \quad (6)$$

Do not change the scale of reference of natural primes. This recommendation for the future in the study of prime numbers comes from the fact that, from Riemann used the natural logarithm and are looking for an empirical formula [1]. To quote from an article by Don Zagier: «Apparently (see table 2), that the ratio of x to $\pi(x)$ the transition from a given degree of ten to follow all the time increases to about 2,3. Mathematics is recognizable among the 2,3 log 10 (of course, to base e). The result suggested that the $\pi(x) \sim |x / \ln x|$, where the sign ~ means that the ratio of their expressions are connected with x tends to 1. This asymptotic equation, first proved in 1896, is now the law of **distribution of prime numbers**. Gauss, the greatest of mathematicians, discovered this law in the age of fifteen, studying tables of primes contained in the gift to him a year before the table of logarithms».

We were not too lazy to check the statement «the ratio of x to $\pi(x)$ in the transition from the present level of ten to follow all the time increases by about 2,3» and the results of the calculations resulted in table 3. Here, the number 2,30 in SPN_3 not (if there is, the approximation error to 2,30 at $100(2,5 - 2,3)/2,3 = 8,70\,\%$, which is very much), but there is an aspiration to 1. At the same time the full range of gives at the beginning of the interval of digits in a larger multiplicity 2,22 (error of 3,47 %).

Equal to the power of two sets SPN_3 and SPN_5 can be considered, starting with the digits $i_{10} \geq 9$ in decimal notation.

With the growth of x a true statement is the convergence to 1. For this purpose we identify the law of death (in a general form of table 1) according to the statistical data of table 3.

For the full range of the obtained formula

$$card\left(\frac{x_i}{\pi(x_i)} \Big/ \frac{x_{i-1}}{\pi(x_{i-1})}\right) = 1,09980 + 1788,3968 \exp(-6,20754 i_{10}^{0,24956}). \quad (7)$$

Table 3

The multiplicity of cardinal number

Discharge i_{10}	Private SPN_3 [1]		Full SPN_5	
	$x/\pi(x)$	multiplicity	$x/\pi(x)$	multiplicity
1	2,5	-	1,6667	-
2	4,0	1,60	3,7037	2,22
3	6,0	1,50	5,8824	1,59
4	8,1	1,35	8,1235	1,38
5	10,4	1,28	10,4232	1,28
6	12,7	1,22	12,7389	1,22
7	15,0	1,18	15,0471	1,18
8	17,4	1,16	17,3567	1,15
9	19,7	1,13	19,6666	1,13
10	22,0	1,12	21,9755	1,12

Equation (7) shows that the ratio of cardinal numbers will not come near to the unit and can only reach the values of the 1,0998.

From the article [1] reads: «After more than a careful and complete calculation, Legendre in 1808 found that particularly good approximation is obtained if we subtract from ln x is not 1, but 1,08366, i.e. $\pi(x) \sim \left|x/(\ln x - 1{,}08366)\right|$». In the formula (7) the constant 1,09980 is little different.

Thus, number of prime numbers, the power has been studied in a number system with base e = 2,718281828 .... . It is known that this system has the greatest density of information recording and refers to the nonintegral positional systems. But non-integers do not belong to the natural numbers N, let alone to a series of prime numbers $a(n)$ = {2, 3, 5, 7, 11, 13, 17, ...}.

Thus, the transformation ln 10 = 2,302585 ... it was a rough rounded, leading to false identification of physico-mathematical regularities of different series of prime numbers.

With «easy» hands Gauss in mathematics, vigorously developed ***the theory of approximation***, which made it possible to linearize the scale of the abscissa and ordinate in terms of ln x and ln y. Thus is the fundamental transformation of the statistical data presented at the beginning of the decimal system, in logarithmic. As a result, the ***closed form of design patterns*** that are not only difficult to understand, but they have lost and the visibility of graphics and even more so – the physical representation. Therefore, we continue to recommend in its publications to readers ***an open system of mathematical constructs*** according to the laws of table 1.

Fundamental constants. Formulas from table 1 gives the identification of fundamental physical constants to the parameters a, b, c, d. Processes themselves are unknown.

Carefully consider the formula (4), and compare the values of parameters of the mathematical model with the fundamental constants. Recall that Don Zagier [1] analyzed (see table 2) a very large number of natural numbers $\tilde{N} = \{0,1,2,3,...,10\}^{10}$ with a finite number $a(n)$ = {2, 3, 5, 7, 11, 13, 17, ...} of prime numbers and gave them a set of up $\pi(x) \to 455\,052\,512$.

We put forward a hypothesis (table. 4): with an increase in the relative power of the total number of prime numbers, the parameters of the model (4) will tend to the fundamental constant [5].

To a first approximation we replace the law (4) to the physical equivalent to the formula

$$\frac{x}{\pi(x)} = \frac{\sqrt{5}+1}{2\cdot 10}\frac{\mu_p}{\mu_N}\mu_B e^{\left(m_e\sigma_a \frac{g_n}{10}\frac{m_p}{m_n}\right) i_{10}^{\frac{4}{\pi}c_2\left(\frac{\mu_e}{\mu_B}g_e-1\right)^8}}, \qquad (8)$$

legend of the model parameters (8) are given in table 4 (10 – radix).

The law with the fundamental constants. After substituting the fundamental physical constants in table 4 we write the model (8) as a law of exponential growth

$$x/\pi(x)_f = 4{,}1908462\cdot 10^{-24}\exp(54{,}435096 i_{10}^{\,0{,}0190103}). \qquad (9)$$

Next check the adequacy of the models (4) and (9). Known formulas allowing to calculate the number of primes faster. In this way, it was calculated that up to 10^{23} is 1 925 320 391 606 803 968 923 primes.

Model (9), obtained from the physical constants in table 4, was even more precise on the relative error, and it gives more accurate predictions of the relative power of the set of prime numbers.

The error for the array i_{10} = 23 is equal to only 0,08 %. By the remnants of (9) is obtained (fig. 3) the equations of the perturbation.

Biotechnical law as a supplement to (9) shows that after the discharge i_{10} = 23 in the relative power is going on a decline. Damped oscillation shows that with increasing power of primes wave $x/\pi(x)$ tends to zero. When $i_{10} >> 23$ the perturbation is almost excluded.

Table 4

Comparison of parameters of the model (4) of power SPN_5 with the fundamental physical constants

Parameter of the first term of the statistical model (6)			The fundamental physical constant		The multiplicity to a parameter of the model (4)
Type	Name	Value	Name	Value	
the number of time		18 characters*	Number of Napier	$e = 2{,}71828$ ...	≈ 1
Trend (tendency) of prime numbers	Initiation of a series of prime numbers	$1{,}50030 \cdot 1^{-24}$	Bohr magneton	$\mu_B = 9{,}27402 \cdot 1^{-24}$	6,1814
	Active growth of power	55,46724	Electron mass (amu)$\cdot 10^{-4}$	$m_e = 5{,}485799$	$55{,}58486 = m_e\sigma = 1{,}0021105$
	The growth rate of power	0,019036	Radiation: a second constant	$c_2 = 0{,}0143877$	$0{,}75582 \rightarrow \pi/4$
The number of harmony		18 characters*	Golden section $\varphi = 1{,}61803$ ...	$\varphi^{-1} = 0{,}61803$ ...	≈ 1
Parameters of the Earth	Atmosphere	exactly	Standard atmosphere	$\sigma_a = 101325$	1
	Gravitation	The acceleration of gravity (standard)		$g_n = 9{,}80665$	1
Atom	Proton	Magnetic moment/nuclear magneton		$\mu_p/\mu_N = 2{,}7928474$	≈ 1
		Mass of the proton (amu)		$m_p = 1{,}00727647$	≈ 1
	Neutron	Magnetic moment of the neutron		$\mu_n = 0{,}96623707$	≈ 1
		Mass of the neutron (near.)		$m_n = 1{,}0086649$	≈ 1
	Electron	Magnetic moment of/Bohr magneton		$\mu_e/\mu_B = 1{,}00115965$	≈ 1
		Anomaly magnetic moment		$g_n = 2{,}0023193$	≈ 1
Number of space		18 characters*	Number Of Archimedes $\pi/4 = \approx 0{,}78540$	$\pi = 3{,}14159$ ...	≈ 1

N o t e . * – In the mathematical environment CurveExpert the possibility of representing irrational numbers.

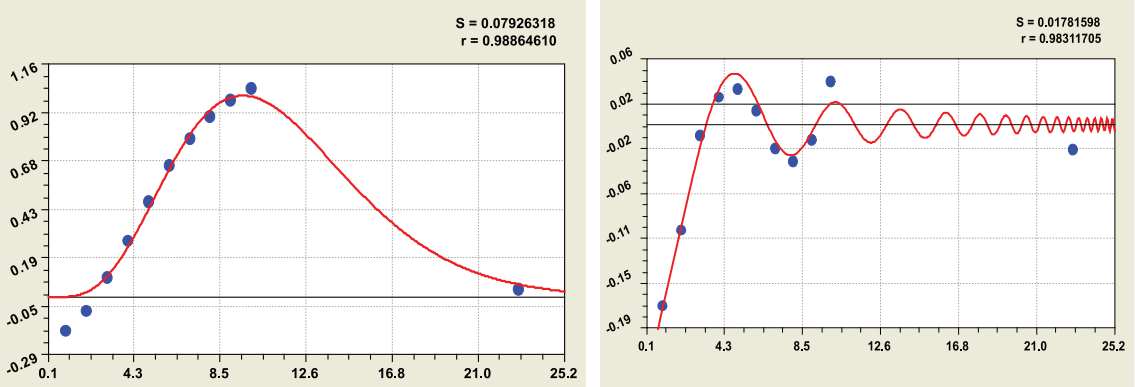

Fig. 3. Diagrams of the perturbation capacity of prime numbers depending on the order of the decimal system

Conclusions

Power total number of primes from the discharge of the decimal system is identified by the law of exponential growth to the fundamental physical constants. With the growth of the power of the prime numbers increases the adequacy of equation (8) with the physical constants, which can lead in the future to the general equation four interactions.

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GROWTH PRIMES

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The growth of prime numbers was a clear indication. Increase – the number increases, the addition of something. If the number of prime numbers, figuratively called the «ladder of Gauss-Riemann», the increase may well be likened to the steps, separated from the ladder itself. We prove that the law is obeyed $z_2(i_2 = 2) = 1/2 - 1/2\cos(\pi p(n)/2)$ in the critical line $i_2 = 2$ of the second digit binary number system. This functional model was stable and in other quantities of prime numbers (3000 and 100 000). The critical line is the Riemann column $i_2 = 2$ binary matrix of a prime rate. Not all non-trivial zeros lie on it. There is also a line of frames, the initial rate (yields patterns of symmetry) and left the envelope binary number 1. Cryptographers cannot worry: even on the critical line growth of prime numbers $z_{2j} = 1/2 - 1/2\cos(\pi p_j/2)$ contain the irrational number $\pi = 3{,}14159$ ...

Keywords: prime numbers, increase, the critical line, the root of 1/2

Gauss, Riemann, and behind them and other mathematicians carried away by the relative power $x/\pi(x)$ of prime numbers with a truncated start, represented in dotted decimal notation. In this case, apparently unconsciously, this figure has been expressed with the logarithm of the irrational basis $e = 2{,}71$ ..., and thus the transition from ten degrees to its natural logarithm of false identification has occurred. It is the main error of more than 150 years.

We refused to logarithms, went to the binary system. It turned out that the very prime, $a(n) = \{2, 3, 5, 7, 11, 13, 17, ...\}$, $n = \{1, 2, 3\}$ is not sufficiently effective measure. To avoid any claims to the proof, we adopt this traditional range.

Algorithm building a number of prime numbers. He is widely known, has the form

$$a(n+1) = a(n) + p(n), \qquad (1)$$

where $p(n)$ – the growth of a prime number; n – the order of (number) of a prime number. The very number of primes is given initially, it is determined by the condition of the indivisibility of the other numbers, except on unit and itself (the latter condition, even excessive).

Therefore, growth is always calculated by subtracting

$$p(n) = a(n+1) - a(n). \qquad (2)$$

In table 1 shows fragments of the growth of a number of $a(n) = \{2, 3, 5, ..., 3571\}$.

Among the 500 prime numbers was a maximum increase $p(217) = 34$ for a prime $a(217) = 1327$ with code 100010 in binary.

The fundamental difference of a number of growth of the number of primes is that in the growth (the same number – an abstract measure of the amount), only one column $i_2 = 2$ bit binary numbers is completely filled and critical, and the first class has only zeros for the set $a(n) > 2$.

Full filling will continue to infinity, therefore, can be considered a proven fact the appearance of the $p(n) = 2$ at any power $a(n)$.

Mathematical landscape. To construct (fig. 1) we take the example $i_2 = 1, 2, 3, 4, 5$ and delete those rows in which the five columns contains at least one trivial zero.

Table 1

A number of primes increase in 10th and binary number systems

Order n prime	Prime $a(n)$	The growth $p(n)$ of a prime	The category of number i_2 of binary system					
			6	5	4	3	2	1
			Part of the increase $p_{i_2}(n) = 2^{i_2-1}$					
			32	16	8	4	2	1
1	2	1						1
2	3	2	trivial zeros				1	0
3	5	2					1	0
4	7	4				1	0	0
5	11	2					1	0
...	...	...	...	...	...	...	...	...
495	3539	2					1	0
496	3541	6				1	1	0
497	3547	10			1	0	1	0
498	3557	2					1	0
499	3559	12			1	1	0	0

An indicator is a binary number z_2 in the field of real numbers (0, 1).

Critical line. The first line in table 1 will automatically fall out of the set. After that, at any length series of prime numbers the first column $i_2 = 1$ is zero. Then each value increment from right to left starting from zero and ends with the unit. And for the unit as a wave broken lines are only trivial zeros.

All non-trivial zeros are arranged in any row between 1 (left) and 0 (first column on the right). Then ***Riemann's critical line*** in a vertical column $i_2 = 2$. But it is clear that not all non-trivial zeros lie on the critical line. They are available in other binary digits, interspersed with trivial zeros.

Critical start of the series. In table 2 shows the three critical primes.

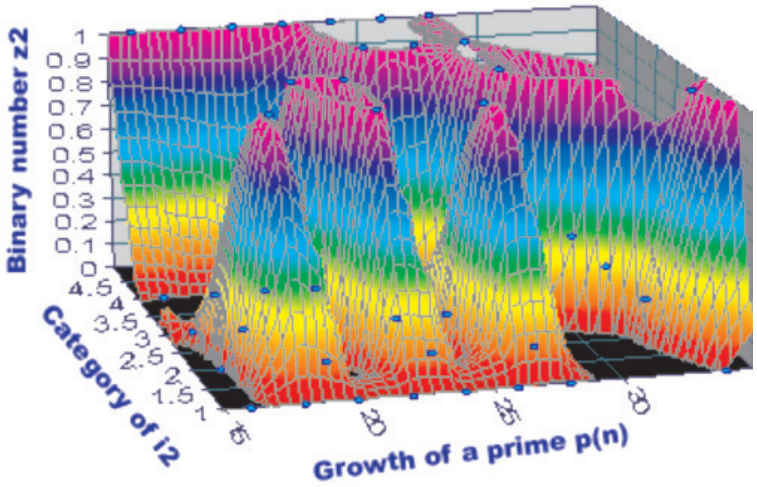


Fig. 1. The landscape of growth in the number of 500 prime numbers

Table 2

Gain critical primes

Order n	Prime $a(n)$	Growth $p(n)$	Digit number i_2					
			6	5	4	3	2	1
			part of the increase					
			32	16	8	4	2	1
-1	0	1						
0	1	1	trivial zeros					1
1	2	1						1

Together with table 1 critical prime numbers give a full range of prime numbers, which this article is not considered. To accept it, you must:

a) to recognize as simple that number which shares only on unit (zero/zero indefinite);

b) change the order in a number $N = \{0, 1, 2, 3, 4, ...\}$;

c) gain 1 is a border in the uncritical range includes non-critical prime $P = \{3, 5, 7, ...\}$.

Further detailed analysis of the growth will fulfill a number of non-critical primes.

Effect of discharge i_2. In the software environment of Excel sum over the columns in table 1 (excluding the first line) and get the number of units $\sum z_2$ in the ranks of the binary system.

Table 3

Influence of discharge binary system (498 lines)

i_2	p_{i_2}	$\sum z_2$	Share 1	$\sum(z_2 = 0)$	Share 0	$2^{i_2-1}\sum z_2$	$\sum z_2 / \sum\sum z_2$
1	1	0	0	498	1	0	0
2	2	298	0,5984	200	0,4016	596	0,3855
3	4	285	0,5723	213	0,4277	1140	0,3687
	8	153	0,3072	345	0,6928	1224	0,1979
5	16	36	0,0723	462	0,9277	576	0,0466
6	32	1	0,0020	497	0,9980	32	0,0013
All		773	-	2215	-	3568	-

Model should give the relative values that allow comparison between different series of growth of prime numbers.

After the identification of bio-law [2] was to teach the following conclusions:

– the share of units (fig. 2) lines of the binary matrix of growth of prime numbers

$$\nu(1) = \frac{\sum z_2}{498} = 0,61623(i_2 - 1)^{0,28783} \exp(-0,029314(i_2 - 1)^{3,22295}). \quad (3)$$

– the proportion of zeros in (fig. 2) lines of the binary matrix of growth of prime numbers

$$\nu(0) = \frac{498 - \sum z_2}{498} = 1 - 0,61623(i_2 - 1)^{0,28783} \exp(-0,029314(i_2 - 1)^{3,22295}). \quad (4)$$

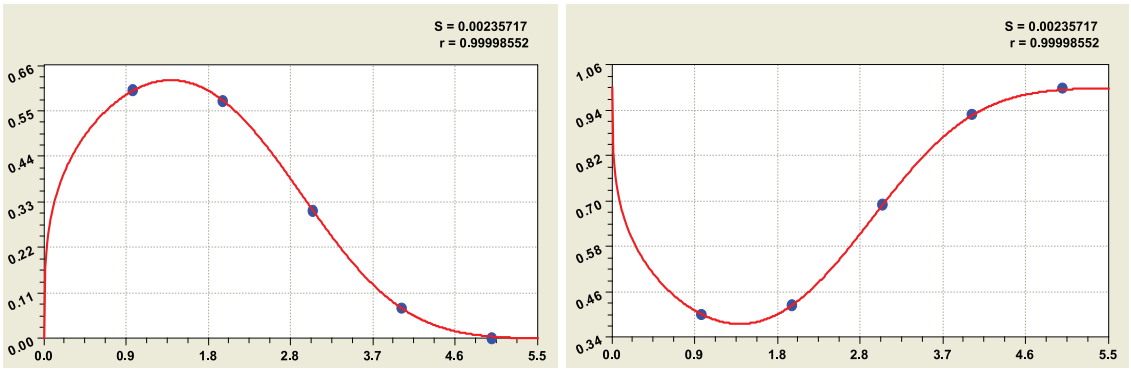


Fig. 2. Share units (left) and zero (right) in the rows of the matrix: – dispersion; – correlation coefficient

In favor of computing the number of units, there are two distinctive features:

1) the number of zeros (trivial and nontrivial) is almost three times as many units (table 3);

2) the design of the formula (2) is easier compared with the expression (3).

Apparently, the option is 0,61623 with increasing number of $n \to \infty$ will approach to the golden ratio 0,618 .... Then, on the critical line are $\varphi^{-1} = 0{,}618...$ ones and 0,6182 zeros.

Contribution amounts for units of columns (fig. 3) to the total (table 3 773) will be equal

$$\frac{\sum z_2}{\sum\sum z_2} = 0{,}39902(i_2 - 1)^{0{,}32247} \exp(-0{,}034914(i_2 - 1)^{3{,}09819}). \quad (5)$$

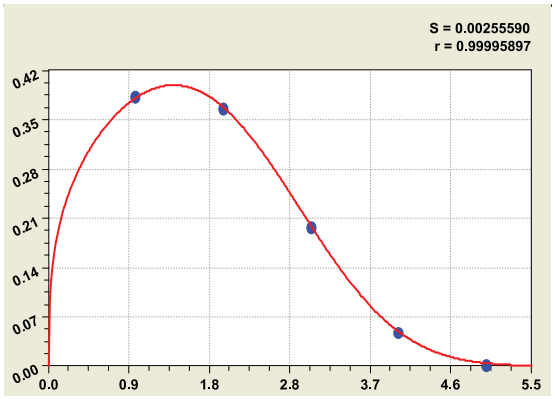


Fig. 3. Schedule the amount of the contribution of units in the columns of table 1

On the critical line $i_2 = 2$ contribution approaching to the square of the golden section.

Influence of growth. The explanatory variable we take the increase of a prime number. Then on the different digits of the binary number system formed their statistical model (tab. 4) type

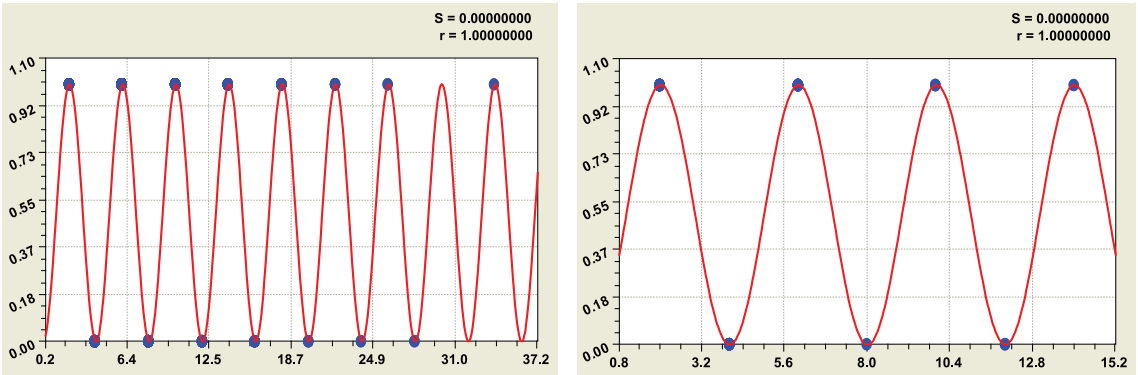
$$z_2 = a_1 - a_2 \cos\left(\frac{\pi p(n)}{a_3 + a_4 p(n)^{a_5}} - a_6\right), \quad (6)$$

where $a_1 ... a_6$ – the parameters of the model (6).

If we ignore the first and last bits binary system, the closest to a rational number 1/2 on real values is the discharge $i_2 = 2$.

For the critical line $i_2 = 2$ (6) is reduced (fig. 4) to the form

$$z_2(i_2 = 2) = \frac{1}{2} - \frac{1}{2} 2 \cos\left(\frac{\pi p(n)}{2}\right). \quad (7)$$



A number of prime numbers 500 A number of prime numbers A000040

Fig. 4. Graphics (6) to prove the Riemann Hypothesis: S – dispersion; r – correlation coefficient

Thus completes the proof of the Riemann hypothesis and remove the message from the Internet: «Here the famous Riemann hypothesis, that the real part of the root is always exactly equal to 1/2, no one has yet proven, although the proof of it would have been for the theory of prime numbers in the highest degree the importance. At the present time, the hypothesis is verified for seven million of the roots». With increasing power of prime numbers equation (7) for the critical line continues, but the graphs such as fig. 4 will be more frequent fluctuations due to higher growth. The growth is growing much more slowly than simple numbers. This will increase the power of the series.

The binary number for non-emergency lines. Then the third category with an increase in power $p(n)$ gets the physical meaning of the formula

$$z_2(i_2 = 3) \to \frac{1}{2} - 0,70711\cos\left(\frac{\pi p(n)}{4} - \frac{\pi}{4}\right), \quad (8)$$

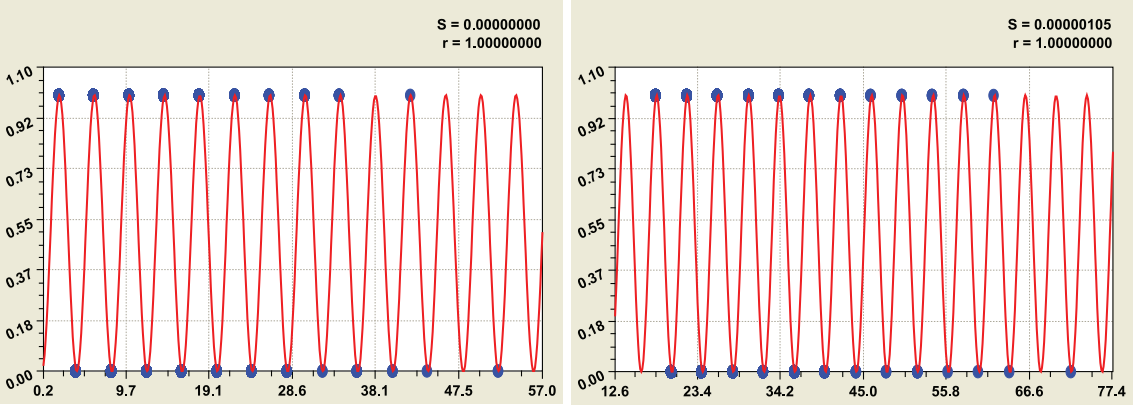
as shear waves 0,78539815 almost coincides with the value of the angle of $\frac{\pi}{4} = 0,7853975\ldots$

Check the law

$$z_2(i_2 = 2) = \frac{1}{2} - \frac{1}{2}2\cos\left(\frac{\pi p(n)}{2}\right).$$

On the critical line $i_2 = 2$ indicated this model is stable and the other quantities of prime numbers (fig. 5).

Primary growth. This – the third parameter (the first – a critical line 1/2), giving a picture of the growth rate of prime numbers. Parameter $p_p(n)$ for a number of 100 000 prime numbers are shown in table 4, and he compiled the first appearance of the subsequent term. Primary growth is irregular, for example, an increase of 14 comes after 8 and earlier values of 10 and 12.



Increase in the number of prime numbers from 3000 members

Increase of more than 16 in a number of 100 000

Fig. 5. Graphs of law the distribution of the binary digits 0 and 1: S – dispersion; r – correlation coefficient

Various font allocated triangles (patterns of geometry) with sides (with $i_2 = 1$ – non-trivial zeros). Then the harmonious geometrical structures define the algorithm capacity growth, and even prime number.

Line growth varies with the initial constant «deuce», and there will be fluctuations, the trend

$$p_P(n) = 2 + 2,09287\, p(n)^{2,09287}\exp(-0,31341 p(n)^{1,06442}). \quad (9)$$

The envelope of the line. Increments to the left of the asymptotic lines have trivial zeros. Therefore, taken into account the wave envelope line, which in different places concerns a critical line $i_2 = 2$. This – the fourth parameter of the series. Divide the increase in two parts $p(n) = p'(n) + p''(n)$.

On the envelope line by line in the table (fig. 6) are located $p'(n) = 2^{i_{2\max}-1}$. And in the $0 \le p''(n) = 2^{i_{2\max}-1} - 1$. The trend with unit from the formula with three fluctuations looks like

$$p'(n) = 1 + 0,59470\, p(n)^{1,06436} + \ldots \quad (10)$$

Table 4

The primary increase in the number of 100 000

Prime number $a(n)$	Growth $p(n)$	Binary digit i_2					
		6	5	4	3	2	1
		Part of increase					
		32	16	8	4	2	1
3	2					1	0
7	4				1	0	0
23	6				1	1	0
89	8			1	0	0	0
113	14			1	1	1	**0**
139	10			1	0	**1**	**0**
199	12			1	**1**	**0**	0
523	18		1	**0**	**0**	1	0
887	20		1	**0**	**1**	0	0
1129	22		**1**	0	1	**1**	0
1327	34	**1**	0	**0**	0	1	**0**
1669	24		**1**	1	**0**	**0**	0
1831	16		1	**0**	**0**	**0**	0
2477	26		1	**1**	**0**	1	**0**
2971	28		**1**	1	1	**0**	**0**
4297	30		1	**1**	1	**1**	**0**
5591	32	1	0	0	**0**	0	0
9551	36	1	0	**0**	1	**0**	0
15683	44	1	**0**	1	1	0	**0**
16141	42	**1**	0	1	0	1	0
19333	40	1	**0**	1	0	0	0
19609	52	1	1	**0**	1	0	0
28229	48	1	1	0	**0**	0	0
30593	38	1	0	0	1	**1**	0
34061	62	1	1	1	1	1	**0**
35617	54	1	1	0	1	1	0
45893	50	1	1	0	0	1	0
58831	58	1	1	1	0	1	0
81463	46	1	0	1	1	1	0
82073	56	1	1	1	0	0	0

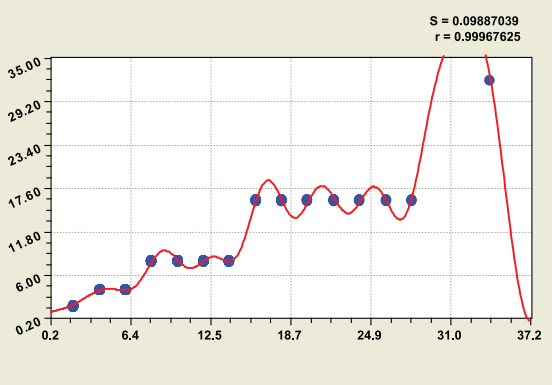


Fig. 6. The graph of the envelope line growth numbers 500

At $n \to \infty$ in the formula (10) always will be in the beginning 1.

Conclusions

The critical line Riemann is located in a vertical column $i_2 = 2$ binary matrix of growth of number of simple. Not all non-trivial zeros lie on it. There is also a line of benchmarks, the initial rate and the bending around.

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ADVANCED PROOF THE RIEMANN HYPOTHESIS

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In the proof of the correctness of the Riemann hypothesis held strong Godel's incompleteness theorem. In keeping with the ideas of Polya and Hadamard's mathematical inventions, we decided to go beyond the modern achievements of the Gauss law of prime numbers and Riemann transformations in the complex numbers, knowing that at equipotent prime natural numbers will be sufficient mathematical transformations in real numbers. In simple numbers on the top left corner of the incidence matrix blocks are of the frame. When they move, a jump of the prime rate. Capacity of a number of prime numbers can be controlled by a frame, and they will be more reliable digits. In the column $i = 1$ there is only one non-trivial zero on $j = (0, \infty)$. By the implicit Gaussian «normal» distribution $z_{1j} = 1 - \exp(-10{,}11900(P_j - 2)^2)$, where P_j – a number of prime numbers with the order-rank j. On the critical line of the formula for prime numbers $z_{2j} = \frac{1}{2} - 0{,}707107\cos\left(\frac{\pi P_j}{2} - 0{,}78540\right) = \frac{1}{2} - 0{,}707107\cos\left(\frac{\pi}{2}P_j - \frac{\pi}{4}\right)$. By «the famous Riemann hypothesis is that the real part of the root is always exactly equal to 1/2» is obtained – the vibration frequency of a series of prime numbers is equal π/2, and the shift of the wave – π/4. Montgomery and Dyson gave the average frequency of occurrences of zeros. But it turns out, it is different and functionally related to the number of spaces π = 3,14159... In 1972, Montgomery showed oscillatory nature of the arrangement of zeros on the critical line. We saw that they (and 1) really varies.

Keywords: prime numbers, the full range, critical line, the equation

While working on the proof of the correctness of the Riemann hypothesis held *strong Godel's incompleteness theorem*: «The logical completeness (or incompleteness) of any system of axioms cannot be proved within this system. For its proof or refutation of the required additional axioms (strengthening of the system)».

In keeping with the ideas of mathematicians Polya and Hadamar about mathematical inventions, we decided to go beyond the modern achievements of the Gauss law of prime numbers and Riemann transformations in the complex numbers, realizing that at equipotent prime natural numbers will be sufficient mathematical transformations in real numbers.

Full range, methods and data. Prime number – this is a natural number $N = \{0, 1, 2, 3, 4, 5, 6, ...\}$ with a natural divider 1 (division by himself – is redundantly).

Of prime numbers $P = \{0, 1, 2, 3, 4, 5, 7, ...\}$ «ladder of Gauss-Riemann» separated «step» increase with the parameter of ***prime numbers*** $p_j = P_{j+1} - P_j$, where $j = 0, 1, 2, 3, 4, ...$ – is the rank order. Rejection of the system with base $e = 2{,}71828...$ led to the translation of the binary system. Understand that mathematics, fascinated by the factorization of prime numbers, forget about the benefits of the decomposition of numbers.

Table 1 shows the conversion of 500 prime numbers from decimal to binary. The decomposition of primes is known by the simple rules on the discharge rank $i = 0, 1, 2, 3, 4, ...$

Table 1

Parameters of the total number of 500 prime numbers in binary

Options			Prime number in binary															Increase in the binary system							
The order of the rank j	Prime number P_j	Growth p_j	Envelope		Discharge-the rank of the number i_j^P of binary systems													Envelope		Discharge-the rank i_j^P of a binary						
			border P'_j	discharge $i_{j\max}^P$	12	11	10	9	8	7	6	5	4	3	2	1	0	border p'_j	discharge $i_{j\max}^P$	6	5	4	3	2	1	0
					Part of the prime number $P_{ij} = 2\wedge(i_j^P - 1)$												2^{-1}			Part of the increase						2^{-1}
					2048	1024	512	256	128	64	32	16	8	4	2	1				32	16	8	4	2	1	
0	0	1	1	1												1	½	1	1						1	½
1	1	1	1	1		Trivial zeros										**1**	½	1	1	Trivial zeros					1	½
2	2	1	2	2											**1**	0	½	1	1						1	½
3	3	2	2	2											1	**1**	½	2	2					1	**0**	½
4	5	2	4	3										1	**0**	**1**	½	2	2					**1**	0	½
5	7	4	4	3										**1**	**1**	**1**	½	4	3				**1**	0	**0**	½
6	11	2	8	4									**1**	0	1	**1**	½	2	2					**1**	0	½
7	13	4	8	4									1	**1**	**0**	**1**	½	4	3				**1**	0	**0**	½
8	17	2	16	5								1	0	0	**0**	**1**	½	2	2					**1**	0	½
9	19	4	16	5								1	0	0	**1**	**1**	½	4	3				**1**	0	**0**	½
10	23	6	16	5								1	0	1	**1**	**1**	½	4	3				1	**1**	0	½

Table 1 shows the symmetrical geometric patterns, but their analysis we did not. It is seen that any prime number before itself has a ratio of 1/2. But it is a sum of terms is not included. Complex mathematical expressions, the parameters of the series has the form:

$$i_j = (1, m); \quad j = (0, n); \quad m = 6; \quad n = 500;$$

$$P_{j+1} = P_j + p_j, \quad p_j = P_{j+1} - P_j; \quad P_j = P'_j + P''_j;$$

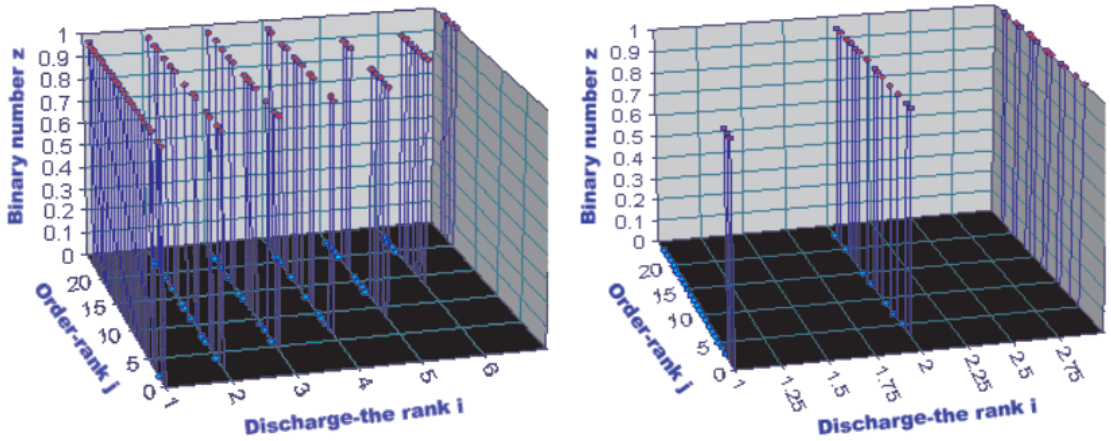
$$P'_j = 2^{i_{j\max}-1}; \quad P''_j = \sum_{i_j=1}^{i_{j\max}-1} \xi_{ij} 2^{i_j-1}; \quad \xi_{ij} = 0 \vee 1;$$

$$p_j = p'_j + p''_j; \quad p'_j = 2^{i_{j\max}-1};$$

$$p''_j = \sum_{i_j=1}^{i_{j\max}-1} \xi_{ij} 2^{i_j-1}; \quad \xi_{ij} = 0 \vee 1. \qquad (1)$$

Mathematical «landscape». In the film «De Code» (19.07; 26.07 and 02.08.2011) showed a three-dimensional picture of the Riemann zeta function. All pay attention to the nontrivial zeros on the critical line. They are already counted several trillion.

Alignment of the binary system is infinitely high «mountain» transforms into ledges of identical height, equal to unity. Fig. 1 shows the landscape of the 24 first prime numbers.



Prime numbers at the beginning of the distribution

Of prime numbers at the beginning of the distribution

Fig. 1. Mathematical «landscape» binary distribution of the 24 first prime numbers

Benchmarks. They are on the upper left corner blocks of prime numbers. It was during the transition to them occurs a jump increase in prime. Therefore, power series of prime numbers is quite possible to manage with the help of a benchmarks, they will be safer decimal digits.

From table 1, we write the nodal values N_R (tab. 2) and other parameters of benchmarks.

Table 2

Asymptotic benchmarks a number of 500 primes

i	1	2	3	4	5	6	7	8	9	10	11	12
j	0	2	4	6	8	13	20	33	56	99	174	311
P_{ij}	0	2	5	11	17	37	67	131	257	521	1031	2053
N_R	1	2	4	8	16	32	64	128	256	512	1024	2048
$P_{ij} - N_R$	-1	0	1	3	1	5	3	3	1	9	7	5

Influence of prime numbers. At $i = 0$ there is $z_0 = 1/2$.

And in the column $i = 1$ (fig. 2) there is only one nontrivial zero throughout $j = (0, n)$, i.e. before $j = (0, \infty)$. By implicitly given us the law of Gauss «normal» distribution have

$$z_{1,j} = 1 - \exp(-10{,}11900(P_j - 2)^2). \qquad (2)$$

Then the prime number 2 is a critical and noncritical series begins with 3.

On the critical line is the formula

$$z_{2j} = 1/2 - 0{,}707107 \cos\left(\frac{\pi P_j}{2} - 0{,}78540\right) = \frac{1}{2} - 0{,}707107 \cos\left(\frac{\pi}{2} P_j - \frac{\pi}{4}\right). \quad (3)$$

Completed (fig. 3) evidence of «the famous Riemann hypothesis about that the real part of the root is always exactly equal to 1/2». The frequency of oscillation is equal π/2, and the shift – π/4.

What does it mean 0,707107 – we do not know. Then obtained (fig. 4) model

$$z_{3j} = \frac{1}{2} - 0{,}707107 \cos\left(\frac{\pi}{4} P_j - \frac{\pi}{2}\right). \quad (4)$$

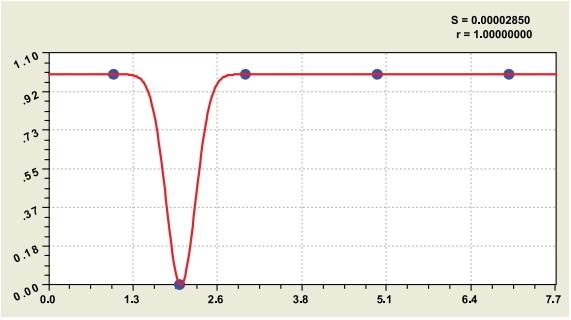


Fig. 2. Schedule of the (5):
S – dispersion; *r* – correlation coefficient

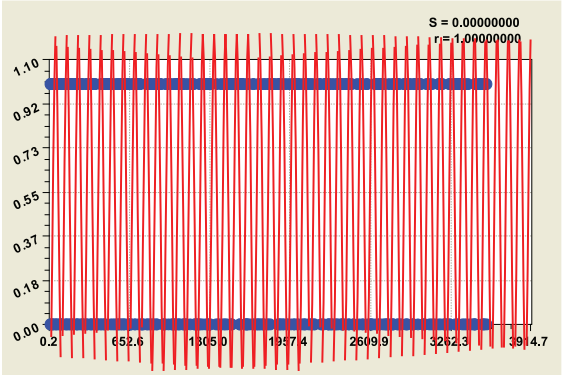
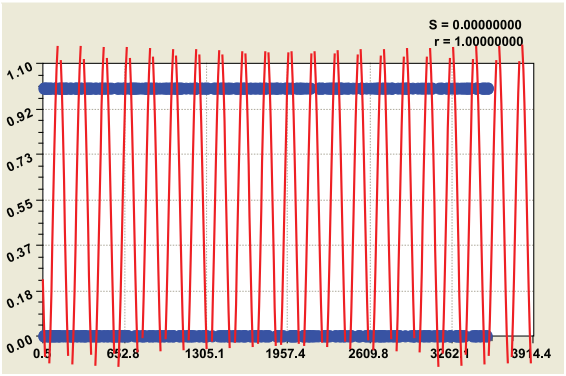
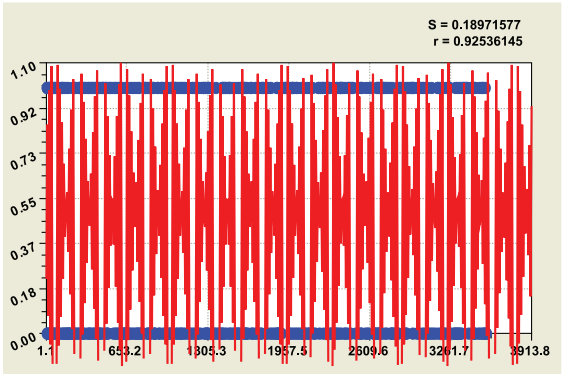


Fig. 3. Schedule of the (3) the distribution of the binary number



The statistical model (4) for the third rank



The statistical model (5) at the fourth digit

Fig. 4. Graphs of the distribution of the binary components of prime numbers

Montgomery and Dyson applied statistical physical methods of the analysis of distributions with respect to a number of primes and determined the average frequency of occurrences of zeros.

From the remains of up to 0,25 for the fourth level was obtained (fig. 4) model

$$z_{4j} = \frac{1}{2} - 0{,}648348 \cos\left(\frac{\pi}{8} P_j - \frac{\pi}{2}\right). \quad (5)$$

For the fifth and sixth digits (fig. 5) were obtained regularities:

$$z_{5j} = \frac{1}{2} - 0{,}643132 \cos\left(\frac{\pi}{16} P_j - \frac{\pi}{2}\right); \quad (6)$$

$$z_{6j} = \frac{1}{2} - 0{,}638209 \cos\left(\frac{\pi}{32} P_j - \frac{\pi}{2}\right). \quad (7)$$

It is noticeable that with increasing level binary system balances (absolute error) increases. This can be seen in the graphs to reduce the correlation coefficient. In 1972 Montgomery proved nature of the distribution of the zeros on the critical line. From formulas (6) and other shows that they (and 1) is indeed fluctuate. We explain the desire of prime numbers, as well as convert them to binary 0 and 1, diverge from each other because of the power produced in the progression $P'_j = 2^{i_{j\max}-1}$. A nontrivial ze-

ros of scatter in the plane (i, j) in laws (3) for summand P_j'' at $\xi_{ij} = 0 \vee 1$.

For the seventh and eighth categories (fig. 6) formulas of a similar design are received:

$$z_{7j} = \frac{1}{2} - 0,633145 \cos\left(\frac{\pi}{64} P_j - \frac{\pi}{2}\right); \quad (11)$$

$$z_{8j} = \frac{1}{2} - 0,636929 \cos\left(\frac{\pi}{128} P_j - \frac{\pi}{2}\right). \quad (12)$$

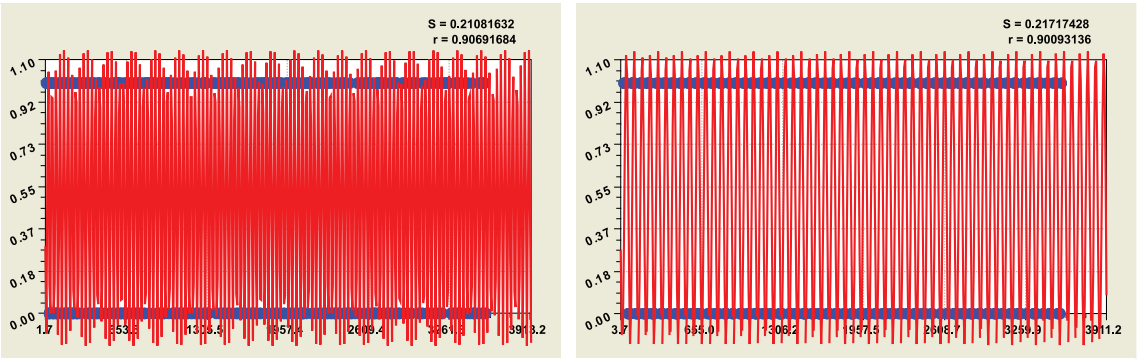
For the ninth and tenth digits have produced similar pattern:

$$z_{9j} = \frac{1}{2} - 0,638599 \cos\left(\frac{\pi}{256} P_j - \frac{\pi}{2}\right); \quad (13)$$

$$z_{10j} = \frac{1}{2} - 0,636726 \cos\left(\frac{\pi}{512} P_j - \frac{\pi}{2}\right). \quad (14)$$

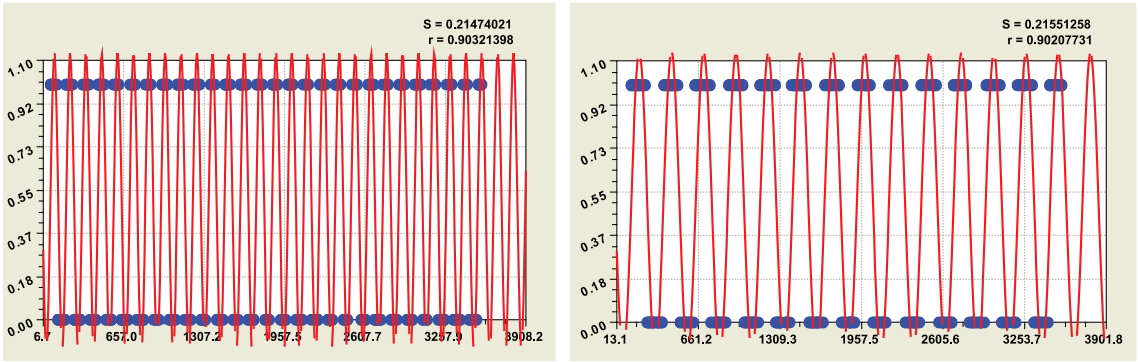
For the 11-th digit similarly has been received the formula (with the $z_{12j} = 1$)

$$z_{11j} = \frac{1}{2} - 0,633526 \cos\left(\frac{\pi}{1024} P_j - \frac{\pi}{2}\right). \quad (15)$$



The statistical model (6) at the fifth discharge — The statistical model (7) at the sixth discharge

Fig. 5. Graphs of the distribution of the binary components of prime numbers



The statistical model (11) for the seventh digit — The statistical model (12) for the eighth digit

Fig. 6. Graphs of the distribution of the binary components of prime numbers

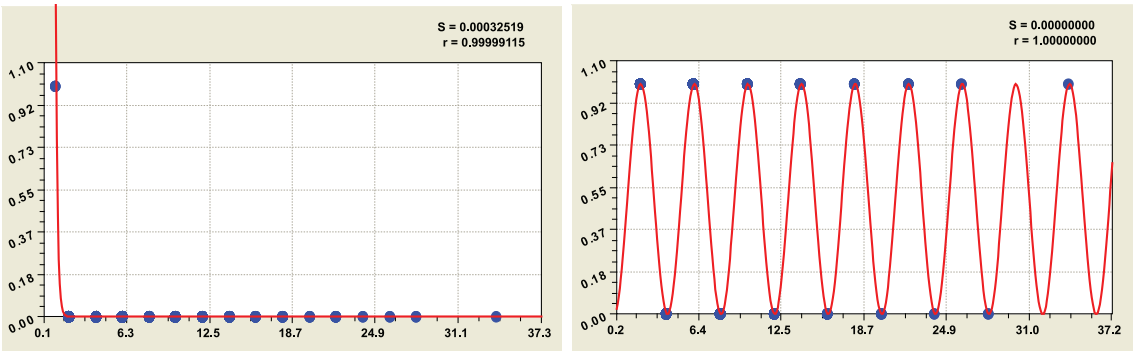
Effect of growth in charges. Bernhard Riemann in 1859, according to the analysis of the zeta function asserted that the zeros are on the same line. Now believe it as critical line crosses the mathematical landscape of the zeta function.

For 1 and 2 categories (fig. 7) on unbroken trivial zeros of the verticals are:

– the law of the Laplace (in physics – Mandelbrot);

$$z_{1j} = 1348,7836 \exp(-7,20702\, p_j); \quad (16)$$

$$z_{2j} = \frac{1}{2} - \frac{1}{2} \cos\left(\frac{\pi p_j}{2}\right). \quad (17)$$



Statistical model (16) at the first category — Functional model (17) on a critical line

Fig. 7. Schedules of distribution of binary number at components of a gain of simple numbers

The critical line $i_j^p = 2$ has received the unequivocal formula, and without wave shift.

Conclusions

The famous Riemann hypothesis is proved. For this was accomplished the transformation of a number of prime numbers from decimal notation to binary. We obtain four new criteria. There were geometric patterns. Became visible «on the floor» non-trivial zeros and appeared units «on the ceiling» of the distribution of 0 and 1 instead of abrupt «hills» of zeta-function.

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THE CONTROL OF THE SPINDLE POSITION ON GAS-STATIC BEARINGS BY VIBROACOUSTIC EMISSION

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The technique of controlling the spindle position on gas-static bearings by vibroacoustic emission is stated. The description of the experimental test bench and measuring equipment is given.

Keywords: control, spindle block, attractor

In flexible automated production, the development of auto control and cutting process control systems ensuring required quality, high productivity and minimum costs for machining parts on metal cutters continues to remain a priority scientific and technical problem.

According to the research on estimating different factors influence on machining accuracy, it is determined by the spindle block (SB) up to 80%. As spindle and spindle bearings effect shaping motion, it is they that make a decisive contribution into accuracy output characteristics [1]. In this connection, one of the main problems in estimating SB operation effectiveness is monitoring spindle rotation accuracy.

SB operation on rolling-contact bearings is accompanied by an unstable path of the spindle motion, thermal shifts of spindle blocks, periodic change of bearings hardness. It is connected with changing the rotation angle of the separator with a set of rolling elements. SBs on gas-static bearings used when subjected to critical parts precision machining lack such drawbacks. In this connection, it is very important to control the spindle position during operation to further determine its best work conditions.

In the paper [2], we give some methods of controlling the clearance between the spindle and the brass of the gas-static bearing. Here we should single out noncontact methods of controlling the spindle position. One of such methods is the method of vibroacoustic emission (VAE) that is well applied to controlling real-time processes.

When machine tool systems are diagnosed, we can not often install a recording sensor in the place where a signal occurs. There is no opportunity to use a recording sensor when determining the spindle position on a gas-static bearing either as it is impossible to mount the measuring element directly on the spindle. The closest place of a measuring element position is the spindle housing. If we move away from the recording place, according to Abbe principle, measurements error increases in quadratic dependence.

The place of recording VAE signal has a very great impact on the accuracy of the decision made. The impossibility of installing a measuring element in the place where the signal occurs causes a noise term. The signal is usually cleaned by frequency filtering with cutting low-frequency oscillations off, without revealing the nature of the signal. In classical methods of VAE signals processing, Fourier expansion is applied. The main drawbacks of Fourier expansion are as follows. Firstly, such a function as sinusoid used in Fourier analysis is harmonic. That is why it causes a great error during the analysis as the analyzed signal is a damped function. Secondly, in Fourier analysis, there is a frequencies diffusion in Fourier spectrum that has a negative effect on accuracy. That is why, for processing VAE signal, it is more correct to use wavelet analysis. Compared to Fourier expansion, it also has the advantage of a weak response to noise terms.

It is estimated that the most qualitative VAE signal cleaning is done by a severe threshold processing of the wavelet analysis. It consists in the fact that we subtract previously defined threshold from wavelet coefficients.

Wavelet analysis is the recorded signal analysis carried out on the basis of wavelet transform. The essence of wavelet transform lies in converting the analyzed function to a set of wavelet coefficients $W(f)$:

$$W(f)=\frac{11}{\sqrt{C_\psi}}\int\frac{}{\sqrt{|a|}}\psi\left(\frac{x-b}{a}\right)f(x)dx,$$

where a, b – data determining scale and $\psi\left(\frac{x-b}{a}\right)$ function shift, respectively; ψ – base wavelet; C_ψ – normalization factor.

Integration is done along the whole number axis forming family by expansions and shifts.

The research on controlling the position of the spindle mounted on gas-static bearings is done on the experimental test bench shown in fig. 1.

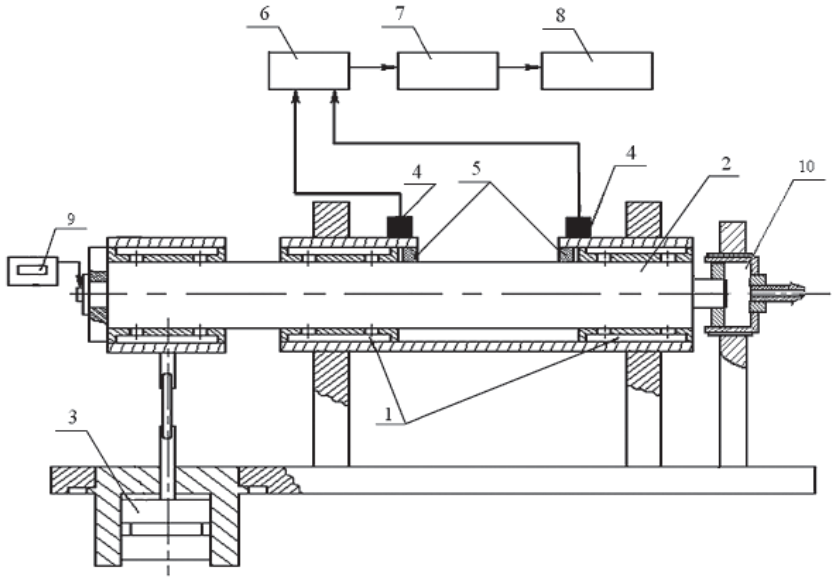

Fig. 1. Experimental test bench diagram

The experimental test bench includes: 1 – gas-static pillow blocks; 2 – spindle; 3 – loading fixture; 4 – VAE sensors; 5 – capacitive pickups; 6 – oscillograph; 7 – analog-to-digital converter (ADC); 8 – PC; 9 – frequency meter; 10 – turbine.

When the spindle position is controlled, signals are registered by sensors attached to the analyzed bearing housing in mutually perpendicular directions. VAE signal registered by piezoelectric sensors gets through the oscillograph to the DAB where analog-to-digital conversion occurs. After that, the signal gets to the computer memory for processing. Using analog oscillograph allows to amplify the registered signal as amplitude scope is small. The computer cleans the signal by wavelet transform and reconstructs the attractor. That allows to get the path of the spindle center line along one coordinate value.

The path of the spindle center line in relative coordinates with the speed of 30000 min^{-1} is shown in fig. 2.

The path of the spindle center line in absolute coordinates is built in the following way. We preliminarily defined the calibration constant equal to arithmetical mean ratio of the spindle center line linear translation measured by capacitive pickups to VAE signal value at the corresponding point of time. The spindle center line deviation in linear values was in real-time mode by multiplying the calibration constant by VAE registered signal.

The path of the spindle center line in absolute coordinates is shown in fig. 3.

In this figure, you can see that in a gas-static bearing, the spindle rotation path is elliptic. The elliptic path of the spindle synchronous rotation with constant velocity can be explained by varying dynamic rigidity (irregularity of pressure profile) on the bearing circle. The line of the path is smooth and practically with no blur. It means that the spindle center line follows a fixed path gaining a stable position in bearings.

A real path of the spindle center line can be obtained with accuracy sufficient for effective control by using such a special high-precision equipment for direct measurements as laser interferometer. It is natural that the use of such a complex and expensive equipment in systems controlling the operation of metal-cutting lathes is economically unreasonable because of too high costs for adjustment and maintenance. That is why less accurate methods are, as a rule, used to measure fluctuations. VAE method is most widely adopted in diagnosing machine tool systems. Together with the wavelet cleaning method, it allows to obtain accuracy comparable to the results of laser interferometry and can, therefore, be effectively used in automation industry.

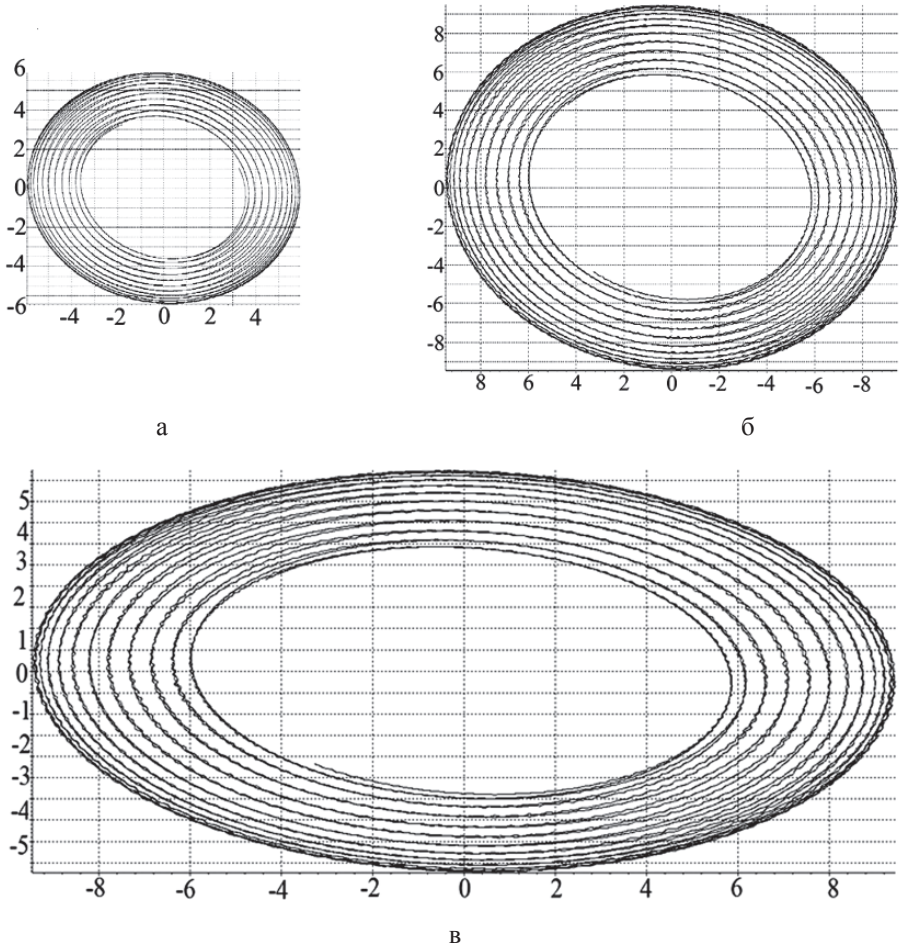

Fig. 2. Path of the spindle center line in relative coordinates:
a – phase portrait of the spindle vertical oscillation;
b – phase portrait of the spindle horisontal oscillation;
c – path of the spindle center line in relative coordinates

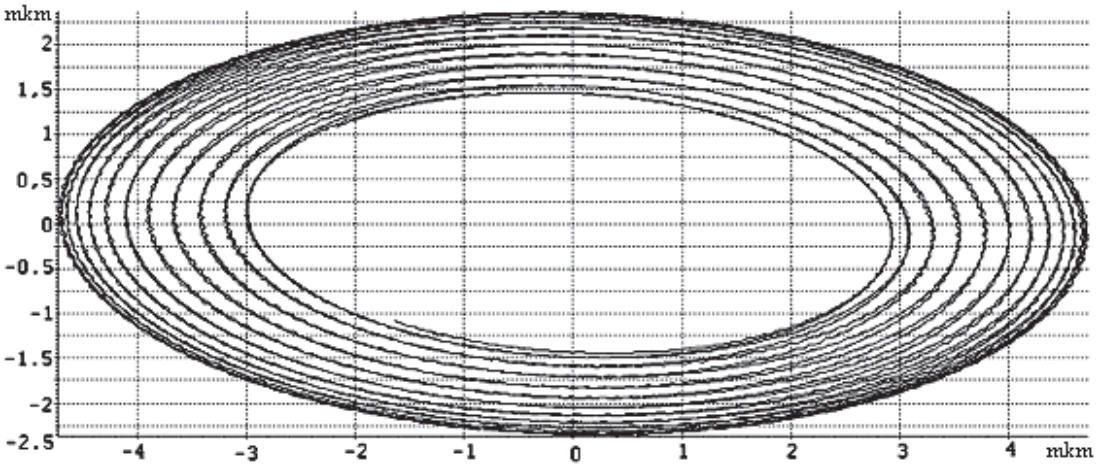

Fig. 3. Path of the spindle center line in absolute coordinates

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THE ENHANCEMENT OF OPERATIONAL CHARACTERISTICS OF CONTACTLESS SPINDLE BEARINGS BY SELF-ORGANIZATION OF A COMBINED DYNAMIC UNIT

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The study analyzes usage of different types of bearings in high speed spindle blocks. It indicates the advantage of gas-magnetic bearings in spindle blocks. It also shows the results of experimental and theoretical research.

Keywords: spindle block, bearing, dynamic unit, combined bearing

Modernization of any country requires implementing of innovative engineering solutions in industry. One of them is creation of highly productive precision equipment, including metal-working machines.

It is known that in the process of edge cutting machining spindle blocks (SBs) stand for 80% of accuracy in details production. Thus, the enhancement of this block construction is one of the main tasks in modern machine-tool industry.

Rotating accuracy and spindle speed, which are among major characteristics of SBs, are closely connected with the type of bearing applied. Here belongs the variety of bearings from rolling bearing to electromagnetic, hydro- and gas-static ones. It must be noticed that evolution of bearings application in SBs corresponds to the dynamism of technics development: one joint – many joints – flexible substance – liquid – gas – field. It should also be highlighted that all the bearings mentioned are not capable of meeting all the requirements to current SBs. It was scientifically proved in Work [7], where a detailed analysis of SB efficiency on different types of bearings was given.

All the bearings have a dynamic unit. For instance, a rolling bearing has a hydrodynamic layer of lubricant, a gas-static bearing – a gas film, and an electromagnetic bearing – a magnetic field.

In general, a scheme of force interaction between the elements of SB bearing can be shown as in Fig. 1.

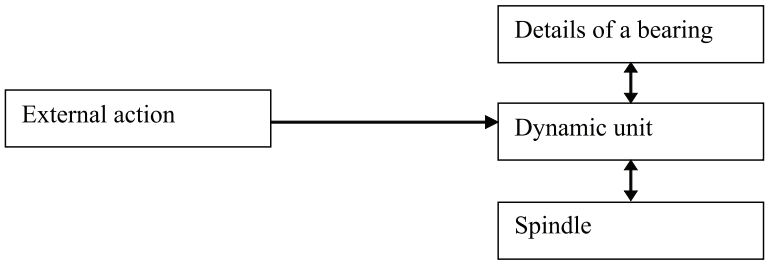

Fig. 1. A scheme of force interaction between the elements of a bearing

To stabilize the work of a bearing, its dynamic unit is regulated by external action, for example, by monitoring of quantity of the taken substance, its properties or by monitoring of magnetic field strength. The dynamic unit itself stands in the equilibrium position in some definite margins or, in other words, we may indicate self-organization of the dynamic unit.

In high speed SBs rolling, gas-static and electromagnetic bearings are applied. Hydrostatic bearings for high speeds of spindle rotation are not used because of big losses during friction in the layers of lubricating liquid.

Stable operation of rolling bearing is reached through persistent hydrodynamic lubricating layer, which is dynamic self-organizing unit. Thus, Work [2] has some methods of self-organizing hydrodynamic lubricating layer control. With the help of such approaches a parameter of speed dn = 1,2 million mm/min [8].

Recently the highest parameter of speed dn = 1,8 million mm/min has been achieved using hollow ceramic rolling element and high quality rolling paths. Though rolling bearings have a limited resource of operation due to a limited quantity of loading cycles.

The most perspective bearings for high speed SBs are gas-static and electromagnetic ones. As it was stated above, the dynamic unit of electromagnetic bearings is a magnetic field that gives an effect of attraction [1]. On decreasing of radial clearance in the bearing the

force of attraction increases with a quadratic dependence. Thus, a magnetic field without external action is not stable.

In comparison with electromagnetic bearings gas-static ones has the advantage, because with external action its gas lubricant layer is capable of stabilizing, that is self-organizing. Besides, gas-static bearings are characterized by almost absolute absence of wear and quite a high stiffness and they have a rather low load-carrying capability of lubricant layer especially with little spindle shift in bearing backing (in eccentricity) [3, 7]. On the whole it leads to undesirable decreasing of the load on to the cutting tool.

Taking into account the principal of superposition of fields, to the self-organizing dynamic unit of gas-static bearing we add a magnetic field which is not self-organizing. The summation influence of these two fields on the spindle leads to the noticeable increase of load-carrying capability of contactless bearing. At the same time an unstable magnetic dynamic unit, that has a little less potential and is situated in the self-organizing dynamic block of a gas field, becomes self-organizing. A bearing with such a combined dynamic unit can be called gas-magnetic. A mode of gas-magnetic bearing operation is described with details in Work [4].

The effect of self-organization of a combined dynamic unit of a gas field and magnetic forces allows to increase load-carrying capability of a bearing up to 50% in the range of working values of eccentricity and twice as much with little eccentricities. As theoretical and experimental research proves, this mode of bearing operation in SBs can be reasonably used in superprecision machining of articles.

Fig. 2 shows theoretical and experimental dependences of load-carrying capability ratio of gas-magnetic bearing $C_Q = Q/Q_{max}$ from eccentricity ratio $\varepsilon = e/c$, where Q is a current value of load-carrying capability of a bearing, Q_{max} is a maximal value of load-carrying capability, e is absolute eccentricity, c is an average radial clearance between a spindle and a spindle backing. The theoretical characteristics were estimated using bundled software [5]. The experimental data were obtained at the stand which was described with details in Work [6].

The graphs given demonstrate even higher values of load-carrying capability ratio of gas-magnetic bearing (lines 2) in comparison with a gas-static bearing (lines 1), especially with little values of eccentricity ratio.

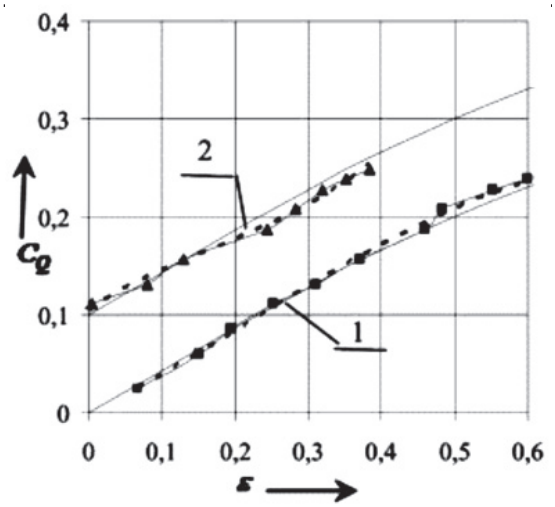

Fig. 2. Dependence of load-carrying capability ratio of gas-magnetic bearing CQ from eccentricity ratio ε:
1 – with the electromagnet off;
2 – with the electromagnet on; theory; experiment

In conclusion it should be underlined that one of the perspective resources of further enhancement of operational characteristics of SBs is external regulation of self-organizing dynamic unit of gas-magnetic bearing.

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MAGNET'IC CONDUCTORDIMENSIONS AFFECTINGOUTPUT PARAMETERSOF SPINDLE UNIT WITH GAS-MAGNETIC SUPPORT

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Methodology of calculation of output descriptions of high speed spindle unit is considered with front gas-magnetic bearing strength of which is condi-tioned by the united action of gas forces and forces of the electromagnetic field. A construction over of such bearing is brought. With the purpose of verification of authenticity of theoretical results of calculations their comparison over is brought with experimental data. Analyzed influence of the length magnetic conductor of double-pole gas-magnetic bearing on operational characteristics of spindle unit. On the basis of the executed researches the industrial construction of high-speed spindle unit the tests of which were shown on high quality and exactness of the processed surfaces is made.

Keywords: spindle unit, gas-and-magnetic support, load carrying ability, lubricating layer hardness

Considered is the output parameters design procedure of the high speed spindle unit with the front gas-magnetic support, its load carrying ability conditioned by the coaction of the forces of gas and the electromagnetic field. Given is a construction of such a bearing. Compared are the theoretical results of the computations with the experimental data to prove the irreliability. Analyzed is the influence of the magnetic conductor length of the bipolar gas-magnetic bearing on the spindle unit output parameters. Produced on the basis of the research is the industrial standard of the high-speed spindle unit which tests have shown the high quality and accuracy of the processed surfaces.

The development of modern industry makes increased demands for productivity and accuracy of the process equipment. By way of example the grinding machines can be cited used in finishing operations for precision and super-precision machining. The accuracy and productivity of such machines depend basically on the spindle unit (SU) precision.

High-speed SU of the grinding machines should provide high speed, hardness on the grinding wheel and sufficient cutting force to increase the productivity and working accuracy.

The high speed of the SU is attained with the help of noncontact gas or magnetic supports. However, such bearings have rather a low load carrying ability [5] which restricts the cutting force of the grinding wheel and results in productivity slowdown, particularly by the rough stock and semi-finished allowances removal.

One of the ways to raise the performance specifications of the noncontact SU supports consists in application of combined bearings, particularly gas-and-magnetic supports. The coaction of gas-film lubrication and magnetic field pressure forces provides the load-carrying ability of these bearings [4].

Let's consider the design procedure of the SU output parameters with the front gas-and-magnetic and the back gas-static supports. The front support has two magnetic poles. Gas is supplied to the bearing clearance through the porous inserts situated in the gastight inlay. Fig. 1 shows the typical SU scheme to mount the grinding wheel on the spindle bracket.

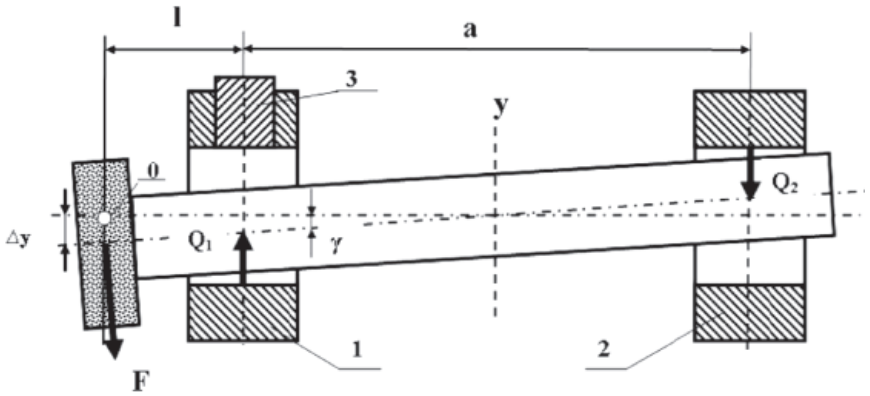

Fig. 1. The SU scheme to mount the grinding wheel on the spindle bracket:
1 – frontgas-and-magneticsupport; 2 – back gas-static support; 3 –magnetic conductor

The load on the grinding wheel is found from the two equations of statics: the sum of projections of forces on axis *Y*:

$$F = Q_1 - Q_2$$

and the moment equation about point *O*:

$$Q_1 l = Q_2 (a + l) + M,$$

where Q_1 and Q_2 is the load carrying ability of the front and the back support respectively, *M* is the restoring moment from the misalignment of the front and the back supports.

According to the above expressions, to determine the load on the grinding wheel one must know the load carrying ability of the supports and the restoring moment from the spindle misalignment. It should be noted as well, that the latter valueis on the order of magnitude less than the moments of forces Q_1 and Q_2 as the calculations show.

The design of the partly porous gas-static SU bearings is developed full enough in paper [2].

Let's consider the performance specifications design procedure of the gas-and-magnetic support with two magnetic suspensions represented on Fig. 2

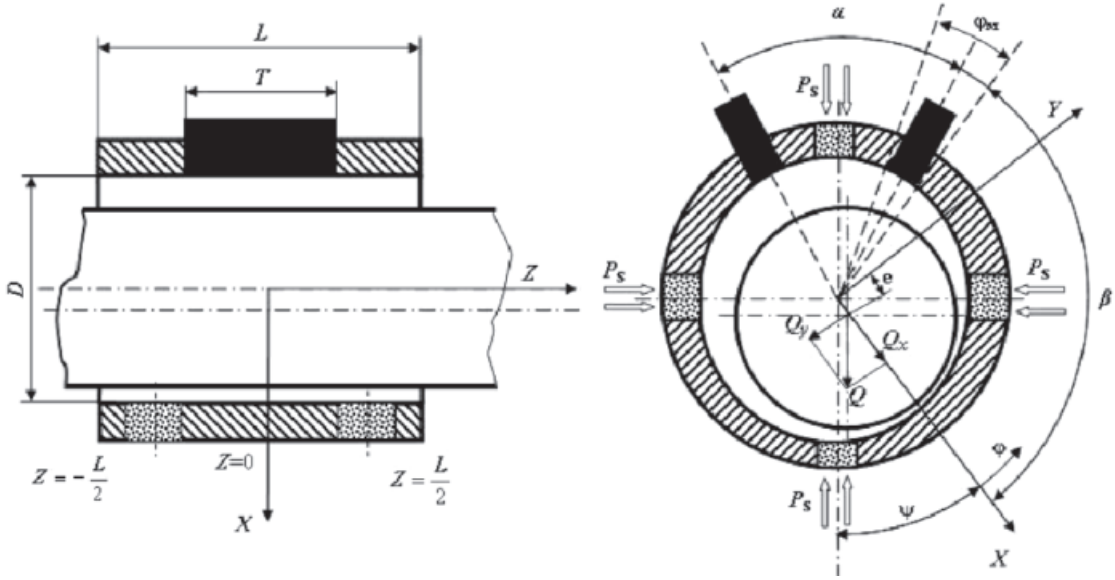

Fig. 2. The scheme of the gas-static support with two magnetic suspensions

The design procedure of the gas-and-magnetic support is based on the fact that the pressure field of gas-film lubrication differs from the magnetic field and that they render almost no influence on each other. Thus, the load carrying ability of the support can be represented as the resultant vector of two vectors of force: the magnetic force and the force of gas pressure. In the scalar form the expression to define the load carrying ability of the gas-and-magnetic support looks like this:

$$Q = \sqrt{Q_x^2 + Q_y^2},$$

where Q_x and Q_y are the projections of the load on axes *X* and *Y* respectively. Each of these projections equals:

$$Q_x = Q_{xg} + F_{xm},$$

$$Q_y = Q_{yg} + F_{ym},$$

where Q_{xg} and Q_{yg} are the projections on axes X and Y of the gas component of the load carrying ability, F_{xm} and F_{ym} are the projections on axes *X* and *Y* of the magnetic component of the load carrying ability.

According to paper [3] the projections on the coordinate axis of the gas component of the load equal:

$$Q_{xg} = R \int_{-\frac{L}{2}}^{\frac{L}{2}} \int_{0}^{2\pi} p \cos\varphi \, d\varphi \, dz;$$

$$Q_{yg} = R \int_{-\frac{L}{2}}^{\frac{L}{2}} \int_{0}^{2\pi} p \sin\varphi \, d\varphi \, dz.$$

where *R* is the inlay radius, *L* is the bearing length, *p* is the pressure in the gaseous layer, φ is the coordinate in the circumferential direction of the bearing, *z* is the coordinate in the axis direction of the bearing.

The magnetic component of the load carrying ability of the support equals in magnitude

to the tractive force of solenoids. Its elementary value is known to be found in this formula:

$$dF_m = \frac{B^2}{2\mu_0} dS, \qquad (1)$$

where B is the magnetic induction, S is the area of the ferromagnetic solid, is the space permeability.

Considering the well-known relation of the induction to the amount of clearance, we put the expression (1) down as follows:

$$dF_m = K_e h^{-2} dS, \qquad (2)$$

where $K_e = 0{,}5\mu_0 (in)^2$ is the factor allowing for the electric parameters of the solenoid; i is the solenoid current; n is the number of turns of the solenoid; h is the clearance between the spindle and the bearing in lay.

The relation (2) is referent to define the magnetic component of the load carrying ability developed by the two electromagnets.

As the clearance value is less than the linear dimensions of the pole by approximately 10^{-3}, we assume the uniformity of the magnetic field. Considering this, we can show that with the angular separation of the electromagnets α the projections of the magnetic component of the load in view of magnetic conductor length T on the coordinate axis are found in the expressions below:

$$F_{xm} = \frac{K_e RT}{c^2}\left[\cos\left(\psi - \frac{\alpha}{2}\right)\int_{\beta}^{\beta+\varphi_m} \frac{d\varphi}{\bar{h}^2} + \cos\left(\psi + \frac{\alpha}{2}\right)\int_{\beta+\alpha}^{\beta+\alpha+\varphi_m} \frac{d\varphi}{\bar{h}^2}\right],$$

$$F_{ym} = \frac{K_e RT}{c^2}\left[\sin\left(\psi - \frac{\alpha}{2}\right)\int_{\beta}^{\beta+\varphi_m} \frac{d\varphi}{\bar{h}^2} + \sin\left(\psi + \frac{\alpha}{2}\right)\int_{\beta+\alpha}^{\beta+\alpha+\varphi_m} \frac{d\varphi}{\bar{h}^2}\right],$$

where ψ is load position angle, β is the circumferential coordinate of the first pole start, φ_m is the polar angle, T is the length of the electromagnet.

It should be noted that the clearance $\bar{h}$ between the spindle and the bearing inlay is found from the following expression:

$$\bar{h} = \frac{h}{c} = 1 - \varepsilon\cos\varphi - \frac{\bar{\gamma}}{\bar{L}} \cdot \bar{z}\cos(\varphi - \psi),$$

where $\bar{\gamma} = \frac{\gamma D\bar{L}}{2c}$ is the misalignment parameter, $\bar{L} = \frac{L}{D}$ is the bearing extension, c is the average radial clearance, ε is the relative centering error, γ is the misalignment angle, D is the bearing diameter, L is the bearing length.

The hardness measured on the grinding wheel is determined by the formula:

$$J = \frac{dF}{dy},$$

where y is the displacement of the wheel axis.

The stated procedure has served as the basis for the research of the influence of the length of the magnetic conductor T, which is one of the basic elements of the gas-and-magnetic support design on the output parameters of SU.

The results of the load F and hardness J computation for the grinding wheel depending on the rotation frequency of the spindle as well as on the magnetic conductor length are given on Fig. 3 and 4 respectively. The computations are made providing that the load carrying ability of the front support is produced only due to gas pressure forces ($T = 0$). We have computed the gaseous and magnetic field coaction with the relative magnetic force $\bar{F}_m = 0{,}1$ too. The experimental data are obtained from the test bench. The designs and the principles of operation of the test bench are described in paper [3] in detail.

The relative magnetic force is determined by the following relation:

$$\bar{F}_{\text{м}} = F_{\text{м}} / DL\Delta P,$$

where $F_{\text{м}} = \sqrt{F_{x\text{м}}^2 + F_{y\text{м}}^2}$ is the absolute magnetic force, ΔP is the forced aspiration surplus pressure.

The presented relations display that the extension of the magnetic conductor makes it possible to increase the load on the grinding wheel. It should be noted that in operation of support, with the gas-and-magnetic regime, and with the constant magnetic force ($\bar{F}_{\text{м}} = \text{const}$) the spindle unit hardness is lower. This deficiency is remedied by means of the control system monitoring the spindle position.

The pilot model of the high-speed internal grinding machinespindle unit which has the front gas-and-magnetic support and the back gas-static support is designed and produced at Komsomolsk-on-Amur State Technical University.

Testing the SU while processing industrial models having 25 and 40 mm in diameter made of steel 20×13, we have obtained the following results: out-of-round of bore – up to 1,0 microns, waviness – up to 0,15 microns, surface roughness R_a up to 0,12 microns, 10–15 % better than with SU having only gas-static supports.

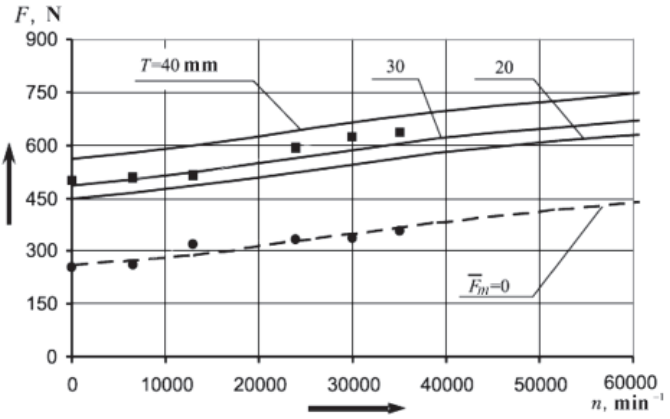

Fig. 3. The relation between load F on the grinding wheel, the spindle rotational speed n and the magnetic conductor length T; —— – SU operating regime with the electromagnet switched off; ———— – SU operating regime with the electromagnet switched on; ■ – the experiment with T = 40 mm; ● – the experiment with the electromagnet switched off

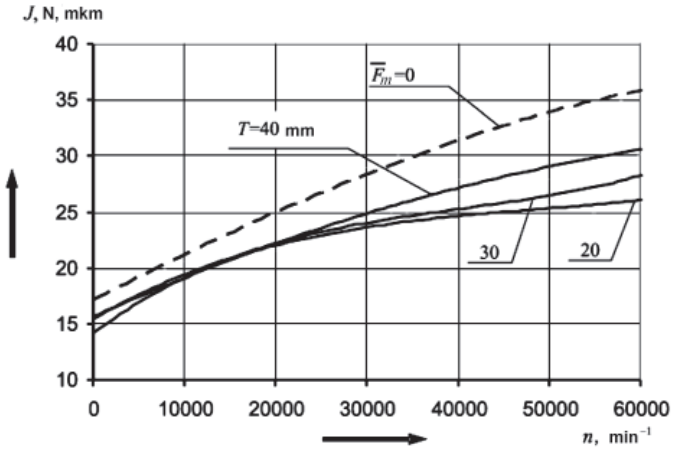

Fig. 4. The relation between hardness J on the grinding wheel, the spindle rotational speed n and the magnetic conductor length T; —— – SU operating regime with the electromagnet switched off; ———— – SU operating regime with the electromagnet switched on

It follows that the application of SU with gas-and-magnetic supports in the machine tools will make it possible to use machinery more effectively due to the matching of the semi-finished and finishing operations in one cutter-settingas well as to get a higher processing quality.

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THE HIGH SPEED SPINDLE UNITS INSIDE GRINDING MACHINE FOR PRECISION PROCESSING DETAIL OF FLYING MACHINERY

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The article reveals the construction of a high-speed spindle block with a front gas and magnetic bearing and a back gas-static one. The results of spindle block service tests are given. Exposed perspective type bearings of spindle units for high speed processing-created experimental industrial model high speed spindle units with front gas-magnetic bearing for inside grinding machine. Operational tests spindle units showed high quality processing materials.

Keywords: high speed processing, spindle units, gas-magnetic bearing

Labour-intensiveness of details mechanical operations on belt grinders is known to constitute a major part of total labour-intensiveness of product manufacturing. Thus the problem to increase mechanical operation efficiency is becoming more and more urgent nowadays, and its solution contributes to reduce labour and maintenance costs and to improve the productivity of separate operations.

High speed processing is the perspective way to reduce the amount of finishing work together with manufacturing cost of details and improve the productivity and precision as well. As a result belt driven grinding spindle blocks should meet different requirements in terms of precision and parameter reliability which, according to the latest research works [3], appeared to determine up to 80 % of a detail mechanical operation precision. As the motion of shaping is accomplished with a spindle and spindle bearings, they make the capital contribution to the output properties of a grinder.

The work of spindle blocks on a rolling-contact bearing is accompanied by an unstable trajectory of a spindle motion as well as thermal displacement of a spindle bearing blocks and their periodic changes in the rigidity, connected with the change of an angular displacement of a bearing cage and solid of revolution set etc. Application of hydrostatic bearings in high-speed spindle blocks results in the limitation of spindle rotational frequency (as a result of losses caused by friction) and complication of bearing block structure. Electromagnetic bearing spindles have not found wide application in a construction of spindle blocks due to the high cost, complexity of spindles and automatic control system. Gas lubricated spindle bearing blocks don't have all disadvantages mentioned above but their relatively low cutting force results in restricting their application. The research work carried out at Komsomolsk-on-Amur State Technical University [1] proved the fact that different ways of organization of gas supercharging into the clearance of a gas-static bearing do not result in a considerable increase of spindle blocks output characteristics.

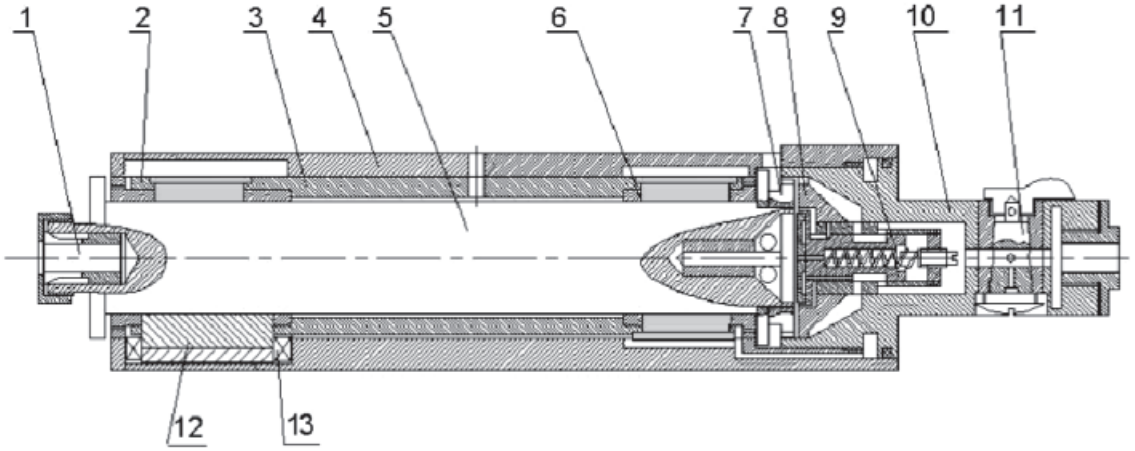
The further improvement of characteristics of spindle blocks with contactless bearings is the application of a combined bearing into their structure. A constructive solution may be a combined gas and magnetic bearing, suggested at Komsomolsk-on-Amur State Technical University [2], it combines the advantages of gas and magnetic bearings. A wide complex of theoretical and experimental researches let the researches make a conclusion about prospects of using such spindle blocks as a part of different metal-working equipment.

The result of Komsomolsk-on-Amur State Technical University research assistants work is the creation of experimentally industrial model of a high-speed belt driven spindle block with gas and magnetic bearings for grinding machines.

The construction of a high-speed spindle block for model 3A228 of a grinding machine is shown on the Figure.

Spindle block body has the length of 310 mm and a 70 mm internal diameter. There are some drillings to supply compressed air to gas bearings. Air tap is provided with a 5 mm air outlet. In the upper part at the side of an inlet device there is a window to get waste turbine air stream off.

A spindle, being 400 mm in length with 50 mm diameter is made of 38XMIOA steel elaborated with nitrogen into 0,4 mm in depth and HRC 50–55 hardness. It has stable dimensions, and it is stable to corrosion. In a spindle nose there is an axial drilling in order to assemble split terminal by means of which a grinding roller is fixed. Alongside with the spindle there is also an abutment of gas-lubricated thrust bearing in a spindle face. The opposite end of a spindle has a drilling made to assemble crossing and a regulator rod of rotational frequency cutoff as well as a thread for fixing a 70 mm diameter turbine operational roller.



The construction of a high-speed belt driven spindle:
1 – split terminal; 2 – gas and magnetic bearing; 3 – an insert; 4 – spindle body; 5 – spindle; 6 – gas-static bearing; 7 – operational turbine roller; 8 – turbine nozzle device; 9 – a regulator rod of rotational frequency cutoff; 10 – input device; 11 – starting valve; 12 – magnetic core; 13 – solenoid

Spindle block has 2 support and thrust bearings: the front one is a gas and magnetic bearing and the back one is gas-static. Bearing backings are provided with spline porous limiters of gas consumption which are 5 mm in width and 40 mm in length, placed in a circular series in a number of 6 inserts. Bearing backings are made of Br010 bronze. In order to provide maximum supporting property the clearance between spindle and its bearing backings is 35 mkm. The front bearing is provided with magnetic cores, having 6mm width and 40 mm length. One supporting bearing in a gas-static mode of operation can bear the load of nearly 180 N under relative eccentricity $\varepsilon = 0,5$ and overpressure of 5 MPa. The front gas and magnetic bearing can bear radial load up to 450 N. PID controllers with spindle position pickups, made on ferrite semi-rings are used as a control system.

Both front and back bearings react upon axial force. Thrust bearing combs have 16 axial supplying holes, placed in a circular series. Feeder diameter is 0,5 mm. Each bearing bears axial load of 60 N.

Supporting and thrust gas bearing backings are fixed in a common bearing bushing on fixing sites by means of pasting in. The glue with epoxide resin in its composition is used for this purpose. Practical work has shown that this compound is effective in operation and simple in performance.

Spindle block operates in a following way. Under its connection to a pneumonet and a closed starting valve compressed air is supplied only to support and thrust bearings, it gives the opportunity for spindle «to emerge». Voltage being supplied to solenoids output, additional force is created thus attracting spindle to a corresponding pole. The starting valve being opened, air stream simultaneously flows to bearings, then through a nozzle device goes to a turbine impeller, thus making a spindle rotate. Turbine wasted air stream flows out of a spindle block through a window and used in bearings air stream goes out of them through a through drilling of 5 mm diameter which is in a bearing bushing and bearing body.

Under air stream overpressure of 0,5 MPa spindle block has the following characteristics:

Spindle operational rotation frequency, min^{-1}	30000
high-speed $d \times n$, mm/min	$1,5 \cdot 10^6$
Grinding hole diameter, mm	20–200
Length of grinding, not more mm,	200
Compressed air mass consumption, kg/sec	$15 \cdot 10^{-4}$
Weight, kg	12

Service tests have proved effective operation of spindle blocks, no lubrication with grease of a grinding roller as well as no need for spindle warming-up. Having been tested, product samples with 25 and 40 mm diameter, made of 20×13 steel, the following results have been obtained: non-roundness accuracy of holes are not more than 0,8 mkm, corrugation-up to 0,15 mkm, roughness of surface R_a – not more than 0,06 mkm.

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Materials of Conferences

DEVELOPMENT OF OIL AND GAS FIELDS AT THE NORTH: INFORMATION SUPPORT OF THE PROBLEM

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The information flow on oil and gas fields geology, exploration and exploitation is very significant, but dispersed in bibliographic tools. Researches carried out on this topic need to be accompanied by information support using new information technologies. SPSTL SB RAS provides information support of scientific research through the creation of electronic bibliographic resources. Materials touching various aspects of oil and gas fields geology, exploration and exploitation are concentrated in the databases «Problems of the North» and «Nature and natural resources of Siberia and the Far East and their protection and rational use» generated by the Division of Scientific Bibliography. The first one covers issues on exploration, evaluation of hydrocarbon resources, extraction, storage and transportation of oil and gas under permafrost conditions, the second – fields geology and prospecting. DBs of SPSTL's own generation are formed on the basis of the legal deposit of national literature and foreign literature entering the scientific institutions of SB RAS, and include various types of documents: books, articles from periodicals, serial publications and scientific journals, conference proceedings, dissertation abstracts, deposited manuscripts, guidelines, patents, maps and atlases, etc. Records of DB contain a bibliographic description, an annotation, geographic and subject headings, translations of foreign publications. Search for material in DBs is possible by key words from the title, abstract, or translation, authors, editors, year and place of publication, geographic or subject heading, publication type and language.

The documentary flow (DF) on «Development of oil and gas fields of the North» was selected out of DB «Problems of the North», which exceeds 10,000 documents from 1987 to 2010 in Russian and foreign languages. A brief scientimetric analysis of DF was made. The analysis of DF dynamics revealed its stable growth since 1995 indicating a renewed interest of scientists and experts in this subject. Low publication activity of the Perestroika period is explained by extremely poor funding of research.

The greater part of DF documents are represented by articles from periodicals (33%). More than a half of DF are proceedings of conferences and articles in collected papers (31% and 23% correspondingly). Abstracts of dissertations and monographs are about 7% of DF, patents – 3%.

The geographical analysis of DF identified the key areas of research: the north of West Siberia (70%), the European North (including the Arctic shelf) (20%). Materials for foreign North are presented mainly by works on the Northern slope of Alaska (USA) and the Mackenzie Delta (Northwest Territories of Canada), the Athabaska basin (Alberta, Canada).

The DF thematic structure highlighted three main spheres of research: geological (the study of hydrocarbon resources of the northern territories); technological (the development of techniques for drilling in the northern fulfillment and technologies for the extraction of oil and gas in permafrost and on the Arctic shelf; ecological (studying effect of oil and gas extraction on northern ecosystems and environmental issues). Information from our DB can be found at the Library Internet site www.spsl.nsc.ru.

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GEOMECHANICAL PECULIARITIES OF DESTRUCTION OF FRAGILE MATERIALS WITH USAGE OF PLASTIC MEANS IN PERCUSSIVE REGIME

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Based on the analysis of features of natural stone, as well as the condition of problem of geomechanical provision for its processing, the author of this report came to the following conclusions:

1. Natural stone, like other kinds of solid raw materials, has a number of specific main and additional features. Thereby a technologist of mining production faces the problem of accounting physical and mechanical characteristics, mineral composition of a rock, and presence of a crack system in it, possibility to use waste products of the main and repeated production, solidity, ornamentality, safety, seasonal prevalence of works, and also size and shape of the future monoliths (blocks) at the same time.

2. According to the modern world trend, the overall production of natural stone in blocks and products of it increases. It makes the problem of increase in its breaking efficiency through introduction of new methods, means, and technologies of its realization urgent.

3. A gradual shift of the leading region of production and processing of natural stone from Europe to Asia takes place in the world.

4. Russian branch of mining and production of items of natural stone faces a number of serious problems, the most important of which are: a lag from the world standards of enterprises' equipment with modern technics and technologies, quality of the output; disparity in requirements of size and shape of the processed monoliths that are accepted by the world practice; lack of permanent market for the production; insufficient development of domestic raw material resources and personnel problems.

5. Regardless of big number of researches of theoretical and applied character on the mechanics of natural massive destruction, the number of unsolved problems remains considerable. One of the ways to solve many of the problems of mining production was the method that was introduced by O.I. Chernov in 1970-ies. It is called the method of direct fluid rupture (DFR) and is aimed to collapse roofings of stope mining output, degassing of coal layers and containing rocks, and also to destruct natural stone through blast holes.

6. A character feature of natural stone production is the implementation of several methods of rock destruction while breaking the same monolith, that distinguishes it from other kinds of solid raw minerals.

7. The share of natural stone that is produced via blast hole methods remains significant. Therefore, an implementation of DFR method with plastic substances that possess a number of advantages, compared to their analogues, as well as the technology of mining production, created on its foundations, is very perspective.

8. Compared to the analogue bore-wedge method, advantages of the method of direct fragile materials destruction with plastic substances are in the ability to: shorten the length and number of blast holes in layers of planned break-offs; shortening of solid production waste products through decrease in curvature of break-offs' surface on rear flatness; preservation of shape of blast hole mouth area; usage of serial percussive tools of different main purpose with its minor adjustment. Compared to the analogue method of destruction with powdery NDM (non-explosive destructive means) its advantages are that it: does not require sealing of horizontal blast hole mouths; allows plastic substances to enter crazings and transfer an impact on their walls; allows us to introduce plastic substances in any volume; can regulate temperature regime of implementation through using compositions with different additives; provides for better technical and sanitary conditions of work.

As a result of theoretical and experimental circle of research on definition of legislations of formation of crazing that is received in fragile materials under the impact of plastic substance from a blast hole and definition of legislations of plastic substance spreading inside a crazing, formed by its ousting from the blast hole, we have concluded that:

1. Possibilities to destruct fragile materials with fluids (water, oil, etc.) are limited by the necessity to use high-pressure force pumps and obligatory technically-complex seling of blst holes' mouths, and impossibility to form flat surface of a rupture, as well as efficiency loss when a crazing enters free surface.

2. In case of implementation of plastic substances to destroy fragile materials, even break-off flatness is formed, and the process of breaking goes on even in case when separate crazing areas enter free surface. No technically-complex sealing of blast holes' mouths and additional volume of plastic substance is needed, as during the process of destruction it isn't filtered through the destroyed material.

3. Ousting of fragile materials with plastic substances along and across blast holes' axes in dynamic or quasi-static regime is considered to be a perspective scheme of destruction of fragile materials.

4. To create extensive crazings of necessary size with usage of plastic substances due to a force that lead to curvature of a crazing surface along with a growth in its size, a combnation of blast holes in a scan line can be used instead of one separate blast hole.

5. Under multiple ousting of a plastic substance from a blast hole into a crazing that is formed in fragile material, its shape comes to a circle.

6. An increase in volume of plastic substance that is introduced into a crazing, formed in fragile material, increases the lag of its border from the border of the crazing.

One of the main stages of the work is the study of the development nature of a crazing that is formed along and across a blast hole axes, from which plastic substance is ousted. As a result of the research we have established that along with increase in its size, the shape of the longitudinal crazing evolves from an ellipse to a circle, and transversal crazing has more expressed circular character and is almost independent from its further size increase.

According to the research, unlike fluids, plastic substances does not fill the formed crazing completely, thus making a «free area» between the line of a crazing and the line of the filling plastic substance. The further study has shown that the distance between the crazing line and the filling line depends on the regime of charging, consumption, and rheological features, as well as physical-mechanical features of the destroyed rock.

As the result of laboratory experiments we have concluded that in order to form a crazing of the right shape with even surfaces it is necessary to provide for permanent consumption of plastic substance during its ousting from a blast hole into the crazing of low extent (up to 150 mm^3/s). Additionally, under laboratory tests on organic glass blocks we have found out that plastic substance, placed in a crazing under dynamic charging, accumulates pressure. This pressure can be hold in it for several days and serve as a cause of further spontaneous destruction of samples.

In has been established that in case of outer loading over the destroyed sample (presence of mining pressure), the primary crazing growth is observed along the direction of this loading, and the distance between the crazing line and the filling line increase independently from the loading direction and its presence.

As we have already said, due to the lack of dynamic calculations of fragile materials' destruction with plastic substances of sufficient accuracy, this calculation can be carried out according to quasi-static principles under conditions of low consumption (up to 150 mm^3/s) of plastic substance during the destruction. Besides, plastic substances can be used to destroy rocks of any known solidity (σ_p = 80 MPa).

As the result of a circle of theoretical and experimental research on definition of legislations that link a blowing energy to the parameters of the formed crazing and plastic substance in it, we have established that:

1. An increase in blowing energy of a tool and linked increase in consumption of plastic substance that is introduced into a crazing, formed in fragile material, increases the lag of its line from the crazing line, correlation of a crazing volume and the volume of introduced plastic substance, and also the overall energy output for its ousting into a crazing.

2. The area of the filling of a crazing that is formed by a blast method across the blast hole axis with usage of plastic substances forms an elastic element, size of which depends on the blowing energy, blast hole parameters, solidity of the destroyed rock and limit of its fluidity.

As follows from the bibliography analysis, carried out by the author, the most perspective is the breaking of blocks of size 2–2,8 m wide and 1,2–1,7 m high. For that it is necessary to plan sizes of blocks as equal or even to these numbers. Besides, to achieve an optimal weight (60 tonnes) it is necessary to evaluate the required block length according to the provided sizes of length and width, and also consider a blowing tool that can form crazings of the required size with usage of plastic substances.

As the result of the experiment series it has been found out that an increase in blowing energy of a tool under the same correlation between blast hole diameter and depth, but with alteration of plastic substances and destroyed materials leads to an increase in number of fractions that are formed during the break-off.

As pressure spreading in plastic substance goes on with a decreasing dependence, a possibility of start and extension of a process of further across crazing development, formed at the level of blast hole stall, will be linked to the necessity to use a tool with greater blowing energy, compared to the longitudinal crazing that is formed sequentially along the blast hole length, starting with its mouth.

Therefore, tools that have lower frequency with the same blowing energy should be selected as the pressure that is accumulated in plastic substance and lags to spread (decrease), resists to the transition of new pressure and, therefore, prevents further destruction of fragile material.

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Materials of Conferences

FALSIFICATION OF THE AMOUNT OF THE MORDVINIAN POPULATION ACCORDING TO THE 1939 CENSUS

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In many publications that reflect the dynamics in number of Mordovian population in XX century, its decrease starts from the census of 1939 that shows general population of Mordovians that equals 1456 thousands of people and refers to the period of World War 2. The analysis of data of censuses shows that decrease in the population of Mordva started earlier – in 1930-ies. According to the census of 1926 this population equaled 1340 thousands of people, including 1196 thousands of people in the European part of Russia[1]. The census of 1937 showed that the number of people who refer themselves to Mordovian nationality decreased down to 1249 thousands of people, including 1163 thousands of people in the European part of Russia[2]. As we know, the census of 1937 was officially declared to be defective. The reason was that absolutely unexpectedly for Stalin leadership, it showed a sharp decrease in rates of the population growth. However, modern analysis gives us ground to conclude that the census results were «relatively correct»[3]. According to its data an absolute decrease in numbers of Mordovians took place in middle-Volga region almost of 200 thousands of people, and in their own autonomy – of 100 thousands of people. Considering the fact of high natural growth that took place during the period, direct losses of Mordovian nation exceeded the provided data considerably. Clearly, they were linked to great number of victims that occurred during collectivization and Stalin repressions and a sharply increased dispersion on the nation due to mass eviction of so-called kulaks, different massive recruitings, etc. The autonomy population decreased from 1389 thousands of people in 1930 to 1149 thousands of people in 1939, and the Mordovian part decreased from 40% down to 34%. The census of 1939, according to specialists, gave an «intentional stock-taking» of the USSR population at a minimum of 2,9 millions of people[4], including a minimum of 200 thousands of Mordva. The letter number comes from the comparison between the parts of urban population of Mordovians in Russia and USSR. In USSR it is higher than in Russia according to all censuses, except that of 1939, and it clearly shows how the problem of artificial increase in Mordovian population was solved in 1939.

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[2] All-Union census of 1937. – M., 1991. – P. 83–93.

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Materials of Conferences

ABOUT THE USE OF SKYPE AT THE ENGLISH LESSONS

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It is well-known that the use of interactive technologies in educational process considerably raises efficiency of mastering of the material by the students. Especially it concerns the teaching of the foreign languages where application of such technologies helps to achieve good results. Here it is possible to refer interactive boards and Skype.

In the technique of teaching of the foreign languages the questions of work with interactive boards and those possibilities which they give at the lessons on all aspects of speech activity are widely discussed. We will stop on some moments of the use of Skype at the English lessons.

Skype gives the following possibilities:

– to listen and communicate with teachers of other higher educational establishments in other cities;

– to hear «live» speech of teachers of the country of the studied language;

– to participate in discussions on the set subjects;

– to carry out various tasks on different themes.

Two directions of the use of Skype have been tested – that is a lecture and the work with the English grammar. Students listened to the lecture of the teacher from the other university about Great Britain, symbols of the country, famous people, and the cultural wealth of the country. After the lecture they could ask questions to the teacher who was in the other city, and then they answered the teacher's questions themselves, carried out a small test and listened to the teacher's resume on the lecture and the executed test.

The second direction is the work with the grammar material. Students listened to the teacher's explanation from the other city and carried out the following tasks: connect the parts of the sentences and read them; insert the necessary forms of the verb; use the explained grammar material in small situations.

Such lessons are very interesting to students, and they carefully prepare for them.

New technologies allow the teacher to make the training process interesting, bright and effective. They help to carry out feedback, promote the increase of motivation of studying of the foreign languages and achieve good results.

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THE NEW INFORMATION TECHNOLOGIES IN THE FUTURE TEACHER PREPARATION FOR THE SCHOOLCHILDREN SOCIO-ECOLOGICAL EDUCATION (FROM THE WORK EXPERIENCE)

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The modern society greening and ecologization, the computerization and also its informatization are needed the corresponding corrections introduction and into the career education, the vocational, and the professional trainings process. So, in this case, the socio-ecological courses inclusion into the future specialist and the expert preparation content, having connected with the younger and the rising generations preparation for the optimal relations establishing with the natural environment, is one of these ways.

The «Schoolchildren Socio-Ecological Education» optional course, having developed by us with the information technologies application, is related to a number of such courses. So, its main content has been presented by the five blocks. The course goals and the tasks, the organization peculiarities and the special features are defined in the first – introductory – one. The socio-ecological presentations in the philosophical and the pedagogical heritage of the antiquity peoples, the middle Ages, the new, and the modern times, the ideas on the nature and the society interaction in the Russian thinkers creative work and their activity are considered in the second – the philosophical – historically and the pedagogical historically – block. The third – target essentially – block is discovered the essence and the evaluative nature of the schoolchildren socio-ecological education, having considered at the state, the social, the personality levels, its main goals and the tasks, the functioning principles. The fourth – substantial – block is defined the essence, the criteria, the SSEE content selection sources and principles, its peculiarities and the specific features, the normative predictively realization under the educational Institution and the educational organization conditions has been shown. The fifth – procedural – block is reflected the essence and the peculiarities and the special features of the schoolchildren socio-ecological education, teaching, and the training processes, having shown the methods, the means, and the forms its connection; it is discovered the content basic elements formation technology, having constructed on the basis of the task approach; it is included the control evaluation component, having presented by the defined and the specified methods,

means, and the control forms combination (e.g. by the questionnaires, the testing tasks, the questions, the interview questions and the others) the inspections and course content assessments mastered by the students.

So, the electronic version development of the teaching and the training aid on the suggested course has been required its content further selection. That is why, this selection has been carried out, with due regard for the defined principles and the specified criteria, which are conditioned, by the main law of the pedagogical and the teaching activities – obligatory assignment by the younger and the rising generation of the older generations social experience (e.g. V.V. Kraevsky, M.N. Skatkin) [1; 2].

Besides, in the process of the content selection there have been taken into account the following: the general pedagogical requirements (e.g. the contents correspondence of the society educational needs, the fundamentalism, humanitarization, the strict content unity at all the levels of its formation, the substantial and the procedural sides unity); the content selection principles of the general ecological education, having singled out by E.D. Zverev, E.T. Suravegina (e.g. the scientific character, the humanization, the predictability, the information level selection, the practical nature – conservative measures and the environmental activities); the specific principles, having formulated by us for the content selection of the studying and the student youth socio-ecological education (e.g. the integration, the development, the disintegration, the integrity, the registration of the geographical and the historical factors, the cultural conditions of the human environment, the axiological one) [2; 3; 4].

Thus, all these principles groups have already been laid the foundation of the specific criteria definition of the content selection, which is being developed by us, the electronic version of the studied course. Among all these, we include the following criteria: the electronic version content correspondence to the course objectives; the students' age-related, age-specific peculiarities and the individual special features registration; the electronic and the printed versions compliance; the PC students' proficiency level recording; the time educational material content correspondence, having available to be studied it; the teachers' computer training recording [4].

In this case, the criteria separation and their definition and the formulation have been needed and one more the significant and the crucial issue's solution, how to be grouped the electronic version content of the developed course. So, the earlier separated and the singled out blocks content has already been redistributed by the both parts: the invariant (e.g. the basic one) one and the variative (e.g. hyperlink). Thus, the parts correlation, for example only the one block, has been presented as follows (e.g. see the table).

The Invariant Part (basic blocks)	The Variative Part (hyperlinks)
Introductory	-
Philosophical – historically and Pedagogical – historically	The philosophers', the enlighteners', the teachers', the psychologists' and the other scientists' and the scholars' names, having reflected in their researches (to one or another extent) some society and man interaction aspects with the nature
Target – essentially	-
Substantial	-
Procedural	-
Control – evaluation	The test tasks and the test items for each from the course's main sections, the questionnaires and the interviews

Similarly, and the other components of the each part are being developed. It should be noted, that the presented electronic version is the working one, it, moreover, is needed the further its improvement and the perfection. So, the last one is one from the perspective and the promising research tasks of the students' education challenge in the field of the socio-ecological relations, the youth' and the schoolchildren' corresponding education, their training and the preparation for the optimal relations establishment with the nature, as in the present, well as in the future.

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THE PROGNOSTIC NORMATIVE REALIZATION OF THE SCHOOLCHILDREN SOCIO-ECOLOGICAL EDUCATION CONTENTS

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The «Schoolchildren Socio-Ecological Education» (SSEE) contents, just like any other, is revealed in the normative and the regulatory documents, such as: the curricula, the programs, the textbooks, the teaching aids and the teaching materials, which are presented themselves the different levels projections of the education contents formation (e.g. the theoretical presentations, the school and the academic subject, the teaching and the educational materials). As it is quite known, the curriculum is the most significant and the most important document, having defined the education contents and having realized its the first level. It, moreover, is established the school and the academic subjects set, having studied in the specific school and the educational Institution, their further distribution by the grades levels; the period of the time on the particular school and the academic subject by the weeks and the years; the school and the academic year structure [3].

In accordance with the RF Law «On the Education» (e.g. 2007) and in the context of the first generation standards (e.g. 1997–1998-es), several curricula and the syllabi are practically used in the educational Institutions and the establishments: the school's basic one, the master one, and the program one. So, each subsequent curriculum and the syllabus is the logical concretization of the previous one. For all this, the school's curriculum and its syllabus are presented by the both types: properly syllabus and the detailed working curriculum, having developed, with due regard for the specific conditions. Then, the federal, the regional – nationally and the school components are singled out in all these curricula and the syllabi; the invariant and the variative parts are being developed [1; 4]. The second generation general education standards (2008–2009-es) are provided, first of all, the Fundamental core curriculum and the education contents creation, then the school subject and the academic areas conceptions, the planned learning outcomes and the training results at the output of the learning stages (e.g. the elementary, the middle, and the high (e.g. the senior secondary) school), the basic training (e.g. educational curriculum), and the sample programs on the school and the academic subjects, and the new generation educational and the training complexes [2; 5].

Due to the fact, that «the society – nature» system is acted, as the current research subject, the consideration in the second generation standards the contents peculiarities and the specific features of the general geographical and the historical education, the tasks solution possibilities establishment of the integrated contents realization of the socio-ecological education are quite necessary. So, the exemplary programs analysis on the school and the academic subjects has been shown such possibilities presence. Thus, ones of the geographical education purposes are acted, firstly, the character, the essence, and the dynamics cognition and the learning of the main natural, the ecological, the socio-economic, the social, the geopolitical and also the other processes, haven taken their place in the Russian geographical space and throughout the world. Secondly, the interaction main peculiarities and the specific features comprehension of the nature and the society at the present stage of its further development, the environmental protection and the rational natural resources importance and the nature management significance, the Russian stable further development and the world strategy realization. So, all these purposes are being realized in the course separate and the individual sections contents, for example, «The Nature and the Human Society» [ibid].

As for the history, then with a view of this school and the academic subject, the society with the nature relations reflection necessity is not formulated, the natural conditions and the resources are considered only, as the society development prerequisites, but not, as one from the most significant factors of the world reconstruction, the struggle for the existence and the last, the present and the future generations development [2; 5]. It was determined at that time, that many social contradictions, the local conflicts, the hotbeds, the world wars had been conditioned by the necessity in the natural and the human resources; the population way of life and the civilizations development level is also determined by the resource – naturally potential of the specific territory; who possesses the natural resources – he has the real power [6; 7].

Unfortunately, the connections with the geography are being formed too weak in the program by the history of the second generation standard (e.g. as well as, the first one), that it is not quite permitted to be formed the integral presentation on the «Society – Nature» system, on the interaction and its elements interdependence. And, today, the integrated courses development necessity is being preserved, having revealed the socio-ecological relations peculiarities and the specific features; their place definition in the school and the academic subjects system, the special training and the preparation, and the pedagogical staffs retraining [2; 5].

Having taken into account the above – mentioned material, the school exemplary working curriculum and the syllabus with the socio-ecological component has been developed by us. Thus, the following criteria have been considered in the process of its development:

1) the curriculum and the syllabus correspondence to the SSEE contents;

2) the interconnection and the interdependence in the curriculum and the syllabus of the federal, regional – nationally, and the school components;

3) the invariant, the variative parts, and the schoolchildren extracurricular activity presence;

4) the interconnection with the particular model of the general ecological and the environmental education [8].

So, the first requirement was being carried out, proceeding from the schoolchildren socio-ecological education contents sources, and also, in accordance with the basic educational (e.g. training and instructional) curriculum. The specific objects of the socio-ecological environment and the main types of its elements interactions have already been defined the specific list of the school, the educational, and the academic disciplines, having revealed the SSEE contents. So, *the construction sources* of one from the possible model curricula and the typical syllabi have already been presented by the reality actual objects: by the nature, by the technique, by the man, and at last, by the society. The general educational *objects domains* are being formed, in accordance with them, having included in themselves the natural, the technical, the anthropological, and the sociological disciplines.

Due to the fact, that the SSEE contents essence is made up the society interaction with the natural environment, the invariant component, in this case, has been presented by *the integrative field of the knowledge*. So, in this case, we relate the «nature – techno – anthropo – social» and the «socio – anthropo – techno – natural» fields just to the integrative ones. So, each integrative field is discovered the quite various and the different interactions: firstly, among the nature, the technique, the man, and the society, where the nature is acted, as the study subject, and the society influence upon it, by means of the technique; secondly, among the society, the man, the technique and the nature. So, in this case, the society and the environment influence upon it is the school and the academic subject.

So, the exemplary basic curriculum and the syllabus with the integrated component have been presented by the invariant part, which is included the following educational fields: the Russian language, as the State one, the languages, the mathematics, and the physical culture. The integrated part in this curriculum and the syllabus – the socio-ecological one – is reflected the environmental main elements interaction (e.g. the nature – the technique – the man – the society). The hours' number is distributed, in accordance with the standards. At the same time, the socio-ecological field should be given the maximum hours' number, having conditioned by the contents complex multicomponent character. The hours' redistribution possibility is appeared, at the expense of the subject fields' integration, in accordance with the specific conditions of the educational Institution.

The basic educational (e.g. training and instructional) curriculum, as it has already been above – noted, is acted, the model and the working curricula and the syllabi construction basis. Due to the fact, that the integrated courses, having revealed some aspects of the socio-ecological interaction, are found themselves, at present, at the development stage, so, all these curricula and the syllabi are being formed on the available objective basis. So, all these courses introduction necessity into the curricula and the syllabi is conditioned by the society objective necessity in the socio-ecological interaction detection, and, on this basis, the causes' identification, having arisen the universal human challenges, the resolving their ways finding out, as in the present, well as in future.

In accordance with the suggested option in the V–VI-th grades of the part – time (primary) school, the developing socio-ecological field «The Nature and the Civilization» (e.g. «The Nature and the Ancient Civilizations» – the 5-th grade; «The Nature and the Society in the Middle Ages» – the 6-th grade) is acted presumably, as the integrated component. So, the specialization and the advanced and the in – depth study of the individual courses in history and geography are carried out in the VII, VIII, IX-th grades. Then, the nature, the society, and the culture interaction is continued to be considered in the «The Social Ecology» course (e.g. the IX–XI-th grades). The other school and the academic subjects, having included into the considered curriculum and the syllabus, are being ecologized, in accordance with the subject contents.

Having summarized, we note, that the basic curricula and the working syllabi of the schoolchildren socio-ecological education, suggested by us, are the prognostic options, and they are needed the further research of their contents, the realization conditions definition, the necessary methodical – educationally basis creation.

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SOCIAL-ECOLOGICAL IDEAS IN PEDAGOGICAL THOUGHT OF ANTIQUE FOLK (SHORT ANALYSIS)

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A necessity to solve modern problems of interaction between the society and nature requires constant attention in different areas of human life and activity. A solution and prognosis of social-ecological relations is mostly defined by experience of former generations. The main forms of its accumulation, keeping and transition to new generations are presented by multi-level knowledge, means of practical activity in natural environment, creative and emotional-value attitude to it. Up to modern days we receive information on peculiarities of usage natural conditions and recourses by nations of antique ages, thus defining the nature of our interaction with nature in present and future. Let us refer to social-ecological heritage of antique nations.

Theoretical analysis of scientific sources allowed us to learn that a need for transition of knowledge on our environment and other people arose in antiquity, during the primitive communal epoch. Different factors provided for it: natural terms (geographical peculiarities, vegetative and animal communities, inhabited territories, etc.) and the necessity to accommodate to them; social terms, where the main is the necessity to familiarize new generations to labour, in other words, interaction with nature, its various kinds and methods. The need for self-preservation made people actively study their environment and transit their experience to new generations. Gradually a need for people who would carry out such transition professionally – tutors arose, and then for special institutions, including those for different sexes, ages, and spiritual upbringing [1; 3].

First ways to use natural resources that were transited to children were: land use (collection of edible plants) and hunt for wild animals; usage of water resources (household needs, fishing, games, etc.). By getting involved into the direct process of nature management, children adopted its different methods, such as land processing with simple tools of laubor; modern methods of hunting (traps, bows and arrows, etc.); wood usage, etc. Children also received the experience to reflect their environment, first of all, through different kinds of art: drawing, dancing, singing, oral creativity, modeling, etc. The content of process of transiting this experience is shown, for example, by the production of primeval art. Form written sources we see evidence of antique Greek and Roman philosophy, starting from the period of antiquity. From them we learn about everything that is related to an upbringing of that time, including the area of a man's interaction with nature [2; 3].

Up to modern days we preserved ideas of thinkers of Ancient East, Antique Greece and Rome on the impact of nature upon the development of the inner world of a child. Thus, ideas of impact of the environment upon the formation of a child can be found in Holy Books which all nations have. The most well-known among them are: the Bible (the ancient Jews), the Avesta (the ancient Irish): Vedas, the Mahabrahata, Ramayana (the ancient Indians); myths and legends of ancient nations. It is character that, for example, at first in myths gods were imagined as plants and animals and their introduction to children allowed them to form their image of the environment, people, an individual; norm of attitude towards nature and human. As an argument for that we can provide, for example, the myth by ancient Egyptians «Isida the charmer and caller», in which God Rah is described – the greatest of all gods that created himself, the earth, water, air, gods, people, animals, cattle, worms, birds, and fish… Even these lines give us information on the environment of that time: the natural and social environment. In nature its main components are outlined: earth, water, air, animals and plants [2; 5].

Similar educative function is carried out by other myths, legends, poetic forms of the reflection of reality: «The Poem of Gilgamesh» (Mesopotamia); «The Fall of Moon», «The Sun and Ocean» (Hittites, III thousand year B.C.); Bible legends: «The making of World», «Edem garden and making of Eve», «Noah's ark», etc.; Vedas (II–I thousand years B.C.), myths on Buddha (IV century B.C.), Ramayana (III-IV centuries C.E.), «Mahabrahata» (II thousand years B.C.) – ancient India; «The Book of Songs» and «The Book of Stories» – ancient China (app. II thousand years B.C.). Scientists have established that a myth replaces science and art for a primeval man, gives him a full knowledge of what an adult should know and remember, calls for different emotions, pushes towards actions and deeds. Mythological heritage is represented by myths: cosmogonical (the nature of space), anthropogenic (the making of man), eschatological (the end of the world), etiological (the nature of different things and phenomenons of nature and society) [Same].

In general, these and other works of antiquity are not only means to reflect the reality, great monuments of culture, but also important sources of cognition of natural and social reality of the past that today allow us to study the distant antiquity: natural terms of human making, social life and activity, relations between the society and nature, methods of nature management, initial forms of protection of separate components of nature, peculiarities of establishment of harmony in social-ecological relations [2; 6; 7].

Therefore we have to admit a great influence of Confucius (551–479 years B.C.), the great thinker and tutor of Ancient China. Many of his ideas still carry their upbringing significance. He paid a huge attention to problems of a nature's impact upon the process of making a child's personality. Confucius compared a perfect man with growing of seeds

(«… a man gets more intelligent just like seeds grow – permanently, involuntarily, and interminably: there is no limit for perfection. Such organic growing of spirit doesn't know dramatic turns of destiny or critical moments…»). He thought this way to be endless and necessary for a man. His words «The real mistake is made by one who does not correct his former mistakes» sound very urgent for social-ecological relations and correction mistakes in nature management. Thereby it is comforting that modern society acknowledges the fact that natural resources are limited, some of them are irretrievable, their extravagant management is not correct, and the necessity to change the way of interaction with nature in future. In this context we should outline the role of upbringing with the process of a child's development, to which Confucius paid a great attention. He wrote, that «… if nature replaces civility in a man, we will have a savage, and if civility replaces nature, we will have a scribe. Only that who combines nature and civility in himself can be called a worthy man». Obviously, even then the thinker considered it necessary to aim for harmony with self and the environment [4].

A big follower of Confucius was another thinker of China – Meng-tzu (app 372–289 years B.C.). His works study problems of interaction between the society and nature and contain examples of negative impact of the society upon its environment; an impact of outer circle upon the upbringing of a child. As the thinker sees it, the main that forms a man is his philanthropy and justice; if these feelings are always exposed to strikes of evil deeds and aren't replenished, then a man's nature stays close to animals… Such condition of a human feeling of goodness he compares to the condition of forest of the mountain Nu that «… used to be wonderful, but, as it became the suburb of a country's capital, its forests were cut with axes. The arisen young sprouts were eaten by cows and sheep. The mountain became nude, and people who looked at it thought that there was never a forest. The same happens to a man…». Meng-tzu also outlines the difficulties of upbringing, saying that «… if someone wants to grow a tree of two girths, he will be able to nurse it. When it comes to one's own personality, we don't know how to train it…» [1; 5; 7; 8].

To sum up, we should once again point out the necessity of permanent appeal to the heritage of the past that helps us to comprehend the present and predict future condition of social-ecological relations.

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Materials of Conferences

W. SHAKESPEARE IN MORDOVIAN

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In August 2008 died a great Mordovian writer, a classic of national literature Kuzma Grigorievich Abramov. While studying his archive, we found waritings of translations of some Russian and foreign poets, including W. Shakespeare. K. Abramov started his literature activity as a poet. He translated into Erzya-Mordovian poems by N. Nekrasov and T. Shevchenko. However, he never printed translations of poems by Shakespeare and didn't even tell anyone about it. Writings have dates of 1948–1951 on them. During this period the writer, being a former prisoner of war, couldn't find a job, and thus he worked at home. 14 sonnets have been found in his archive

The first sonnet by W. Shakespeare, as we know, starts with the words:

From fairest creatures we desire increase,
That thereby beauty's rose might never die,
But as the riper should by time decease,
His tender heir might bear his memory:

Translated by K. Abramov into Erzya-Mordovian this sonnet looks as follows[1]:

Sad piren' chuvtos' sex tunda tsvetyas',
Pryasonzo ney umartne velt yaksterdit'
Kadyk pevery pujzhon' tselyan' pryas', –
Od tsetsyat minek eise esest terdit'.

Vechksak to ansyak eset' mazychit'
Dy sonze turtov altat vese viet'.
Chavoks kadovy ton' eryamo kit',
Koda chavoks ulnest vese ton yet'.

A kuvat' ton mazoldomo karmat,
Istya eryaz' ey pokolen' sedeise,
Ikeltsepelen' ushodksont' kalmat
Dy, teke marto, ertniat' vyet' eise.

Ilit' naxavto vidymetnet', konet
Valske kasytyt' od panzhovkst dy zernat!

For the hundred years from Birthday of K. Abramov, that will be celebrated in 2014, the V council of Mordovian nation resolved to publish the full collection of his compositions in Erzya-Mordovian in 10 or 12 volumes. All his translations are considered to be included into the collection, including the translations of sonnets by W. Shakespeare.

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