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VALUATION OF WATER RESOURCES FOR THE SYSTEM OF NATIONAL ACCOUNTS PURPOSES UNDER THE RENT-BASED APPROACH: METHODOLOGY & EXPERIMENTAL ESTIMATES OBTAINED FOR RUSSIA

¹Filchenkova O.A., ²Medvedeva O.E., ²Artemenkov A.I.

¹*Ministry of Natural Resources and Ecology of the Russian Federation, Moscow, e-mail: ofilchenkova@gmail.com;*

²*State University of Management, Moscow, e-mail: medvedeva_o@list.ru, achudakhin02@gmail.com*

This Paper is focused on the methodology for water resource valuations in conformity with the System of National Accounts (SNA 2008) principles. We offer a residual estimating technique based on resource rent capitalization and apply it to generate experimental estimates for the Russian surface and ground water resources for the year 2013 – on the statistical macro-level of analysis. We report the findings of water rent estimates on the capitalized and un-capitalized basis, as well as unit valuations for water abstractions – as differentiated by the major water-using industries accounting for more than 60% of the water abstraction in the country. The technique provides a differentiated treatment for what we call “mono-industries” and “mixed-use industries” and urges the importance of not neglecting the contributions from the latter in valuing water resources for SNA purposes.

Keywords: water resources, assets, resource rent, economic rent, residual valuation techniques, value

Abbreviations/Acronyms used:

NCU – National Currency Units; rubbles – in case of Russia;

Rosstat – the Russian Statistical Service;

SNA – System of National Accounts (its 2008 version is implied by default);

PPP – purchasing power parity (for currency exchange rate).

In 2016, the authors have been commissioned to develop Guidelines and conduct experimental estimates for incorporating the value of national water resources into the National balance sheet in conformity with the SNA-2008 framework [1]. This work has been performed in furtherance of a parallel 2014 Rosstat project [2] to account for the value of Land resources on the National balance sheet in order to reflect more comprehensively the extent of the National wealth using SNA-2008 classification of asset classes. The outcome of this project was represented by Guidelines for valuation of water resources at current market prices through capitalization of water rent derived by the main water-using sectors of the economy. These Guidelines have been trialed on the basis of experimental macro-level estimates for the overall value of the national water resources, as well as exploring their applicability on the river-basin (i.e. “micro-level”) basis (with the respective value estimates/water accounts obtained for the Pechora, Don and Ob’ river basins). The Guidelines identify the requisite sources of input information and conclude with the algorithms for the proper recording of the value of the water resources, and the reconciliation of the annual changes therein, on the asset accounts and the national balance sheet.

The reported work follows the (to date) thin streak of international research on experimental SNA-related water account statistics in value terms centered on such jurisdictions as the United Kingdom ([3, 4], the United States [5], Netherlands [6] and Australia [7] [8]. As far as the treatment of Russian water resources for SNA purposes is concerned, it represents a pioneering initiative carried out according to the Rosstat WorkPlan.

Thus, it appears from published sources that water valuation accounts for SNAs purposes are available in the minority of jurisdictions – and even there still bear an experimental character – despite the fact that SNA 2008 framework for valuation of water resources is now almost a decade old. This Paper is an attempt to contribute yet another such experimental water valuation exercise to the above-mentioned pioneering body of research – in furtherance of the statistical aims of SNA-2008 as far as accounting for water resources is concerned.

Since in the Russian jurisdiction large surface water bodies (and underground water) are deemed to be officially held in sole ownership of the State (with an exception of minor water bodies, such as ponds, which are located inside private parcels of land), this circumstance, in a sense, much simplifies the accounting for national water resources on assets accounts – i.e. there is no need of allowing for intersectoral division of water ownership and, in line with p. 13.3 of SNA 2008 (which only, if at all, allows for a separation of economic and legal ownership of a natural resource when the resource usage/extraction rights akin to financial leasing arrangements are in evidence), all water

is attributed to its titular owner – the State. This institutional matter, therefore, obviates the need for maintaining the capital-transactions-with-water-resources account and enables to attribute the entire derived water resource valuations to the “public sector”.

On the other hand, the complicating factor is that, unlike in the US and Australia, there is no market mechanism for water rights pricing whatsoever instituted in the Russian jurisdiction which would have created and registered market prices for transactions with marginal units of water resources. Whichever water usage rights endowments are in place (i.e. artesian water abstraction rights, waterways and ponds abstraction quotas) – even though since 2006 they are increasingly being based on negotiated bilateral contracts with the Federal Water Authority, as far as abstractions from waterways and surface water bodies is concerned – their price-setting is based on totally non-market related principles, i.e. a mandated tax-like levy which usually is a flat-scale one and insensitive to amounts, and variations in, economic rent generated by abstracted water resources. Therefore, akin to the approach pursued in other jurisdictions where water rights are not market-priced, the lack of market valuations for marginal transactions with water resources has necessitated the reliance on the deductive (residual) procedure of resource (water) rent capitalization, which is usually considered a default procedure of first recourse in instances where no market derived valuations are available (i.e. see [6, 7]).

The resource rent capitalization procedure has a long history of practical applications since early on in 20th century and is intended to value natural/water resources in a wide variety of contexts – from an analysis of public investment projects and resource taxation to now, increasingly, SNA-related valuation purposes.

The standard reference textbook on water valuation in investment and public policy domains [9] places water rent capitalization techniques as one of the principal varieties of the Residual method for water valuation – to first estimate and then capitalize “economic rents” derivable by industrial water resource users. The method commends itself for its simplicity as one

“that satisfies many needs for private and public evaluation of proposed water policies: a single surrogate shadow price or WTP [Willingness-to-pay] per unit of water that is comparable to and commensurate with prices observed for other goods and services in the economy” [9, p. 90–91].

On the other hand, the limitations of economic rent estimates for industrial users as applied to water resource valuations are inherently associated with the often arbitrary and uncertain nature of intermediate-input capital charges making the method very sensitive to assumptions and errors of omission in this regard and, therefore, often biased towards overstating the value of water resources.

While in other applications this water rent capitalization technique may be applied on the level of individual enterprises, or be specific only to regions affected by water investment projects under consideration, the SNA-related valuation analysis makes it necessary to apply the technique on the highest (most aggregated) level of industry analysis – with all the attendant issues associated with contamination of rents data by inputs from “collateral (i.e. non industry-specific) activities” of enterprises included in the industry groupings analyzed.

Nonetheless, SNA 2008 mandates that valuation of water resources for asset accounts should be conducted on the basis of general asset valuation principles (including those for mineral resource valuations) provided in SNA [1, pp. 13.16-13.25], but mentioning that other more practicable alternative approaches may also be utilized – such as sole reliance on the capitalization of water use/abstraction charges levied by the titular owner (the state) absent the better estimates [1, p. A3.85]. However, in SNA there is a putative hierarchy of approaches lined in the continuum of their “market-orientedness”. That is, similar to international accounting measurements under IFRS (e.g. the International Financial Reporting Standard 13 “Fair Value Measurements”), the mentioned SNA asset valuation principles prioritize the use of observable market data on resource prices where those are abundant enough (i.e. the pursuance of the market approach to resource valuation), but also – as a “second-best” option status-- permit the use of the cost approach techniques (which, in unrefined form, are mostly relevant to produced assets only), as well as income approach methods (the Net present value method (NPV), which is the workhorse of mineral resource valuations, and associated capitalization techniques) – where direct market price comparisons to infer the resource value are in thin supply.

Further – to condition the application of those approaches – an important SNA principle is that natural resources, including water, should be valued at their in-situ value – that is in “as is” condition, but not in some refined state for which their prices are indeed most

often available. Thus, in line with other strictures on the application of “benefit transfers”, this suffices to show that the value of, say, tap water (or other destination use estimate) can’t be taken to immediately represent the value of a water resource in its “raw state” as found “at source”.

But given the absence of market-based raw-state pricing for water resources in Russia, falling back on the capitalization of water rent as a version of the residual (net present value -style) method of valuation is immediately self-suggestive – also given the respective precedents for the choice of this method for SNA valuation purposes in Netherlands, UK and Australia, e.g. even in those jurisdictions where water- resource pricing is more responsive to market signals and raw-water markets actually exist (i.e. in Australia). A variety of the cost approach – i.e. the least costs method – has also been considered by us and applied in the instance of one important water-reliant industry (hydroelectricity generation) as a back-up method to corroborate estimates obtained through water rent capitalization. On the other hand, it is a well-known lapse of the rent capitalization techniques that, where the estimated rents they return are zero- or negative- valued, the method itself ceases to be useful (since water value is bounded at zero and, being a public asset, can’t be negative- valued). In such instances, we believe that negative industry-wide rents indicate that resource fails to generate any rent and should therefore be zero-valued in the context of that industry in economic terms. We refrain from pursuing other roundabout methods of valuation (e.g. those least-costs-of-substitution ones proposed in [6] where the estimates return zero or negative-valued economic industry rents, and consider such instances as zero-valued uses of water. We also chose to aggregate in industry-wide rent calculations only those enterprises which have positive rolling-average operating performance indicators on which economic rent estimates are based (i.e. the industry-wide sample is purged of enterprises with a priori negative rents). This is justified on the basis of the Ricardian notion of differential rent, where the rent is viewed as any overage, or surplus, above the basic acceptable conditions or reproduction—continuously recorded negative operating surplus in that sense is not a viable “condition of reproduction”.

Given this approach, it is clear that our aim is not to obtain the maximum, but best-substantiated assessment of the value of national water resources for statistical purposes, subject

to the assumptions and limitations of the analysis listed below.

Assumptions of and limitations to the experimental study

The following assumptions underlie the obtained experimental estimates:

1. Only economic assets generating benefits over the averaging period of rent assessment are subject to valuation. That is, we consider only economic effects from the use of water resources without incorporating into the estimates the effects of water assimilative potential or the value of ecosystem services provided by water. In line with SNA 2008 provisions, our focus is the economic value, not the total (existence) value of the resource, which can be more exhaustively explored in the context of satellite accounts such as can be drawn under the provisions of SEEA-Water document [10].

2. Two types of institutional units drawing income from the use of water resources are considered for valuation purposes – the state as a titular owner which supervises the use of water resources, and the economic entities – enterprises with primary reliance on water use belonging to various branches of the economy – with their selection as explained below.

3. Estimates were conducted on the macro-(national economy) level, with separate trials also undertaken on the river-basin basis.

4. Since the market for water resources and water abstraction rights is absent in Russia, with market prices failing to register in consequence, the water rent capitalization technique, a specie of the residual (NPV) approach, has been put to use as a primary valuation tool.

5. Due to the limitations of the national statistics on water use in physical terms and related abstraction data, only two statistical quality classes for water resources have been identified and considered in the analysis – underground (artesian, subterranean) water, and surface water. No further differentiation for water quality has been provided, and both identified categories of water are treated independently of each other, i.e. even though the surface-to-underground-to-surface water circuits may exist in the physical water analysis, no such processes are recorded in the value accounts – among other things, because either category of the water resource is not in deficit on the macro-level of the analysis.

6. The degree of accuracy of the analysis is limited by the degree of robustness of the data inputs contained in the public industry database used (EMISS by Rosstat), Water

Resource Agency, Natural Resource Agency and the Federal Tax authority databases. On macro-level, the fact that an entity may abstract water in one region but return statistical forms (accounting statements, water abstraction statements etc.) in another region depending on its registration with tax authorities is less of a concern than for a regional basin-wide analysis, but various forms of tax optimization, joint economic activities reported under one industrial code etc., may bias statistical inputs.

Description of the water rent capitalization technique proposed

Two models are used to value water resources depending on the classification of particular selected industries on the basis of the extent of contribution of water resources to their core production activities – *mono-industries*, and *mixed use industries*.

Mono-industries are those industries the core activities in which are closely associated with the use/consumption of water resources (hydroelectric generation, mineral water bottling, fishing, communal water supply to households etc.). The entire elicited economic rent in such industries is fully attributed to water rent – since it forms the overwhelming basis for generation of value-added in those industries. The production becomes untenable and halts without water.

Among identified mixed-use industries for water are those industries in which the water is a substantial, but not the sole contributant to the produced output (irrigated agriculture, some water intensive metallurgical and chemical industry classifications). In such industries other production factors are also material contributants to the value-added, for example, land in irrigated agriculture, intellectual property and intangible assets in the industrial branches, etc.). Given the consideration of mixed-use industries spectrum, our experimental approach appears to be broader in scope than other referred applications of the residual technique for SNA water valuation purposes. Often, as in the case of UK, these applications are limited by only the consideration of water-supplying and agricultural industries [3]. By contrast, our application also places considerable emphasis on the importance of water to the value-added and economic rents generated in the mixed-use industries.

Economic rent is a term occasionally used but only definitionally adumbrated in SNA 2008 [1, 20.45) – to the extent that it implies financial yield on “capital services” provided by assets; in other contexts the term used to be often defined as “unearned surplus”, or “re-

sidual income” (which gave name to “residual techniques” of economic rent elicitation). As applicable to industrial branches, the economic rent is calculated as a part of the operating income from the sales of goods and services by the industry less a deduction for capital (plant, property and equipment) charges.

Indeed, in SEEA-Framework [11] document, which forms the basis for compiling “green” satellite accounts to SNA, Economic rent is explicitly considered as:

“the surplus value accruing to the extractor or user of an asset [natural resource] calculated after all costs and normal returns have been taken into account. The surplus value, referred to as resource rent in the context of environmental assets, can be taken to be the return attributable to the asset [natural resource] itself.” [11, pp. 5.113-5.114]

Thus, the resource rent is a part of economic rent arising in the form of surplus value from using a certain natural resource and accruing to the user of that resource (or being generated by an industry as a whole). Same as for economic rent, it is estimated as a residual income remaining after deductions from the operating profit of all costs and returns on plant and equipment items and working capital employed by the user (or within the industry), – with that difference that the residual income is also reduced by returns accruing on other co-employed production factors and natural resources. Within the SNA accountancy context, the economic rent is a sole source of resource rent allowed under the SNA-2008 document. In mono-industries, therefore, the economic rent coincides with the resource rent. And as applied to water resources, the resource rent is otherwise referred to as the “water rent”.

The technique for estimating the value of water resources employed

The value of water resources is determined as the sum of capitalized resource rents derivable by entities within the principal water-consuming industries (mono and mixed-use) and capitalized rent received by the state in the form of water tax and water-use payments:

$$V_w = Ven + Vg, \quad (1)$$

where V_w – is a water resource valuation; in the National currency units (NCUs);
 Ven – capitalized resource (water) rent (i.e. at present value) obtained in the aggregate by the economic entities in the water-using industries (averaged on the rolling basis); in NCUs;
 Vg – capitalized resource rent obtained, in the aggregate, by the state; in NCUs.

The capitalized rent of the economic entities is calculated as the sum of capitalized industry rents:

$$V_{en} = \sum_{i=1}^n \frac{ER_i}{e}, \quad (2)$$

where ER_i – is the averaged (on the 5-year rolling basis) resource rent obtained by the industry i ; $i = 1, 2 \dots n$; as estimated under formula (3); in NCUs; (given the non-negligible national-currency headline rate of inflation in the country, the averaging process also included adjustments for the pace of inflation in the 5-year interim – in order to express the ER_i values subject to averaging on a comparable basis).

n – the number of the principal water-using industries being considered;

e – the discount rate; the market-based risk-free rate on the NCU market can be employed for that (on the real-terms basis, i.e. net of inflation); for example, we have used the rubble – denominated long-term federal bonds yield which, netted of inflation, has been estimated to be at the long-term value of approximately 0.05 (5% per annum). Thus, by employing the direct (annuity) capitalization technique to the capitalization of resource rent Formula (2) assumes that there will be no (real, ex ante) growth in the rents going forward, which assumption is justified by the current stagnant long-term outlook for the national economy plus that the overall economic significance of the major water-using industries accounted for will remain as before. This doesn't mean, however, that the water valuation result should remain one and the same for SNA purposes going forward. The SNA system of natural resource accounting provides for recurrent, at least annual, revaluations of the natural resources. Since the water rent used for the capitalization is a sliding historical average of the past calculated rents, the valuation figure will undergo change from year to year, capturing, on the ex-post basis, the change in the calculated rents (see Table 1).

For **mono-industries**, the ER_i rent is determinable as:

$$ER_i = PS_i - V_{Bi} \times R, \quad (3)$$

where PS_i – is the operating (gross) sales profit in the considered industry i ; it reflects statistically aggregated accounting “sales profit” of reporting entities on the industry level, as reported in the Rosstat' EMISS database [12] (loss-making enterprises are excluded, not netted, in the industry aggregate); The choice of

“gross sales profits” as an apex indicator from which the economic rent is derived is informed by the consideration that it best reflects immediate operating activities of enterprises in the industry grouping net of subsidies, thus this indicator based on aggregated industry-level data collected from accounting statements of enterprises filed with Rosstat suggests itself as the best available proxy on which the estimates can be based.

R – Rate of return on capital in the country, or the average returns on industrial investments. This metric is usually used in the residual valuation techniques to separate income accruing to the specific natural resource, i.e. water, or other resource, rent, and is functionally intended to account for excluded returns on produced assets by the identification of full “user costs”. Accordingly, $V_{Bi} \times R$ – stands for the (to be excluded) contribution to income/profit generation of plant, property and equipment items (PP&E) in industry i , given the rate or return R ;

On the macroeconomic level, the rate of return on capital represents the average “profitability” of invested capital which can be used to determine the rate of return on produced assets (in our instance, Plant, Property and Equipment items employed within the industry).

The rate of return on capital investments, R , can be based on internal industry measures (such as an average Internal Rate of Return (IRR) estimated on projects within the industry) or, else, can be externally determined in nominal terms on the basis of the federal securities market (i.e. GKO and OFZ bonds). The experimental estimates presented in this Paper feature the nominal rate of return of 5% across all the considered industries (which seems to reflect the secular inferior conditions of profitability and performance in the overall industrial sector of the economy compared to its financial sector).

For **mixed-use industries**, the ER_i rent was determined as:

$$ER_i = K_{wri} \times (PS_i - V_{Bi} \times R). \quad (4)$$

Where, additionally to formula (3), K_{wri} – is the water rent share in the overall economic rent for the mixed-use industry i ., while the V_{Bi} variable also includes in its base the value of Land, since Land can be an appreciable production factor in the mixed-use industries.

It is advised that K_{wri} factor be determined on the basis of more detailed surveys of water and land contribution to the generation of the industry economic rents – which can be achieved on the basis of more detailed linear

programming techniques. One of such methods is the production function approach. Essentially, such a method is a detailization of the resource rent capitalization techniques as applied to mixed-used industries. It enables to optimally distribute the economic rent between other production factors over and above water resources – within the context of mixed-use industries. This method has enjoyed a measure of recognition in valuing water resources (albeit in policy contexts other than for SNA accounting purposes) – both in the developed, as well as developing countries, and scores a mention in both SEEA-Framework [11], and SEEA-Water [10] documents. The latter document (p. 125,130) records 7 instances of its application to valuing water resources in the US as of the year 2000. It has also been experimented with in the Canadian context, as well as in India and China. However, the Russian statistics wouldn't be able to support its applicability without making the primary statistical data available (which are deemed to be confidential under the Russian Statistical Observations Law). To date, we are not aware of its applications to the national water resources in whatever context.

Since the subject estimates bore an experimental nature and the entire project aimed to offer an algorithm to estimate the value of water resources on the basis of available statistical information, the K_{wri} factor wasn't elaborated in any great detail for different mixed-use industries: it was assumed at 0,1 for all mixed-use industries, except for irrigated agriculture where its value of 0,2 has been used.

The imputed value of 0,1 is optimal on many counts. It is determined proceeding from the fact that the contribution of water resources to economic rent generation in mixed-use industries can be accepted to be approximately the same as the contribution of land to overall value of production assets. The share of the land value, according to the analysis of domestic and international statistical sources on market prices of the industrial real estate, usually doesn't exceed 10% in the overall value of industrial concerns [2]. The 20% share of water rent for agriculture can also be considered at an optimal level, since in irrigated agriculture where the water rent can principally be generated agricultural yields are boosted by a factor of 300–400% compared to non-irrigated agriculture, while the share of lands under irrigation in the country can be estimated at about 7–10%. The international practice of experimental SNA-compliant water valuations records the cases of application of K_{wri} equal to

30% (e.g. for Netherlands, as reported in [6], economic rents generated in the agricultural sector.

It would be expedient in further exploratory work to differentiate the water rent share depending on each particular industry employing the methods of factor analysis, including the production function approach mentioned above.

Having regard to institutional arrangements for water use payments in Russia, the rent accruing to the state (Vg) has been determined as:

$$Vg = \sum_{i=1}^n \frac{P_{PW i}}{e} + \frac{T_w + P_{AW}}{e}, \quad (5)$$

where $P_{PW i}$ – are the aggregate annual payments of economic entities operating within industry i to the state for the discharge of contaminants into water bodies, $i = 1, 2, \dots, n$;

T_w – are the aggregate state revenues from the water tax payable by all water users; if ground water is to be included into the valuation analysis, this element of proceeds should also include the respective tax levied on extraction of mineral resources, since a part of subterranean water resource extraction is taxable under this heading;

P_{AW} – aggregate annual payments for water use rights, including under contractual negotiated arrangements with the state, etc;

e – the discount rate.

The water valuations thus obtained under formulas 1-5 are absolute values in NCU which can be included within the national wealth accounts on par with other non-produced assets.

Findings from the experimental estimates

We report our findings on the water resource monetary estimates in both NCU (Russian ruble) amounts and the converted US dollar amounts. The Purchasing Power Parity (PPP) exchange rate has been used for such a conversion. The value of ruble exchange rate to US dollar at PPP has been reckoned to be at about 25 rubbles per 1 USD (the exchange rate during the year of experimental estimates (2013), at about 30 rubbles to the dollar, has been close to this parity, while, following the devaluation of ruble in late 2014, the current market exchange rate of about 60 rubbles per 1 dollar deviates from this PPP value by a factor of about 2,5 (e.g. see [14]). In line with SNA-2008 economic asset boundary requirements, only the water in inland water bodies was considered – not oceans, or seas. As a result of our experimental water resource valuations,

the overall value of water resources for Russia has been estimated at about 4 trln. rubbles (or around USD 150 bln., if converted at PPP exchange rate of 25 rubbles to US dollar) for 2013 (or at about 5,5% of the Russian GDP at 2013 current prices). Out of which 3,3 trln. rubble value falls on account of the surface water resources, and 0,7 trln. rubbles accounts for the value of the ground water.

This can be treated as a minor component in the structure of the national wealth. It represents short of 1,5% of the value of the produced capital in Russia (on the basis of Rosstat (2017) related-period data on the National Assets and Liabilities Balance).

The breakdown of water resource valuation estimates between the surface and ground water categories for the year 2013, being the year for which we undertook the experimental estimates, is presented in Table 1. This table is drafted in a format consistent for incorporation into SNA sectoral asset accounts (given the legal situation with water ownership in Russia, the 100% owner of the resource, as explained above, is the general government itself, therefore, no presentation of changes through the financial (transactional) account is required).

The estimates featured the requisite industry performance (i.e. gross operating profit (“profit from sales”), and net carrying amount of PP&E items) and water consumption (abstraction) data derived from the EMISS database for 20 industries accounting for more than 60% of water abstraction in the country, as well as those that use water without abstracting it (i.e. the fishing industry, and inland water transport). Out of these 20 industries, 8 have been classified as mono-industries, while the remaining 12 – were considered to be the mixed-use industries..

The application of the uniform valuation methodology for water resources, coupled with the estimating process based on official data on the value of plant, property and equipment assets and industry-level operating profits, has enabled to obtain the indicators of value for the water resources which are commensurate with the value of other assets considered in the assessment of the national wealth and statistical treatment thereof. So ensuring comparability with reference to matching discount rates, rates of return etc. vis-à-vis other national natural resource estimates (e.g. for Land) has been a priority.

Table 1
Experimental macro-level valuation of the Russian water resources for 2013

Level of valuation	General government sector: Value of water resources as at 01.01.2013, in bln. rubles (USD \$ bln.at PPP), at current prices		
	Ground water	Surface water	Total for water resources
<i>The Russian Federation</i>	657,8 (26,3)	3 277,0 (131,1)	3 934,9 (157,4)
<i>For reference: Ground water/surface water ratio</i>	17%	83%	100%
Changes over 2013, incl. on account of:			
– <i>financial account/ transactions</i>	0	0	0
– <i>other changes in the volume of assets account</i>	0	0	0
– <i>revaluation account</i> <i>[of which the real holding gain/loss*]</i>	18,9 (0,76) [-15,3(0,61)]	322,5 (12,9) [152,1(6,0)]	341,3 (13,6) [136,7(5,47)]
	General government sector: Value of water resources as at 01.01.2014, in bln. rubles (USD \$ bln.at PPP), at current prices		
<i>The Russian Federation</i>	676,7 (27,0)	3 599,5 (144,0)	4 276,2 (171,0)
<i>For reference: Ground water/surface water ratio</i>	15,8%	84,2%	100%
Notes: **“real holding gain/loss” is that part of the revaluation account which exceeds the revaluation (the resource value appreciation/depreciation) had it proceeded in exact conformity with the inflation rate prevailing in the country (5,2% CPI inflation rate for Russia in 2013).			

Source: authors' estimates.

Distribution of water rents across major water using industries

Table 2

Distribution of water rents accruing to economic enterprises across the analyzed industries for 2013

Industries	2013	
	Water rent, in bln. rubles (\$ mln, at PPP)	Contribution of the industry-level water rent to the overall water rent estimate
Mono-industries:		
Fishing and harvesting of aquatic cultures in rivers and lakes – by all types of producers	0	0%
Activities of inland water transport	1,4 (56)	1%
Generation of electricity by hydroelectric stations	35,6 (1424)	18%
Production, transmission and distribution of steam and hot water (thermal power)	0	0%
Fish-breeding	0,6 (24)	0%
Collection, purification and distribution of water	0	0%
Production of mineral waters	2 (80)	1%
Collection of water discharges, refuse run-off and similar activities (drainage industry)	0	0%
<i>Total for mono-industries</i>	<i>39,6 (1584)</i>	<i>20%</i>
Mixed-use industries:		
Manufacture of cellulose, wood pulp, paper, cardboard and items made out of them	3,9 (156)	2%
Production of electricity by thermal powerplants	5,4 (216)	3%
Crop agriculture	11,1 (444)	6%
Animal farming	1,3 (52)	1%
Extraction and enrichment of iron ores	15,6 (624)	8%
Extraction and enrichment of non-ferrous ores, except for uranium and thorium ores	11,9 (476)	6%
Chemical production	28,7 (1148)	15%
Production of cast-iron, steel and ferrous alloys	8,3 (332)	4%
Manufacture of artificial and synthetic fibers	0,1 (4)	0%
Aluminium production	2,3 (92)	1%
Production of coke and oil products	68,4 (2736)	35%
<i>Total for mixed-use industries</i>	<i>157,1 (6284)</i>	<i>80%</i>
<i>Total</i>	<i>196,7 (7868)</i>	<i>100%</i>

Source: authors' estimates.

The analysis of data in table 2 demonstrates that it is mixed-use industries that generate most (80%) of overall water rent in the country – highlighting the importance of not neglecting the rents formed in those industries in which many industrial processes depend on the continuous consumption of water. At the same time, it is for mono-industries where the estimate is the more immediate, less “experimental” and more reliable one: it appears that the mono-industries are roughly accountable for 20% of overall water rent generation.

However, about half of the mono-industries are patently loss-making or have zero-bounded economic rents (in part, due to peculiarities of pricing in those industries, e.g. water supply and canalization industries are subject to the state regulation of tariffs which are based on the cost-recovery principles and, thus, do not allow for any rents). Such industries in which the rent doesn't manifest itself include: fishing in inland waters; production, transfer and distribution of steam and hot water (thermal power); collection, purification and distribution of

water, as well as the drainage industry. In a sense, water is still a “non-economic good” in these industries – that is often due to the tariffication principles used for the output of those industries, which sometimes allow only for the recovery of costs.

The principal contribution to the generation of water rents in the mono-industries is on account of the hydro-electrogenation industry. This industry accounts for more than 90% of all water rents generated in industries classified as mono-industries: 35 bln. rubles (\$1,4 bln.) out of 39,6 bln. rubles (\$1,58 bln.) of elicited mono-industry water rents. (The estimates for water rent in the hydroelectric generation industry have been also cross-checked by an analysis under the least-costs method, i.e. through multiplication of the volume of electric power annually produced on hydro-electric installations within the country by economic savings achievable through generating electricity on hydroelectric-plants compared to using the next least-costs alternative of thermal plants. The estimates under this method for major hydroelectric plants consolidated into the Rushydro holding yielded about 19 bln. rubbles in annual water rent, which is a fair match for the 35 bln. rubble estimate obtained under the water rent capitalization technique). The second running rent-generating industry in this group is the mineral water bottling industry (that accounted for about 2 bln rubbles in water rent for 2013).

Thus, the elicited water rent across all water-using industries in the aggregate (net of the share captured by the state in the form of water taxes and payments) has been estimated at close to 200 bln. rubbles. (\$8 bln. at the PPP rate) (See Tables 2 and 3). In this context, only the minority of overall water rent (less than 10%) is collected by the state in the form of compulsory water payments – P_{pw} , T_w and P_{AW} (water tax, discharge tax, or contractual water rates levied on industrial water users, which are the bulk of water taxation) – Also see Table 5.

Transitioning to unit valuations of abstracted water resources

For practical water management purposes, including the analysis of efficiency of water use policies and water taxation impact—both on the country-wide and industry specific level, – it is expedient to further develop unit valuations of water resources consumed in the economy:

$$R_{wu} = \frac{WR}{B_w}, \quad (6)$$

where R_{wu} – is a unit rental (annual) valuation of water resources deriving from the SNA-

2008 conformable estimates developed above; NCUs./cubic.m;

WR – aggregate water rent; in NCUs;

B_w – annual volume of water resourced used (i.e. consumed or abstracted) in the analyzed industrial sectors; NCUs/cubic m./year.

The aggregate water rent WR has been estimated as:

$$WR = \sum_{i=1}^n ER_i + R_g, \quad (7)$$

where ER_i – water rent remaining with the economic entities (industries), in NCUs;

R_g – water rent accruing to the state, in NCUs;

Similarly, the water rent accruing to the state (R_g) has been determined as:

$$R_g = T_w + P_{AW} + \sum_{i=1}^n P_{PW_i}, \quad (8)$$

where the right-hand side notation used is identical to one already defined in the context of Formula (5).

In transitioning to unit values one should bear in mind their certain notional character associated with the inherent features of water use. The peculiarity lies in the fact that quite a number of industries rely on the water use without abstracting water in the first place – in connection with which it is not always possible to apportion on a fair basis the amount of water consumed by them (i.e. inland water transport, fishing, hydro-electric generation, etc). Therefore, prorating the overall amount of elicited water rent to just water industries that rely on water abstraction (as was done) is liable to result in slight overstatement of the average unit values. On the other hand, where unit valuations relate to specific water-abstracting industries the degree of accuracy is only compounded by the inexactitude of water abstraction statistics (In Russia, water-using industries that pay water tax or have water-abstraction agreements with the state in place have to self-report to Water Authority on the annual basis as to the amount of water abstracted (and discharged) by them-- with breakdown by ground and surface water sources. There might, therefore, be a slight downward bias in the annual water abstractions reported to the Authority compounding the overstatement of unit valuations derived, as some water-using agreements make water payments to the state contingent on the amount of water abstracted).

The unit valuation we report on below can be notionally termed as a rental value of water on the macro-level (or a unit water rent), or the value of water abstraction – if differentiated between abstractions by water-using industries.

The estimated average unit water rent for Russia has amounted to 3,8 rubles (15 US cents at the PPP exchange rate) per cubic m. of abstracted water in 2013 in overall terms. For mono-industries – the respective estimate was 2,7 rub/cubic m. (11 US cents) , while for mixed-use industries the derived estimate is about twice higher – at 5,6 rubles (22 US cents)/cubic m. (See Table 3).

The USA is one of the few jurisdictions, in which a developed water resource market exists. By way of cross-checking, a comparison of the estimates derived with the value of water abstraction rights prevailing on the US market (based on the unit market prices reported for sales of short-term water rights in agriculture for 11 Western semi-arid US states) – see Ta-

ble 4 – indicates the closeness of estimates and similarities in the order-of-magnitude, which is the additional supporting justification for the soundness of the estimates of water rent obtained for the Russian water resources – since, whatever the strictures on the usage of the benefits transfer method in the SNA-compliant natural resource valuations, the sales comparison (market) approach to valuation is the ultimate touchstone of the robustness of valuations reported.

Fig. 1 depicts the diagram with the unit valuation of water abstraction for mixed-use industries in Russia for the year 2013, which is based on the derived industry-level water rents and the volume of water abstracted from the surface and ground sources.

Table 3

Estimates of water rent accruing to economic entities in the principal water using industries in Russia, 2013

Waterusers	Water rent, in bln. rubbles (\$ bln. at PPP)	Water abstraction, in cubic kms.	Unit valuations of water rent, in rubbles/cubic m., (US cents at PPP per cubic m.)
Mono-industries	39,6 (1,6)	14,7	2,7 (11)
Mixed-use industries	157,0 (6,28)	27,8	5,6 (22)
TOTAL	196,7 (7,9)	42,5	3,8 (15)

Source : authors' estimates.

Table 4

Median unit value of water abstraction rights on the US water market, as determined on the basis of recorded transactions in which short-term water rights (1-year leases) were sold by the agricultural sector to municipal water-users, data for 1987-2005

State	1-year lease	
	\$/acre-foot	\$/cubic.m
Arizona	55	0,045
California	83	0,067
Colorado	29	0,024
Idaho	2	0,002
Montana	18	0,015
Nevada	24	0,019
Oregon	6	0,005
Texas	19	0,015
Utah	92	0,075
Washington	25	0,020
Wyoming	45	0,036

Source : Brewer et al, 2007; as adapted in [9, p. 235].

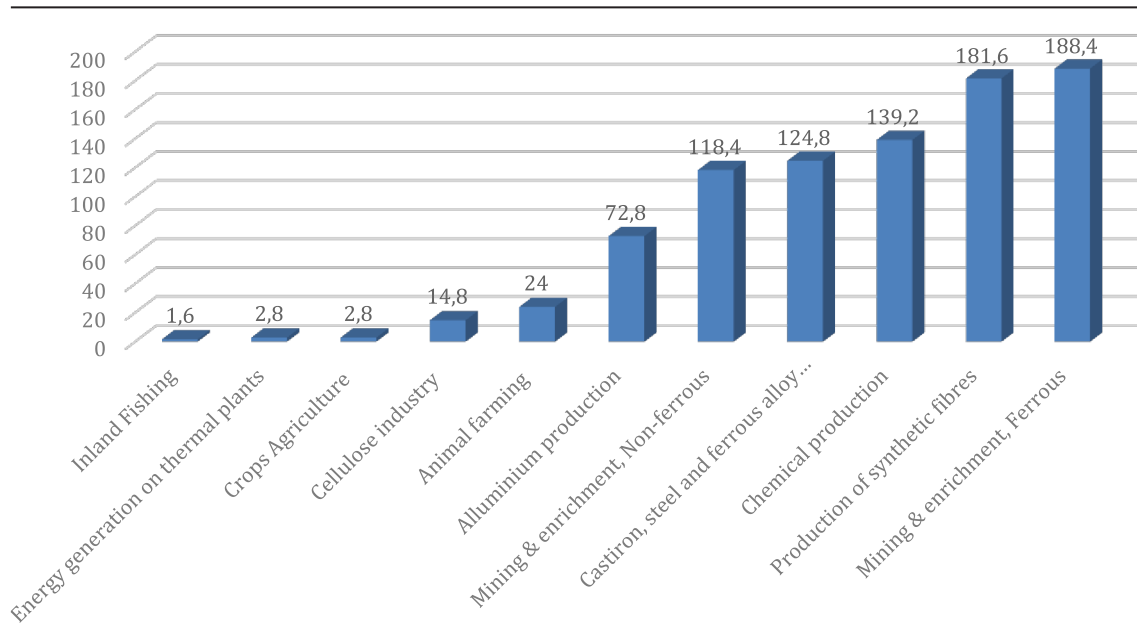


Fig 1. Unit valuations of water abstraction by mixed-use industries 2013, US cents at PPP/cubic.m

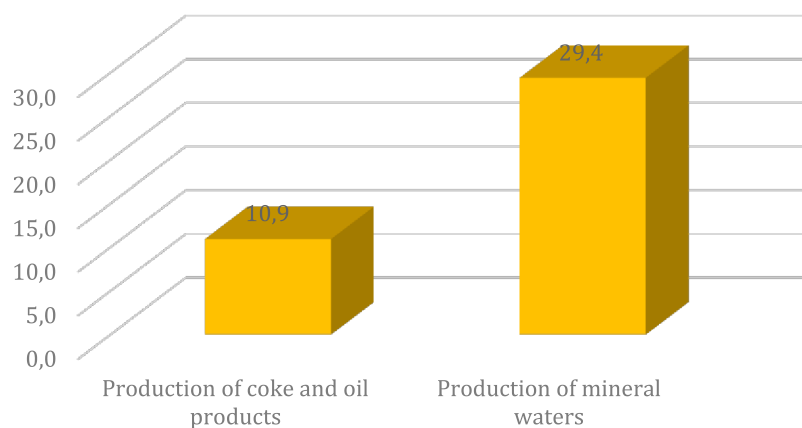


Fig. 2. Industries with the highest unit valuations of water abstraction in 2013, USD PPP/cubic. m.
Source: Authors' estimates

High values of unit rent valuations have been elicited for coke and oil production industry (10 USD at PPP per cubic meter), for the ferrous mining and enrichment industry (1,88 USD at PPP per cubic m.), production of synthetic and artificial fibres (1,81 USD PPP/cubic.m), in chemical production overall (DG code) – at 1,39 USD per cubic.m.), and mining and enrichment of non-ferrous ores, except for thorium and uranium ores – at 1,18 USD PPP per cubic. m.

Since mono-industries recording positive water rent (hydroelectric power generation,

inland water transport, fishing) represent non-consumptive uses of water (with the exception of the production on mineral waters), any unit valuations of water rent based on water abstraction would be devoid of common sense for them.

At the same time, the mineral waters “production” (i.e. bottling) industry is characterized by the highest unit valuation for water rent among all the 20 water-using industries surveyed – the unit valuation estimate for it in 2013 stands at 29,4 USD PPP per cubic.m. of (ground) water withdrawn (Fig. 2).

Distribution of water rent between surface and ground waters and estimates of the rental appropriation by the state

Based on the data obtained for industrial water abstraction from surface and ground water categories, it is possible to allocate the aggregate water rent valuation between ground and surface waters (see. Table 5) – relying on the same proportion as for the annual volume of water abstraction from the ground and surface sources.

The share of water rent from the use of surface waters captured by the state doesn't exceed the level of 9-10%, that for the ground waters – is only at 5%, i.e. twice less. This indicates the existence of possibilities to increase the compulsory payments for water use by 2-3 times. But such an increase should bear a targeted (industry-differentiated) character, since not all analyzed water-using industries demonstrate the existence of positive water rents. In some industries, the economic rent can be negative – the industry being subsidized due to its socially important character (e.g. water supply to households).

As attested by the data from our experimental estimates (Table 5), the elicited aggregate annual water rent (212,8 rubble bln, or about \$8,5 bln. at PPP) is, in principle, comparable by its order of magnitude with the volumes of annual funding allocated by the state for the maintenance and development of the water infrastructure of the country (around 200 bln. rubles-- principally originating from the public budgetary sources – are annually expended for these purposes [15]. Thus, such expenditures seem to be justified on economic grounds as

being conducive to the generation of the water rents of comparable magnitudes in various branches of the economy associated with the intensive water-use.

Resulting policy suggestions and conclusions

The level of water rent generated in Russia as a whole points to overall economic efficiency of operating and investment costs borne by the water-management sector (i.e. more than 200 bln. rubbles per annum, or about \$3,5 bln. at the current market exchange rate).

The analysis we undertook also provides an economic justification, or illustrates the case, for the increase in statutory water-use charges – as the share of water rent captured by the state through the existing water taxes and contractual water use charges falls short of even 10% level on the country-wide basis.

The elicited high degree of differentiation of macro-level unit valuations for water rent (on water abstraction basis) – from under 1 rubble per cubic m. of abstracted water in agriculture, to 750 rubbles per cubic m. in the mineral water bottling industry – attests to the untapped possibility for switching to the industry-differentiated structure for statutory water-use charges, instead of pursuing the flat-rate water taxes/contractual charges.

Preparation of the water resource balance (in value terms) on the macro-level is not too labour-consuming an exercise, and can be recommended for the regular work-plans of the Statistical Agency in the process of compilation of the national accounts for the public sector.

Table 5

Macro-level distribution of the aggregate water rent as between surface and ground water sources and as between the state and other economic entities

Aggregate water rent on the macro-level (un-capitalized basis), 2013	All sources, bln. rubbles (PPP \$ billion)	Out of which:	
		Surface water sources, in bln. rubbles (PPP \$ billion)	Ground water sources, in bln. rubbles, (PPP \$ billion)
Aggregate rent from water resources on macro-level, including:	213,8 (8,5)	179,9 (7,16)	33,8 (1,35)
due to water rent accruing to water-users	196,7 (7,8)	164,5 (6,58)	32,1 (1,28)
due to water rent extracted by the state in the form of compulsory water-use payments and taxes.	17,1 (0,7)	15,4 (0,61)	1,7 (0,07)
Share of water rent extracted by the state, in% of overall rent.	8,0%	8,6%	5,0%

Sources: authors' estimates.

Reinforcing the presentation on the macro-level in this Paper, the analysis of water rent generation on the basin-wide basis additionally undertaken by us (for Pechora, Don and Ob' river basins) that relied on water-user's statistics from 30 constituent entities of the Russian Federation has also confirmed the view that the major role in water rent generation is likewise played by mixed-use industries. In this connection, it appears reasonable on cost-benefit basis to advocate further studies aiming to develop complex statistical factor analysis models in order to elicit, and achieve allocation, of water rent in mixed-use industries on a more refined basis and then proceed to implementing industry-differentiated policy on water-use charges.

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COMPARATIVE EVALUATION OF PHYSICAL DEVELOPMENT AND FUNCTIONAL RESERVES OF SCHOOLCHILDREN AT THE HIGH AND LOW-ALTITUDE OF THE SOUTH OF KYRGYZSTAN

Belov G.V., Abdyganiev N.A., Syed Ali Abbas Rahat

Osh State University, Osh, e-mail: bagdan1954@mail.ru

The work was aimed at studying the functional development and functional reserves of school children of primary, secondary and graduate classes living in the lowlands and highlands of southern Kyrgyzstan – a total of 2,000 surveyed. Anthropometric methods, sports and medical functional tests of Martine-Kushelevsky, the test of Stange and Genchi were applied. Comparative analysis revealed differences in body weight at different age periods in both boys and girls, and different growth rates in the highlands and lowlands. Boys in the highlands at the age of 10–13 years old have a smaller height and lower body weight than their fellows from the lowlands, girls have a smaller mass at the age of 8–13 years, then both boys and girls of the highlands catch up on the mass of their fellows in the lowlands. Greater chest coverage in high school students was accompanied by a greater lung capacity. The features of anaerobic reserve, endurance and performance tests, sports results interconnected with anthropometric parameters are revealed.

Keywords: highlands, schoolchildren, physical development, anthropometry, functional tests

The rapid growth of population leads to the development of new territories, be it the polar zone, the desert or the highlands. Of course, at the same time, each climatic-geographical habitat imposes its own characteristics on the anatomical and physiological characteristics of the development of children and adolescents. Physical development of a person in a mountain climate has its own distinctive features [1, 2]. One of the primary values is the height of the population, but also genetic and medico-social aspects are important. The Kyrgyz – herders for decades have adapted themselves to live in high mountains, unlike their neighbors – farmers, which allowed them to preserve their originality and not to assimilate into other ethnic groups, for example, the Chinese, whose number is many dozen times higher than that of the Kyrgyz. Adaptation of the Kyrgyz to the conditions of the highlands ensures the country's defense and economic development.

Multi-center data of many years shows that children in the highlands of Tibet and the Andes are lagging behind their fellows in the lowland areas, but they are more likely to have good height when sitting, due to the size of the chest, which is more developed to compensate for the increased load on the lungs in high-altitude hypoxia [1, 6 ten]. At the same time, there was no lag in the intellectual development and behavior of adolescents [5]. Also, the effect of gender on the direction and severity of shifts in anthropometric characteristics among high-mountain residents was not observed [3]. However, in functional terms, in modern socio-economic conditions, high school students are not examined enough to suggest any corrective interventions. True,

scientifically substantiated increased nutritional standards for military personnel and workers in the mining industry in high-altitude conditions, but extensive research is required for children and adolescents.

Aim of study

The work was aimed at studying the physical development of primary, secondary and graduate schoolchildren living in the high-altitude villages of Alai and Chon-Alai districts of the Osh region.

Materials and research methods

2000 healthy children aged 7-17 years old living at an altitude of more than 3000 m above sea level in the villages of Sary-Tash, Kyzyl-Suu, Kashka-Suu, Kara-Kabak were surveyed. The survey was conducted in the autumn period of 2017-2018. Anthropometric methods (50 height, weight and length parameters, circumference parameters and their annual analysis), sports tests for speed, strength and endurance (pulling up, pushing up, running at 80m and 1 km, hand strength, deadlift), medical functional tests (Vital capacity of lungs, BP, pulse at rest and after 20 squats in 30 seconds – Martine-Kushelevsky's test, breath holding while inhaling – Shtanga test and exhaling – Genchi's test). As a control parameter, a database of schoolchildren of the city of Osh (elevation 900 m above sea level), accumulated in the anthropology laboratory of the Department of Normal Anatomy of the Medical Faculty of Osh State University, was taken. The exclusion criterion from the study was patients with chronic diseases of any organs and systems.

Research results and discussion

The results of the study testify to the special characteristics of the dynamics of the physical development of schoolchildren living in the high mountains compared with their fellows living in the plain and low mountains. Anatomical and physiological indicators of schoolchildren of the city of Osh were close to those in the city of Bishkek, other low-mountain and mid-mountain regions of Kyrgyzstan [2, 7–9].

Comparative analysis revealed differences in body mass at different age periods in both boys and girls, and different growth rates in the high mountains and low mountains (Table 1).

Boys living at high altitudes at the age of 10-13 years old have a lower body weight than their fellows from the low altitudes, girls

have a smaller mass at the age of 8-13 years, then both boys and girls of the high altitudes catch up on the mass of their fellow in the low altitudes. At 16-17 years old boys and girls living at high altitudes have a weight corresponding to the age norm for Kyrgyzstan as a whole.

The growth of the body also differs in according to the place of residence (Table 2).

Boys at the high altitudes at the age of 10–15 years old have a significantly smaller growth compared to their fellows from the low altitudes, at 16–17 years old they have a sharp increase in body length, and during this period the difference in height is not significant. Similar growth rates were noted by other authors who studied the anthropometric indicators of students in southern Kyrgyzstan [9, 10].

Table 1

Age dynamics of body weight of school children at high and low altitudes (kg)

Age	BOYS		GIRLS	
	High altitude	Low altitude	High altitude	Low altitude
7 years	22,3 ± 0,4	22,5 ± 0,4	21,4 ± 0,3	21,8 ± 0,2
8 years	24,5 ± 0,3	25,5 ± 0,3	22,6 ± 0,3 *	24,1 ± 0,3
9 years	26,3 ± 0,3	27,1 ± 0,3	25,9 ± 0,8 *	27,9 ± 0,7
10 years	28,1 ± 0,4 *	34,1 ± 0,9	28,5 ± 0,6 *	29,6 ± 0,6
11 years	30,6 ± 0,3 *	37,2 ± 0,9	29,1 ± 0,9 *	31,3 ± 0,8
12 years	34,6 ± 0,7 *	43,7 ± 0,8	34,3 ± 0,8 *	36,5 ± 0,8
13 years	38,1 ± 0,5 *	42,5 ± 1,2	40,7 ± 1,1 *	43,7 ± 1,06
14 years	46,2 ± 1,0	48,2 ± 1,0	46,1 ± 1,0	46,4 ± 1,0
15 years	51,9 ± 0,9	52,8 ± 0,9	49,2 ± 1,22	49,8 ± 1,22
16 years	57,6 ± 0,6	57,9 ± 0,6	50,8 ± 1,0	53,8 ± 1,0
17 years	61,6 ± 0,9	61,9 ± 0,9	55,6 ± 0,8	55,8 ± 0,8

Note : * – the difference with the comparison group p < 0.05.

Table 2

Age dynamics of body length at high altitude and low altitude schoolchildren (cm).

Age	BOYS		GIRLS	
	High altitude	Low altitude	High altitude	High altitude
7 years	115,7 ± 1,3	114,3 ± 1,3	113,6 ± 2,3	113,6 ± 2,3
8 years	118,8 ± 1,4	119,7 ± 1,4	117,7 ± 1,6	118,8 ± 2,1
9 years	123,2 ± 1,4	125,2 ± 1,4	124,2 ± 1,8	124,6 ± 2,3
10 years	124,3 ± 2,1 *	129,3 ± 2,0	125,8 ± 1,8 *	131,2 ± 2,3
11 years	130,6 ± 2,1 *	136,6 ± 2,0	130,0 ± 1,5 *	136,7 ± 1,9
12 years	138,4 ± 1,6 *	148,4 ± 1,9	134,5 ± 2,2 *	139,3 ± 1,5
13 years	145,1 ± 1,8 *	151,1 ± 1,8	140,3 ± 2,0 *	146,1 ± 1,9
14 years	149,3 ± 1,8 *	158,3 ± 1,8	146,2 ± 2,1	149,2 ± 2,1
15 years	156,5 ± 1,8 *	165,5 ± 1,8	150,1 ± 2,1	154,5 ± 2,1
16 years	164,7 ± 2,1	171,3 ± 1,6	152,8 ± 2,1	157,3 ± 2,8
17 years	171,4 ± 1,5	172,2 ± 1,5	155,4 ± 2,2	157,7 ± 2,5

Note : * – the difference with the comparison group p < 0.05.

The coverage parameters of body parts at different levels were almost the same in both groups, with the exception of greater breast coverage in high school students (Table 3).

In boys of highlands, in 6 of the periods under consideration, breast coverage was significantly greater than that of fellows from low altitude ($p < 0.05$), in other periods the difference was not significant. In girls, the high altitude also had more breast coverage than their fellows from the low altitude, the difference was also significant for 6 age periods.

Greater chest coverage in high school students was accompanied by a higher lung capacity (Table 4).

Analysis of digital data suggests that among high school students the vital capacity of the lungs significantly exceeds the values of the control group in 9 age groups. In girls, the difference is not so significant – only reliably in 3 age periods. Higher numbers of VCs are explained by increased load on the respiratory organs in conditions of high-altitude hypoxia. Such an adaptation of the respiratory organs in children of the high altitudes in Tibet and in the Andes has been described by foreign authors [1, 6]. The results of sports tests of high school students for speed (80 m run) and endurance (1 km run) at high altitudes were lower than in the low mountains, which will be described in detail in the next report.

Table 3

The age dynamics of the circumference of the chest in schoolchildren of high altitude and low altitude (cm)

Age	BOYS		GIRLS	
	High altitude	Low altitude	High altitude	Low altitude
7 years	58,2 ± 0,5 *	56,4 ± 0,5	57,6 ± 0,2 *	56,3 ± 0,4
8 years	61,0 ± 0,6	60,2 ± 0,6	59,2 ± 0,2	59,0 ± 0,2
9 years	61,5 ± 0,3	60,9 ± 0,4	60,6 ± 0,2	60,1 ± 0,3
10 years	63,4 ± 0,4	62,4 ± 0,4	61,7 ± 0,3	61,3 ± 0,3
11 years	65,9 ± 0,4 *	63,9 ± 0,4	64,9 ± 0,3 *	64,0 ± 0,3
12 years	68,2 ± 0,4 *	66,6 ± 0,4	69,8 ± 0,4	66,1 ± 0,3
13 years	71,5 ± 0,4 *	69,5 ± 0,5	73,6 ± 0,48	70,4 ± 0,3
14 years	76,3 ± 0,9 *	72,4 ± 0,8	79,2 ± 0,8 *	74,3 ± 0,4
15 years	80,2 ± 1,3	78,2 ± 1,1	82,3 ± 0,9 *	77,5 ± 0,5
16 years	84,3 ± 1,0 *	81,1 ± 1,1	85,4 ± 0,9 *	82,3 ± 0,8
17 years	87,1 ± 0,7	86,1 ± 0,9	87,2 ± 0,8 *	84,1 ± 0,8

Note: * – the difference with the comparison group $p < 0.05$.

Table 4

Age dynamics of the vital capacity of the lungs in school children of high and low altitudes (ml)

Age	BOYS		GIRLS	
	High altitude	Low altitude	High altitude	Low altitude
7 years	1752 ± 37 *	1618 ± 45	1630 ± 28 *	1555 ± 36
8 years	1820 ± 36 *	1715 ± 32	1728 ± 34 *	1632 ± 34
9 years	1940 ± 32 *	1820 ± 44	1820 ± 28	1740 ± 36
10 years	2106 ± 32 *	1960 ± 52	1881 ± 45	1821 ± 45
11 years	2175 ± 35 *	2048 ± 45	1936 ± 28 *	1852 ± 51
12 years	2242 ± 39 *	2171 ± 33	1978 ± 34	1920 ± 37
13 years	2293 ± 32	2220 ± 48	2035 ± 28	2011 ± 36
14 years	2306 ± 38 *	2296 ± 47	2069 ± 45	2054 ± 45
15 years	2387 ± 37	2337 ± 38	2154 ± 37	2137 ± 38
16 years	2489 ± 32 *	2380 ± 32	2226 ± 32	2180 ± 33
17 years	2596 ± 38 *	2413 ± 38	2246 ± 38	2213 ± 30

Note: * – the difference with the comparison group $p < 0.05$.

The strength exercises in most tests did not reveal significant differences in the results of the main groups of boys and girls with the comparison groups.

Samples with delayed breathing showed features in the anaerobic reserve in high school and low mountain schoolchildren (Table 5).

Endurance to hypoxic samples increases with age in all groups. By the age of 17, the duration of breath holding during the Stange test in young men of low mountains reaches 50 seconds, which is considered to be an excellent result of functional reserves. In the low mountain males, the Stange sample did

not achieve an excellent result, but the difference with the comparison group is not reliable ($p > 0.05$). In high-altitude girls, the delay time of the Stange test was significantly less than in the comparison group ($p < 0.05$). The Genchy test in the high altitude boys only at one age period was slightly higher than that in the low altitude fellows, and in girls of 9 years the same peculiarity was noted.

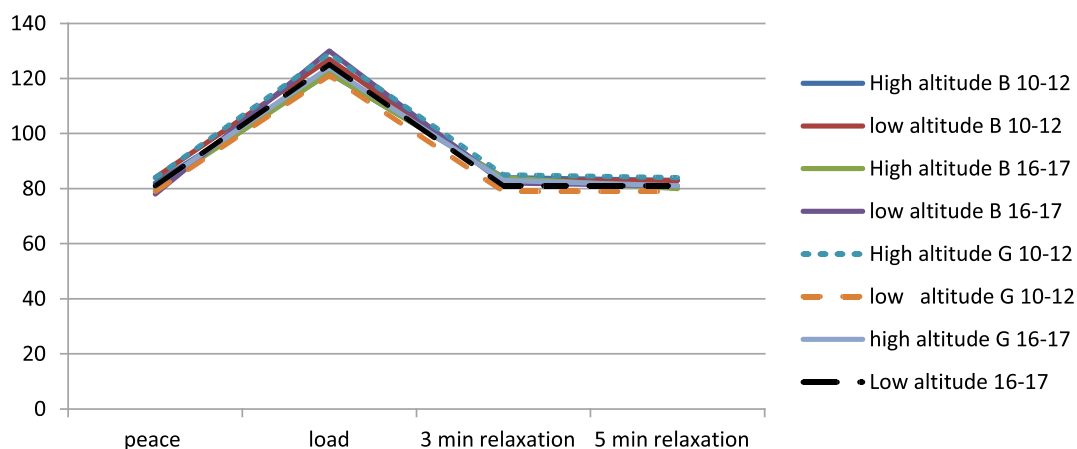
Thus, it can be seen that the anaerobic reserve of high altitude students is sufficient, although at the same time they experience additional effects of natural hypoxia.

Table 5

Age dynamics of the Stange-Genchi test in children of high and low altitudes(s)

AGE	STANGE TEST				GENCHI TEST			
	BOYS		GIRLS		BOYS		GIRLS	
	High altitude	Low altitude	High altitude	Low altitude	High altitude	Low altitude	High altitude	Low altitude
7 years	28,5 ± 2,3	27,2 ± 3,5	25,9 ± 2,1	25,1 ± 2,5	14,4 ± 2,0	11,4 ± 2,0	14,2 ± 1,8	11,4 ± 1,7
8 years	28,9 ± 2,4	30,2 ± 2,9	31,8 ± 2,5	28,5 ± 2,4	15,9 ± 2,3	12,8 ± 2,7	17,1 ± 1,5	11,6 ± 1,8
9 years	31,2 ± 2,0	31,0 ± 2,0	34,8 ± 1,6	38,9 ± 1,8	18,4 ± 1,9	14,6 ± 1,8	17,8 ± 1,9*	13,2 ± 1,5
10 years	36,2 ± 2,8	33,3 ± 1,9	31,3 ± 2,0*	39,2 ± 1,4	21,6 ± 1,5*	16,2 ± 1,5	19,8 ± 2,1	15,5 ± 2,0
11 years	37,3 ± 2,0	38,2 ± 1,9	34,3 ± 2,0	38,2 ± 1,9	23,3 ± 1,5	18,2 ± 1,5	20,5 ± 2,1	17,8 ± 2,0
12 years	38,1 ± 2,2	38,9 ± 2,0	36,1 ± 2,2	38,9 ± 2,0	24,6 ± 1,6	21,2 ± 1,5	21,8 ± 2,0	20,0 ± 2,1
13 years	38,8 ± 2,0	39,8 ± 1,8	37,8 ± 2,0	39,9 ± 1,6	24,6 ± 1,5	24,2 ± 1,5	23,8 ± 1,8	23,0 ± 2,0
14 years	39,2 ± 2,1	41,3 ± 1,8	38,2 ± 2,1	41,3 ± 1,8	25,7 ± 1,5	25,2 ± 1,5	24,2 ± 2,1	24,7 ± 1,7
15 years	40,1 ± 2,8	43,4 ± 1,9	39,6 ± 2,0	42,3 ± 1,9	29,6 ± 1,7	28,2 ± 1,5	26,8 ± 2,0	30,0 ± 2,0
16 years	43,2 ± 2,1	47,3 ± 1,9	41,2 ± 2,1	46,6 ± 1,9	34,6 ± 1,6	32,2 ± 1,5	31,8 ± 2,1	29,7 ± 1,8
17 years	46,1 ± 1,8	50,3 ± 1,8	44,1 ± 1,9*	50,0 ± 1,7	38,6 ± 1,7	38,2 ± 1,5	34,8 ± 2,1	34,5 ± 1,0

Note: * – the difference with the comparison group $p < 0.05$.



Heart rate during the Martin-Kushelevsky test in high and low altitude schoolchildren

We carried out the Martine-Kushelevsky sample only in two age groups of 10–12 years old and 16–17 years old. The indicators of heart rate at rest in all the studied groups were slightly higher than the previously described data, although they did not go beyond the age norm. Perhaps, mass surveys of schoolchildren have become less frequent, and those examined experience more stress in front of doctors and classmates than before.

All the students reacted to the Martine-Kushelevsky test with a significant increase in heart rate and blood pressure, that is, a normal physiological response (Figure). Recall that there are other reactions to intense physical activity (hypertonic, hypotonic, dystonic), but the vast majority of schoolchildren reacted physiologically.

Restoration of the pulse of schoolchildren from both the high altitude of the south of Kyrgyzstan and the low altitude took place mainly in three minutes, that is, modern high school students have sufficient backup reserve capabilities.

Conclusion

The anatomical and physiological features of high school students differ from those of their fellows in the low mountains and valleys, but do not go beyond the age norm and physiological response to additional physical and hypoxic stress, which must be considered when moving young men to low mountains for military service or study.

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IMPACT OF PEPTIDE BIOREGULATORS, EXTRACTED FROM WALL OF INFLAMED GALL BLADDER OF PATIENTS WITH CHRONIC CALCULOUS CHOLECYSTITIS, UPON HEMOSTASIS WITHIN IN AN EXPERIMENT

Beysnenaliyeva S.T., Sharshenaliyeva G.A., Kyrbashova M.T.

Kyrgyz state university of I. Arabayev, Bishkek, e-mail: salkun-beishenaliyeva@mail.ru

Study of condition of hemostasis system among 30 rabbits after 15-day intramuscular introduction of peptide bioregulators, extracted from wall of inflamed removed gall bladders of patients with chronic calculous cholecystitis (CCC) after laparoscopic cholecystectomy (LCE), has been carried out. The objective of this research is to study impact of peptide bioregulators (XKXG₁, XKXG₂), extracted from inflamed removed chronic calculous bladders of patients with CCC after LCE, upon homeostasis within an experiment upon rabbits. Peptide bioregulators were extracted via method of acetous extraction. It has been shown that peptide bioregulators XKXG₁ and XKXG₂ cause multidirectional hyper- and hypocoagulation shifts in organism of experimental animals. It is established that on day 15 an expressed disseminated intravascular coagulation syndrome (DIC-syndrome) is formed within organism of rabbits which is caused by influence of humoral peptide bioregulators, as explained by the authors.

Keywords: chronic calculous cholecystitis, peptides, bioregulators, hemostasis

In recent years is has been established that inflammatory chronic calculous [9], acute catarrhal, acute pultaceous, and acute gangrenous gall bladders of patients with cholecystitis contain biological active humoral factors [1; 11-12].

The study of peptide regulatory mechanisms of multi-cell systems is one of the most important directions in modern biology and medicine [2-3; 8; 13]. Development of this problem enables us not only to understand causes of individual development, but also study deeper physiological processes that undergo within a multi-cell organism, and their changes in conditions of pathology [4-5; 7; 10].

Disturbance in peptide regulation, and, therefore, transition of informational molecules between cells must inevitably result in development of pathologies, including diseases of outer-liver biliary tracts, and it served as object of our research.

The goal of this research is to study influence of peptide bioregulators (XKXG₁, XKXG₂), extracted from inflamed removed chronic calculous gall bladders of patients with CCC after LCE, upon hemostasis within an experiment on rabbits.

Materials and research methods

In our test breedless rabbits of both sexes with body mass of 2 to 3 kgs were used. Examination of hemostasis was undertaken before the experiment (background), on day 15 of introducing peptide fractions, extracted from inflamed removed chronic calculous gall bladders of patients with CCC after LCE. Peptide fractions in our experiments were introduced to animals intramuscularly in dose of 1 mg/kg of body mass. Before introduction peptide fractions were dissolved in sterile phisio-

logical solution. Preparations were introduced 1 time per day during 15 days. As a control (preparation of comparison) same volume of sterile 0,9% solution of natrium chloride was introduced over the same period to 10 rabbits, among which condition of hemostasis system was inspected. During the research we used methods that characterise all links of hemostasis system: counting number of thrombocytes in thrombocyte-dense plasma, adhesion of thrombocytes, aggregation of blood plates, retraction of blood clot. Methods that characterize overall coagulative blood activity: period of plasma recalcification, kaolin plasma time, kaolin cephalin clotting time, plasma tolerance against heparin (TPH), auto-coagulative test (ACT), prothrombin time, thrombin time, coagulating fibrinogen, antithrombin III (At III), protaminsulphate test, ethanol test. Methods that characterize fibrinolytic activity of blood: total euglobulin clot dissolution, Hageman-dependent euglobulin clot dissolution. The received material was processed via methods of variational statistics for the related and non-related observations, index of difference reliability (D) was calculated.

Research results and discussion

From chronic calculous gall bladders of patients with CCC after LCE we have extracted via method of acetous extraction 4 peptide fractions that were named XKXG₁, XKXG₂, XKXG₃ and XKXG₄. The data of table 1 in blood, taken from a.pulmonalis of experimental rabbits on day 15 of introducing fraction XKXG₁ testified for hyper-, hypocoagulative shifts in hemostasis. Thus, number of thrombocytes decreased from $215,6 \pm 18,8$ to $168,6 \pm 2,1$ ($P < 0,001$). At the same time

their adhesion decreased from $60,0 \pm 3,59$ to $38,6 \pm 2,1$ ($P < 0,001$), and time of aggregation, on the opposite, increased from $30,0 \pm 2,5$ to $41,0 \pm 2,51$ ($P < 0,05$). Time of whole blood clotting according to Lee-White in non-siliconized and siliconized test tubes decreased from $5,6 \pm 0,35$ to $2,5 \pm 0,08$ ($P < 0,05$) and from $9,4 \pm 0,86$ to $3,3 \pm 1,4$ ($P < 0,001$) correspondingly. Data of electrocoagulogramme also revealed hypercoagulation. Periods of beginning, duration, and end of blood clotting decreased from $592,5 \pm 11,6$ to $153,0 \pm 8,9$ ($P < 0,001$), from $353,0 \pm 7,1$ to $113,3 \pm 4,2$ ($P < 0,001$), from $945,5 \pm 17,9$ to $266,6 \pm 13,1$ ($P < 0,001$) correspondingly. Hypercoagulation is attended to increase in blood viscosity ($P < 0,05$) and unchanged density of blood clot.

Biochemical indexes of hemostasiogram in blood of a.pulmonalis of experimental rab-

bits on day 15 if introducing fraction XKXG1 testified for multi-directed hypercoaguative shifts: sharply decreased time of plasma recalcification, kaolin, and kaolin-cephalic time – from $180,0 \pm 7,1$ to $40,0 \pm 1,7$ ($P < 0,001$), from $79,1 \pm 6,2$ to $23,0 \pm 1,7$ ($P < 0,001$), from $67,8 \pm 4,4$ to $21,0 \pm 2,1$ ($P < 0,001$) correspondingly. Time of plasma clot formation, according to the data of autocoagulogram, decreased by 6 min. ($P < 0,001$), and definition increased by 8 min. ($P < 0,001$) and 10 min ($P < 0,001$). In blood of a.pulmonalis rabbits tolerance of plasma against heparin increased sharply from $12,3 \pm 0,89$ to $2,0 \pm 0,4$ ($P < 0,001$). However, thrombin time changed unreliably ($P > 0,2$), and content of free heparin increased from $10,1 \pm 0,8$ to $12,0 \pm 0,89$ ($P < 0,01$). Among 5 of 10 experimental animals ethanol tests and among 4 of 10 – protamine sulfate were positive.

Table 1

Indexes of hemostasis in blood, taken from a.pulmonalis of rabbits after 15 days of intramuscular introduction of peptide, received from chronic calculous gall bladders of patients after LCE (fraction –XKXG₁)

№	Indexes	Healthy animals (control)	After introduction of fraction XKXG ₁
1	Number of thrombocytes ($\times 10^9/l$)	$215,5 \pm 18,8$	$168,6 \pm 2,1^*$
2	Adhesion of thrombocytes (%)	$60,0 \pm 3,59$	$38,6 \pm 2,1^*$
3	Aggregation of thrombocytes (s)	$30,0 \pm 2,5$	$41,0 \pm 2,54^*$
4	Time of clotting according to Lee-White (min) in non-siliconized test tube.	$5,6 \pm 0,35$	$2,5 \pm 0,08^*$
	In siliconized test tube	$9,4 \pm 0,86$	$3,31 \pm 1,4^*$
5	Beginning of blood clotting (s)	$592,5 \pm 11,6$	$153,0 \pm 8,9^*$
6	Duration of blood clotting (s)	$353,0 \pm 7,1$	$113,3 \pm 4,2^*$
7	End of blood clotting	$945,5 \pm 17,9$	$266,6 \pm 13,1^*$
8	Blood viscosity (units)	$5,0 \pm 0,35$	$2,7 \pm 0,2^*$
9	Clot density (units)	$0,02 \pm 0,0$	$0,02 \pm 0,0$
10	Time of plasma recalcification (s)	$180,0 \pm 7,1$	$40,0 \pm 1,7^*$
11	Kaolin time of plasma (s)	$79,1 \pm 6,2$	$23,0 \pm 1,7^*$
12	Kaolin-cephalic time (s)	$67,8 \pm 4,4$	$21,0 \pm 2,1^*$
13	Autocoagulogram (s) on 6 min	$15,0 \pm 0,7$	$12,0 \pm 1,7^*$
	On 8 min	$9,6 \pm 0,89$	$11,0 \pm 1,7^*$
	On 10 min	$7,8 \pm 0,7$	$9,6 \pm 0,8$
14	TPH (min)	$12,3 \pm 0,89$	$2,0 \pm 0,4^*$
15	Prothrombin time (s)	$35,0 \pm 3,4$	$43,0 \pm 3,4^*$
16	Trombin time (s)	$38,3 \pm 3,7$	$35,0 \pm 2,5$
17	Free heparin (s)	$10,1 \pm 0,8$	$12,0 \pm 0,89$
18	Ethanol test	10 (-)	5 (+)
19	Protamine sulfate test	10 (-)	4 (+)

Note: * $P < 0,05$ in comparison to hemostasis indexes among healthy animals.

Table 2

Indexes of hemostasis in blood, taken from v.pulmonalis of rabbits after 15 days of intramuscular introduction of peptide, received from chronic calculous gall bladders of patients after LCE (fraction –XKXG₁)

№	Indexes	Healthy animals (control)	After introduction of fraction XKXG ₁
1	Number of thrombocytes (x10 ⁹ /l)	309,1 ± 7,1	165,3 ± 1,8*
2	Adhesion of thrombocytes (%)	30,5 ± 7,1	29,3 ± 0,71*
3	Aggregation of thrombocytes (s)	28,0 ± 2,5	39,6 ± 1,4*
4	Time of clotting according to Lee-White (min) in non-siliconized test tube.	4,6 ± 0,4	4,8 ± 0,1
	In siliconized test tube	7,0 ± 0,3	5,4 ± 0,0
5	Beginning of blood clotting (s)	608,0 ± 7,1	150,0 ± 3,6*
6	Duration of blood clotting (s)	410,0 ± 8,0	109,1 ± 1,8*
7	End of blood clotting	1017,0 ± 14,3	259,1 ± 5,4*
8	Blood viscosity (units)	5,0 ± 0,3	5,0 ± 0,05
9	Clot density (units)	0,02 ± 0,71	0,02 ± 0,0
10	Time of plasma recalcification (s)	210,0 ± 3,23	58,0 ± 0,3*
11	Kaolin time of plasma (s)	130,0 ± 7,1	25,0 ± 0,3*
12	Kaolin-cephalic time (s)	80,0 ± 3,5	23,0 ± 0,7*
13	Autocoagulogram (s) on 6 min	14,0 ± 1,43	9,0 ± 0,35*
	On 8 min	12,0 ± 0,71	8,0 ± 0,3*
	On 10 min	7,0 ± 0,71	7,0 ± 0,35
14	TPH (min)	14,0 ± 0,71	2,5 ± 0,2*
15	Prothrombin time (s)	37,0 ± 0,7	40,1 ± 1,07*
16	Thrombin time (s)	40,0 ± 0,53	30,0 ± 0,35*
17	Free heparin (s)	10,0 ± 0,5	8,0 ± 0,3*
18	Fibrinogen (g/l)	1,6 ± 0,07	1,0 ± 0,01*
19	Total euglobulin fibrinolysis (min)	160,0 ± 3,0	190,0 ± 3,4*
20	Hageman-dependent fibrinolysis (min)	138,0 ± 4,4	200,0 ± 3,2*
21	Ethanol test	10 (-)	10 (+)
22	Protamine sulfate test	10 (-)	10 (+)

Note: * P < 0,05 in comparison to hemostasis indexes among healthy animals.

In blood, taken from v.pulmonalis (table 2) of experimental rabbits on day 15 of introducing fraction XKXG₁, number of thrombocytes decreased from 309,1 ± 7,1 to 165,3 ± 1,8 (P < 0,001). Their adhesive function remained almost unchanged (P > 0,2) at the background of increase in time of their aggregation from c 28,0 ± 2,5 to 39,6 ± 1,4 (P < 0,05). Time of whole blood clotting according to Lee-White of hyper-, normal coagulation in hemostasis: in non-siliconized test tube (P > 0,2) time of blood clotting did not increase reliably, and in siliconized tube it decreased (P < 0,001). According to electrocoagulograph, periods of beginning, duration, and end of blood coagulation decreased

from 608,0 ± 7,1 to 150,0 ± 3,6 (P < 0,001), from 410,0 ± 8,0 to 109,1 ± 1,8 (P < 0,001), and from 1017,0 ± 14,3 to 259,1 ± 5,4 (P < 0,001) respectively. However, a difference between hemostasis of blood, received from a.pulmonalis (table 1) and v.pulmonalis (table 2) of rabbits at the same period of observation was change in blood viscosity (P > 0,2). Density of blood clot in blood a.pulmonalis (table 1) of the experimental rabbits, as well as in blood v.pulmonalis (table 2) didn't change. The data of biochemical indexes in blood v.pulmonalis among experimental rabbits on day 15 of introducing fraction XKXG₁ testified for hyper-, hypocoagulation. Time of plasma recalcification decreased

from $210,0 \pm 3,23$ до $58,0 \pm 0,3$ ($P < 0,001$). It was attended by increasing activation of Hageman factor. Thus, kaolin time decreased from $130,0 \pm 7,1$ to $25,0 \pm 0,3$ ($P < 0,001$). A decrease in kaolin-cephalic time from $130,0 \pm 7,1$ to $25,0 \pm 0,3$ ($P < 0,001$) indicates a coagulational completeness of thrombocytes in blood v.pulmonalis of the experimental rabbits. Autocoagulogramme on 6 min ($P < 0,05$) and on 8 min ($P < 0,05$) shortened, and on 10 min ($P > 0,2$) of determination remained the same. Fraction XKXG₁ suppressed anti-coagulative system of rabbit blood on day 15 of introduction in blood v.pulmonalis. Thus, thrombin time decreased from $40,0 \pm 0,53$ to $30,0 \pm 0,35$

($P < 0,05$). Content of free heparin decreased from $10,0 \pm 0,5$ to $8,0 \pm 0,3$ ($P < 0,05$). It was confirmed by sharp increase in plasma tolerance against heparin from $14,0 \pm 0,71$ to $2,5 \pm 0,2$ ($P < 0,001$). Content of fibrinogen decreased from $1,6 \pm 0,07$ to $1,0 \pm 0,01$ ($P < 0,01$). We should point out that in blood v.pulmonalis of experimental rabbits on day 15 of introducing fraction XKXG₁ total euglobulin fibrinolysis and Hageman-dependent fibrinolysis from $160,0 \pm 3,0$ to $190,0 \pm 3,4$ ($P < 0,001$) and from $138,0 \pm 4,4$ to $200,0 \pm 3,2$ ($P < 0,001$) correspondingly. Among all 10 animals tests on ethanol and protamine sulfate resulted positively.

Table 3

Indexes of hemostasis in blood, taken from a.pulmonalis of rabbits after 15 days of intramuscular introduction of peptide, received from chronic calculous gall bladders of patients after LCE (fraction XKXG₂)

№	Indexes	Healthy animals (control)	After introduction of fraction XKXG ₂
1	Number of thrombocytes ($\times 10^9/l$)	$215, \pm 18,8$	$114,0 \pm 6,65^*$
2	Adhesion of thrombocytes (%)	$60,0 \pm 3,59$	$60,00,35$
3	Aggregation of thrombocytes (s)	$30,0 \pm 2,5$	$30,0 \pm 0,35$
4	Time of clotting according to Lee-White (min) in non-siliconized test tube.	$5,6 \pm 0,35$	$4,1 \pm 0,19^*$
	In siliconized test tube	$9,4 \pm 0,86$	$7,8 \pm 0,08$
5	Beginning of blood clotting (s)	$592,5 \pm 11,6$	$391,0 \pm 3,95^*$
6	Duration of blood clotting (s)	$353,0 \pm 7,1$	$350,0 \pm 3,59$
7	End of blood clotting	$945,5 \pm 17,9$	$741,0 \pm 7,55^*$
8	Blood viscosity (units)	$5,0 \pm 0,35$	$5,0 \pm 0,05$
9	Clot density (units)	$0,02 \pm 0,0$	$0,02 \pm 0,0$
10	Time of plasma recalcification (s)	$180,0 \pm 7,1$	$80,3 \pm 3,23^*$
11	Kaolin time of plasma (s)	$79,1 \pm 6,2$	$60,1 \pm 0,35^*$
12	Kaolin-cephalic time (s)	$67,8 \pm 4,4$	$66,8 \pm 0,3$
13	Autocoagulogram (s) on 6 min	$15,0 \pm 0,7$	$12,0 \pm 0,35^*$
	On 8 min	$9,6 \pm 0,89$	$11,0 \pm 0,3$
	On 10 min	$7,8 \pm 0,7$	$7,0 \pm 0,3$
14	TPH (min)	$12,3 \pm 0,8$	$9,8 \pm 0,10^*$
15	Prothrombin time (s)	$35,0 \pm 3,4$	$20,8 \pm 1,79^*$
16	Thrombin time (s)	$38,3 \pm 3,7$	$28,0 \pm 1,97^*$
17	Free heparin (s)	$10,1 \pm 0,8$	$10,0 \pm 0,3$
18	Fibrinogen (g/l)	$71,6 \pm 3,9$	$59,8 \pm 1,07^*$
19	Anti-thrombin 3 (s)	$1,2 \pm 0,07$	$1,2 \pm 0,03$
20	Total euglobulin fibrinolysis (min)	$123,6 \pm 6,6$	$122,1 \pm 4,31$
21	Hageman-dependent fibrinolysis (min)	$133,3 \pm 6,29$	$132,8 \pm 1,79$
22	Ethanol test	10 (-)	10 (+)
23	Protamine sulfate test	10 (-)	10 (+)

Note: * $P < 0,05$ in comparison to hemostasis indexes among healthy animals.

Table 4

Indexes of hemostasis in blood, taken from v.pulmonalis of rabbits after 15 days of intramuscular introduction of peptide, received from chronic calculous gall bladders of patients after LCE (fraction XKXG₂)

№	Indexes	Healthy animals (control)	After introduction of fraction XKXG ₂
1	Number of thrombocytes (x10 ⁹ /l)	309,1 ± 7,1	209,0 ± 3,5*
2	Adhesion of thrombocytes (%)	30,5 ± 7,1	20,0 ± 2,51
3	Aggregation of thrombocytes (s)	28,0 ± 2,5	17,8 ± 0,89*
4	Time of clotting according to Lee-White (min) in non-siliconized test tube.	4,6 ± 0,4	3,4 ± 0,07*
	In siliconized test tube	7,0 ± 0,3	4,9 ± 0,16*
5	Beginning of blood clotting (s)	608,0 ± 7,1	207,0 ± 2,51*
6	Duration of blood clotting (s)	410,0 ± 8,0	199,0 ± 1,79*
7	End of blood clotting	1017,0 ± 14,3	407,5 ± 4,31*
8	Blood viscosity (units)	5,0 ± 0,3	3,8 ± 0,3*
9	Clot density (units)	0,02 ± 0,0	0,02 ± 0,0
10	Time of plasma recalcification (s)	210,0 ± 3,23	109,5 ± 3,59*
11	Kaolin time of plasma (s)	130,0 ± 7,1	30,0 ± 2,51*
12	Kaolin-cephalic time (s)	80,0 ± 3,5	30,0 ± 1,07*
13	Autocoagulogram (s) on 6 min	14,0 ± 1,43	12,0 ± 0,35
	On 8 min	12,0 ± 0,71	9,8 ± 0,35
	On 10 min	7,0 ± 0,71	5,0 ± 0,35*
14	TPH (min)	14,0 ± 0,7	11,0 ± 0,35*
15	Prothrombin time (s)	37,0 ± 0,71	20,0 ± 0,3*
16	Thrombin time (s)	40,0 ± 0,53	39,8 ± 0,53
17	Free heparin (s)	10,0 ± 0,5	10,0 ± 0,3
18	Fibrinogen (g/l)	80,0 ± 3,5	60,0 ± 0,89*
19	Anti-thrombin 3 (s)	1,6 ± 0,07	1,0 ± 0,03*
20	Total euglobulin fibrinolysis (min)	160,0 ± 3,0	159,0 ± 1,97
21	Hageman-dependent fibrinolysis (min)	138,0 ± 4,4	130,0 ± 1,79
22	Ethanol test	10 (-)	10 (+)
23	Protamine sulfate test	10 (-)	10 (+)

Note: * P < 0,05 in comparison to hemostasis indexes among healthy animals.

In blood, taken from a. pulmonalis (table 3) on day 15 of introducing fraction XKXG₂, number of thrombocytes decreased from 215,5 ± 18,8 to 114,0 ± 6,65 (P < 0,001). But, unlike blood, taken from the heart, in lung artery on day 15 of the experiment adhesive (P > 0,2) and aggregation (P > 0,2) function of blood plates didn't change. Such integral indicator of blood coagulation as Lee-White demonstrated us a clear growth in coagulation potential in blood a.pulmonalis on day 15 of the experiment. Period of blood clot formation decreased from 5,6 ± 0,5 to 4,1 ± 0,19 (P < 0,05) in non-siliconized test tubes and from 9,4 ± 0,86 to 7,8 ± 0,08 (P < 0,05) in siliconized tubes. However, data of electrocoagulogram registered multi-directional shifts in hemosta-

sis. Although duration of blood clotting did not change reliably on day 15, periods of beginning and end of clotting shortened correspondingly from 353,0 ± 7,1 to 350,0 ± 3,59 (P < 0,001) and from 945,5 ± 17,9 до 741,0 ± 7,55 (P < 0,001). So how can we explain this multi-directional nature of shifts in hemostasis of a.pulmonalis blood on day 15 of introducing this fraction XKXG₂? Analysis of hemostasiogram shows us that kaolin-cephalic time of plasma did not change reliably (P > 0,2). In other words, different directions of blood clotting shifts is explained by the fact that fraction XKXG₂ in blood a.pulmonalis on day 15 suppresses activity of thrombocyte factor. Besides, this defect of thrombocyte hemostasis, formed under the influence of peptide

XKXG₂ is combine with above-mentioned disturbance in thrombocyte adhesion and aggregation. At the same time, activity of Hageman was not suppressed in blood of the studied rabbits, that is proven by decrease in kaolin plasma time from $79,1 \pm 6,2$ to $60,1 \pm 0,35$ ($P < 0,05$). Also, according to shortening in time of plasma recalcification from $180,0 \pm 7,1$ to $80,3 \pm 3,23$ ($P < 0,001$), acceleration of thrombic plates formation takes place. In our discussion multidirectional nature of shifts in autocoagulation tests is supported by shortening in clot formation from $15,0 \pm 0,7$ to $12,0 \pm 0,35$ ($P < 0,05$) on 6 min and its unchanged time on 8 min ($P > 0,2$) and 10 min ($P > 0,2$). Considering the fact that TPH shortened from $12,3 \pm 0,8$ to $9,8 \pm 0,10$ ($P < 0,05$) and regardless of the fact that level of free heparin amongst experimental animals didn't change in comparison to control, we can conclude that on day 15 of introducing fraction XKXG₂ in blood of a.pulmonalis anti-coagulative system is suppressed. In other words, we should underline that peptide XKXG₂ in pool of lung artery forms favourable conditions for clot formation. Danger of clot formation is also increased by the fact that on day 15 of introducing this peptide in the studied blood content of anti-thrombin III is decreased from $71,6 \pm 3,9$ to $59,8 \pm 1,07$ ($P < 0,001$). Regardless of the fact that level of fibrinogen and activity of fibrinogen remained unchanged, FPD tests were positive among all 10 animals.

In blood, taken from v. pulmonalis (table 4) on day 15 of introducing fraction XKXG₂, number of thrombocytes decreased from $309,1 \pm 7,1$ to $209,0 \pm 3,5$ ($P < 0,001$), their aggregation strengthened from $28,0 \pm 2,5$ to $17,8 \pm 0,89$ ($P < 0,001$), and adhesion remained unchanged ($P > 0,2$). Parameters of biochemical hemostasiogram testified synonymously for an expressed hypercoagulation. Time of whole blood clotting decreased from $4,6 \pm 0,4$ до $3,4 \pm 0,07$ ($P < 0,05$) in non-siliconized test tube, and from $7,0 \pm 0,3$ to $4,9 \pm 0,16$ ($P < 0,001$) in siliconized tube. According to electrocoagulogramme, beginning of blood clotting shortened from $608,0 \pm 7,1$ to $207,0 \pm 2,51$ ($P < 0,001$), as well as duration and ending – from $410,0 \pm 8,0$ to $199,0 \pm 1,79$ ($P < 0,001$) and from $1017,0 \pm 14,3$ to $407,5 \pm 4,31$ ($P < 0,001$) correspondingly. At the same time, according to the data of electrocoagulograph, blood viscosity grew from $5,03 \pm 0,3$ to $3,8 \pm 0,3$ ($P < 0,001$). Biochemical hemostasiogram registered a clear hypercoagulation: time of recalcification shortened ($P < 0,001$), kaolin time of plasma ($P < 0,001$) and kaolin-cephalic time of plasma ($P < 0,001$) was shortened as well. Only according to

the data of autocoagulogram, time of blood clot formation did not change reliably on 6 min ($P > 0,2$) and 8 min ($P > 0,2$) of observation. However, it shortened from $7,0 \pm 0,71$ to $5,0 \pm 0,35$ ($P < 0,05$) on 10 min. Like in previous tests, fraction XKXG₂ suppressed anti-coagulative blood system TPH ($P < 0,05$), free heparin ($P > 0,2$), thrombin time ($P > 0,2$) decreased content of anti-thrombin III from $80,0 \pm 3,5$ to $60,0 \pm 0,89$ ($P < 0,001$) and fibrinogen levels from $1,6 \pm 0,7$ to $1,0 \pm 0,03$ ($P < 0,01$).

Conclusion

Peptide fractions of chronic calculous cholecystitis after 15 days of introducing them intramuscularly into blood, taken from a. and v.pulmonalis formed thrombopenia and increased time of their aggregation.

Thus, 15-days intramuscular introduction of peptide bioregulators, extracted from wall of inflamed removed gall bladders of patients with chronic cholecystitis forms THS-syndrome within organism of experimental rabbits.

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CLINICAL CASE OF HYPOTHYROIDISM IN A PATIENT WITH AUTOIMMUNE THYROIDITIS

Shamitova E.N., Myasnikova I.A. Tuizarova. A.V., Alekseeva. A.V.

Chuvash State University named after I.N. Ulyanova, Cheboksary, e-mail:irinatuizarova@mail.ru

This article discusses a disease of autoimmune nature – Hashimoto hypothyroidism. It presents the clinical picture of the patient suffering from chronic autoimmune thyroiditis (AIT). The diagnosis was confirmed by biochemical blood tests for thyroid hormones. Patients with autoimmune thyroiditis often suffer from other autoimmune diseases of somatic and endocrine origin as well: diffuse toxic goiter, myasthenia gravis, infiltrative (autoimmune) ophthalmopathy, Sjogren's syndrome, alopecia, vitiligo, collagenoses, lymphoid cell hypophysitis. The onset of the disease can also be preceded by any effects leading to disruption in the integrity of the thyroid gland structure and penetration of thyroid antigens into the bloodstream (various infectious diseases, inflammatory processes, less often – thyroid injury or surgery on the thyroid gland. The factors that can trigger thyroiditis of an autoimmune nature can also be: environmental degradation, iodine deficiency or excess, radioactive contamination and others). Therefore, screening for hypothyroidism is conducted among individuals with adrenal insufficiency, patients with characteristic skin changes, vitiligo and alopecia, patients with arrhythmia, chronic heart failure, arterial hypertension, hypercholesterolemia.

Keywords: hypothyroidism, Hashimoto autoimmune thyroiditis, thyroid hormones

Hypothyroidism can have various causes. The autoimmune cause accounts for approximately 90% of adult hypothyroidism, mainly due to Hashimoto's disease. This disease was first described in 1912 by a Japanese doctor, a surgeon Hashimoto Hakaru in 4 patients with chronic thyroid disease. Histologically in autoimmune thyroiditis, lymphocytic infiltration, fibrosis of various degrees, parenchyma atrophy and eosinophilic changes in some acinar cells are observed.

The pathophysiology of an autoimmune thyroid disease over the past decades has been described in detail. Many thyroid antigens (thyroid stimulating hormone or TSH, thyroglobulin, thyroperoxidase) and antibodies have been identified. It has been established that autoantibodies, in particular, antibodies to thyroperoxidase and thyroglobulin, are produced during AIT [1].

The majority of patients with Hashimoto disease are women aged from 20 to 60, and almost 10% have obvious hypothyroidism. Among children, autoimmune thyroiditis occurs 2-6 times more often in girls than in boys [2].

The etiology of autoimmune thyroiditis is not clear. It combines genetic and environmental factors. Genetic factors dominate and affect about 80% of the onset of an immune response. Genetic predisposition is confirmed by the factor of association with some genes of HLA system (HLA-DR3, HLA-DR4, HLA-DR5 and HLA-DQA) and some non-HLA genes (T-lymphocyte 4-CTLA-4 antigen, CD40 gene, tyrosine phosphatase gene 22 -PTPN22, thyroglobulin and gene TSH). In 20% of cases, the etiology of Hashimoto thyroiditis is due to

environmental factors (smoking, selenium deficiency, pollution, infectious diseases, physical and emotional stress and iodine deficiency) and physiological conditions (puberty, rapid growth, pregnancy, menopause, aging, female sex). Although Hashimoto's thyroiditis has been known for many years, it is still occasionally met in surprisingly diverse clinical manifestations and often surprises many doctors [3].

The Chuvash Republic is a goiter-endemic region of the Russian Federation. In recent years, there has been an increase in the prevalence of multinodal (endemic) goiter associated with iodine deficiency, subclinical hypothyroidism, and AIT [4].

The prevalence of autoimmune thyroiditis per 100 thousand of population in Chuvashia tended to increase from 2011 to 2013. So, in 2011, the incidence of thyroiditis was 200.4 persons per 100 thousand of population, in 2012 – 206 persons per 100 thousand of population, in 2013 – 243.8 persons per 100 thousand of population. The incidence of endocrine disorders, metabolic pathologies among working age people in the administrative areas of the Chuvash Republic in 2014–2016 amounted to almost 300 persons (per 1 thousand of adult population). The leading positions in the frequency of these violations are taken by Yalchiksky (164), Krasnochetaysky (110), Poret-sky (106), Kanashsky (79.9) regions [5].

The clinical picture of autoimmune thyroiditis depends on changes in the thyroid function. Clinical manifestations of this disease are usually detected along with hypothyroidism development.

Clinical hypothyroidism is a sign of permanent deficiency in thyroid hormones,

including modulation of calorigenesis (which results in hypothermia), decrease in oxygen consumption in most tissues and additional organ-specific effects. Disorders of protein metabolism lead to a slowdown in the synthesis and breakdown of proteins, impaired metabolism of glycosaminoglycans, accumulation of glycoprotein, mucin and hyaluronic acid in tissues. The excess of these substances changes the colloidal structure of the connective tissue, increases its hydrophilicity, sodium binding to sodium increases, generally causing myxedema formation. The mechanism of water and sodium accumulation in the tissues may also depend on excessive production of vasopressin, the synthesis of which is usually inhibited by thyroid hormones [1].

Symptoms and signs of primary hypothyroidism are often invisible and insidious. Symptoms may include chilliness, constipation, forgetfulness, and personality changes. A moderate weight gain is mainly the result of fluid retention and metabolism decrease. Paresthesias of the arms and legs are common, often due to carpal tunnel syndrome, caused by deposition of a protein base substance in the ligament around the wrist and ankle. Women with hypothyroidism can develop menorrhagia or secondary amenorrhea. Facial expression is boring; the voice is hoarse, and speech is slow; swelling of the face and periorbital edema are caused by infiltration of hyaluronic acid mucopolysaccharides and chondroitin sulfate; drooping eyelids are due to decreased sympathetic activity; the hair is thin, coarse and dry; and the skin is calloused and dry. The relaxation phase of deep tendon reflexes is slowed down. Hypothermia is noted. Dementia or overt psychosis may occur ("myxedema madness"). Often carotenemia is present which is especially noticeable on the palms and plantae, caused by deposition of carotene in lipid-rich epidermal layers. Deposition of a protein base substance in the tongue can cause macroglossia. Reduced hormonal and adrenergic stimulation of the thyroid gland causes bradycardia. The heart may appear enlarged during examination and imaging, partly due to dilation, but mainly due to pericardial effusion. Often there is effusion in the pleural and abdominal cavities. Pericardial and pleural effusions develop slowly and only in rare cases cause respiratory or hemodynamic distress syndrome.

In elderly patients, the symptoms of hypothyroidism are less pronounced than in young people, and the complaints are often vague. Many elderly patients with hypothyroidism have non-specific geriatric syndromes – con-

fusion, anorexia, weight loss, fallings, incontinence, and decreased mobility. Musculoskeletal symptoms (especially arthralgia) are common, but arthritis is rare. Muscle aches and weaknesses often imitate rheumatic polymyalgia or polymyositis. In older people, hypothyroidism can mimic dementia or Parkinsonism [6].

We present a clinical case. Patient M., 60 years old, born in the Kanashsky region of the Chuvash Republic, applied to a hospital in Cheboksary complaining of headaches, dizziness, noise in the head, poor coordination of movements, weakness, a feeling of "fog before the eyes", numbness of the fingers, coldness of the extremities, hoarseness, hair loss, dry mouth, dry skin, constipation, swelling of the face, feet, drowsiness.

Anamnesis. The patient considers herself to be ill during 6 months, when the above-mentioned symptoms appeared and began to progress. There was no outpatient examination. She denies having pathology of the internal organs.

An objective examination showed the general condition of moderate severity. The skin is pale, dry, of "parchment paper" type, the face is puffy, the lips are cyanotic. Pastosity of the legs and feet is marked. The thyroid gland is not palpable. In the lungs vesicular breathing with a frequency of 16 respiratory movements per minute is revealed, there is no wheezing. The heart sounds are muffled having a correct rhythm. The blood pressure is 100/70 mm Hg, D = S, the heart rate is 68 per minute. The abdomen is soft, painless. The liver is not enlarged. The body temperature is 36.7°C. The patient was emotionally irritable.

To verify the diagnosis, a number of studies were carried out.

According to biochemical studies, type IIA hyperlipidemia was observed with a total cholesterol level making 9.6 mmol/l (the normal values are 3.5-5.2 mmol/l), and low density lipoproteins 7.56 mmol/l (the normal values are 1.5-3, 5 mmol/l). Normally, triglycerides: 2.20 mmol/l (norm 0.50-2.30 mmol/l), HDL 1.12 mmol/l (norm 0.90-1.89 mmol/l). Elevated levels of alanine aminotransferase of 57.3 U/l (the norm is 1.0-45.0 U/l) and aspartate aminotransferase 82 U/l (the norm is 1.0-35.0 U/l) were observed. The rest of biochemical analyzes, including the level of electrolytes in the blood, were within the normal range. A blood test for thyroid hormones showed an increased level of thyroid stimulating hormone up to 31.00 mIU/l (norm 0.23 – 3.40 mIU/l), antibodies to thyroperoxidase 825.30 IU/ml (the norm is 0.00 – 30.00 IU/ml) and a reduced

level of free thyroxine (T4) 7.7 mmol/l (the normal values are 10.0 – 24.0 mmol/l). The remaining indicators for thyroid hormones were within normal limits.

The data of the brain magnetic resonance imaging showed a picture of multiple small focal changes in the white matter of the brain, most likely of a vascular nature.

The electrocardiogram results showed a sinus rhythm with a heart rate of 68 beats/min, deviation of electrical axes was not observed. Echocardiographic examination revealed the presence of atherosclerosis in the aorta, fibrosis of the mitral valve cusps with the first degree regurgitation on the mitral valve, an abnormal left ventricular cord.

According to the thyroid gland ultrasound examination, signs of diffuse changes in the thyroid gland of the AIT type with a decrease in the size of the thyroid gland to 7.3 cm³ (the normal values are up to 18 cm³) were detected. The right lobe: the width is 13 mm, the thickness is 17 mm, the length is 36 mm. The left lobe: the width is 15 mm, the thickness is 13 mm, the length is 38 mm. the thickness of the isthmus is 2 mm. The echo was reduced; the structure was diffuse-heterogeneous. Color Doppler flow mapping showed that vascularization of thyroid tissue was within normal limits. In the structure of both lobes there were hypoechoic areas of 3 mm and 5 mm and hyperechoic strands. In the CFM, the vascular pattern was not enhanced. Regional lymph nodes were not enlarged.

According to the ultrasound examination of the mammary glands, no pathologies were detected, peripheral nodes were unchanged. During examination focal pathology was not detected in the projection of the adrenal glands.

The patient was consulted by an endocrinologist, diagnosed with chronic autoimmune thyroiditis (AIT), struma 0, symptomatic hypothyroidism.

It was recommended to take levothyroxine in the dose of 25 mcg in 1 tablet in the morning 30 minutes before meals, with condition was to be monitored, rosuvastatin 20 mg daily in the evening, cardiomagnyl 75 mg, indapamide retard 1.5 mg in the morning, losartan 50 mg daily in the morning under plasma lipid control, ALAT, ASAT, repeated blood tests for thyroid-stimulating hormone, free thyroxin in

6-8 weeks, as well as clinical follow-up by the district physician, a visit to the endocrinologist at the place of residence.

When examined by a dermatologist the patient was diagnosed with vulgar ichthyosis.

In view of the above data, a clinical diagnosis is made: Chronic autoimmune thyroiditis (AIT), struma 0, symptomatic hypothyroidism.

Concomitant diagnoses: Type IIA hyperlipidemia. Aortic atherosclerosis. Vulgar ichthyosis. Erosive duodenitis.

While taking Levothyroxine, the patient's condition improved, clinically weakness decreased, puffiness of the face and pastosity of the legs and feet were gone. The level of thyroid hormones, namely thyrotropic hormone and free thyroxin, was normalized as a result of treatment.

Conclusion

The Chuvash Republic is an endemic area for thyroid diseases, in particular, hypothyroidism. The article presents a clinical picture of symptomatic hypothyroidism as the outcome of autoimmune thyroiditis in an elderly patient. The disease often develops slowly – this feature makes it difficult to diagnose, which was reflected in the description of this case. Lipid disorders in poorly compensated hypothyroidism, which occurred in our patient, carry a high risk of coronary artery atherosclerosis.

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NEURO-LINGUISTIC PROGRAMMING AS AN EFFECTIVE TOOL IN TEACHING ENGLISH

Satbek L.M., Akynova D.B.

L.N. Gumilyov Eurasian National University, Astana, e-mail: laura.satbek@mail.ru, akynova.d@yandex.kz

The article deals with the main points of the neuro-linguistic programming in regards to the foreign language teaching. As the requirements for the study of foreign languages include communicative competence it is necessary to apply the effective techniques to develop the language skills. The analysis showed the effectiveness of using neuro-linguistic programming techniques in teaching a foreign language. The paper gives a review of the emergence of neuroscience and its connection to the study of foreign languages. The authors analyze the levels of learning and development in connection to neuro-linguistic programming. Neuro-linguistic programming is considered within main representative systems, which are highly relevant in teaching a foreign language. Studying a foreign language is considered by means of perception conditions, consciousness, subconsciousness, anchors, associated images, and dissociated images. The overall analysis illustrates the effectiveness of using neuro-linguistic programming in teaching foreign languages. It assists in acquiring a foreign language in a more efficient way.

Keywords: neuro-linguistic programming, English, levels of learning, representative systems

Currently, the requirements for the study of a foreign language are quite high, since one of the tasks facing the teacher is the formation of students' communicative abilities. That is why the use of various methods and techniques allows you to open new learning opportunities. Neuro-linguistic programming (NLP) is one of the most powerful psychotechniques, which helps to change oneself and others in the most effective and elegant way. NLP emerged in the early 1970s and was the fruit of the collaboration of John Grinder, who was then an assistant professor of linguistics at the University of California at Santa Cruz, and Richard Bandler, a psychology student at the same university. Richard Bandler was also interested in psychotherapy. Together they studied the actions of three prominent psychotherapists: Fritz Perls, an innovator of psychotherapy and the founder of a school of therapy known as Gestalt therapy, Virginia Satir, a family therapist who managed to resolve such difficult family relationships that many other family psychotherapists found impregnable, and finally, Milton Erickson, the world famous hypnotherapist [1].

In the spring of 1976, Grinder and Bandler gave the name to their work – neuro-linguistic programming, a cumbersome phrase that hides three simple ideas. The “neuro” part reflects the fundamental idea that behavior originates in the neurological processes of vision, hearing, smell, taste, touch and sensation. We perceive the world through our five senses, we extract the “meaning” from information and then follow it. Our neuroscience includes not only invisible thought processes, but also our visible physiological reactions to ideas and events. One is simply a reflection of the other on the physical level. Body and mind form an inseparable unity, a human being. The “linguistic”

part of the title indicates that we use language to streamline our thoughts and behavior and to communicate with other people. “Programming” refers to the ways in which we organize our ideas and actions to get results [2].

NLP distinguishes the following levels of learning and development:

- environment (external opportunities or restrictions on activities, place, time and material conditions necessary for its implementation);
- behavior (specific steps, actions or operations necessary to achieve the goal);
- abilities (a system of cognitive maps, plans and strategies, criteria for selecting and evaluating specific actions);
- beliefs and values (the motivation and choice of the general direction of activity, taking into account the existing abilities, goals and conditions; the answer to the question “why?” Regarding this activity and its psychological reinforcement);
- identity (the awareness of a person of his role, the answer to the question “who?” Regarding this activity);
- mission (understanding of its task within the framework of a larger system, of which a person is a part – families, groups, etc.)

The application of this concept to the context of leadership in education allows you to notice different levels or styles of leadership, depending on the focus of the teacher's attention in the implementation of the educational process – providing the necessary conditions, behavioral competence (skills), development of abilities (training and in a wide range), education of the individual and etc [3].

In NLP, a lot has been said about the various ways of structuring experience. One of the presuppositions of NLP is: “Experience has its own structure.” At the same time, as we have

already noted, it is believed that people differ in the dominant channels of perception, storage and transmission of information. So, according to some (unverified) data, the visual channel predominates in 40% of people, in 40% – the auditory channel, in 20% – kinesthetic.

In recent years, a sea of various materials has appeared for the study of foreign languages. And any person (especially who decided to study his first foreign language) is often not sure where to start this way: buy a textbook, audio, video course, or even go to courses. Full knowledge of a foreign language at the level of your mother tongue implies that, when communicating with you, they will not be able to distinguish you from “their own”, as if you were growing up in a country whose language you are learning from infancy. The only thing that can give you the color of your skin or facial features when dealing with carriers is, but, as you understand, this goes beyond our competence. Thus, full-fledged knowledge of a foreign language implies a complete understanding of the language in the vast majority of situations and its correct use also in the vast majority of situations; in both cases, first of all – oral, but, of course, written (compare with the native language). Here it is necessary to emphasize one important point: a full-fledged proficiency in a language includes the ability to understand, the ability to speak and write in a given language, but not the ability to explain certain linguistic phenomena.

With regular lessons on studying a foreign language with maximum efforts, your vocabulary a year later will be at least 10-12 thousand words (of which more than half are active vocabulary). When reading modern literature or watching a modern film, we are not immune from the fact that the writer or actor uses some rare words, expressions, special terms, or we are faced with some social reality that has not yet been encountered while learning the language. And believe me, if you really want to qualitatively understand oral and written speech in a foreign language, not one of these 10 thousand will be superfluous. Sometimes there are articles where the figures are cheerfully given, which, they say, actively carriers in such and such language use only 500/1000/2000 words, so guys learn this 1000 words, and that's all – you know the language. The figure, of course, is seductive, but, having only 1000 words, do not expect that you will understand well films, television, radio programs and even more so fiction or the press. Thus, after reaching the optimum goal, the level of proficiency in a foreign language

will approximately correspond to the level of your teenager's native language of sixteen from an intelligent family who, at the age of 11-12, immigrated with his parents abroad. Of course, after immigration, the family continued to speak their native language. Thus, you will have the correct pronunciation, you will have a tremendously developed sense of the language, you will become easy to express yourself in it, but to fully master the language you will lack vocabulary, plus you will not be familiar with some of the social realities of the country of the language being taught. But, as you understand, this can be quickly typed by reading literature containing the necessary vocabulary, as well as watching television news, serials, and films “for volume”. Here I will make a reservation: maybe the language will drag you down so much that in a year you will have time to read and become familiar with the social realities of the country of the language being studied in a sufficiently large volume and achieve full-fledged knowledge of a foreign language.

This is the minimum necessary to achieve the goals of the optimum program. Here I proceed from the assumption that a person can really be physically busy (you need, for example, to study at a university, earn money to feed a family). If you are not sure that you can find one hour daily for classes, I advise you to think three times before you begin to learn any foreign language. If we imagine language learning in the form of a car race, then any decrease in the intensity of classes (less than one hour per day, skipping classes) is not even a brake on language learning, but a 180 ° turn and riding in the opposite direction. If your language classes are irregular, then you will not “reach”, and you will only hang out at the beginning of the distance or even near the starting line. Or, for example, such an analogy: imagine that learning a language is like swimming along a river against a stream. The slightest loss of pace – and blows you back. DO NOT SWIM ! Maybe, of course, you will then overcome the same distance a little faster – you learned to swim, but you still have to overcome it, no matter how cool. By the way, the exact same thing applies to your native language: without active use, the process of forgetting a language is inevitable. On the other hand, this time – one hour per day – can be increased, and without limit. With the right motivation and a good selection of interesting materials, your desire to study the language will be so strong that you do not want to break away from classes [4].

In NLP there are three main representative systems: visual (visual), auditory (auditory),

kinesthetic (sensitive). Through these three systems, a person receives 99% of the information from the surrounding world (they also emit the olfactory-hustatory system, but I will not dwell on it). There is an important point. Take, for example, these three situations. The first situation: stand in front of the door and look at it – in this case, you receive an external visual signal from the outside world. Another situation: remember the color of the door in your room. In this case, the brain also receives certain information, though from itself, and this is an internal visual image. Third situation: imagine what you would look like with red hair. In this case, the brain again receives information (again from itself), which is also an internal visual image, but this is a constructed image in contrast to the previous, recalled, visual image. The same can be done for a different modality, for example, the audio one. Suppose you hear music on the radio – this is an external audio signal. Now you remember your favorite song – this is an internal recalled auditory image. Can you imagine further how your favorite song, played in an accelerated pace, sounded, is an internal constructed auditory image.

Perception positions

There are three main positions of perception. Suppose you are talking to a friend. The first position: you see the process of communication with your own eyes, you hear it with your own ears, you are experiencing the process of communication with your senses. The second position: you put yourself in the shoes of a friend and imagine what he can see, hear and feel during the conversation. Finally, the third position: you imagine how you and a friend look from the outside, how your dialogue sounds to someone third.

Consciousness / Subconscious

The term “consciousness” means everything that your attention is directed to at the moment. The subconscious is what is in memory, as well as those parts of your life experience that you are used to and which you don't pay conscious attention to at the moment. For example: you walk down the street, in one hand – a bag, you remember the events of yesterday. To rearrange the legs, you do not exert the slightest effort of your conscious attention, nevertheless do it correctly, “on the machine”; you do not pay attention to the fingers of your hand, clutching the handle of the bag, nevertheless they hold it tightly. Let us take as an example the speech in the native language: you

do not think about where to put the subject and predicate, how to verb one or another verb. The processes of building sentences occur unconsciously, naturally. Virtually any complex skill that a person possesses is realized unconsciously. For example, a professional musician, when performing a work he has learned, does not think about where to put his index finger at one time or another, which key to press, he is excited by other – creative – tasks. It is not necessary that the skill that you unconsciously develop as a result of a step-by-step conscious understanding of its component parts, such as occurs when you learn to solve quadratic equations using a math textbook or learn to print using a 10-finger blind method using a self-guide. Sometimes the unconscious skill can be acquired without the participation of consciousness. Suppose you talked for a long time with a person who has a habit of saying a parasitic word like “as it were”. After some time, you can include this little word in your speech, although you have never paid conscious attention to it either in the speech of this person or in your own. We can also give an example: a child learns his native language and as early as three years says: “This is a girl. I see girls. Surely none of the parents explained to the kid that the “girl” is a feminine noun, of the 2nd declension, so the ending changes in the accusative case. Skill correctly incline nouns child has acquired unconsciously.

Anchors

Has it ever happened that you hear a familiar song, and its melody, words cause you to recall specific situations? Or, looking at a photo of your school, do you suddenly remember a physics lesson in 7th grade? Both the song and the photo in this case are anchors for you, that is, external (most often) stimuli that cause you to have any feelings or make you remember any visual and / or auditory images. Unlike visual (photography) and audible (song) anchors, there are kinesthetic anchors. For example, if a person who is in a joyfully excited state presses his hand on his knee, then this state will “anchor”. After some time, when you need to make yourself excited, you just have to press your knee in exactly the same way.

Associated / dissociated image

Suppose you swim in a pool. Associated image: you see, hear, feel directly while swimming. Dissociated image: you imagine yourself floating in a pool, that is, you see how this person swims, how he waves his arms; this person is you.

Condition

A state is a combination of the neurophysiological characteristics of an organism at a given point in time. There is a state of total immersion in something, absolute involvement (for example, in reading a textbook, in a game of tennis). In the state of “reading a textbook,” you are unlikely to be able to play tennis well, and in the state of “game of tennis,” you are unlikely to be able to tell anyone convincingly something. When learning a language, you will need special states, and we will talk about it again. For example: Bandler and Grinder. What allowed them to learn quickly? Why did others fail to grasp the actions of a genius, but did they succeed? The secret is HOW they learned the behavior of a genius: they copied the actions of a simulated person! Thus, the basic scheme looks like so: saw + heard + repeated [5].

As we clearly see from the abovementioned, NLP techniques help us acquire the foreign language in a more effective way. Therefore, the teachers of English should take into account the efficient NLP techniques to boost the learners’ productivity.

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ON THE ISSUE OF CODE-SWITCHING

Ybyray B.N., Akynova D.B.

L.N. Gumilyov Eurasian National University, Astana, e-mail: Bakyt_1997@mail.ru, akynova.d@yandex.kz

The article deals with the main points of the theory of code-switching which is considered to be the least studied issue in Kazakhstani linguistics. The capability to switch codes shows an adequately high level of language proficiency and a certain communicative and a general culture of a person. Mechanisms of code-switching makes sure understanding between people and provide convenience of communication process. On the contrary, inability of a person to vary his speech depending on the situation of communication and being accustomed to only one code is believed to be as an abnormality. As a result, different intercultural or communicative misinterpretations may occur. In most cases, people get amazed when they hear conversations which are produced in two or more languages. Negotiations on daily topics taking place in such natural way are the subject matter of this study. The analysis showed that the phenomenon of code-switching depends on different factors and occurs naturally in the speech.

Keywords: code-switching, insertion, interlocutor, language alternation

The term code-switching (or, as it is sometimes written, codeswitching or code switching) is widely discussed and used in linguistics. The most common definition of code-switching is using two or more language varieties in conversation.

Concerning code-switching, the active research continues for about half century. During this time it has been developed into an independent linguistic discipline. This fact is explained by the increased interest in the difficulties of language contact.

A pivotal thing for understanding the nature of various types of code-switching is K. Myers-Scotton's opposition of 'marked' and 'unmarked choice' in code-switching. When the speaker follows the established rules of speech behavior in the language community and makes switching in accordance with the expectations of the listener is called 'unmarked code-switching'. But if the speaker consciously produces switching in a way that it is noticed as a deviation by the interlocutor it is called 'marked code-switching' [1].

To the latter position is quite close Peter Auer's view where he proposed to distinguish cases of a combination of two languages from code-switching in which their usage is not local for speakers but it possesses rather global meaning, i.e. is not determined by the specific features of the situation and that such use of languages is accepted in this community [2].

Milroy and Muysken (1995) suggests "perhaps the central issue in bilingualism research is code-switching" [3, p. 7]. In fact, regarding the studies on bilingual speech, it can be proved that bilinguals have a tendency to mix their languages in a process of communication. Consequently, such mixing has been evoked misinterpretations as bilinguals do not possess enough competence in communicating one or both languages.

According to Chirsheva, in multilingual world, interplay of languages, bilingualism and bilingual type of communication are becoming a widespread phenomenon [4, p. 23]. It is believed that a person who speaks two languages is able to participate in two monolingual conversations as well as in bilingual types of communication. A characterization of bilingual type of communication is interplay of languages which include forms such as interference and code-switching. Bilingual type of communication is described with incomplete deactivation of one languages and with gradation of activity of two languages in speech of bilingual while producing an utterance. In a production of speech, a person who possesses two languages may deactivate first language incompletely which provides an interference in speech in second language which mostly occur in monolingual type of communication. When a bilingual is having a conversation with other bilinguals, it can be seen gradation of activity of two languages which is called bilingual speech.

Muhamedova and Auer assume that languages have a potential to be mixed in such a way that language A is considered as a dominant language and language B is an embedded language [5, p. 35]. Embedded language can be inserted in the forms of phrases or even single words into the grammatical frame determined by language A (matrix language). The grammatical frame of the sentence is provided by the grammar of language A (matrix language) whereas language B (embedded language) is utilized only in complex insertions in order to define the structure of inserted constituent.

Code-switching examines ways of dealing with the difficulties and language barriers occurring while sentence-planning by using elements of two or more languages. This phenomenon particularly noticed in child's speech

when they make errors and have some problems in acquisition of phrases or sentences. From the psycholinguistic point of view, one of the crucial features of code-switching is flexibility of language production. Psycholinguists consider the problem for debate called as 'coordination problem' which means the fluent achievement of speech.

In terms of language contact, code-switching or language alternation is a transition of the speaker from one language to another in the process of speech communication. A similar pattern is observed in societies where two (or more) languages are used rather than one. It is believed that bilinguals resort to code-switching because they can not express their thoughts in one language. To some extent, it is a truth and inability to transfer what they want to say force them to switch to another language in order to compensate those omissions.

According to the researchers, it is in bilingual (multilingual) language teams native speakers receive an opportunity of contrastive based on intuitive deductions and distinction of two different language systems. Bilinguals, i.e. people who speak two (or more) languages usually "distribute" their usage depending on the conditions of communication, for instance, in official meetings where dominant language is only one while communicating with the authorities but in everyday life (in the family, contacts with neighbors) using several languages simultaneously is acceptable.

Code-switching can be induced, for instance, by the change of addressee, i.e. the one to whom the speaker addresses. If the addressee speaks only one of the two languages that the speaker knows, then, the latter, no doubt, has to utilize a language which is familiar to the addressee. Although, until this moment in communication with bilingual interlocutors another or both languages could be used. Switching to a known language code can occur even in the case of changing group members. For example, if a third person owning only one language joins to the conversation of two bilinguals and that language known to these bilinguals, they will speak in the language of the third person. Refusal of interlocutors to switch to the code familiar to the third participant of communication can be regarded as an unwillingness to involve him to a conversation or as a neglect to his communicative inquiries.

The factor that evokes code-switching can be a change of a role of the speaker. Take, for example, the role of a father (when communicating in the family) he can use a convenient code for him but when turning to the authori-

ties, he forced to switch to more or less conventional forms of speech.

The topic of conversation also influences on a choice of code. Researchers who dealt with the problems of communication found out that members of a certain sphere have discussions in a language that has the appropriate special terminology which describes technical processes, devices, instruments, etc. But as soon as a change of a theme occurs from production to household, another language code switches on: native language or dialect of interlocutors. In a monolingual society, with such a change of code there is a switch only from professional language to vernacular language means.

Code-switching can be used by bilinguals as a "sociolinguistic tool" or "technique" [6].

Code-switching can serve for the expression of speaker's solidarity from a certain social group. When a listener responds to a code-switching with the same switch, a specific connection is established between the speaker and the listener. At the same time, exclusion of unwanted listeners (who do not speak the language to which interlocutors switch) can happen. Sometimes a code-switching is used to show the attitude of the speaker to the listener. While monolinguals express their relation by varying the content of speech, bilingual speakers often use a code-switching for this purpose.

Code-switching may also serve to impress a listener. If bilingual interlocutors are used to communicate in a certain language, switching from one language to another is unexpected for the interlocutor and evokes a "special effect". In other words, a code-switching is not only a linguistic but also a sociolinguistic phenomenon [7].

As a rule, the situation of full bilingualism in the language team has two immensely opposite consequences. On the one hand, as it has mentioned above, native speakers have a possibility to make a distinction of two systems and, as a result, understanding of structural differences. On the other hand, constant use of two languages simultaneously expressed in permanent switching of codes, native speakers cease to distinguish codes which they use [3] and there is a possibility of interference. Therefore, it should be noted that code-switching and interference have an absolute difference which is that interference implies modification of grammatical, syntactical or phonetic forms of one language under the influence of another but not the change of one language to another. Furthermore, code-switching contributes to the implementation of the act of communication whereas interference indicates mixed usage of

different language norms or rules which can lead to misunderstanding. Interference mainly depicts the relationship between language systems when they are in contact and code-switching has to do with bilingualism itself. Thus, it can be concluded that interference may manifest in speech of bilingual along with code-switching. However, it is vital to distinguish described phenomena [8].

It should be noted that there are three main categories in the study of the problem of code-switching in modern researches. To the first category belong researchers who investigate “extrasentential” (or “intersentential”) code-switching. In this way, some representatives of theoretical linguistics and psycholinguistics conduct their research. According to N. Kamwangamalu, representatives of theoretical linguistics primarily examine grammatical aspects of code-switching [9]. Psycholinguists are interested in how sentences are generated from code-switching, is there a difference between sentence construction of monolingual and bilingual speakers and the number of grammatical systems that are included in a sentence with code-switching [10].

The second category includes scientists who follow sociolinguistics. They are not so much interested in a difference between “intra-sentential” and “intersentential” code-switchings as in finding out the reason for the existence of such phenomenon code-switching among bilinguals.

The third category entails linguists who conduct researches on code-switching in the frame of communicative and pragmatic approach. P. Angermeyer claims that representatives of this category aim to scrutinize the structure of communication process in which a phenomenon of code-switching takes place. Moreover, he attempts to figure out the role of switching codes in establishing the order of replicas of interlocutors, thematic construction of communication process, starting a conversation and continuing a talk on a certain topic, switching from one topic to another, etc. [11].

What are the parts of sentences where switchings take place? It depends on the nature of impact of those factors just discussed

above. If the speaker can foresee and even plan the influence of a particular factor, then the switching occurs naturally, i.e. at the end of the phrase with the most quite mode of communication – at the end of the discussion of any topic. However, if the intervention of the factor inducing code-switching is unexpected for the speaker, he can switch from code to code in the middle of the phrase sometimes even without saying a word. In case of high level proficiency of codes or sub-codes, the process of code-switching may not be realized by the speaker if their use is highly automated. Especially in cases where another code is not entirely used but in fragments. For instance, a person can insert elements of another language into his speech such as idioms, modal words, interjections, particles.

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PROBLEMS OF ARTISTIC TRANSLATION IN THE LIGHT OF INTERCULTURAL COMMUNICATION

Mustafina M.A.

University of International Business, Almaty, e-mail: MMA_MAI@mail.ru

The article highlights the problems of artistic translation. Translation is a multifaceted object of study. The questions of translation can be considered from different points of view – philosophical, linguistic, cultural, psychological, etc. Since culture manifests itself primarily in language, language is the true reality of the culture. In this connection, the translation is considered not only as the process of inter-language communication, but also as an intercultural dialogue. Translation, therefore, is an important auxiliary tool, ensuring the performance of the communicative function of the language in cases where people express their thoughts in different languages. Translation plays a big role in the exchange of thoughts between different people. The entry of Kazakh literature into the world literary process has always been due to such factors as artistic translation, which is considered the most effective way of including the author in a foreign language environment. Artistic translation plays an important role in the development of contacts between national literatures and in the history of domestic literature.

Keywords: artistic text, intercultural communication, ethnic individuality, intercultural dialogue

Translation – one of the forms of literary connections, which allows to comprehend intentions, ideas of a writer, the meaning of writer's words, ways of his thinking. The importance of translation for the development of national literature and the work of writers was highlighted by many outstanding artists.

There are a lot of unexplored areas in the field of artistic translation from Kazakh into other languages and vice versa (especially in the case of foreign languages) and more needs to be done. In particular, translations of Kazakh poetry and prose into English are subject of great interest, taking into account the growing popularity and increasing proliferation of the English language in the world. Artistic translation can play valuable role as a means of mutual rapprochement of people. It is time to answer the following questions: what is the situation of translations of works of Kazakh writers and poets into foreign languages, in particular, into English, French, Yiddish, German, Arabic and other? What is the significance of these translations for the development of world literature? What is the role of these translations for closer acquaintance with Kazakhstan, with people, history, culture, language? This interest is natural because the works of Abai, Auezov, Seifullin and other authors are not the property only of the Kazakhs. Now, thanks to artistic translations, their work would be available to people in the most remote corners of the earth, speaking different languages. In this regard, one cannot help but mention the ethnic Kazakhs living in the far and near abroad who not only would like to listen and enjoy translations of the immortal works of literature written in their historical homeland, but also to bring these inexhaustible sources to their children, grandchildren, friends, who are

usually not good at Kazakh. For these people, translation is a unique opportunity to comprehend the content and feel the aesthetic impact of beautiful work of verbal and artistic creativity in the Kazakh language. Without a doubt, these questions will make care many foreign citizens who permanently reside and work in the territory of the Republic of Kazakhstan. This will contribute to a deeper understanding, study of the Kazakh language and raising its status, which is especially important nowadays, when so much attention is paid to the development of the state language and the issues of languages trinity: Kazakh, Russian and English. Translated literature and general interest in translations from any language always raises the status of the language, since only a rich, well-developed language is capable to give the world the literature worth to be translated.

At present, there are not many translations from Kazakh into foreign languages, although there is a notable increasing trend. It remains to hope for an improvement of the quality of these translations. The translations from Kazakh into Russian and into the languages of the CIS peoples are not good either.

However, science is not interested in lists of untranslatable facts, but in ways of overcoming difficulties in translation. At the same time, it is necessary to realize that translation is not always possible. On the other hand, theory and practice do not have the right to capitulate to this fact, since the field of “translatable” is constantly expanding. Consequently, the scientific study of translation from the standpoint of various scientific disciplines and usage of different conceptual devices are no longer sufficient because new approaches to translation practice are emerging [1–3].

Kazakhstan is multinational and multilingual country, therefore, it would be fair to conduct research, to present in mass media the situation related to translations from the languages of different nations of Kazakhstan into Kazakh, Russian, and foreign languages. This would promote even greater stability in the country, mutual understanding and respect for its peoples. It is mentioned in the Address of the President of the Republic of Kazakhstan N.A. Nazarbayev to the people of Kazakhstan dated December 14, 2012: “Kazakhstan today is an important international center for intercultural and interdenominational dialogue ... In the twenty-first century, Kazakhstan should become a bridge for dialogue and interaction between East and West” [4].

It is no coincidence that the translator Nikolai Chukovsky called the translation “magic”: “Isn’t it magical that the spiritual wealth of one nation, sometimes even small numbered, but gifted and unique, as all other countries, can become the spiritual wealth of all human, whole universe? ... The main issue of the development of the artistic translation – the lack of public attention to it. Literary critics write about authors and keep silent about translators”. For this scientific researches in this area can be valuable.

In addition to the issues mentioned above, it would be advisable to include in the studies such areas as: “The history of translations in Kazakhstan”, “Philological traditions of translations in the world”, “Outstanding masters of translation in Kazakhstan, CIS and abroad”, “The best translations of the world classics”, “Mismatch of language systems and translation” (for example, briefly compare lexical and stylistic systems of Kazakh and English languages and show how this is reflected in the translation), “Translation through translation” (about translations from one language, for example, Kazakh, to another for example, English, through the third language, for example, from the Russian translation of the Kazakh poem). It would be interesting and useful to study areas devoted to the little-known aspects of the work of writers and poets, to little-studied pages in the history of Kazakh literature, for example: “Abai and the West”, “Acquaintance with multilingual translations of the same literary work”, “The influence of the East on the English Poetry”, “Poetry of nomads in translations into European languages”, “Shakarim as an translator of Russian literature”, “Features of the translation of Eastern literature into the languages of Europe”, “Russian translators of Kazakhs literature”, “Baron Poetry in the Ka-

zakh language”, “Goethe and literature of the East” and others.

I would like to emphasize the educational function of translation, which can arouse the interest, the creativity of a person, elevate morally and encourage enriching one’s with culture of other worlds.

Under the artistic translation, one should understand not the copying of the original letter and the transfer of the phraseological units of the original, but the exact reproduction of the spirit of the work, the delivery of the author’s worldview by means of another language. The heart of each writer’s creative process is an idea and a poetic image, which are inseparable from the word and expressed in word. For a translator, the work itself as a whole living light-image that highlights all the details should be primarily important. Translation has its own rigid laws. Important task of a translator is to comprehensively reflect the original poetic system in all its forms: volume, sound, color, words, etc. It should be taken into account that there is no artistic translation without a certain understanding and interpretation of the original work, and in the process of translation the image undergoes reconstruction and there appears the possibilities of its various transformations – in time, in space, in the semantic components [5].

Translation is a multifaceted object of study. The questions of translation can be considered from different perspectives – philosophical, linguistic, cultural, psychological, etc. Since culture manifests itself primarily in language, language is the true reality of this very culture. Due to this the translation is considered not only as the process of interlanguage communication, but also as an intercultural dialogue, in the lexical meanings of words, national identity, which develops historically, and finds its expression through it. The words of each language have specific functioning laws. This is can be observed in the fact that during the translation from one language to another it is often necessary to use words and expressions that do not precisely coincide with the lexical meaning. These words are not exact equivalents of concepts, but words of a close meaning, they do not contain all the semantic and emotional nuances of the source language. For example, the Kazakh language is rich in types of singers-improvisers: zhyrshy, zhyrau kuyshi, olenshi, anshi, akyn, ertekshi. They cannot be conveyed identically by Russian words like a singer, a musician, a storyteller. The words of two languages close in meaning are not absolutely identical semantically [6].

“There is nothing committed untranslatable” or according to Umberto Eco translation is “to say almost the same thing” [7]. Every translator is a researcher of the culture the language he is using. The people with developed self-awareness value their ethnic identity, the uniqueness of their culture and their history. It is not accidental that Wilhelm von Humboldt wrote that language is the unified spiritual energy of the people miraculously imprinted in certain sounds. We can reveal the richness of the world and the multifacetedness of what we know through the diversity of languages.

It is accepted to distinguish three types of translation: word-for-word translation (literal), semantic translation, literary or artistic translation, the linguistic principle of translation.

Word-for-word translation (literal). This is a mechanical translation of the words of a foreign text and they occur in the text, without regarding to the syntactic and logical connections. It is used mainly as a basis for further translation work.

The semantic translation, with the correct transfer of the thought of the translated text, tends to maximally close the reproduction of the syntactic construction and the lexical composition of the original. Despite the fact that semantic translation often violates the syntactic norms of the translating language, it can also be applied at the first, at rough stage of work on the text, as it helps to understand the structure and difficult places of the script.

Artistic or literary translation. This kind of translation conveys the thoughts of the original in the form of correct literary speech, and causes the greatest number of disagreements in the scientific environment – many researchers believe that the best translations should be performed not mainly by lexical and syntactic correspondences as by creative findings of artistic relations, in relation to language consistency are subordinated [8].

Special difficulties arise when the languages of the original and the translation belong to different cultures. For example, the works of Arab authors abound with quotations from the Koran and hints about this topic. The Arabic reader recognizes them as easily as an educated European referring to the Bible or ancient myths. In translation, these quotes remain incomprehensible to the European reader. There are also different literary traditions: European comparison of a beautiful woman with a camel appears ridiculous, and in Arabic poetry it is quite common. A fairytale “Snow Maiden”, based on Slavic pagan images, it is not clear how to translate it into hot African languages.

Difficulties are created by different cultures rather than different languages.

Such a high-quality translation is impossible if there is no qualification, which we understand as the basis of the translator’s skill, as to have deeper development of the original signs of the psychology of people from whose language the work is translated [9].

The translator must be a master of the artistic word, subtly feel the soul of the people, in whose language the original is created. The skillful translator ensures language consistency, therefore, he/she fulfills his task the more accurately and fully. According to I. Kashkin, every experienced translator knows because of the mismatch of language systems and aesthetic norms, it is necessary to replace certain original parts with others that arise only in translation. However the skillful artistic translator also keeps the boundaries allowed by the original. It is known that the translation is done for those who do not know and do not understand the original language. Therefore, first of all, during the translation, it is necessary to pay attention to the main content of the original, then to the details reflecting the semantic and artistic features of the text. “The task of a translator, according to V. A. Zhukovsky, is being able to create and find in translation all the beautiful things that are given in the original.” The skillful translator, before translating the work, studies the content, semantic and artistic features of the original, the originality of the author’s style, because it is important not only know the original language well, but to be able to think in that language. For example, Mukagali Makatayev, an outstanding Kazakh poet, whose poetic attitude to the world is based on desire for the truth of being, fusion and harmony with nature, where word by being converged broadcasts about the inmost sources of Kazakh spiritual culture. Artistic translation into Russian of selected poetic works by M. Makatayev was performed by the Kazakh poet-translator Zhanat Baymukhametov, known for his translations of Western European poetry. Trying to express in Russian almost the same thing that was said in the original language, with his translations of the poetic creations of Makatayev, he presented the opportunity for the Russian-speaking reader to feel the third rhyme of the Kazakh verse, the wonderful charm and depth of the poetry of Makatayev.

“As you know, the core of any artistic translation is that, having arisen, dissolve in the nature of the original text. The uniqueness of Mukagali Makatayev’s poetic works is the fact that, being produced on the

motherland of the Kazakh language, they are the accumulators of those subtle ideas and meanings, which reveal the essence of not only Kazakh poetry, but also poetry as such. Having made an attempt to translate the “spirit” and “letter” of Makatayev’s poetry from Kazakh into Russian, from the very beginning of this complex but fascinating enterprise, I decided to adhere to this translation a strategy as difficult to implement, as well as promising from the position of approaching the language of the original text. With my translation of the poetic works of Makatayev I tried to give the Russian-speaking reader the opportunity to feel the third rhyme of the Kazakh verse, the taste of Makatayev’s text, to express in Russian almost the same things what is said in the original language” [10].

First of all, the linguistic principle of translation supposes the re-creation of the formal structure of the original. However, the proclamation of the linguistic principle can lead to excessive adherence of the translation the original text – to a literal, linguistically exact, but weak artistic translation, which would be one of the varieties of formalism, when foreign language forms are accurately translated, styled according to laws of a foreign language. In cases where the syntactic structure of the translated sentence can be expressed in a similar way in translation, the literal translation can be considered as the final version of the translation without further literary processing. However, the coincidence of syntactic means in two languages is relatively rare; most often in artistic translation occurs another violation of the syntactic norms of the translated language. In such cases, we come across a certain gap between content and form: the author’s thought is clear, but the form of its expression is alien to the translated language. Literally accurate translation does not always reproduce the emotional effect of genuine. Actual and artistic reality is in constant contradiction with each other. Undoubtedly, the translation is based on language resource and without translation of words and phrases there is no artistic translation. The translation process itself also relies on knowledge of the laws of both languages and on the understanding of the laws of their correlation. Compliance with language laws is required for

both the original and the translation, but artistic translation is not only a correspondence of linguistic relations.

The cultural (conceptual) picture of the world is a reflection of the real picture through the prism of concepts formed on the basis of human representations, with the help of sense organs and passed through his consciousness, both individual and collective [11]. The cultural picture of the world is specific and different for different peoples. This is due to a number of factors: traditions and customs, way of life, social structure, beliefs, geography, climate, natural conditions, history, etc.

Thus, multicultural and multilingual education is necessary for the formation agents of intercultural communication, professionals, who meet the world standards, competitive specialists, communicative personalities, who are capable to work in a multicultural environment, who possess a sense of respect for the spiritual values of other cultures, and the ability to live in peace and harmony.

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MULTILINGUAL APPROACH TO POWER ENGINEERING STUDENTS LANGUAGE TEACHING

Prokhorova A.A.

Ivanovo State Power Engineering University named after V.I. Lenin, Ivanovo, e-mail: prohanna@yandex.ru

This article addresses the role of foreign languages in the actual development of multilingualism among Russian engineers-to-be who will work in synchronously interconnected international power systems. It also brings in the discussion the measures that Higher Engineering Institutions should undertake for encouraging the development of future engineers' multilingual and intercultural competence. The article pays particular attention to the identification of the main characteristics which multilingual engineers should strive to have for working in an increasingly globalized professional society. The study is based on the extensive research made during the trilingual training of Heat Power Engineering, Electromechanical, Electro Engineering, and Physical Engineering students in the context of educational multilingualism of the Power Engineering University (Ivanovo, Russian Federation). The present study proposes to consider the experimental procedure using the first foreign language (FL1-English) as a mediator for the development of the second (FL2-German) and the third (FL3-French) foreign languages as the most significant in the European Union and the most common to study in Russian schools and universities. The results of the trilingual training prove that the process of learning a new foreign language within a single system on the basis of contrast and comparison with others, already learnt languages, is an effective tool not only for the formation of power engineering students professional competencies, but also for the sustainable evolution of multilingualism and multiculturalism.

Keywords: Educational multilingualism, multilingual communication skills, multilingual competence, multilingual engineers-to-be, language-mediator

Multilingualism and intercultural communication skills seem to be considered important for the employability of graduates all over the world. For example in New Jersey and Massachusetts (U.S. states), between 2010 and 2015 job postings have clearly demonstrated the multilingual career advantage since the demand for multilingual workers more than doubled [10]. In European countries 54% of graduates are able to hold a conversation in one additional language, 25% in two additional languages, and 10% in at least three additional languages [5]. If a graduate of linguistic or technical university wants to be attractive in the international labour market [4], knowledge of languages can potentially lead to consensus on both personal and professional matters.

In this context the implementation of multilingual education into the educational process of the Russian Power Engineering Universities is a qualitatively new stage of foreign language education, coupled with the prospect of the synchronous interconnection of the Russian and foreign energy systems and the provision of the project with qualified personnel capable of international professional communication in the electrical power engineering sector. For Russia, the interconnection has a long-term strategic importance in terms of cooperation with European countries, integration into the European electricity market. Development Association project is a combination of research synchronously interconnected systems and numerical modeling of their operating conditions, provided that countries generally main-

tain ownership and operation standards. At the same time maintaining an adequate level of reliability and sustainability of energy systems was and is the main prerequisite and the most important task to be solved by the joint efforts of engineers who need to have not only the general professional skills, but also the ability to conduct multilingual cross-cultural communication to achieve effective cooperation with the partners from the foreign countries. The increase in professional collaboration and interaction in the field of power engineering foreseen within and beyond European countries [11], begs at least one crucial question of interest today: Are Russian engineers-to-be linguistically prepared for these endeavours to a sufficient degree?

In order to answer this question let us turn to the term of multilingualism which is usually defined as a redesign of how we think about languages that takes into account 'the complex linguistic realities of millions of people in diverse socio-cultural contexts'[20]. It is also understood as 'the ability for institutions, groups and individuals to engage with more than one language in their everyday communication' [5].

Multilingual education is, at its best, (1) multilingual in that it uses and values more than two languages in teaching and learning, (2) intercultural in that it recognizes and values understanding and dialogue across different lived experiences and cultural worldviews, and (3) educational in that it draws out a special knowledge which 'students can apply in their society – locally, nationally, and globally' [12].

Thus, multilinguals are not just those who have an equal and perfect knowledge of their languages but, rather, those who use two or more languages in their everyday lives [8]. So, the social nature of the modern multilingual education is to build not just a language, but a general socio-cultural competence. For this reason, the respect for native cultural heritage and the perception of valued elements of others through the dialogue of cultures is the main way of human civilization evolution in the era of globalization. Therefore, each lesson of a foreign language is an intersection of cultures; it is the practice of intercultural communication, which results into the certain concepts about another culture, from euphoric and illusory, to reliable and adequately acceptable. To learn another language is one of the best ways to recognize the world and to see how others and otherness inhabit it. It is an education in difference as a pathway to understanding how to contribute to [...] global citizenship [18].

Since today's engineering students will form the part of the future global society and will have to interact on the global professional arena, they need languages [1]. That is why foreign language communicative competence is one of the basic, key competencies for technical students, conceived as an independent unit in the structure of general professional competence of the specialist. It allows the graduate to use a foreign language (bilingualism) or several foreign languages (multilingualism) as a means of information activities, regular replenishment of their professional knowledge, professional communication and professional culture [2]. This fact is confirmed in surveys of the Russian Moscow "Skolkovo" Management School and the Strategic Initiatives Agency, which undertook a large "Foresight Competence 2030" study [6, 15, 16]. It featured among the major professional competences of the XXI century such competence as: 'Multilingualism and multiculturalism' which includes English fluency and knowledge of a second foreign language; understanding of national and cultural context of the partner countries.

However, Russian graduates usually learn only one of the offered at the university foreign languages. This linguistic approach to language learning is definitely a lapse of general professional training that deprives future professionals of the opportunities to get a comprehensive multicultural development, and, therefore, reduces the degree of their relevance at labor market. So, in order to start the new educational policy of language teaching it is necessary to

harmonize a number of existing contradictions. The most important of them are:

- a contradiction between the social request for well qualified engineers with a high level of multilingual competence and insufficient development of multilingual teaching techniques, able to fulfill that social request;
- a contradiction between the need to develop students' multilingual communication skills and underdevelopment of the methods for simultaneous study of several foreign languages.

So, the objective of the following research is to address the role of English and other foreign languages for the development of multilingualism among the power engineers-to-be, to discuss the steps that Higher Technical Institutions could or should undertake for encouraging the multilingual competence development and, finally, to determine the main characteristics which multilingual engineers should strive to have for living and working in an increasingly multilingual and multicultural globalized professional society.

Materials and research methods

The experimental course of trilingual training for the future engineers of Ivanovo State Power Engineering University (ISPEU, Russian Federation) was provided by the experienced multilingual instructors of English, German and French with the aim to develop communicative, inquiring and intelligent young people who will have to create a better and more peaceful world of international professional communication through intercultural understanding, tolerance and respect. The first course students of four faculties (Heat Power Engineering, Electromechanical, Electro Engineering, and Physical Engineering) in the amount of 100 people were taught, and then tested on their ability to develop multilingual skills of 'translanguaging' [7] and cross-cultural communication.

Since in Russian educational system the first foreign target language is English and its role tends to be higher in comparison with other foreign languages, the authors of trilingual training used English as a mediation language while teaching German and French to engineering ISPEU students. A new experimental "*Multilingual Guide to the English Speaking World*" [17] served as a supporting workbook aimed at improving the multilingual skills of both Russian-speaking and foreign students in terms of educational trilingualism.

The novelty of this tutorial is seen in the introduction of the new system of simultaneous

multilingual studying of the English-speaking world realities, based on the possibility of linguistic mediation as a special kind of interactive activity, which allows students to develop a mediation competence of transferring the semantic contents of the texts from one language to the other, taking into account the cultural assumptions of the recipient.

The above-mentioned 'Guide' [17] is based on three postulates: firstly, on the principle of linguistic and cultural contrasts; secondly, on the idea of building the multilingual competence of the non-linguistic students; thirdly, on the methods of multiple languages simultaneous teaching which are built on the genetic relationship of taught languages and their comparison. So, it is based on a model of shifting to the second and third foreign languages by studying the linguistic and socio-cultural features of the language-mediator country in the context of the educational multilingualism.

Thus, during the multilingual training course the future engineers were immersed into the atmosphere of multilingualism and simultaneous learning of several foreign languages; learned the native professional culture and language in comparison with the foreign ones; used the English language as a mediator for switching to the second and third foreign languages (German and French); expanded the linguistic and country study horizons etc.

Research results and discussion

The following results were obtained at the end of the pilot multilingual training: 89.5% of students have successfully mastered the new technique, demonstrating excellent, good and satisfactory skills of language switching (45.5% of the students received excellent results, 32.7% of the pollee did well; 11.3% of the tested students achieved satisfactory results). Despite the fact that the engineering students result is not the most ideal, the positive dynamics of the sustainable multilingualism development is obvious.

The experimental results also prove that the students of technical specialties are focused on the evolution of bilingualism and formation of multilingualism and multiculturalism. However, they need a stronger motivation, new unusual forms of interaction, access to extracurricular classes, enhanced control of the assignments, and that is very important, the innovative teaching manuals aimed at the development of critical thinking, finding the language contrasts (similarities and differences), drafting the models and paradigms etc., inher-

ent in the technical mindset and perception of the world.

Furthermore, the professional features which technical students should master during the multilingual training course were determined in order to make up the multilingual learner portrait which can help individuals and groups become responsible members of local, national and global professional communities.

Following the aim to develop internationally minded engineers who recognize their common humanity, share guardianship of the world and help to create a better and more peaceful world of industrial cooperation, we worked out the Multilingual Learner Profile of Engineering Students, who should strive to be:

1. *Good communicators*: express professional interests confidently and creatively in more than one language and in many ways; master several languages and collaborate effectively, listening carefully to the perspectives of other specialists – representatives of partner countries.

2. *Multilingual mediators*: send information to the foreign-language recipient to obtain feedback in the sphere of professional communication; provide multilingual (interlingual and intercultural) communication between two or more interlocutors who are unable to speak to each other directly; serve as a tool to solve the professional conflicts or misunderstandings that are caused by differences in language and cultural representations.

3. *Multicultural thinkers*: study other cultures of the globalized society, inspired by the goal of becoming sensitive to the plurality of the ways of life, different modes of analyzing experiences and ideas.

4. *Tolerant*: appreciate native culture and history, as well as the values and traditions of other nationalities; respect the diversities of cultures.

5. *Intelligent*: develop and use conceptual understanding, exploring professional knowledge across a range of related disciplines; engage with issues and ideas that have local and global professional significance.

6. *Critical thinkers*: use critical and creative thinking to analyze and take responsible action on complex professional problems; exercise initiative in making substantive, reasoned decisions.

7. *Enlightened*: analyze a range of points of view and grow from the intercultural professional experience.

8. *Curious*: develop skills of professional inquiry and research; learn with enthusiasm independently and with others throughout life.

9. *Venturous*: approach professional uncertainty with forethought; work cooperatively to explore new ideas and innovative strategies of the development; be resourceful in the face of professional challenges.

10. *Multitaskers*: perform simultaneously multiple mental and manual tasks in the sphere of professional cooperation.

In the context of the XXI century, the elaborated Multilingual Learner Profile reflects a number of essential characteristics for engineering students to achieve in order to become the full members of the globalized professional society. For the purpose of creating the favorable grounds for the balanced growth and foreign language development of the engineers-to-be, multilingual teaching should become a necessary component of the modern engineering education.

The successful results of ISPEU students trilingual training proves that multilingual teaching can take place on the basis of comparison of the languages studied, allowing to determine the subjective difficulty of the linguistic phenomena of the second and third foreign languages through a dialogue with the native (for each student) language and culture. The results of this research also demonstrate that the second foreign language is learned more quickly and easily if the first foreign language appears to it as a support (a mediator). However, the level of the first foreign language should be high enough.

To show and prove to the students how surprisingly much they already know in a new, unfamiliar language, it is necessary to activate the existing but not yet relevant students' knowledge. The search and discovery of 'the familiar in the strange' [19] is grounded on two linguistic bases: the relation of the languages and the internationalisms (lexical units widely used in various areas of modern life). This language relationship plays a major role, as it allows the students to discover the familiar units at the linguistic and cultural levels.

Besides, multilingual teaching of the future power engineers can be connected with the dynamic model of multilingualism, which ensures the development of the related languages (such as English, German and French) on the basis of the main (first) foreign language. The first foreign language affects the ability to adapt to the system of each new foreign language [14]. It usually serves as the material for cross-language and socio-cultural comparisons, so despite the customary approach, language teaching should not be limited by learning vocabulary, grammar and translation

techniques. The program also needs to include classes on history, culture and traditions of the target language countries. This creates a positive students' attitude to the subject, as well as enhances their motivation to learn the new languages.

It is also noteworthy that multilingual teaching is a process of forming not only sustainable multilingual communicative competence, but also critical thinking, social, cultural and mediation competence of power engineering students. In modern multicultural world mediation skills seem an educational field of professionals' training as well as an important component on the individual's generic competences list [13]. By the way, for many scientists (Garzone, Rudvin, 2003; Valero-Garcés, 2004; Zarate, Gohard-Radenkovic, Lussier, 2004, etc.) the problems of language mediation is an important part of linguodidactics and it is studied in the light of professionally-oriented activities of the specialists in a multicultural context.

During the process of multilingual training of power engineering students a special environment is formed, in which three factors have mutual influence: the mother tongue, the first (FL1) and the second (FL2) foreign languages. Moreover, a fascinating atmosphere of multilingual thinking appears and helps to form a multilingual individual able to navigate in the diverse translanguing context.

Conclusions

The analysis of the situation in the area of power engineering education reveals that the responsibility of higher education institutions is to develop the professionals of the future – the ones who will have to ensure the sustainable development of the country. These young people – the engineers-to-be – must be multilingual, even if they do not have a sufficient level when they leave secondary education, the tertiary system must take over.

It is worth emphasizing that about eight years after the Russian language policy of mother tongue plus two foreign languages was introduced, there is still a long way to go before that goal has been reached for the majority of technical students. Academic and professional mobility has resulted in a much more complex linguistic landscape where English has obtained a special role of the generally accepted *lingua franca* almost in all spheres of life [3]. This fact has led many people to believe that English is enough for international communication, especially in the professional field, and there is no need to learn more foreign languages. Consequently, there is a dramatic fall in the

learning of foreign languages and the range of languages offered to and taken by the power engineering students is extremely limited.

It's evident that more research is needed to make clear how promote languages among non-linguistic students and develop their linguistic competence since engineers-to-be have a crucial role to play in the growth of their native country. It is the responsibility of the university leaders to ensure that their graduates are properly prepared to be part of the development – not only in physics, math, chemistry, electrical, civil, industrial, mechanical and etc engineering, but also when it comes to languages and intercultural communication skills.

Thus, for the formation of multilingual competence in the power engineering university it is necessary to create such a method of teaching that: would meet the principles of communicative, cognitive and activity approaches; would be an integral part of a program for teaching foreign languages; would be built on non-traditional approaches to training in line with the new educational technologies; would be consistent with the requirements of the XXI century and linguistic needs of university youth; would take into account the peculiarities of technical mentality and engineering students specifics.

In this article attempt made to prove that the process of learning a new foreign language within a single system on the basis of contrast and comparison with others, already learnt languages, is an effective tool not only for the formation of power engineering students professional competencies, but also for the sustainable evolution of multilingualism and multiculturalism. The development of functional multilingualism and students' multicultural thinking should be performed in line with the language mediation as a form of communication activity.

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ON RESONANCE TUNNELING OF ELECTROMAGNETIC WAVES THROUGH THE INHOMOGENEOUS MEDIUM WITH SMALL-SCALE INHOMOGENEITY

Gayurov Kh.Sh., Rahimova U.

Tajik State University of Law, Business and Politics, Khudzhand, e-mail: gayrov1964@mail.ru

An unidimensional task is considered about resonant tunneling of hertzian wave through a layer gases to the heterogeneous environment on an example to the ionosphere with the subwave structures of closeness of large amplitude. In hired a linear unidimensional task is considered about resonant tunneling of hertzian wave through the layer of gas to the heterogeneous environment on an example to the ionosphere with the subwave structures of closeness of large amplitude. The most simple situations arise up in case of hertzian wave in the layer of ionosphere without external magnetic-field or at distribution of hertzian wave across homogeneous external magnetic-field in magnetoactive gas. Shown, that simple situations arise up in case of hertzian wave in the layer of ionosphere without external magnetic-field or at distribution of hertzian wave across homogeneous external magnetic-field in magnetoactive gas. Then using for the wave field presentation of $E(x, t) = F(x)\exp(i\omega t)$, we get for a amplitude wave, equalization is Gel.

Keywords: ionosphere, subwave, amplitude, magnetoactive gas, tunneling, electromagnetic wave, reflectorless

Nowadays in many countries of CIS and abroad a great attention is paid to study of effective resonance tunneling of electromagnetic waves through mediums with small-scale inhomogeneities [1-3]. It was proved that in most cases it is a non-reflective passage of waves in various mediums through different layers of an inhomogeneous medium. Particularly, such cases such cases were studied through layers of plasma inhomogeneity in lack of external magnetic field [3-4].

An analysis, undertaken for a number of situations (for example, works [2, 3]) showed us that it is possible to establish non-reflective tunneling of electromagnetic waves from vacuum into inhomogeneous layer regardless of dielectric penetration at the border of division. Here we should underline that analysis of exactly-solved models allows us to advance significantly in our understanding of spatial-time dynamics of electromagnetic fields in inhomogeneous dielectric structures with a strong spatial dispersion.

In this article we studied a linear single-dimension problem on resonance tunneling of an electromagnetic wave through a layer of gases in inhomogeneous medium at the example of ionosphere with small-scaled structures. We can outline that the simplest situations emerge in case of electromagnetic wave (or flow of particles) passing through a layer of ionosphere without external magnetic field or in case of spread of electromagnetic wave across homogeneous external magnetic field in magnet-active gas.

Main equations and solution of them

According to the above-mentioned, this work implements exactly-solved model of Helmholtz equation and also studied non-

reflective resonant tunneling of transverse electromagnetic wave (or flow of particles) through a layer of inhomogeneous medium of gases with small-scale structures.

Thus, within the analysis of this work it studies standard relations between values of induction ($\mathbf{B}, \mathbf{H}, \mathbf{E}, \mathbf{D}$) in medium:

$$\vec{B} = \vec{H} - i\gamma\vec{E}, \quad \vec{D} = i\gamma\vec{H} + (\epsilon + \gamma^2)\vec{E},$$

where γ is small parameter of inhomogeneity.

While studying a wave of flow of particles across homogeneous external magnetic field for wave field we use standard presentation of $E(x, t) = F(x)\exp(-i\omega t)$, where ω is wave frequency. In this case we receive for wave amplitude $F(x)$ with Helmholtz equation [1]:

$$d^2F / dx^2 + k_0^2 \epsilon_{ef}(x) F = 0, \quad (1)$$

where axis x corresponds to direction of inhomogeneity, $k_0 = \omega / c$ is vacuum wave number, $\epsilon_{ef}(x)$ is effective dielectric penetration of gas. Thus, in case of wave spread in different layers of gas without external magnetic field we have $\epsilon_{ef}(x) = 1 - [\omega_{pe}(x) / \omega]^2$ where $\omega_{pe}(x)$ is electronic Langmuir frequency. In practice we see that during spread on unusual wave in magnet-active layer of gas across external magnetic field we can receive $\epsilon_{ef}(x) \equiv N^2(x) = \epsilon_{\perp} - (\epsilon_c^2 / \epsilon_{\perp})$. Here N is deflection index, $\epsilon_{xx} = \epsilon_{yy} \equiv \epsilon_{\perp}$ and $\epsilon_{xy} = -i\epsilon_c$ are components of tensor of dielectric gas penetration (for example, [4]). For the further analysis and simplification of problem we introduce variable $\zeta = k_0 x$ and size-less wave vector $Z(\zeta) = c k_x(x) / \omega$. Thus, exact solution of equation (1) is drawn similarly to [2, 3] as:

$$F(\zeta) = F_0 \exp[i \Psi(\zeta)] [1/z(\zeta)]^{1/2},$$

$$d\Psi/d\zeta = z(\zeta), \quad F_0 = \text{const.} \quad (2)$$

Then, considering (1), (2) in order to establish exactness of solution, value of effective dielectric penetration $\varepsilon_f(x)$ that is related to size-less wave vector $z(\zeta)$, obtains the following non-linear equation:

$$\varepsilon_f(\zeta) = [z(\zeta)]^2 + (d^2z/d\zeta^2)/2z - 0.75(dz/d\zeta)^2/z^2. \quad (3)$$

According to (3), in exact solution emerges a non-local relation between functions $\varepsilon_f(\zeta)$ and $z(\zeta)$, and it is a principal difference of it from classic solutions. Let us also introduce normed amplitude of wave $|F / F_0| \equiv A(\zeta) = [1/z(\zeta)]^{1/2}$. In this case formula (3) can be drawn as an equation for wave amplitude with $A(\zeta)$ with cubic non-linear effect

$$d^2A / d\zeta^2 + \varepsilon_f(\zeta) A - [1 / A(\zeta)]^3 = 0. \quad (4)$$

We should outline that non-linear equation (4) for the given function of effective dielectric penetration $\varepsilon_f(\zeta)$ defines spatial profile of size-less amplitude of electromagnetic wave. Let us point out the following: in case of homogeneous layer of gas, when $\varepsilon_f(\zeta) = \text{const}$, solution to equation (4) for the fixed wave length, in other words, actual equation of non-linear oscillator without dissipation with $\varepsilon_f(\zeta) > 0$ describes both spread of electromagnetic wave or flow of particles in gas with constant amplitude $A_0 = 1/\varepsilon_f^{1/4}$ and also spatially-modulated wave set with parameter that defines values of variations $A_{\min} < A < A_{\max}$ of amplitude A , besides, these variations can be rather large.

Further let us study non-reflective passage of transverse electromagnetic wave through layer of gas that occupies area $0 \leq \zeta \leq 3b$, on the left ($\zeta = 0$) and on the right ($\zeta = 3b$) is borders vacuum. As the simplest analytic model that automatically provides at the border of gas layer $\zeta = 0, \zeta = 3b$ conditions for non-reflective seaming of fields that fall from the vacuum ($\zeta < 0$) and distance to the right from gas layer ($\zeta > 3b$) as electromagnetic waves, we use the following expression for size-less wave vector $z(\zeta) = 1 - \mu [1 - \cos(\gamma\zeta)]$ where μ -parameter of problem ($0 < \mu < 0.5$), $\gamma = 2\pi / b$, b is parameter of gas layer thickness, further it is considered as $b = 20$. Included into this formula multiplier $[1 - \cos(\gamma\zeta)]$ provides for fulfilment of conditions of non-reflective seaming of fields of electromagnetic waves at borders gas-vacuum, specifically $p(0) = p(b) = 1$, $dp / d\zeta = 0$ while $\zeta = 0, \zeta = 3b$.

Let us introduce nominations $g(\zeta) = \mu \gamma^2 \cos(\gamma\zeta)$, $h(\zeta) = 0.5 / p(\zeta)$, $q(\zeta) = [\mu \gamma \sin(\gamma\zeta)]^2$. As a result, formula (3) for effective dielectric gas penetration is presented as:

$$\varepsilon_f(\zeta) = [p(\zeta)]^2 - g(\zeta) h(\zeta) - 0.75 q(\zeta) / [p(\zeta)]^2. \quad (5)$$

Numerical calculations show us that for $\mu < 0.49$ function $\varepsilon_f(\zeta) < 1$, and for $\mu > 0.44$ it is positive. In case $\mu > 0.44$, certain layers emerge in gas layer, in them $\varepsilon_f(\zeta)$ is negative, and, according to classic concepts, it corresponds to gas opacity [4, 5].

A more generalized variant of model of gas inhomogeneities can be drawn, for example [5], as the following model of size-less wave vector $p(\zeta) = 1 - \mu f(\zeta)[1 - \cos(\gamma\zeta)]$, where $f(\zeta)$ is a limited function (generally-speaking, random), $\gamma = 2\pi / b$ is parameter of gas layer thickness. Multiplier $[1 - \cos(\gamma\zeta)]$, included into this function, provides for fulfilment of condition of non-reflective seaming of fields of electromagnetic waves at borders gas-vacuum, particularly $p(0) = p(b) = 1$, $dp/d\zeta = 0$ при $\zeta = 0, \zeta = b$.

Research results and discussion

The received results can be studied as implementation of this function in dependence on parameters as well as calculation on the basis of computer programmes. Therefore, as an example we shall study the following variation of selecting function $f(\zeta)$:

$$f(\zeta) = [1 + \cos(2\gamma\zeta) - \cos(3\gamma\zeta) - 0.5 \cos(4\gamma\zeta) + 0.5 \cos(5\gamma\zeta)], \quad (6)$$

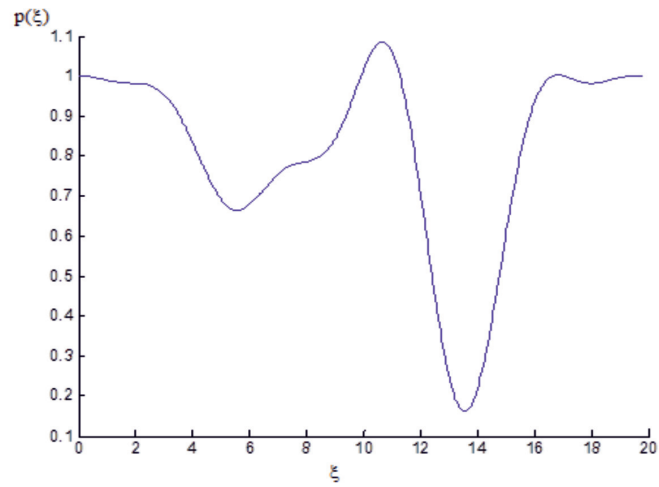
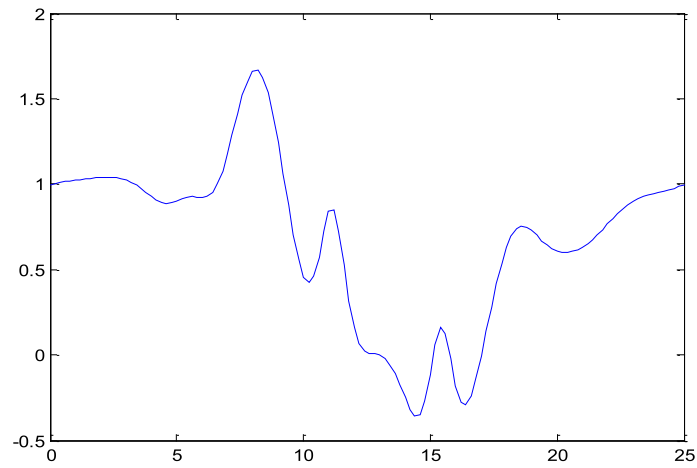
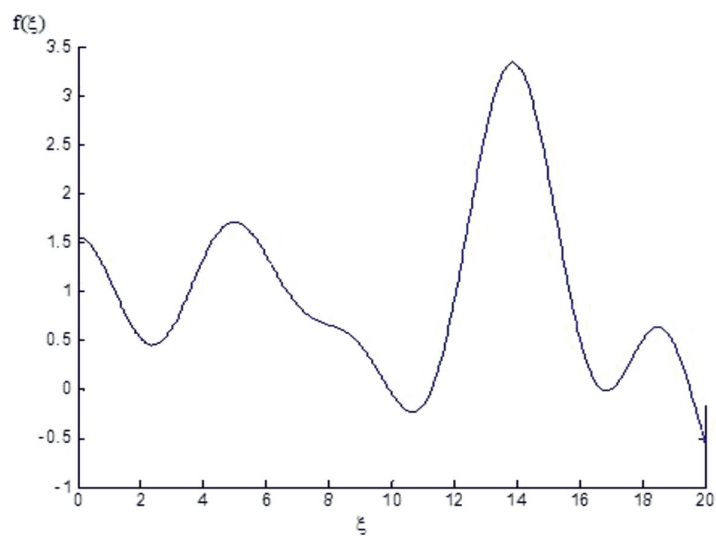
where μ is free parameter of the problem, and condition $f(0) = f(b) = 0$ is fulfilled. Using expression (5) we shall calculate through formula (3) effective dielectric penetration $\varepsilon_f(\zeta)$.

Let us study the variation of non-reflective interaction between electromagnetic wave with inhomogeneous gas layer with implementation of a more complicated function $f(\zeta)$, compared to expression (5), then

$$f(\zeta) = 0.125 \mu [1 - 0.25 \cos(\gamma\zeta) - 0.5 \cos(2\gamma\zeta) - 1.25 \cos(3\gamma\zeta) - \cos(4\gamma\zeta) - 0.25 \cos(5\gamma\zeta) - 0.5 \cos(6\gamma\zeta) - 0.5 \cos(7\gamma\zeta) - 0.25 \cos(9\gamma\zeta)]. \quad (7)$$

If we select these parameters, we receive variant of gases without external magnetic field, as well as certain graphs at the example of spatial profiles of dielectric penetration $\varepsilon_f(\zeta)$ of wave number $p(\zeta)$ and other parameters, these graphs are presented below.

As we can see in fig. 1, profile of wave vector also includes layers of opacity in which $\varepsilon_f(\zeta) < 0$. Let us outline that outside of layers of hybrid resonance there is correlation of maximum $p(\zeta)$.

Fig. 1. Graph of dependence $p(\xi)$ Fig. 2. Graph of dependence $\varepsilon(\xi)$ Fig. 3. Graph of dependence $f(\xi)$

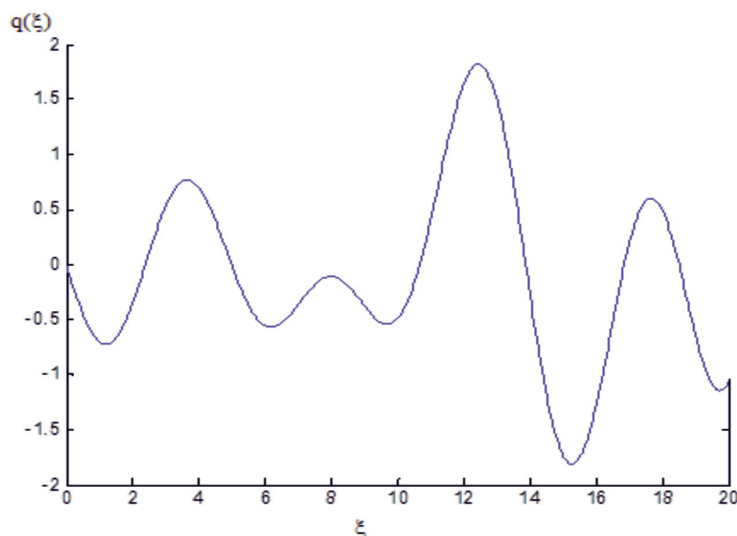


Fig. 4. Graph of dependence $q(\zeta)$

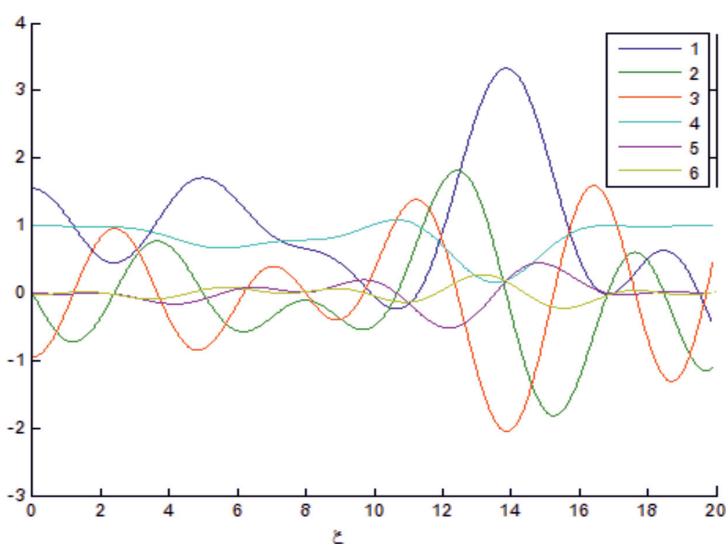


Fig. 5. Overall view of $p(\zeta)$, $\varepsilon(\zeta)$, $f(\zeta)$, $q(\zeta)$, totally 5 parameters

Since fig. 2 shows us that value $\varepsilon(\zeta)$ in inhomogeneous gas layer means that certain layers of opacity exist, in other words, spatial profiles of dielectric penetration $\varepsilon(\zeta)$, below zero it creates layers of opacity

As shown, in fig. 3, by changing function $f(\zeta)$ we can receive subwave structures for which non-reflective passage of electromagnetic waves through medium is realized.

As we can see in fig. 4, value $q(\zeta)$ is a dependence of effective dielectric penetration of different gases on wave number. Change in line of graph depends on parameter ζ

As follows from the comparison in fig. 5, in overall view, decrease in parameters b and μ results in narrowing in area of gas layer opacity, value of main minimum $p(\zeta)$ becomes slightly larger, and value of maximum $\varepsilon_f(\zeta)$ decreases several times.

Conclusion

The above-studied methodic of researching exact solutions to unidimensional problem through wave equation in terms of gas inhomogeneity can be of interest, for example, in regard to gas characteristics and electromagnetic

wave, falling from vacuum as instrument of significant improvement in efficiency of absorption of electromagnetic radiation in the area of gas resonance. Obviously, the problem of resonance tunneling of electromagnetic waves through a layer or certain barrier draws interest in terms of various practical implementation. The studied exactly-solved models can reveal new features in dynamics of wave processes in inhomogeneous gas, especially non-linear processes in terms of strong inhomogeneity.

Thus, in this work at the foundation of exactly-solved models we have studied non-reflective interaction between electromagnetic waves and inhomogeneous small-scale structure of gas layer. The problem has a number of independent parameters, particularly thickness of inhomogeneous layer, depth of modulation of dielectric penetration, etc. By changing these parameters and using method of calculation through computer programmes we can

receive graphs and a large number of completely – illuminated inhomogeneous layers with small-scale structures of gas layers.

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THE ATTITUDE OF THE RUSSIANS TO THE USA, GREAT BRITAIN, GERMANY, FRANCE, CHINA AND INDIA

Lymarev A.V., Talanov S.L.

Yaroslavl State Pedagogical University, e-mail: talanov_serger@mail.ru, avlymarev@gmail.com

The authors study the attitude of Russians to NATO countries (USA, UK, Germany, France) and also to China and India. A trend sociological study was conducted with an interval in time (in 2014 and in 2017) on similar samples within a single exponential population. It is revealed that the image of the United States in the social and political discourse of Russia is generally negative. The attitude of student youth to other countries is determined by their satisfaction with their lives, level of education, and gender characteristics. In addition, it was found that a significant part of student youth is negatively related to the United States, since in the materials of permanent columnists, in news articles, reports, newspaper and magazine articles about the United States, a negative image is created. At the same time, girls relate better than boys to NATO countries, but they treat China worse than boys. The authors propose the tools of "soft power", which the Russian Federation should use to raise its status on the world stage. In addition, authors are proposing the measures aimed at easing tensions between the Russian Federation and the NATO countries, as well as aimed at even greater rapprochement with such countries as China and India.

Keywords: "soft power", image of country, sociological surveys, values, students, universities, trend survey

According to positional experts, the leading countries of the modern world are the United States, Great Britain, China, India, Germany, France, and Russia. [1, 3] The assessment criteria are many, ranging from the level of GDP, CWP, unemployment, quality and standard of living, prestige of education, economic growth, up to the army equipment. It is possible to disagree with the opinion of experts in some ways, but, of course, those countries that are listed above have a huge impact on current events in the world. A lot depends on how these countries interact with each other. As a number of authors rightly point out that, more often citizens relate to a particular country better than the specific political leadership of a particular country. As researchers, it was interesting for us to find out how the attitude of student youth towards the USA, Great Britain, Germany, France, China, and India is changing among Russians. We conducted a sociological survey (survey) in 2014 and 2017, in the framework of which we found out the attitude of university students to the above countries.

Empirical base of research

A survey of students has been conducted at:

- Yaroslavl State Pedagogical University named after K.D.Ushinsky (YSPU);
- Yaroslavl State University named after P.G. Demidov (YSU);
- Rybinsk branch of the Russian Academy of National Economy and Public Administration under the President of the Russian Federation (RANEPА).

Quota sample. Sample set N = 820. Quota variables: gender, age, university

Content analysis of following magazines has been done:

- Russian Reporter (from 2013 to 2019);
 - Around the World (from 2013 to 2019),
- The content analysis of the weekly newspaper Version (2013-2019) has been done.

The content analysis of the blogosphere has been conducted as well.

A series of in-depth interviews with positional experts (political scientists, politicians, etc.) were carried out, n = 10.

Research hypotheses:

- a significant part of student youth is negative about the USA, since in the materials of permanent columnists, in news articles, reports, newspaper and magazine articles a negative image of the USA is created.

– Ukrainian crisis of 2013-2014 significantly affected the deterioration of the attitude of Russian citizens to such countries as the USA, Germany, France, United Kingdom.

– A small part of the student youth, in spite of everything, believes that it is necessary to build a constructive dialogue with NATO countries.

– A considerable part of the students express positive attitude to countries such as China and India.

The methodological basis of the research was the concept of "soft power" developed by the prominent American political scientist J. Nye [4], as well as scientific works of such authors as Koryakovtseva O.A., Lymarev A.V. Talanov S. L. and others [2, 5].

The results of the study and their analysis

In the beginning, we studied how our respondents relate to the United States, Britain, Germany, France, China and India. It was found that the best students' attitude is expressed to India. The worst students' attitude is

expressed to NATO countries, and the opinion from 2014 to 2017 has not changed fundamentally (Tables 1 and 2)

At the same time, female respondents treat NATO countries better than male respondents do. On the other hand, girls' attitude is worse for China than boys' one.

Content analysis of magazines: Russian Reporter and Around the World, newspapers Version and content analysis of the blogosphere showed that in recent years there has been a lot of negative information about the NATO countries.

Respondents could clarify their choices. So, when evaluating their attitude to the UK, students considered the incident of Salisbury (the Skripal case). The media constantly focused on this situation.

Considering that, from the point of view of respondents, the United States has a special role in the world in negative and positive processes, in our article we devote a large part to analyzing the attitude of students to the United States, as well as to India and China, which are the most interesting and important from the point of view of research data.

Further on, we studied why citizens of the Russian Federation have a bad attitude towards the United States.

Opinion of respondents is presented in table 3.

It is positive that, despite the events of 2014, sanctions, etc., the students in the surveys both in 2014 and 2017 believe that the

citizens of the Russian Federation treat badly not the citizens of the United States, but their government.

Further on, we studied why citizens of the Russian Federation have a good attitude towards the United States?

Opinion of respondents is presented in table 4.

Next, we studied, which qualities are inherent to Americans from respondents' point of view (Table 5).

As you can see, the responses in 2014 are not fundamentally different from those in 2017.

Next, we analyzed who must be blamed for the deterioration of Russian-American relations, according to respondents. The data is presented in table 6.

In 2014, students were less inclined to blame the Russian Federation for the deterioration of Russian-American relations than in 2017.

Further, we studied what forecasts our respondents make regarding the deterioration or improvement of relations between Russia and the United States. The data is presented in table 7.

In 2014, about 50% of students believed that relations between the Russian Federation and the United States would improve in the near future. The survey was conducted prior to the well-known events in the Crimea (referendum in 2014). Obviously, if the poll were carried out after the referendum and the annexation of the Crimea to the Russian Federation, the data would have been less optimistic.

Table 1

Attitude of Russians to the USA, Great Britain, Germany, France, China and India in 2017
(in %, out of total respondents)

	USA		Great Britain		Germany		France		China		India	
	Mal	Fem	Mal	Fem	Mal	Fem	Mal	Fem	Mal	Fem	Mal	Fem
Positive	31	42	38	52	29	51	26	54	74	50	80	84
Indifferent	13	10	11	11	6	18	5	19	6	9	12	16
Negative	56	48	51	37	65	31	69	27	20	41	8	–

Table 2

Attitude of Russians to the USA, Great Britain, Germany, France, China and India in 2014
(in %, out of total respondents)

	USA		Great Britain		Germany		France		China		India	
	Mal	Fem	Mal	Fem	Mal	Fem	Mal	Fem	Mal	Fem	Mal	Fem
Positive	33	46	39	53	39	53	42	56	78	52	82	82
Indifferent	12	7	13	11	17	18	16	19	8	10	11	18
Negative	55	47	48	36	44	29	42	25	14	38	7	–

Table 3

The answer to the question: “How do you think, why the citizens of the Russian Federation have a bad attitude to the United States?” *
(in%, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Citizens of the Russian Federation are not disposing badly towards US citizens, but towards their government	43	44	46	40	42	41
The United States interferes in the internal affairs of the Russian Federation	34	32	35	64	65	62
The USA seeks to divide the Russian Federation into many “principalities”	28	27	29	60	59	57
The USA wants to take all the oil fields in the Russian Federation	23	22	21	50	48	49
The USA every time dictates all countries how to live	19	20	18	23	24	22
Due to western sanctions	–	–	–	89	90	88
Others	6	6	5	5	6	5

Note: * The number of percent vertically is more than 100, because respondents could indicate several answer options.

Table 4

The answer to the question: “How do you think, why do citizens of the Russian Federation have a good attitude towards the United States?” *
(in%, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Citizens of the Russian Federation are able to find information on the Internet about real-world events	45	44	47	54	53	51
Citizens of the Russian Federation have repeatedly communicated with citizens from the United States and have a real idea of them.	32	34	30	27	28	25
Part of the citizens were in the United States, and have a real idea of the country	21	22	20	24	25	23
Others	5	5	5	6	5	5

Note: * The number of percent vertically is more than 100, because respondents could indicate several answer options.

Further on, we analyzed how, in the opinion of respondents, today the leaders of Russia should or shouldn't strive to improve relations with the United States? The data is presented in table 8.

In 2014, among the respondents were more of those who believed that the leaders of the

Russian Federation needed to improve relations with the US.

Then we studied, which country needed the good relations between Russia and the United States more – Russia or the United States? The data is presented in table 9.

Table 5

The answer to the question: "In your opinion, which of these qualities are most inherent to Americans?" *
(in%, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Egoists	30	29	30	31	32	29
Power-hungry	29	30	28	27	28	26
Rational	26	27	25	26	28	27
Brutal	20	21	18	18	19	17
Hypocritical	18	17	19	17	17	18
Secretive	16	18	17	19	15	16
Hardworking	16	15	17	16	15	18
Envious	14	13	15	13	16	15
Proud	10	11	12	10	13	12
Kind	5	6	5	7	5	6
Others	5	6	5	5	5	5

Note: * The number of percent vertically is more than 100, because respondents could indicate several answer options.

Table 6

The answer to the question: "In your opinion, have Russian-American relations recently deteriorated due to the policy of Russia or the United States?"
(in%, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Only because of the policy of Russia	44	42	45	58	55	56
Only because of the policy of the USA	35	36	34	26	25	27
The deterioration of relations caused by the policies of both countries	21	22	21	16	20	17

Table 7

The answer to the question: "Do you think that relations between Russia and the United States will improve, worsen or not change in the near future?"
(in%, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Will improve	52	53	50	29	28	31
Will not change	12	11	15	19	14	15
Will worsen	36	36	35	52	85	54

In 2014, there were more students who supported more active cooperation between Russia and the United States than among students surveyed in 2017.

Then we analyzed the role of the United States in the world from the point of view of university students of the Yaroslavl region. The data is presented in table 10.

Table 8

The answer to the question: “Do you think that today the Russian leaders should or shouldn’t strive to improve relations with the United States?”
(in %, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Should	80	79	78	63	65	67
Shouldn’t	20	21	22	37	35	33

Table 9

The answer to the question: “In your opinion, which country needs the good relations between Russia and the United States more?”
(in %, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Russia	77	75	73	63	60	64
Both countries in equal proportion	10	7	8	11	8	7
The USA	7	9	11	18	23	21
Neither Russia nor the USA	6	9	8	8	9	8

Table 10

The answer to the question: “What role does the USA play in today’s world?”
(in %, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
The USA play a positive role	40	42	39	32	31	33
The USA play a negative role	60	58	61	68	69	67

Table 11

The answer to the question: “Do you think the influence of the United States, China, India in the world has recently increased or decreased?”
(in %, out of total respondents)

	Survey of 2014			Survey of 2017		
	YSPU	YSU	Rybinsk branch of RANEPA	YSPU	YSU	Rybinsk branch of RANEPA
Influence of the United States						
Increased	32	30	35	22	23	19
Nothing changed	5	19	6	6	7	14
Decreased	63	61	59	72	70	67
Influence of China						
Increased	28	27	26	30	31	32
Nothing changed	12	14	13	15	16	14
Decreased	60	59	61	55	53	54
Influence of India						
Increased	28	27	29	65	66	67
Nothing changed	6	8	7	23	26	24
Decreased	66	65	64	13	8	9

As can be seen from the 2017 survey, the majority of students from all three universities believe that the United States currently play a rather negative role. When comparing with the 2014 survey data, we see that in 2014 there were more students who believe that the United States play a positive role in the world than in 2017.

Further, we studied how, in the opinion of respondents, the influence of the United States, China, and India in the world has recently been increasing or decreasing? The data is presented in table 11.

Comparing with 2014, students who believe that the US influence on world events is decreasing, their amount has now increased. Students had the opportunity to clarify their answers. So, 86% of respondents believe that new centers of power appear in the world, and this is most of all China and India. At the same time, these respondents believe that the role of the United States in the world will still be quite high, at least until 2030. After that India will have absolute leadership.

As part of our research, we conducted a series of in-depth interviews with positional experts. Next, we present some of their statements.

Positional Expert 1. "The Russian Federation needs to more actively present itself in a number of leading countries of the world. For example, broadcasting in Russian has been conducted in France since 1937. It is important to make broadcasts for our compatriots in all countries of the world, first of all, where the big Russian diasporas are".

Positional Expert 2. "Pay attention, for example, Radio Liberty broadcasts in 26 languages, not only in Europe, but also in Asia. It is important in economically developed countries, through the opening of their channels on television and radio, to conduct programs in the language of the host countries and thus inform the population of those countries about real events in Russia".

Positional Expert 3. "Russia is closing many non-governmental organizations on its territory, it is possible that some really need to be closed, if only within the framework of the information war. But it is important to open their funds in the territory of other countries. We must do what the authorities in Italy do, they have created a wide network of representative offices of the Italian Institute of Culture abroad".

As we can see, positional experts believe that the Russian Federation needs to more effectively use the tools of soft power, and bor-

row the experience of countries such as Italy, France and the United States.

Within the research the testing has been conducted, where it was studied how well respondents know about life in the USA.

95% of boys and 66% of girls know that the United States is a Federation, administratively divided into 50 states and the District of Columbia.

92% of boys and 89% of girls know the US political parties: Democratic and Republican. But testing showed that most students who took part in testing do not know how these parties differ from each other.

Unfortunately, none of the respondents know that in the US, in addition to English, some residents speak 300 different languages. 54% of boys and 38% of girls know that among the most developed countries in terms of GDP, the United States is the most religious country. 39% of boys and 32% of girls know all US holidays. At the same time, 87% of boys and 84% of girls know that on July 4, Independence Day is celebrated in the USA. 62% of boys and 87% of girls have an idea about the education system in the United States. The respondents have a particularly good idea about the higher education system. Respondents were able to list the best American universities. Absolutely all respondents, regardless of gender, know that the most prestigious university in the world is Harvard University. The respondents not only know the leading US universities, but were able to rank them according to the degree of prestige. So, among the main universities in the country they listed: Massachusetts Institute of Technology, Stanford University, Yale University, California Institute of Technology, Princeton University, University of Chicago. 56% of boys and 83% of girls have a good idea of American cuisine. 57% of boys and 73% of girls are aware of the core values of the United States. According to respondents, Americans respect the institution of the family, despite the large number of divorces.

Absolutely all respondents know that in the United States most of the population lives in cities and the most typical family is the nuclear family.

A gender imbalance has been identified, as 100% of boys and only 47% of girls know that so many Americans have military weapons at home.

34% of boys and 100% of girls know that US residents like to visit the museum, exhibitions and theaters.

Interviewees are very familiar with the musical preferences of Americans.

The situation is even better with movies. Both boys and girls know American actors and movies well.

12% of boys and 54% of girls are very well acquainted with the fine arts.

Young men (69%) are more familiar with the main features of modern American architecture than ladies (38%).

The respondents reflected fragmentary ideas about the housing of Americans. So, 63% of boys and 61% of girls are sure that the majority of US residents live in their own homes, when in reality more and more Americans prefer to live in their own apartment, rather than in the suburbs in their own home.

It was pleasant to know that absolutely all respondents know that the United States occupies a dominant position in the scientific sphere.

In addition, most respondents know the main news agencies in the United States. So, 98% of young men and 80% mentioned such agencies as Associated Press, United Press International, Bloomberg.

As part of testing, it was revealed that students who studied German and French have a fragmentary view of life in the United States, unlike those who studied English. Obviously, when studying foreign languages, a detailed overview of the life of countries is given.

Then we studied what ideas students have about life in Germany. In the framework of testing, we established the following:

91% of boys and 74% of girls know that Germany has a federal structure (16 federal lands).

Only 54% of boys and 12% of girls were able to list the main parties in Germany: Christian Democratic Union – the CDU, Social Democratic Party of Germany – the SPD.

55% of boys and 37% of girls correctly listed modern German politicians: Angela Merkel, Frank-Walter Steinmeier, Heiko Mas

87% of boys and 38% of girls know that Germany is one of the leaders in world exports.

67% of boys and 54% of girls correctly indicated in the test that Germany is the second country in Europe in terms of population.

32% of boys and 17% of girls said that a quarter of the population in Germany is retired.

The respondents know very well German scientists such as Kant, Hegel, Nietzsche, Heidegger, Schopenhauer, and others.

87% of boys and 98% of girls know that Hamburg has about 2500 bridges.

Only 33% of boys and 39% of girls know that in Germany the different dialects of the German language as a result, many living in

the north in Germany do not understand those who live in the south of the country.

The respondents showed a lower awareness of the higher education system in Germany than in the US universities. Thus, only 23% of boys and 19% of girls were able to list leading universities in the test, in particular, noted such as Rhine-Westphalia Technical University of Aachen, Mannheim University, Karlsruhe Institute of Technology, Technical University of Munich.

As part of testing, it was found that those students who studied German in high school have a clearer idea about life in Germany than students who learn English.

Only 23% of boys and 20% of girls know about major holidays in Germany.

The interviewed students showed excellent knowledge when answering alcoholic beverages in Germany and about the specialties of German cuisine.

Absolutely everyone who took part in the test admired German thoroughness, punctuality, thrift.

All students were able to easily list all German car brands.

Despite the fact that Germany is part of the NATO bloc, absolutely all students believe that this country does not pose a danger to the future of the Russian Federation.

Next, we studied how well the students know about France.

We found that 43% of boys and 58% of girls know that France is the largest country in the EU. Unfortunately, only 7% of boys and 12% of girls were able to correctly indicate that a quarter of the country's territory is covered with forest. Most of the test participants 78% of boys and 82% of girls were able to correctly note that the highest mountain in Western Europe – Mont Blanc (4 810 m) – is in the French Alps. Only 12% of boys and 18% of girls know that France covers 12 different time zones. This is more than any other country in the world!

It is interesting that most of the students know the largest cities in France and easily (without orographic errors) listed them. 67% of boys and 54% of girls correctly ranked the cities of France taking into account the number of population, namely Paris, Marseille, Lyon, Toulouse, Nice, Nantes, Strasbourg.

Only 48% of boys and 29% of girls were able to list the main parties in France: the National Front, the Union for the Popular Movement, the Democratic Movement.

When answering the question of the rivers in France, students had certain difficulties, so only 12% of boys and 13% of girls know

that the longest rivers in France are the Loire, the Seine, the Rhone, the Garonne. Only 5% of boys and 6% of girls were able to rank the rivers in descending order. It is surprising that absolutely everyone who took part in the testing knows the Seine River, although this river is not the longest river in France.

56% of boys and 89% of girls correctly noted that France is the most popular country among tourists. Girls know better about the sights of France than boys. The main attractions in the opinion of the participants of the testing are the Eiffel Tower, the Louvre.

43% of young men correctly indicated in the test that France once ruled almost 10% of the world's territories.

Gender imbalance identified: girls are better than boys know French cuisine and, in particular, the fact that France produces 1,200 different types of cheese. Young men are more informed about sportsmen and the development of sports in France, in particular, absolutely all young men who took part in testing know the world's largest cycling race – the Tour de France.

In addition, girls know better modern French writers. So, 87% of girls indicated that Frederick Beigbeder, Michel Welbeck, Bernard Werber, Anna Gavaldà are the most famous modern writers. The young men could not, within the framework of testing, write at least one contemporary French writer. 14% of boys and 90% of girls were able to list the writers of the 17-19 centuries, in particular, pointed out Pierre Corneille, Jean Racine, Jean-Baptiste Molière, F. Chateaubriand, J. de Stael, J. Sand, V. Hugo.

Only 23% of boys and 31% of girls correctly listed all major holidays in France. Despite the fact that a significant part of the students could not list all the holidays in France, absolutely all the students who took part in the testing, know the holiday "Bastille Day".

67% of boys and 68% of girls are equally aware of the best universities in France. Moreover, within the framework of testing, universities were ranked according to the degree of prestige. But absolutely all test participants know that the Higher Normal School (Paris) and the Polytechnic School are the most prestigious universities in France.

Absolutely all young men and 32% of girls know that France is in the NATO bloc.

It is encouraging that, despite the fact that France is in the NATO bloc, none of the respondents consider France a threat to Russia.

The part of students who study French is more knowledgeable about life in France than students studying Italian, German and English.

Next, we studied, as well, students know about life in the UK.

86% of boys and 58% of girls know that Great Britain is an island nation, besides being one of the largest states in Europe. 85% of boys and 14% of girls know that Britain has nuclear weapon, and as well as the Russian Federation, is a permanent member of the UN Security Council.

57% of boys and 42% of girls were able to list the main political parties in the UK: Labor, conservatives, Scottish national party.

It is gratifying that the majority of students, both boys (89%) and girls (87%), know the country's main newspapers: The Times, The Guardian, The Independent, The Daily Telegraph.

81% of boys and 61% of girls were able to correctly list the most famous people in Great Britain: Oliver Cromwell, Neville Chamberlain, Winston Churchill, Margaret Thatcher, Gordon Brown, Queen Elizabeth II.

64% of boys and 58% of girls were able to list the main cities of the country: London, Birmingham, Leeds, Glasgow.

69% of boys and 78% of girls know the main universities in the UK. Most of the students who participated in the testing were able to rank the universities in descending order of prestige. But absolutely all the students know two prestigious universities in the UK: Cambridge and Oxford, and all those who took part in testing know that these two universities are not only the most prestigious universities in the country, but also are among the top five universities in the world.

Absolutely all students are aware of the existence of one of the largest libraries in the world – the British Library in London.

Good knowledge was shown when answering the questions about monuments of Great Britain, and not only ancient, but also modern ones. So, 56% of boys and 87% of girls know that Hyde Park in 2004 opened the Memorial Fountain of Diana, Princess of Wales.

25% of boys and 73% of girls were able to list the main contemporary writers in the UK: Ian McEwan, Julian Barnes, Antonia Byette, Jonathan Coe, David Mitchell. It is gratifying that absolutely all students know English and Irish dramatist and poet Oscar Wilde.

23% of boys and 86% of girls have a good understanding of British cuisine.

At the same time, the students explained that the basic information about life in the UK is obtained in English classes and from the television program "Heads and tails", as well as from news channels.

Despite the fact that the UK is part of NATO, a significant portion of students do not believe that this country is a threat to the Russian Federation.

Next, we studied how well students know about life in India.

89% of boys and 74% of girls know that India is the largest country in South Asia and ranks second in population in the world.

57% of boys and 18% of girls know that India is a federal state, and is a parliamentary republic. Only 12% of boys and 7% of girls know that India is divided into 29 states and 7 union territories.

68% of boys and 57% of girls were able to correctly list the largest cities in India: Mumbai, Delhi, Bangalore, Calcutta.

Absolutely all students know that India is the most multi-ethnic country (more than 400 ethnic groups). In addition, all those who took part in the testing know that the largest city in the country is Mumbai.

It is interesting that absolutely all respondents know that India is the most multilingual country in the world.

Only 11% of boys and 6% of girls know the main parties of India: the Indian National Congress, the party of supporters of Indira Gandhi.

12% of boys and 67% of girls know that one third of India's population is vegetarians.

Girls know Indian cuisine better than boys. So, girls, unlike boys, know that the cuisine in India is divided into 2 types: North Indian (meat) and South Indian (vegetarian).

Girls who are addicted to yoga have shown very good knowledge about India.

27% of boys and 71% of girls have a good understanding of the Indian film industry.

93% of boys and 63% of girls know that motorcycles and motorbikes are the most popular transport in India.

87% of girls know that women in India are very fond of gold jewelry.

92% of boys and 90% of girls know that in India there is a big social stratification. Even in Mumbai, in the richest city in the country, there are a lot of poor people.

83% of youths were able to correctly answer that India has the third largest army in the world after the United States and China. Despite this fact, none of the students who took the test did not consider India a threat to Russia.

Next, we studied in testing how well students know about life in China.

Absolutely all students know that China is the largest country in the world in terms of population. In addition, everyone correctly an-

swered that China ranks third in the territory after the Russian Federation and Canada.

89% of boys and 66% of girls know that China is a permanent member of the UN Security Council.

92% of boys and 15% of girls know that China possesses nuclear weapons.

All students, regardless of the university, course and gender, correctly noted that the most famous politicians in China: Deng Xiaoping, Mao Zedong.

Absolutely all students know that China is currently the world's largest exporter of goods.

Absolutely all students, regardless of gender, know that China is among the five strongest economies in the world in terms of GDP.

68% of boys and 35% of girls know that China is a socialist state and the ruling party is the Chinese Communist Party.

63% of boys and 33% of girls were able to correctly rank the largest cities of China: Shanghai, Beijing, Chengdu, Wuhan, Tianjin.

Absolutely all students know about the main attractions of China: The Great Wall of China, the Forbidden City, the Temple of Heaven, the Summer Palace, the tombs of the Ming emperors, the Mausoleum of Mao Zedong.

47% of boys and 39% of girls correctly indicated that ping-pong is a national sport in the country.

82% of boys and 38% of girls know that China is one of the least religious countries in the world.

65% of young men and 73% of girls know modern writers of the country: Yu Hua, Yun Zhang.

Absolutely all participants in the testing know Chinese philosophy, which speaks about the quality of training in high school.

91% of boys and 98% of girls were able to correctly rank universities of China by prestige: Peking University, Tsinghua University, Fudan University, Hefei Scientific-Technical University.

Absolutely all participants in the testing are aware of Southwest Jiaotong University, where students and teachers of the YaGPU periodically do internships.

Students from YaSPU could easily list the directors of China: John Wu, Jackie Chan, Liang Qiao, Jia Zhanke, Yuyan Zhenyang.

It should be noted that the excellent knowledge of China was demonstrated by students who study Chinese at the Yaroslavl State Pedagogical University (YSPU). This university is preparing Chinese teachers. In addition, teachers from China systematically teach at this department. YSPU teachers also purposefully visit universities in China, where Chinese

students give lectures. Students from YSPU periodically study in universities of China.

Testing has shown that students from YSPU are best informed about life in China. Second place took the USA and Great Britain, and France and Germany are on the third place.

Students from YSU and Rybinsky (Orlovsky) branch of RANEPa know better about life in the USA and the UK.

Conclusion

For harmonization of relations between NATO countries and Russia it is necessary:

- to purposefully allocate grants on a competitive basis for studying in the USA, Great Britain, Germany, France, China, India;
- at the expense of the Government of the Russian Federation to create appropriate structures that will systematically organize the festivals and days of American, German, French and other cultures;
- to develop humanitarian international cooperation;

– to hold periodically scientific and practical conferences on intercultural issues;

– to work more actively with various target groups in the USA, UK, Germany, France, China, India;

– to invite systematically well-known teachers and politicians from the USA, Germany, France, Great Britain, China, India to conduct public lectures to universities.

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PSYCHODIAGNOSTIC EXPERT SYSTEM OF STAFF REQUIREMENT

But A.N., Nazhimova N.A., Pavlycheva T.N., Kuligina N.O.

DPI NNSTU n.a. R.E. Alekseev, e-mail: fedor_ais@bk.ru

This article provides an assessment and description of the methods of preliminary psychological diagnostics of an applicant for a job vacancy and formulates recommendations on the structure of the expert system of choice for an applicant of a suitable position. The article describes the principle of the expert system, consisting of three main modules, the joint result are recommendations for choosing a suitable job for the contestant, as well as the characteristics of the personality and possible disorders and deviations from normal conditions. In the first module the predominant type of temperament is determined and the manifestation of qualities of other types is revealed. In the second module character accentuation is determined, as well as some individual personality traits that are character dependent. In the third module, the results of the first two modules are processed, followed by the output of the results of the system. An example of the work of the expert system with the issuance of characteristics of the person and recommendations on the compliance of the personality characteristics with the types of work and professions is presented. The direction and prospects for the further development of the expert system are proposed.

Keywords: expert system, psychodiagnostics, knowledge formalization

The success of a modern enterprise depends largely on the psychological characteristics of its employees. Often there are questions whether the personnel have been correctly selected, whether their basic personal characteristics meet the requirements of the work being done, whether they have the necessary level of knowledge and skills to be effective for the company. It is impossible to answer all the questions when you talk with employees, observing their activities or simply analyzing their past achievements. In such cases, the evaluation of employee performance should begin with a preliminary psychological diagnostic [1].

To simplify and automate the solution of problems associated with effective recruitment, it is proposed to use a psychodiagnostic expert system with a modular structure. The developed expert system consists of three main modules, the joint result of which are recommendations on hiring a job seeker containing preferred activities of the test person, characterization of personality characteristics and possible disorders and deviations from normal states.

The starting point in complex psychological diagnostics is the temperament determination module [2]. In this module A.N. Below's method is used, which allows to determine the predominant type of temperament and identify the percentage of different qualities of other types. Tests are performed of 20 questions in 4 blocks for each type of temperament.

After determining the sum of all points (A), the percentage ratio of temperaments is calculated using the formula of A.N. Below:

$$T = \frac{A_h}{A} \times 100\% + \frac{A_s}{A} \times 100\% + \frac{A_f}{A} \times 100\% + \frac{A_m}{A} \times 100\%,$$

where T is the formula of temperament (integral temperament);

A – the total number of points of all types of temperament;

A_h – the total number of points corresponding to the qualities of a choleric;

A_s – the total number of points corresponding to the qualities of a sanguine person;

A_f – the total number of points corresponding to the qualities of a phlegmatic person;

A_m – the total number of points corresponding to the qualities of a melancholic.

Based on the data obtained, the percentage of points for each type of temperament is calculated from the total number of points and the values of variables for choleric, sanguine, phlegmatic and melancholic temperament are formed, respectively.

To visualize the results obtained, a graphic model is constructed showing the relationship between the four classical types of temperaments and the results of modern methods of a factor-analytical description of a person.

Indicators of the type of temperament in percent, obtained according to the formula calculated above, are deposited on the coordinate axes. Distance from the center of the axis indicates the severity of a particular type of temperament. All values of temperament indicators less than 30% are in an empty quadrangle, reflecting the absence of a severity of one or another type of temperament and corresponding qualities for it.

The second module of the psychodiagnostic expert system is the character determination module, which allows to determine character accentuation and some personality traits which depends on the character [3].

To determine the severity of accentuations is used a method for diagnosing types of character accentuations, published by G. Schmishek and being a modification of the method of studying the accentuations of the personality of K. Leongard [4].

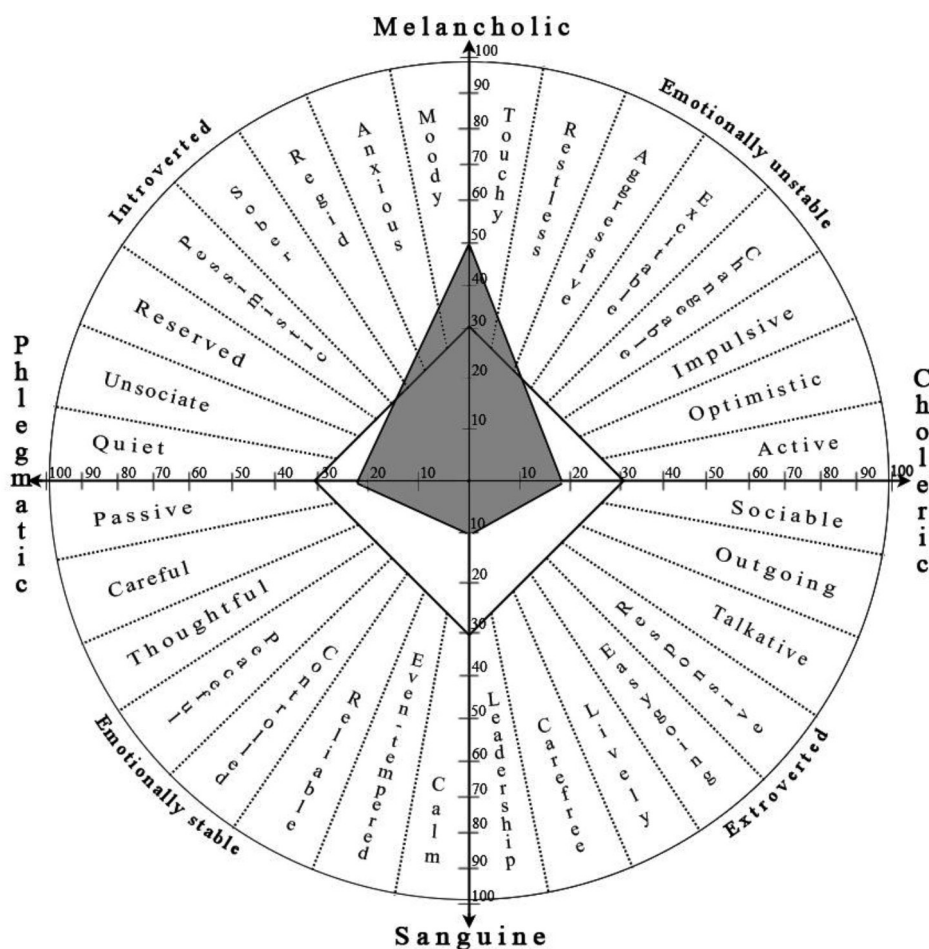


Fig. 1. An example of a graphical model showing the relationship of pronounced temperament types

K. Leonhard identified 10 types of accentuated personalities: demonstrative, pedantic, stuck, excitable, hyperthymic, dysthymic, disturbing, cyclothymic, exalted, emotive [5].

To determine the accentuation test is conducted, consisting of 88 questions. Then the indicators are converted using the appropriate coefficients according to the formula:

$$A = P * C,$$

where A is the total value;

P – the number of points scored in the test for this type of accentuation;

C – coefficient for this type of accentuation.

The coefficients for each type of accentuation are presented in table.

To visualize the results obtained, a graphical model is constructed showing the relationship between the types of accentuations and the severity of each of them according to the test results.

Coefficients of types of accentuations

Type of accentuation	Coefficient
1. Hyperthymic	3
2. Cyclothymic	3
3. Exalted	6
4. Emotive	3
5. Disturbing	3
6. Pedantic	2
7. Excitable	3
8. Demonstrative	2
9. Stuck	2
10. Dysthymic	3

On the coordinate axes, indicators of expressiveness of the types of accentuations in points, obtained by the formula presented above, are laid. The distance from the center of the axes indicates the severity of one or another type of accentuation.

The lines connecting the obtained points on the axes of the types of accentuations form a figure corresponding to the relationship of the types of accentuations of the character of the person being tested.

The model allows you to graphically display the test results, presenting quantitative indicators of the severity of all types of accentuations on one scheme, and thus visualizing the individual characteristics of a person's character. The considered example of the scheme is presented in fig. 2.

Along with the modules for determining temperament and character, the joint work of the solver who aggregates their results with the module of the formation of recommendations is of practical interest. Therefore, in the third module, the results of the work of the first two modules are taken and the obtained data is processed, followed by issuing recommendations for choosing a job suitable for a contestant, information and a predisposition to one or another type of work, as well as an extended characteristic of his personality [6].

When the applicant passes the test, the obtained values of temperament and character are recorded in the database. Further data processing takes place dynamically in a solving expert system based on production rules stored in the knowledge base. Then there is a comparison of the results of testing temperament and character with each other, as well as a comparison of the variables responsible for the severity of character traits among themselves, and recommendations are given on how to match the personal qualities of the tested vacant position. The structure of the expert system is presented in fig. 3.

Briefly, the work of the expert system and the sequence of results output can be represented as follows:

1. Identifying individual personal characteristics according to the results of tests of temperament and character. In the intermediate result is determined by the overall characteristics of the job seeker.

2. Establishing of the character's relationships accentuations and the indicators associated with them.

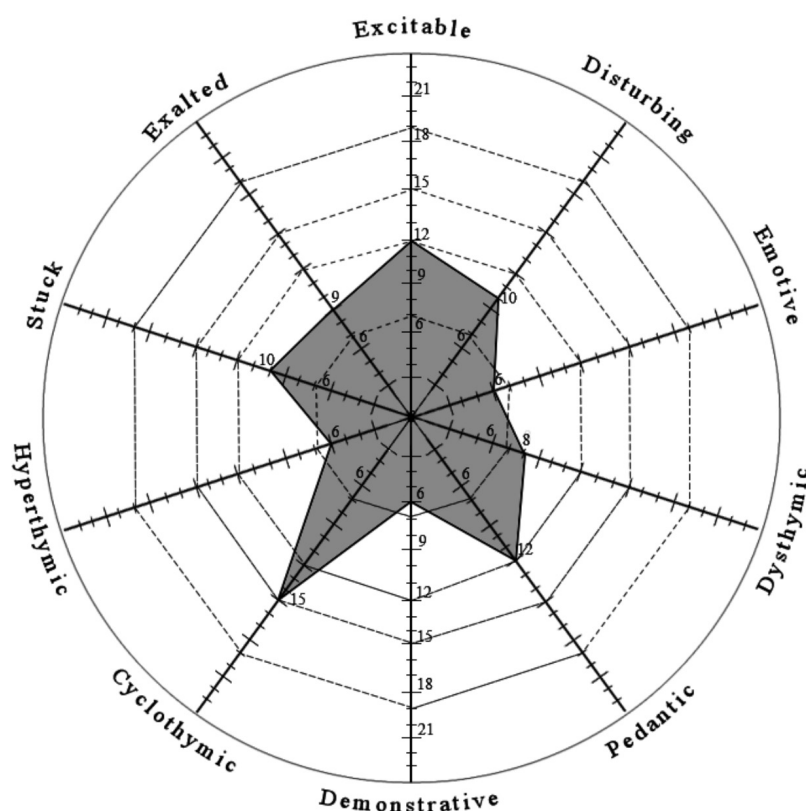


Fig. 2. An example of a graphical model showing the relationship of certain character accentuations

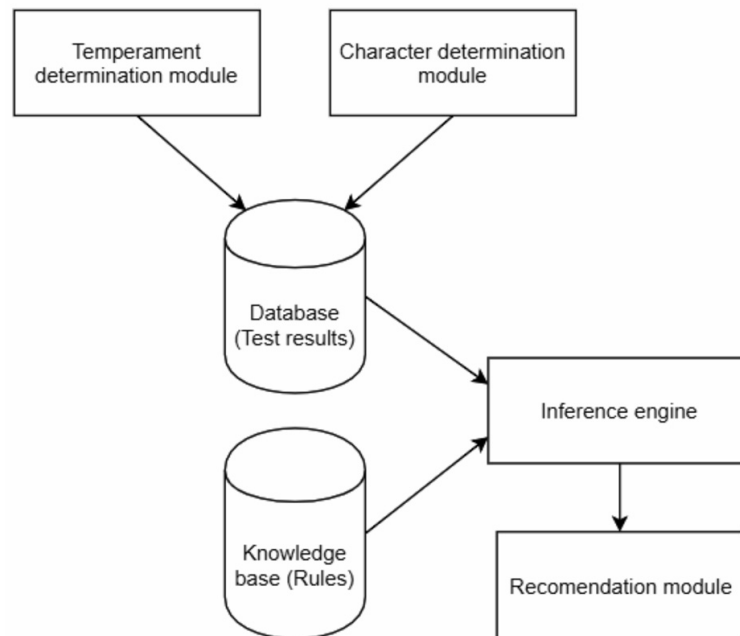


Fig. 3. Expert system's scheme

3. Identifying of indicators that depend on the relationship of temperament and character. Recommendations are formed for preferred activities and professions. Professions are grouping by type of temperament and character, each recommendation by profession is tied to a specific set of personality traits of the applicant. In other words, the proposed list of professions depends on the results of testing, both character and temperament.

In the future, after validation of the research and obtained rules by experts in this field, the improvement of an expert system is expected due to the intellectual processing of the collected statistical data on the results of testing more applicants.

It is also possible to conduct further research with the aim of expanding the expert system by adding additional tests and methods for identifying personal qualities associated with a predisposition to the types of professions and psychological characteristics that affect to work.

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MODELS OF WORK OF THE HEART AND CARDIOVASCULAR SYSTEM¹Arutyunov Yu.A., ¹Arutyunova E.Yu., ²Chaschin E.A.¹LLC "Double spiral, Moscow, e-mail: double-spiral@yandex.ru, ekaterina.arutyunova2001@gmail.com²Kovrov State Technical Academy, Kovrov, e-mail: kanircha@list.ru

The development of the software-hardware tools and technologies aimed at building a model of the heart in order to increase diagnostic efficiency is relevant in modern medicine. This is especially true in the direction of predicting the evolution of pathologies. The article analyzes and considers the possibility of expanding the diagnostic effectiveness of kinetic, hemodynamic and electrical models of the heart and cardiovascular system (which are already exist). Here we show that the further development of classical theories used to describe the electrical, bio, mechanical processes in the cardiovascular system will not significantly improve the diagnostic efficiency. This is due to the fact that classical methods do not take into account the effect of myocardial topology on the work of the heart and cardiovascular system. The necessity of a system-synergetic approach to the fundamental rethinking and revision of existing mathematical models describing the work of the heart and the cardiovascular system is shown. It should be done from the point of view of accounting for new, critically important qualitative properties and features of the myocardium of the heart, related to the effect of the myocardial topology on the work of the heart and the cardiovascular system.

Keywords: myocardium, model, cardiovascular system, topology, pathology, diagnostics

The development of the software-hardware tools and technologies aimed at building a model of the heart in order to increase diagnostic efficiency is relevant in modern medicine. This is especially true in the direction of predicting the evolution of pathologies [1]. It is known that for all areas of medical research, both applied and fundamental, modeling of the hemodynamic, physicomachanical and electrophysical characteristics of biological objects is integral part of these studies [2-3]. Currently, a sufficiently large number of models of the heart and cardiovascular system (HCS) have been developed. In medical practice, due to the high level of visualization of the studied structures, as a rule, geometric and physical models of HCS are used [4, 5]. However, due to the large number of possible states caused by both morphological and functional features, such models do not allow to take into account the extensive experimental material accumulated to date. Models that allow to describe the factors and parameters that are significant for the original object are more interesting. Such models of biological objects suggest the presence of three main subclasses, namely hemodynamic, kinetic, and electrical mathematical models. However, the classical mathematical models that describe the processes occurring in the HCS have limited practical application. The theoretical background is based on the postulate of myocardial homogeneity, and is limited to the construction of simplified models that do not take into account the physiological and pathophysiological influence of the phenomenon of myocardial topology. At the same time, a theoretical description of the HCS was set forth in [5, 6] and the problem

of mathematical modeling of the HCS was formulated, based on the recent discovery of scientists [4] which showed that the heart myocardium has the Mobius topology. It is argued that the construction of a mathematical model that reproduces the main functions of the HCS, taking into account such anatomy of the myocardium, provides hemodynamic, physical and mechanical and electrophysical characteristics of the HCS, physiologically real and close to the results of clinical observations.

At the same time, it should be noted that currently there is a significant progress in the technical characteristics and functionality of the ECG analyzers. They allow you to visualize informative components related to the field of chaotic dynamics, in particular low-amplitude measurements of the ECG signal in consecutive heartbeats. For example, there are known methods for monitoring myocardial electrical instability, for example, the MTWA method and a number of others, as well as foreign-made devices (CH-2000 from Cambridge Heart, CardioDM 06 from Heart View) and Russian productions ("KardioVizor-06c"). Their work is based on the registration and analysis of microvolt alternations, which have the form of a random process, and allows us to assess the propensity of the myocardium to develop certain pathologies in the analyzed lead based on the analysis of the dispersion of amplitudes of ECG signals. At the same time, the measured ECG amplitudes of micro-oscillations of electrical voltages in the range of 3 ... 20 μV are comparable in level with the noise signal of the surface ECG, which makes it difficult to analyze the severity of pathological changes in the myocardium. In addition, the recorded

fluctuations of electrical signals can be significantly distorted by the heterogeneous nature of the biological tissue surrounding the heart, which greatly complicates the accuracy of the analysis of the amplitude of the recorded electrical signal [7]. Due to these shortcomings, registration of electrical signals is not very suitable for early detection of pathological changes in the myocardium, despite its high sensitivity to electrical instability of the myocardium.

The aim of the study is to analyze the currently existing models of the heart and cardiovascular system, established during the formation of existing systems and methods for diagnosing pathologies based on the postulate of myocardial uniformity.

Hemodynamic model is one of the most famous models of HCS disease at present. [8]. Consider the features of modeling C in the framework of the concept of “myocardium new topology”. It is known [9] that the mathematical description of the flow of blood is based on the use of a system of equations, in which the formal record of a general form on each edge of the graph is:

$$\begin{aligned} \partial s / \partial t + \partial u s / \partial x &= 0, \\ \partial u / \partial t + \partial (u^2 / 2 + p / \rho) / \partial t &= F_t + F_{mp}, \\ S &= S(p), \end{aligned} \quad (1)$$

where S is the cross-sectional area of a blood vessel; u – linear blood velocity; p – blood pressure; t – time; x – length along the axis of each vessel; ρ – blood density $\rho = \text{const}$; F_t – external force for example gravity; $F_{mp} = -8pnu/s$ – force of viscous friction of blood flow against vessel walls; n – blood viscosity coefficient.

From the system of hemodynamic equations (1), consisting of nonlinear differential and algebraic equations, it is clear that the most convenient way to solve it is the numerical method. It is convenient to use software packages of mathematical modeling of objects for the implementation of numerical methods for solving systems of differential equations, such as hardware packages for computing systems like ANSIS, NASTRAN / PATRAN, ELCUT, etc. It should be noted that the listed hardware packages also allow to calculate, for example, non-Newtonian biological fluids (such as blood), to take into account the anisotropic nature of the medium (in particular, the physico-mechanical properties of the myocardium), the characteristics of the electromagnetic conducting media to account for the electrical properties of the myocardium. The use of ANSIS, NASTRAN / PATRAN, ELCUT hardware

packages makes the development and further complication of a theoretical model and system of equations (1) describing hemodynamic processes promising. This primarily relates to ensuring the operation of highly promising medical equipment, for example, a multifunctional ultrasound device for carrying out cardiovascular research, as well as to other medical devices using micro- and nano-electromechanical components. However, it can be seen that the mathematical model (1) does not allow to take into account the change in the kinetic viscosity of the blood during the cardiac cycle, as well as the difference and dissimilarity in the blood flow regimes, including, for example, the absorption effect of the flow of non-Newtonian fluid. Thus, the hemodynamic model currently cannot be used to solve problems associated with optimizing the blood flow regime in the HCS. It is necessary to additionally include in the system of hemodynamic equations the consideration of the hydromechanical properties and features of HCS for the solving optimization problems. In this case, the description of the blood flow regime, for example, based on the ANSIS and NASTRAN / PATRAN programs, will require the creation of a computational complex describing the hemodynamics of the HCS in the framework of the “myocardium of the new topology” concept in the form of a 3D finite-differential grid of the heart bloodstream. It should be noted that the creation of a hemodynamic model of the HCS with a program is possible on the basis of information obtained with the help of modern ultrasound diagnostic complexes. This will improve the mechanism of operation of electronic sensors, and other components of diagnostic equipment, which suggests that the model created will change the fundamental concepts in this area. Another well-known and no less common classical theoretical model describing the activities of the HCS is the kinetic model [10, 11], whose mathematical apparatus regards the heart as a kind of uniform object that creates pressure and reports blood kinetic energy [12]. Consider the features of the theoretical basis of the kinetic model. It is known that the main parameter of modeling in such a physicomachanical model is heart rate. Then the work of any of the ventricles of the heart in the interval of one contraction can be determined from the form:

$$W = QR + 0,5Qv^2/g, \quad (2)$$

where Q is discharge of blood from the ventricle; R – blood flow resistance; g – acceleration of gravity.

It can be seen that in the kinetic model (2) the work of the heart for one heartbeat in general depends not only on the transfer of a certain amount of blood in the arteries, but also is associated with the formation of elastic tension in the cardiac muscle. Within the framework of the “myocardium of the new topology” concept, this makes it relevant to develop a functional model of the heart. It should describe the physicommechanical processes for multi-frequency broadband electronic sensors when forming a beam for reception / transmission in multifunctional diagnostic medical devices for conducting ultrasound studies of the HCS.

As was shown above, one of the new directions in modeling processes and building a simulation model of the work of the HCS is based on the representation of the myocardium as a figure with the Mobius topology [13]. The consideration of the critical quality properties and features of the myocardium of the heart in the description of the work of the HCS allows us to consider the myocardium as a combination of a combination of a set of magnetic domains. This, in turn, makes it possible to link the biomechanics of heart muscle contractions and the hemodynamics of blood flow in elastic vessels in close interaction with electrically conductive processes that regulate HCS in general:

$$U = -0,5 \iiint_V \vec{J}_s \vec{H}_m dV, \quad (3)$$

where V is a magnet volume; J_s – magnetization; H_m – magnetic field strength.

The ideas about the structure of the myocardium in the form of a sheet rolled up in accordance with the Moebius topology raise the question of further studying the effect of coherence and orientation of the entire circulatory system and its conjugation with the heart, since the Mobius transformation is a composition of a finite number of inversions relative to spheres in Euclidean space $\bar{R}^n = R^n \cup \{\infty\}$. Moreover, the set of all Moebius transformations of space \bar{R}^n is finite-dimensional, and the subgroup composed of its orientation-preserving mappings is isomorphic [14]. The isomorphism of a subgroup made up of mappings is of particular importance in mathematical modeling in the framework of the transformer model of the heart. According to this model, the emission of the magnetic field created by the myocardium of the heart is described in the approximation that the myocardium of the heart is a magnetic core, which is formed by materials with an oriented domain structure. Indeed, it can be seen from (3) that for a space filled with magnetic

material with magnetization J_s , the magnetostatic interaction of separate volume elements inside a magnetized body leads to the presence of its own magnetostatic energy of this body, and the magnitude of the stray field H_m leads to the formation of spontaneous magnetization regions, i.e. domain structure. This allows us to consider the myocardium of the heart as a magnetic domain structure, namely, a set of regions in the magnetic subsystem of magnetic materials that associate the microscopic magnetic characteristics with their macroscopic properties. Thus, we accept during the mathematical description of the processes of formation in the myocardium of the magnetic field that the magnetization and the magnetization reversal is determined by the properties of the domain structure.

When transforming the topology of the magnetic circuit, a change in the magnetic field strength is observed. In particular, its change from a toroidal form to a form in the form of a Mobius loop is observed. This is caused by the effect of a change in domain orientation. It allows us to solve the problem of “visualization” of the internal structure of the myocardium of the heart according to the results of the analysis of the magnetic field strength. The amplitude values of the magnetic field strength differ for normal (twisted myocardium) and pathologies by up to 2 times. The reliability of the assumptions made (3) is qualitatively confirmed by the results of a physical experiment conducted in the form of clinical observations [15].

A new approach to modeling the HCS man, allows you to link together electro-biomechanical processes. This allows early diagnosis of the involvement of pathologies based on the assessment of changes in the characteristics of the functioning of the HCS. In this case, the CCC model can be represented as a 3D finite element model describing the physicommechanical processes occurring in the heart. It is based on the study and proof of the results of the following hypotheses: the spiral mode of oscillations is a significant characteristic of a healthy heart (this is the basis for early diagnosis of pathologies); the energy of a healthy heart is 4 times less than the energy of a sick heart (the configuration of a cylindrical ring is the basis for predicting the myocardial fiber deceleration); muscle stimulation of the myocardium spreads in the form of a solitary “compression-tension” wave.

The analysis of currently existing models of the heart and cardiovascular system, assuming homogeneity of the myocardium, showed interest in the revision and further

development of the classical theories used to describe the electrical, bio-, mechanical processes in the cardiovascular system. Taking into account the fact that the physiological and pathophysiological significance of the phenomenon of myocardial topology has not been fully studied yet, there is a high need for a system-synergetic approach to a fundamental rethinking and revision of the existing mathematical models describing the work of the heart and cardiovascular system in terms of the new, critically important qualitative properties and features of the myocardium of the heart.

Conclusion

Based on a practical approach to the study of electrical and mechanical functions in comparing the homogeneous and heterogeneous myocardium of the heart, the paper analyzes the existing mathematical models describing the work of the HCS. A distinctive feature of this approach is the possibility of identifying the need to take into account the physiological and pathophysiological significance of myocardial heterogeneity. The system-synergetic approach to modeling the HCS takes into account the synchronization between the various processes that form the electro-biomechanics of the functioning of the HCS, and this will make it possible to better match the local and non-local characteristics to the results of physiological experiments and clinical observations. This will contribute to the growth of efficiency and accelerate the adaptation of new modeling tools in clinical applications both for the diagnosis of cardiac activity, and for the development of electromechanical stimulants of cardiovascular system and target simulators for cardiac surgeons. Consequently, reliability will increase and the probability of effective surgical operations on the cardiovascular system will increase.

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AUTOMATED PROCESS OF SHIPMENT OF LIQUID PETROLEUM PRODUCTS FROM THE DISCHARGE RAILWAY TRESTLE

Fadeev D.A., Vadova L.Yu.

Polytechnic Institute of NNSTU, Dzerzhinsk, e-mail: fadeev.14atpp@yandex.ru

Today, all over the world, people are trying to completely clean gasoline from harmful impurities, increase its efficiency and increase the volume of complete combustion to reduce its harmful effects on the environment. One of the factors influencing the solution of these problems is the automation of technological processes. It contributes to the improvement of productivity, product quality, working conditions, safety and environmental friendliness, which gives great opportunities for research and experimentation. In the presented project, the process of shipment of liquid petroleum products from the discharge railway trestle is considered, which go first to storage, and then to the installation of catalytic reforming. The main task here, for an automated control system, is to diagnose and prevent the occurrence of accidents, as well as reduce the cost of the process. To achieve these goals, an automated control system is introduced, which is able to provide the best flow of the technological process, in contrast to manual labor and, thereby, to provide a solution to the task.

Keywords: Automation, liquid petroleum products, gasoline, storage, catalytic reforming facility

Here we develop and implement automation and control system for the process described above.

Shipment of liquid petroleum products is a dangerous process, because of following factors:

- petroleum products, in particular gasoline, is a flammable explosive volatile substance which exerts a general toxic and narcotic effect that can become a cause of death;
- increased vibration of moving machines and mechanisms;
- excessive pump noise;
- the threat of electric shock [1].

The introduction of an automation system for shipment of liquid petroleum products is necessary for solving the following tasks:

- increase the safety of the process;
- reduce the total cost of the process;
- provide an ability of the remote process control;
- reduce the impact of human labor on the process;
- counteraction and diagnostics of emergency situation.

Automated process of shipment of liquid petroleum products from the discharge railway trestle consists of the next stages:

- pumping gasoline from a rail tank to a storage tank;
- storage of gasoline for future use;
- pumping gasoline for catalytic reformer.

Now we take a closer look at all stages of the automated process of shipment of liquid petroleum products from the discharge railway trestle.

Stage 1.

The installation of pipe communications is carried out through which, with the help of a powerful pump, gasoline is transported from the railway tank to storage. There are also spare pipe communications with a separate,

emergency, pump. At this stage, the automation system controls the valves, continuously measuring the inlet and outlet pressure of the pump, the temperature of gasoline.

Stage 2.

Gasoline is stored in a storage barrel, where the level and temperature are constantly measuring.

Stage 3.

With the help of pumps gasoline is transported to the stage of catalytic reforming on pipe communications. There are also spare pipe communications with a separate, emergency, pump. At this stage, the automation system also controls the valves, continuously measuring the inlet and outlet pressure of the pump, the temperature of gasoline.

Initially, it is necessary to select the appropriate level of automation. The choice of local automation is not optimal, because such a system is characterized by low reliability and poor scalability. Based on this, the choice falls on the use of process automation at the level of APCS [3]. It uses microprocessor technology, which have some advantages:

- full automation of the process of interaction with information;
- formation of archives and reports;
- ability to communicate with staff;
- monitoring of devices, their operation and condition.

The main purpose of using process control systems for the process of shipment of liquid petroleum products – diagnosis and prevention of accidents.

The automation system, for the implementation of the goals, should perform the following functions:

- collection and primary processing of information;

– control of technological parameters, namely:

– automatic measurement of the flammability limit and activation of the alarm when that value is exceeded;

– registration of pressure at the pump inputs and discharge lines, activation of the alarm in case of deviation from the nominal values.

To perform such a range of functions in the designed automation system, it is advisable to use computer technology that means automation at the level of APCS is necessary [2].

Due to the large territorial distribution of controls and the presence of a large number of input-output signals, we decided to use a centralized control system. The main advantages of this system are:

– ensuring high coherence among the elements of the organization;

– improvement of control over the work of production departments;

– process controls by hands of those who are more aware of the general situation in the system;

– elimination of unnecessary duplicate control functions.

But, of course, that automation system has its own disadvantages, such as:

– it is necessary to spend a relatively large amount of time on the movement of information, that means that the possibility of loss or distortion of the information increases;

– the most important decisions are made by those who do not specialize in a particular situation.

The automated process control system consists of the following levels:

Lower level of automation.

This level includes sensors, measuring devices and actuators. It collects information about the parameters of the process, the state of the equipment and the implementation of control actions.

Criteria for selection of devices:

– ability to perform tasks;

– reliability of structural design and its compliance with the category of fire and explosion hazard of the process;

– high metrological characteristics.

Based on these criteria, we selected following devices:

– measurement of hydrocarbon vapor concentration in a mixture with air: stationary sensor – gas analyzer DGS ERIS – 230-IR;

– tank liquid (petrol) level measurement: non-contact radar level transmitter – Micropilot FMR 60;

– pressure measurement on pump discharge lines: absolute pressure transducer EJA510A;

– measurement of pressure at the inputs of pumps: absolute pressure transmitter EJA510A;

– shut-off valve for electric motor: stainless steel wedge gate valve with sliding spindle;

– electric motor for shut-off valves: IQ Pro multi-turn electric drive;

– spark protection barriers: Analog – BREEZE 420P-Ex, Discrete – BREEZE NAM-Ex.

Medium level of automation.

At this level, we provide automatic control and regulation of process parameters, start and stop of equipment, emergency response. The middle level is represented by a programmable logic controller (PLC).

PLC selection criteria steel:

– high MTBF;

– reliability of structural design and its compliance with the category of fire and explosion hazard of the installation;

– relatively inexpensive.

Based on these criteria, we selected the FCN-RTU controller which belongs to the STARDOM system controller line [4].

The advantages of the controller described above:

– wide operating temperature range (-40...+70C) and mounting height range (up to 3000 m);

– wide operating voltage range (10...30 VDC. input current);

– low heat dissipation, no need for active cooling;

– CPU self-diagnosis, temperature control, and other;

– support for hot-swapping additional modules (except CPU).

The FCN-RTU controller includes:

– base module NFBU050;

– power module NFPW426;

– the CPU module NFPC050;

– selectable input module NFDV151;

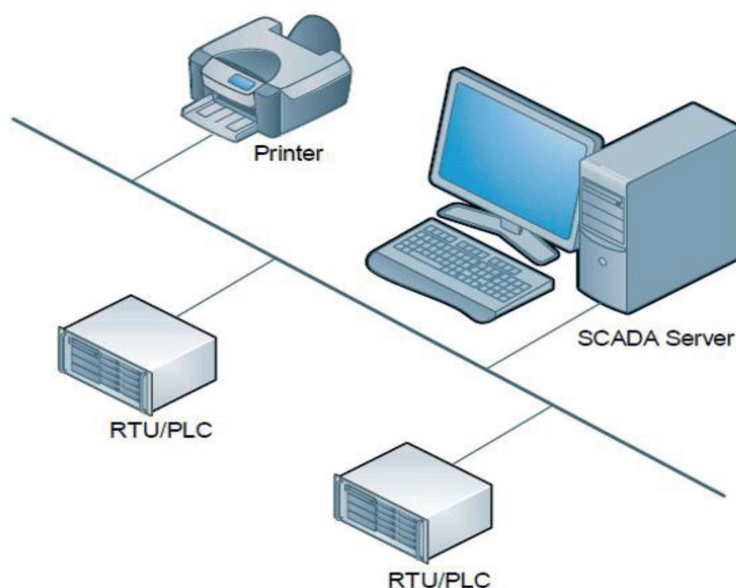
– discrete output module NFDV561;

– analog input module NFAI143.

High level of automation.

At this level, the APCS are able to visualize the system and the manager or operator can interact with it. First of all, the equipment of this level and the software performs the following functions: collection, processing, storage and delivery of information, depending on the requirements of the operator.

In addition, the system provides not only interaction with information relating to the parameters of the process and the operation of automatic safety, but also external interference of staff in the process.



Structure of the Standalone concept

With the help of software, we have an opportunity of a remote control of process and adjustment of parameters of SU is carried out.

In our case, the high level of the APCS is represented by the operator station (OS), implemented in the form of a personal computer (PC). OS connected to the controller by an Ethernet network.

Software.

For communicating with the controller FCN-RTU we used the system platform for real-time applications SCADA FAST/TOOLS (Flexible Advances Techniques System Tools/ System Flexible Advanced Techniques / Tools). It includes a web-based supervisory control interface, OPC client-server functions, data collection from numerous controllers and devices, alarm management and data archiving.

Type of communication:

- Ethernet;
- optical fiber;
- radio;
- wireless.

At the moment, there is a large number of possible configurations of the fast/TOOLS system for the implementation of work on a separate technological process, and on a huge, significantly geographically distributed

production. In the presented project, it would be enough to use the simplest configuration, called Standalone, where the runtime and development environment is on one machine (full-featured SCADA) [5].

The structure of the Standalone concept is shown in figure.

In the end, we made an economic calculation of the cost of implementing the automation system in the process of gasoline shipment. It showed that the use of such a system is beneficial for implementation.

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NEURAL NETWORKS ANR THEIR LEARNING

Ivanko A.F., Ivanko M.A., Sorokina P.E.

Moscow Polytechnic University, Moscow, e-mail: alekfed@mail.ru

Despite the fact that artificial neural networks became popular quite recently almost every day on the Internet we hear something new about their achievements. They are already actively used in many areas of human life. Thus, the action of such systems can be seen, for example, in online stores advertisements based on your purchases, text recognition, cell phone cameras, weather forecasts, in control applications using voice commands, and, of course, video surveillance systems simply cannot do without them. Otherwise in things without which our modern life is no longer possible. Since machines are beyond things like fatigue, diseases, and feelings that can distract ordinary people from their work, such networks learn quite quickly, efficiently, and can always show results. Maybe in some cases it will be wrong, but in time, after some learning, they will be able to minimize the possibility of mistake. The article discusses artificial neural networks, their main types of learning, and tasks to which systems trained in its various types can be applied. In the final part of the article, a conclusion regarding the current stage of development of neural networks and their future prospects is made.

Keywords: neural network, neuron, brain, neural system, learning

The human body is built in an incredibly complex way. Consisting of living cells, tissues, organs, and perfect systems, it never ceases to amaze with its ability to be constantly updated and to resist infections and diseases. Thus, every day we make about 10 thousand blinks, 29 thousand sighs, and the heart manages to make 100 thousand beats. One of the most important systems, thanks to which all the listed things and the life we are used to are possible is nervous. Consisting of two parts, central, which includes the spinal cord and brain, and peripheral, located outside of them, it not only coordinates and reconciles the work of all organs and the rest of the systems in the human body, but is the first one that responds to any changes in the external environment and is the basis of human mental activity [1].

The human brain is a complex structure that consists of a large number of neurons – the main functional cells of the nervous system, and their numerous processes. Connected with each other, they form a unified system. As a result, such habitual actions inherent only to a person, such as the ability to reflect, and even the transformation of thoughts into conscious speech, we take as something ordinary and proper. For centuries scientists have tried to disassemble all the processes of functioning and perception of the brain. Although at first glance it seems so simple, but in fact they are still trying to finally describe all the occurring in the brain processes.

Except the processes occurring in the brain, neurons – the main functional elements of the nervous tissue of the organism that permeates the entire human body – are responsible, including for movement in space and for the correct functioning of the senses, that is, for human interaction with internal and exter-

nal environment. The main functions of nerve cells are: obtaining information, for which dendrites, short cell processes are responsible; its processing, for which the neuron itself is responsible; and the subsequent conduction and transmission of information to the subsequent neurons, for which axons, the longest cell branches are responsible. When a pulse is supplied to a neuron that is sufficient to overcome the excitation threshold of a nerve cell, determined by the connected dendrites of neighboring cells, the signal is transmitted to the next neuron and the next one from it until the pulse is small enough for the neuron to ignore it. Thanks to the aforementioned processes that connect cells of the nervous system and synapses, junctions of the axon of one neuron and the dendrite of another, the nervous system forms, along which the impulses move, and the prototyping of which in the middle of the last century began to gain popularity and for many years ahead predetermined the development of computer technology.

Purpose of the study

So what is a neural network? It is a kind of learning system, created, as the name implies, in the way, similar to human brain neurons. This is a kind of its machine interpretation, which, acting on the basis of a specific predetermined algorithm, by analyzing the results of previous calculations and originally provided information, corrects the answer, minimizing the possibility of error in subsequent operations [2]. It is a kind of computing system that allows you to give the most accurate answer for given conditions.

In the early forties of the twentieth century, American artificial neural network (INS) theorist McCulloch Pitts proposed an artificial

neuron model that simply explains the basis of all neural networks, the basic functional unit of which is previously described ordinary neuron. In the simplified artificial architecture all the important functions of the original cell are saved. In that case, the synapse is characterized by its own weight and to determine the impulse needed to continue or attenuate the signal, the weight characteristic of an individual neuron is multiplied by the value of its input signal. Further, the value of each signal, due to the fact that several processes of other cells fit one neuron, is added to the other values, which happens in the so-called adder, which in our case acts as a replacement for the body of the original cell. After completing the addition, the final value enters the activation function, which compares it with the level of excitation of the neuron and decides whether or not to transmit the signal to the processes of the next cell. Of course, this model does not take into consideration many of the parameters of a normal biological neuron, which we have not previously mentioned in the description of its action, and the absence of which, according to some experts, affects the work of the artificial architecture, causing errors. For example, in a natural neuron important factors are the number of synoptic connections between two cells, how well these compounds are developed, where these compounds are located on the neuron's body, etc. But even without these parameters, artificial neural networks strongly resemble the usual nervous system.

The most commonly used neural networks today have a multi-layered structure, which allows us to achieve good results. Unlike single-layer ones, where signals from the input layer are immediately applied to the output layer, in multilayer ones everything is much more complicated. Created like the aforementioned model of artificial neural networks, they consist of an input layer that receives information, a hidden layer in which the network tries to find the correct coefficients, and an output layer that gives us the result. The existence of hidden layers at the same time and complicates the process of learning networks, and opens up great opportunities. So, in the case of their absence, the network simply remembers the input data, and as soon as it is given to the input, but slightly modified, the output signal can be very far from the truth, because the number of layers and their constituent elements directly affects the complexity of the calculated functions responsible for calculating and issuing the correct result. Further, the article speaks about networks with a multilayer structure. Research methods.

According to scientists, there are about 100 billion neurons in a person's head ($1 * 10^{11}$). Of course, this number is not entirely accurate, but it is as close to reality as possible. Even if humanity manages to create such a model, and a network with such a number of neurons will be constructed in the laboratory, the next equally important step will be to create multiple connections between them and to establish the correct weights for each individual connection, which is another problem [3, 4].

As we have said, these coefficients are needed to calculate the final function, which determines the signal level and is responsible for its subsequent transmission or attenuation. The process of finding correct coefficients is called neural network training, in result of which network performance and the quality of its output data are improved. In the very best cases, the process of adjusting the synoptic scales, or as we called them before, the coefficients, occurs every time as it goes to the correct answer. It is a training, to the consideration of which we have come a long way, and which is the main topic of the article, can occur with a teacher, and accordingly without it.

In the first case, the model is given a markup data set, it remembers the information provided, and subsequently compares it with new incoming data, and, based on the comparison, gives the answer. So, for example, a tagged data set depicting a different species of bird will teach her to predict the answer and distinguish the dove from the hummingbird in the future. This type of training is used if we have a huge amount of data, and all of them are completely reliable, which, unfortunately, not often occurs in practice. In this case, we give the system input, and the result we want it to achieve. The model must understand what result to strive for, and in the process of learning, after a long analysis, anticipate the answer.

In the second case, as well as in the previous one, the neural network is given input data for analysis, it remembers them, and comparing the criteria from the previous input data sequences with new information, it gradually develops its algorithm for predicting the answer, decreasing each time probability of error. A huge amount of information is initially loaded into the network, and the model is trying to find any regularities on its own without outside help.

Due to the fact that learning takes place in different ways, in most cases the results obtained by the first and second models will be radically different. In view of this, different tasks are given to networks with different learning methods.

For networks that have been trained in the first way, most often are given for solving the regression and classification problems. In regression problems based on the given features of the object, we want to predict any other quantitatively previously unmeasured feature. In other words, in the case of, for example, linear regression, we are trying to establish a relationship between one or several input variables and one final variable, trying to find a function that will approximate a set of initial points. In classification problems on the same input data, we are trying to predict not a quantitative, but a qualitative feature. So, initially, information about some “classes” is loaded into the system, and the network, based on examples of input data, should put incoming information into one of them [2, 5, 6].

In fact, all elements of the artificial network, in the case of this training, when input is a couple of reference input actions and desired output signals, interconnected using bidirectional channels, which makes it possible to use the inverse and forward propagation of error to find the correct result. In the first case, input data is given, then weights are corrected and a simple prediction of the answer is given, while in the second case everything is a little more complicated: like in any other training, the networks are fed with the data input, with their subsequent propagation in the direction of the outputs, and only after that, the calculation and the backward propagation of the corresponding error and the adjustment of the weights occur. It looks like a decomposition into a Taylor series, only we are trying to optimize not all the members of a function, but only the very first one [7, 8].

We now turn to learning without a teacher. For it, the most popular systems use tasks of:

- clustering. Here, comparing the input data, the model organizes and divides them into special groups – clusters. Similar data by the selected parameters are recorded in one cluster, similar in other parameters – to another. There is something similar to the classification task mentioned above, but it should be understood that in this case the network itself determines the groups into which the input data is divided, whereas in the previous one they were incorporated into the system initially.

- detection of anomalies. As you can see, here the system is looking for objects, the signs of which seem to it to be very different from the signs specified at the beginning of the program, or from the signs that the neural network has identified during work. The characteristics of these objects are not registered in the train-

ing set, and their detection becomes the main goal of this method.

- searching for association rules – when the system examines the input information and, on its basis, tries to recommend data that is similar to it according to some criteria. This is one of the most popular tasks in many online stores, when on the basis of purchases made, the system offers products similar to them.

- reduction of the dimension, or, as they are otherwise called, autoencoders, which encode the input information, and then decode it, receiving data as close as possible to the original information, which allows to reduce the amount of information while maintaining its basic positions [3, 4, 6].

Except of these two methods, of course, there exist all sorts of their combinations. Here it is necessary to mention training with reinforcements. To some extent, it combines the previous two methods. So, reminding learning without a teacher, an unallocated data set is given to the system, and it also tries to predict the correct answer itself, but when it finds it, we intervene and in some way encourage our model. The system itself chooses which answer to come to, but it stops only after finding the right option and receiving a reward. The network eventually learns from its mistakes, and better finds the right path and the appropriate answer.

In addition to everything listed in any network is laid a so-called loss function, which calculates the difference between real and received answers. It gives an efficiency mark of the quality of work, and shows how one or another weights are suitable for solving this problem. Gradual minimization of errors, respectively, leads to improved and closest to real output data. It turns out that the smaller this function, the better result the selected model will give. The simplest and most known loss function is the standard deviation, which shows the average degree of variation in magnitudes relative to its expectation [7].

Another of the important functions, which was already mentioned in passing earlier, is the activation function, which decides which number to transfer further. After counting all the signals, it should convert the received number to another one, processed by some pledged function, and already issue it as the result of the program. As you can understand, different activation functions are used for different tasks. One of the simplest functions is the single-hop function, the result of which can be only one of two integers: one and zero, which respectively mean positive and negative results. Here the

function compares the input value with some fixed constant, and simply says more or less of it was the number supplied. There is also a huge number of sigmoidal functions in which the input value is compared with the number obtained from the calculation of a complex formula. Among them, the logistic function and the hyperbolic tangent function are among the most popular. Here the network is not limited to two integers, and can give, in the first case, a fractional number in the range from 0 to 1, and in the second, a fractional number from -1 to 1. Despite the fact that the network should automate all the factors needed to find the correct output values, some of them are manually configured. For example, one of these important parameters is the speed of its learning, because if you choose too small number, the system will go to the answer for a very long time, whereas in the opposite case, it may not notice the correct answer and skip it, or find it, but remote from the arithmetic mean by a number close to the value of its error, which, of course, is also the correct answer, but which, with the correct value of speed, can be found and more precisely. These so-called hyperparameters, which, unfortunately, have to be guessed and corrected manually over and over again, also include the number of hidden layers and elements that make them up, which affects the complexity of the activation function mentioned in the previous paragraph and how its output will be close to real [8].

Scientists are going through all sorts of neural network architectures, trying to teach each of them. Based on this, they draw conclusions regarding a particular network or method of its training. Finding the right network architecture and its training are the main problems in creating a properly functioning neural network. As practice shows, small narrowly specialized networks, which are sharpened for one task, give a better result than those that have several specified goals. So in many sci-fi works, after creating a fully working neural network to facilitate a person's life, something is not going according to plan and leads to terrible consequences [9,10]. It would seem that the whole process should go through without various types of problems, but in fact, due to the fact that a wide range of possibilities may incorrectly influence the finding of weights and the creation of incorrect connections within the network, the neural network leads to incorrect results.

Conclusion

Of course, any cars have their drawbacks. For example, we cannot explain why a neural

network will give one answer or another, and how it came to it. We cannot even guarantee, with an absolute probability, the unambiguity of obtaining a result when re-entering the same data. But, on the other hand, the same network can easily adapt to changes in the environment, solve problems at an unusually high speed, and with unknown regularities of the input data. They are also potentially fault-tolerant – if suddenly the work in any neuron does not go according to plan – the performance practically does not decrease. It is better, of course, to correct the mistake, but if there is no such possibility, then it is possible to continue work under such conditions [11, 12].

Progress does not stand still and inexorably moves us forward. There is no sphere of human life in which neither now nor in the future can one imagine the replacement of human labor by machine labor. It is already clear that soon artificial neural networks will serve us well. They will be able to automate many processes, reach places that cannot be reached by people, help scientists, and simplify our lives.

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COMPARATIVE ANALYSIS OF TWO MOST POPULAR JAVASCRIPT FRAMEWORKS FOR MOBILE APPLICATION DEVELOPMENT

Ten T.L., Chernov S.S.

Karaganda Economic University, Karaganda, e-mail: chernov.home@gmail.com

This article presents a comparative analysis of two of the most popular Java Script frameworks for development of a mobile application such as Ionic 2 and React Native. At the very beginning, necessity of having mobile applications in modern times was considered. After that, the article explained a way mobile applications are distributed among their consumers. Then the author continues with a general explanation of the main functions of each of the frameworks. Furthermore, each framework's features will be discussed. Moreover, the way of writing the code using each of the tools will be also explained. Then we will focus on the debugging process for both Ionic 2 and React Native; look at the way how to work with styles; we will consider how the precise tool influences the size of the final application. Next, frameworks will be compared depending on their popularity. Finally, the conclusion will be provided in the form of a list of the main advantages and disadvantages of compared tools.

Keywords: mobile application, front-end framework, information systems, Ionic 2, React Native

The need for mobile data access speeds across the company's business processes. Mobile coordination of reports or approval of vacations is already a must have component of the work process in corporations. Every employee has a mobile device, so the company can use these devices without investing in them. A large variety of mobile devices must be considered when developing a corporate mobile application: it should work and have the same appearance on all devices. In this article, I will consider the creation of such corporate mobile applications using various Java Script frameworks.

Corporate mobile apps are usually distributed through the company's internal app stores. This makes it possible to control access to applications within the company, as well as forcefully install application updates. For the development and delivery of corporate mobile applications, an appropriate infrastructure, known as the Mobile Enterprise Application Platform (MEAP), is required.

For MEAP, there was conducted an analysis and a comparison of existing platforms and vendors by such leading companies as Gartner and Forrester (Gartner Magic Quadrant and Forrester Wave, respectively). All the leaders of these comparisons are considering the possibility of creating native and hybrid mobile applications. Native applications are written using specific platform programming languages (Swift or Objective-C for iOS, Java for Android). Hybrid mobile applications are written in JavaScript using various libraries and frameworks.

Using JavaScript frameworks allows us to create new mobile applications using the existing front-end development team. For the company, this means that the same team

can perform different tasks – website development, mobile application development. Therefore, it appears to be pretty beneficial for the both sides.

Among the leading frameworks, two of the most popular frameworks can be identified: Ionic 2 and React Native. Further, each of them is considered separately, and their comparison is carried out. The comparison was performed only for two operating systems: iOS and Android.

Ionic Framework is designed for creating hybrid mobile applications. It includes a set of Java Script and CSS components created on top of Angular 2, SASS and Apache Cordova. The history of this SDK begins in 2013, when the company Drifty Co. decided to create its own infrastructure for the purpose of writing hybrid applications, which was supposed to be focused on performance and built using modern web standards. Release Ionic 1 was held in May 2015. Version 2 was released in 2016. The main difference between the second release and the first one is the transition from Angular 1.x to Angular 2.x.

At its core, the Ionic Framework is an add-on over the very popular Apache Cordova framework, but with its powerful CLI (Command Line Interface) and extensive documentation. Following the principles of Apache Cordova, applications built with the Ionic Framework are hybrid HTML applications. Such applications are run in a special shell on devices (UIWebView for iOS and WebView for Android), which allows you to display HTML and execute JavaScript. Accordingly, when working in the application, the user works as if in a web browser [1].

Apache Cordova is a kind of layer between the user interface and device resources. Any

user interface widgets or MV* (Model-View) frameworks are not included. If you need to use UI widgets and / or MV* framework, then you need to select and include them into the application yourself, as third-party resources. Ionic 2 is one of the frameworks that provides UI widgets. The Angular 2+ framework provides the MVC model for it.

Native phone features (for example, camera, key store, GPS coordinates) are not accessible from a web browser. Therefore, Apache Cordova plugins are used to work with them. In addition to the official plug-ins, there are a number of third-party open source plug-ins.

React Native

React Native is a JavaScript framework developed by Facebook for creating native mobile applications using JavaScript. The history of React Native began in 2013 with Facebook's internal hackathon project. React Native was first publicly mentioned at React.js Conf in January 2015, in March 2015 at F8 it was announced that React Native is available on GitHub. The framework is built on top of the ReactJS library. React Native uses JavaScript API on top of native components. During the implementation of an application, developer writes JavaScript code that works with the native components of the operating system. That is, React Native uses the same fundamental standard UI blocks as regular iOS and Android applications without using either a browser or WebView / UIWebView [2].

An application on React Native uses a separate thread to execute javascript on the device. This thread interacts directly with native code. It is important to mention that native components (including user interface elements) are different for various operating systems. And, accordingly, for each operating system it is necessary to create its own "bridges" between the JavaScript code and these components. A number of such components are provided by Facebook, and there are also many freely available components developed by the open source community.

Ionic 2 vs React Native

Both Ionic 2 and React Native allow you to create mobile applications. The fundamental difference between these frameworks lies in the type of mobile application that is created using one or another framework. Ionic 2 allows you to create a hybrid mobile application that renders in WebView / UIWebView. If you need to use the platform API, you will need to use additional plugins. React Native on the other

hand allows you to create a native mobile application using the fundamental UI building blocks (like regular iOS and Android applications that are written in the native language Objective-C / Swift and Java, respectively). The application on React Native uses certain templates defined by the platform itself.

Application code

For creating an application on Ionic 2, the Angular 2 framework and Apache Cordova are used. The application can be written in JavaScript or any other language that is broadcast in JavaScript. The most popular typed JS superset is TypeScript, introduced by Microsoft in 2012 and positioned as a web application development tool that extends JavaScript capabilities, and most of the examples in the Angular 2 documentation are implemented in it. [5] Angular 2 implements the dependency injection design pattern (software design pattern), which consists of 3 elements:

- Injector – provides API access for dependency injection;
- Provider – describes how to create a dependency instance, has a marker pointing to the factory function that creates the object;
- Dependency – the type to which the created object belongs.

In addition, Angular 2 uses a component approach that allows you to separate business logic and things related to the UI. In addition, the separation is also used at the level of the project elements: HTML, JavaScript and CSS are kept in separate files.

In order to start writing an application on React Native you need to get acquainted with ReactJS, JSX. It is also recommended to be familiar with Redux and EcmaScript 2015 to speed up development, but knowledge of these components is optional.

You can also use Flow – this is a static code analyzer and a set of syntactic structures to directly indicate the type of a variable. Flow can calculate the type of a variable, without making changes to the code (unlike TypeScript), which allows you to start using it now in any project. It is possible to specify types in the TypeScript style independently.

In the process of writing an application using React Native, you create components that are self-sufficient, each component is responsible for changes in its state. There are stateless and stateful components. Components that do not have a state can pass properties down the component structure (props are set by the parent component and are fixed during the entire life cycle of the component) [3].

Debugging process

Debugging applications in Ionic 2 is standard for front-end developers. After running the application on the emulator / device, it is possible to debug applications using Safari web inspector (iOS only) or Chrome Developer tools. These tools provide access to HTML, CSS, and JavaScript. During debug, you can quickly edit styles, search for nodes in html, execute and watch the result of JavaScript functions, as well as network requests. In addition to running on a device or an emulator, in the case of Ionic 2, it is also possible to launch the application directly in the browser (ionic serve). This can speed up development, and with the help of the ionic serve --lab command, it is easier to test applications on different screen diagonals and platforms.

Ionic 2 has the Hot Reload option. It allows you to make changes to the code and see these changes on the device / emulator without rebuilding. However, it is not always possible to use it. Due to the fact that application is working in a web browser when using http requests, we encounter a CORS problem.

To debug applications on React Native, it is also possible to use Chrome Developer Tools. If development is conducted on Apple devices, then it is possible to use the Safari web inspector for an emulator or an iOS device. To view the items, you can select the "Show inspector" option in the Emulator / Device Developer Menu. At the same time, you can see the styles of elements, but changing them is possible only in the IDE (the method for quickly editing styles in developer tools does not work here). But using LiveReload or HotReload options within a few seconds, the saved changes will be reflected in the emulator / device. In case of global changes made, it is better to rebuild the project. Also, there is the Network Tab in the Developer Menu, which allows you to track HTTP requests. Here you can see the type of request, method, url, and more. It is kind of unusual if you got used to debug in the browser. For debugging,

you can also use IDE for each of the platforms – Android Studio and Xcode, that allows you to inspect in detail all the logs and operation of the application (resource consumption, speed, etc.) [4].

Styles

Ionic 2 is written HTML5 code and uses the familiar front-end developer SASS. There are no restrictions on dimensional units, the SASS preprocessor is used, you can also use flex markup. I often had to redefine Ionic 2 variables. But sometimes this was not enough, it was necessary to study the final html in the browser, see what additional elements were generated and what styles they had in order to understand what and where to redefine or add. Also, a significant difference was in the display of elements on different platforms. What looked good on iOS devices sometimes broke styles on Android devices, it was necessary to find compromises.

In React Native, the creation of styles differs from the usual for frontend developer. Here css-detailed syntax is used, which is written as a js object. Then this object with "styles" is transformed into understandable for the platform instructions on the location and coloring of elements.

Application size

For both frameworks, there are "empty" applications – these are application frameworks with minimal code. Such applications are generated using the CLI:

- Ionic 2: ionic start myApp blank --v2
- React Native: react-native init Awesome-Project

Empty applications were collected in two modes: debug and release. The first mode is designed for debugging the application, the second – for the direct delivery of ready-made applications to end users.

Applications on different frameworks have different sizes on different platforms. Ionic 2 wins on Android, and React Native wins on iOS.

Application builds sizes in different modes

	Ionic 2		React Native	
	Application in debug mode	Application in release mode	Application in debug mode	Application in release mode
IOS	18.3 Mb	17.9 Mb	4.8 Mb	4.6 Mb
Android	5.54 Mb	4.0 Mb	32.38 Mb	16.35 Mb

Popularity and activity of the community of the frameworks

When comparing the popularity of frameworks, you need to consider that React Native is a younger technology. Initially, React Native had support for iOS only. Android support in React Native appeared only in August 2015, and the Ionic Framework at that time was developing for more than two years (although it had version 1.0) and had the support of all popular platforms.

Popularity and activity were compared by the two most popular resources: stackoverflow and github.

For the Ionic Framework on stackoverflow, there are about 60,000 results for Ionic and Ionic 2. When considering statistics on the Github repository, it is important to note that in mid-2016, the Ionic 2 code migrated to the Ionic repository. In the Ionic repository, more than 200 participants made about 6000 commits in 15 branches with 88 releases. About 700 open questions and ~ 9000 closed questions are in the repository of the project.

For React Native on stackoverflow, there are about 25,000 results for react-native. Statistics on the Github React Native repository show that this framework is more active than Ionic 2: over 1200 participants made about 10,000 commits in 60 branches with 160 releases. The project repository contains ~ 1100 open questions and ~ 7000 closed.

Conclusions

Corporate applications for mobile devices, created using JavaScript, have occupied their niche. The speed of such applications is sufficient compared to applications written in native platform languages. In general, one cannot say that some kind of framework is better, and some kind is worse. They are just different. The choice depends on the tasks, the ultimate goal and many other factors. In general, we can recommend using Ionic 2 for rapid development of prototypes of mobile applications, and React Native – for the full development of ready-made solutions. Below is a list of the advantages and disadvantages of each framework, based on our impressions of using Ionic 2 and React Native.

Advantages of Ionic 2:

- a well-known set of tools – for a frontend developer, the set of technologies used is familiar, it significantly reduces the time to complete the task

- quick start – using the application templates provided to us by Ionic, you can create a prototype in a short time to show to the customer (we are talking only about the methods of the

frameworks described on the official websites, third-party Starter Kit were not considered by us)

- “Write once, run anywhere” – the written application works on all popular platforms, it gives cross-platform with minor code changes

Disadvantages of Ionic 2:

- stylization – changing the default styles to bring them in accordance with the layout significantly increases the time spent on creating and testing applications on different platforms and devices

- Browser use – longer application load and poor responsiveness when the CPU is loaded due to using the browser shell to simulate the behavior of the components of each platform

- native functions – when a native event occurs, the main thread is blocked and control is passed to the JavaScript code, waiting for its instructions, which can lead to unpredictable operation of native functions

Benefits of React Native:

- standard native UI blocks – the use of the fundamental standard UI blocks, like regular iOS and Android applications, familiar to the user from other native applications, facilitates user interaction with the application

- non-blocking javascript execution – javascript runs in a separate background thread, interacting with the main thread asynchronously

- styling – the application looks equally good on different platforms and devices

- load on the CPU – the tests carried out by the application using the CPU and memory show better results compared to the Ionic 2.

Disadvantages of React Native:

- the need to work with native code platform – it may be necessary to understand the components written in ObjectiveC / Swift or Java

- complexity of the start (without experience with ReactJS) – additional time is needed for getting to know React, JSX and a different writing approach (components as separate interface units that are responsible for their own state and behavior).

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