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Borodzich Eduard Vladimirovich

ABOUT MULTICELLULAR ORGANISM FORMATION

retired

Abstract

While admiring the achievements of genetics let's draw their attention to the following. If there is no any distinguished direction between 4π-strd possibilities of an object (subject), then it is optimally to limit it's shape by minimum surface. In this case a spherical ball should be formed instead of the predetermined 3-d multicellular organism. Given "predeterminedness" determined by heredity and three-dimensionality defined by anisotropy, there must exist distinguished three-pieces set of directions which form a coordinate system. The existence of such triples is indicated by centriol and sister chromatid movement to poles of the cell (dipole anisotropy) as well as chromosomes straightening near the equator in the M-phase (multipole anisotropy). It is also confirmed by the fact of "correct" eyes location on the "facial" (not the "back") side after the segregation of the blocks of the front and rear parts through dipole axis of emerging organism.

Thanks to nonzero square common parcel of dividing cell membranes the directions of coordinate system of initial cell can be saved and transmitted. Unit vectors in the equatorial plane and axis dipole prove to be unchanged. Between unicellular organisms new and initial cell coordinate systems are disoriented due to shared cells deviation and their relative non-progressive movement. It is obvious that one set of multipole anisotropy, moreover just three directions, is not enough for complex 3D-formed external and internal organs constructing. Additional directions may appear during dislocations, disturbance in cells, for example, due to nonsynchronous cell dividing. Since dislocation's coordinate system can not totally coincide with block's one there must exist at least one additional "free" direction.

Probably namely the variety of dislocations provides multiformity of multicellular organisms.

Organism forming permits temporary, spatially and mixed types of errors. The first type means violation in the dividing sequence (until its omission) which can lead to an organ's anomaly or absence. The second means transferring even correct sequences in the wrong direction which leads to creating excess organs and even versions of Siamese twins. The mixed type of error means the combination of the previous ones. These errors are often lethal.

We do not know where and how all triples all the coordinate systems are encoded, although segregational and genome genes show to DNA. This 3D spiral - "stairwell" contains $\sim 10^{10}$ "steps"-spaced $h = 2.4 \cdot 10^{-10}$ m. DNA is coiled over cell core with diameter $d \sim 10^{-5}$ m so that steps can be viewed from the core center under angle α , presented ⁵ Centre where the distance between the "visible" angle $\alpha = 2h/d \approx 5 \cdot 10^{-6}$.

Spatial resolution equals $\alpha^2 \approx 2,5 \cdot 10^{-11}$ on the sphere containing $4\pi r^2$ and one unit vector quantity is $K = 4\pi/2,5 \cdot 10^{-11} \approx 5 \cdot 10^{11}$. Rotating about the first the other unit vectors including non-orthogonal ones are «closing» $2\pi r^2$ what means multiplier $L = 2\pi/\alpha^2$ (without possible repetitions).

Taking into account M part and coordinate system doubling during segregation we can value possible direction $N = K \cdot L \cdot 2^M \approx 8\pi^2/\alpha^4 \approx 2^M \cdot 10^{20}$. Therefore, the DNA could encode enough coordinate systems to generate existing and even prospective multicellular organisms.

All stated above leaves open the question: what is orientation of the folded in the kernel into superspiralanizotropic DNA relatively its own coordinate system; as the daughter cells know "their" dividing sequences by directions, etc. Answers to these and related questions will multiply genetic advancements.

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Bukharina I. L., Kuzmin P. A.

DYNAMICS OF TANNIN CONTENT IN THE LEAVES OF WOODY PLANTS IN DIFFERENT PLANTATION CATEGORIES (ON THE EXAMPLE OF THE TOWN OF NABEREZHNYE CHELNY)

Udmurt State University

Branch of Kazan (Privolzhskii) Federal University in Elabuga

The dynamics of tannin content in the leaves of woody plants growing in plantations of different functional areas of the town has been studied. The participation of this metabolite in the formation of adaptive responses of woody plants to technogenic environment conditions has been shown.

Key words: tannins, woody plants, plantation categories.

The intensive development of industry and a growing number of vehicles lead to a very rapid decline in the living condition of woody plants because of their adaptive mechanism reduction.

Various metabolites, such as vitamins, enzymes, pigments, hormones, phenol compounds are involved in the adaptive responses of plants to the conditions of technogenic stress. Phenol compounds in plants perform protective functions. When the mechanical damage of tissues occurs, new intensive formation of phenol compounds with oxidative condensation in the surface layers begins and condensation products form a protective layer. Some phenol compounds are able to increase plant resistance to diseases [6]. An important chemical property of phenol compounds is their ability to reverse oxidation. They form a system and the elements of it are bound by mutual redox process. However, due to their ability to give and capture electrons easily, phenol compounds act as reductants (deoxidizers) showing (pro)oxidant properties [1]. Tannins refer to phenol compounds.

Thus, phenol compounds, especially tannins, are the important elements in forming the responses of woody plants to rising level of pollution, so we set a goal to

explore the features of dynamics of tannin content in the leaves of woody plants as part of the antioxidant defense system during the active vegetation period of trees in plantations with different level of technogenic impact (on the example of the town of Naberezhnye Chelny).

Naberezhnye Chelny is a town in the Republic of Tatarstan. The Republic of Tatarstan is located in the Middle Volga region where two major rivers, the Volga and the Kama, join in the area of sufficient moisture. The climate is temperate continental characterized by warm summers and moderately cold winters. The annual rainfall in the region is the average of 555 mm. The warmest month of the year is July (+18...+20 C), the coldest month is January (-13...-14 C).

Naberezhnye Chelny is a major industrial centre with the population of 530 thousand people. Mechanical engineering, electric power, construction industry, food and processing industries are the main industries in the city. The main enterprise of the city is Kamskii Automobile Plant. On the basis of the "Report on the ecological state of the Republic of Tatarstan" we gave the characteristic of the level of air pollution in the areas of growing woody plants. A comprehensive air pollution index (API) shows a very high level of pollution and excess of maximum permissible concentration of benzo(a)pyrene, formaldehyde, phenols and anoxides of carbon and nitrogen [7, 10, 11].

The object of study is tree species: box elder (*Acer negundo* L.) and maple platanoides (*Acer platanoides* L.), small-leaved lime (*Tilia cordata* Mill.), Balsam poplar (*Populus balsamifera* L.). The studied species grow in the town in various categories of environmental plantations: along highways (the major highways are Auto 1, Naberezhnochelninskii avenue and avenue of Mira) and the sanitary-protective zones (SPZ) of industrial enterprises. The main polluters of the town are plc "Kamaz": plants "Liteinii", "Kuznechnii" and "Dvigateli". The areas of Chelninskii (forest and steppe zone of 9539 hectares, forest and steppe region in the European part of Russia) and Elabuzhskii (coniferous and deciduous forest zone of 8996 hectares, mixed coniferous and deciduous forest region in the European part of Russia) forestry were

chosen as zones of conventional control (CCZ). The area of the city park “Grenada” was chosen for the alien species.

The sample plots were laid in a regular way (5 plots in each area the size of which is not less than 0.25 hectares). Within the test plot the selection (10 plants of different species) and the numbering of woody plants were carried out and their living condition was assessed [9]. The chosen species of plants were in a good living and middle-aged generative ontogenetic state (g_2). The soil samples were taken in the areas of the test plots [4, 5, 8].

The condensed tannin content in the leaves of woody plants was tested three times during the period of vegetation (June, July, August) using permanganatometric method (Leventhal method modified by Kursanov) [2]. The analyses were carried out in the Ecology and Plant Physiology laboratory of Biology Faculty of the Branch of Kazan (Privolzhskii) Federal University in Elabuga.

The statistical package “Statistica 5.5” was used for mathematical processing of the materials. For the interpretation of the materials we used methods of descriptive statistics and multivariate analysis of variance (by cross-hierarchical scheme with the subsequent assessment of differences by multiple comparison LSD-test). The agrochemical analysis of soil samples showed high content of organic substances, a very high content of available phosphorus and exchangeable potassium and high content of nitrate nitrogen and low content of ammonium nitrogen in the soils of the plantations in zones of conventional control (CCZ) of industrial enterprises and highways. The pH of soils is characterized as weakly alkaline.

The analysis of variance revealed a significant effect of species characteristics (the level of significance of $P < 10^{-5}$), a set of conditions of growing location ($P = 5.9 \cdot 10^{-5}$), the period of vegetation ($P < 10^{-5}$), as well as the interaction of these factors ($P < 10^{-5}$) on the tannin content in the leaves of woody plants.

In tested species the highest amount of tannins was observed in August in the leaves of balsam poplar and maple (1.53 and 1.60% respectively). In July the content of this metabolite in the leaves of balsam poplar growing in the Sanitary – protective

zones (SPZ) of industrial enterprises and along highways increases by 0.1 and 0.13% in comparison with its content in conventional control zones (CCZ) when $HCP_{05}=0.01\%$ (Table 1).

Table 1

Dynamics of tannin content in the leaves of woody plants in different plantation categories Naberezhnye Chelny, %

Month	Plant species			
	<i>Tilia cordata</i> Mill.	<i>Populus balsamifera</i> L.	<i>Acer platanoides</i> L.	<i>Acer negundo</i> L.
Conventional control zone ($HCP_{05} = 0.01$)				
June	0.61	0.72	0.88	0.72
July	0.95	1.10	1.16	1.17
August	1.23	1.53	1.62	1.48
Sanitary-protective zones of industrial enterprises				
June	0.59	0.73	0.86	0.69
July	1.11	1.20	1.06	1.05
August	1.13	1.53	1.56	1.33
Highway plantations				
June	0.58	0.75	0.84	0.66
July	0.90	1.33	1.03	1.15
August	1.16	1.53	1.61	1.31

By August the tannin content in the leaves of balsam poplar is aligned with the categories of plantations and amounts 1.53% which indicates an increase in the synthesis of this metabolite in the urban environment. The maple species have the opposite reaction. The *platanoides* maple and box elder from the beginning of the period of active vegetation in the plantations of the sanitary – protective zones of industrial enterprises and along highways significantly reduce the amount of tannins in the leaves in June by 0.02-0.04 and 0,03-0.06% respectively in comparison with the plantations in conventional control zones (CCZ), in July by 0.1-0.13% and 0.02-

0.12, in August by 0.01-0.08 and 0.15- 0.17%. These results indicate the performance of this intense metabolite and its possible involvement in the life processes of woody plants under technogenic stress. The general trend of metabolite dynamics in *Tilia Cordata* is similar to maple. But there is a difference. In July, the content of tannins in the leaves of species growing in the sanitary – protective zones of industrial enterprises increases by 0.16% in comparison with the plantations in conventional control zones (CCZ) and then in August it decreases by 0.1%.

All studied species of woody plants react to the increasing level of technogenic stress. The average data on condensed tannin content in the leaves of woody plants in June and August are shown in Figure 1.

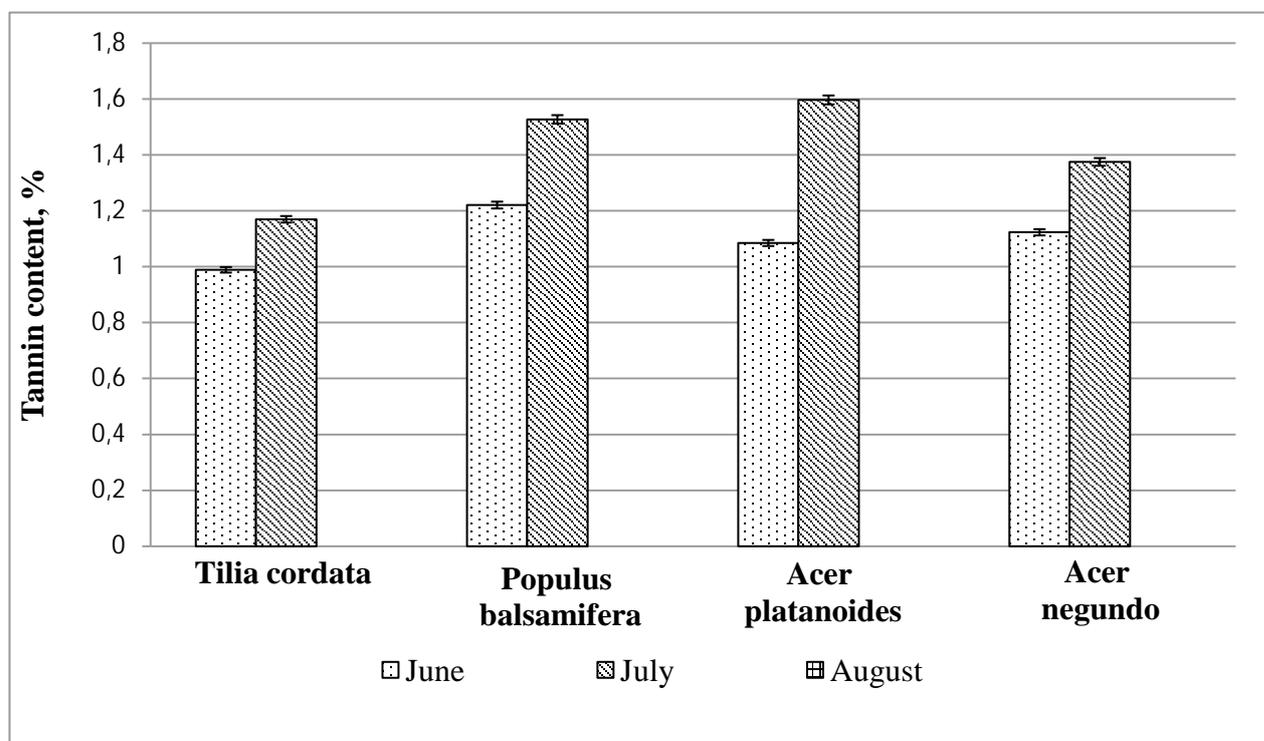


Figure 1. Tannin content in the leaves of woody plants during the period of vegetation

At the end of the active plant vegetation period in each of the studied plantation categories a significant increase of condensed tannins in the leaves of all tested woody plants is observed ($P < 10^{-5}$).

Thus, the content of condensed tannins in the leaves of tested woody plants increases during the whole period of active vegetation and it reaches its maximum value in August. And the amount of this metabolite was significantly reduced in

studied species (except for balsam poplar) in the sanitary-protective zones of industrial enterprises and along highways in comparison with the level of tannin content in conventional control zone.

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N.V. Repina, D.V. Repin

VOCALIZATION PROCESSES LATERALITY IN THE BIRDS

FOREBRAIN

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Work is devoted studying of hemispheric forebrain differences in cytoarchitectonic field Mesopallium of rock pigeon and gray crows.

Keywords: pigeon, crow, brain, neurons, glia, asymmetry, singing.

According to the modern concept of the structural and functional brain asymmetry, there are significant differences in the functions of left and right hemispheres of the brain of birds [1, 3, 4]. Currently, many species of birds found left-sided dominance gipoglossalnaya [3, 4]. The system of vocal control in birds consists of several centers, the highest of which is the field Mesopallium (M) [2].

However, there is evidence of functional asymmetry of the brain of birds, the materials on the structural differences between the hemispheres is extremely small. In connection with this research was to study hemispheric differences in cytoarchitectonic field M telencephalon rock pigeon and gray crows.

A study of the density of neurons distribution in males of both species studied revealed significant left-hemispheric dominance. In this case the gray crows asymmetry coefficient was higher than that of rock pigeon (0.114 vs. 0.097). Females have installed the same pattern, with the density of neurons in them was greater than that of males in 11,1-21,6%, and the asymmetry factor - smaller (0,045-0,046). In the area marked by the inverse pattern of neurons - the males were larger than those of females on 7,7-28,3%. Moreover, reliable interhemispheric differences were found only in male gray crows in the area of pyramidal and stellate neurons.

An analysis of the density distribution of glial significant left-hemispheric dominance is set, the most pronounced in male and female crows ($R_a = 0.108$ and

0.094) than the pigeon ($R_a = 0.068$ and 0.058). The value of this index was higher in females than in males in 12,2-32,0%.

All birds studied revealed significant interhemispheric differences in the density distribution of neuroglial complexes. Moreover, the asymmetry was most pronounced in male and female crows ($R_a = 0.139$ and 0.114) than the pigeon ($R_a = 0.090$ and 0.075). At the same time the share of large crows neuroglial complexes was greater than medium and small, and vice versa in the pigeon.

Thus, the study of M in all studied birds found left-hemispheric dominance for this indicator, the most pronounced in the gray crow, than a rock pigeon. Males compared with females revealed lower values for the overall density of neurons and glia and large values of the area of single neurons.

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Dyganova R.Y., Belyaeva Y. S.

**ALCOHOL INDUSTRY ECOLOGIZATION BY WASTE UTILIZATION
IN THE BIOENERGY FACILITIES**

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The possibility of using waste from the alcohol industry as a valuable raw material to produce electricity and thermal energy in biomass energy plants is estimated and experimentally substantiated.

Keywords: bio-energy facilities, alcohol waste utilization, disposal of sewage sludge, obtaining heat and electricity.

According to the authors the alcohol industry ecologization is possible with the use of biotechnology in several ways. The use of alcohol waste in the bioenergy facilities has been previously examined, that could allowed to put into practice the provisions of the Federal Law № 102-FZ of 21.07.2005, providing the full alcohol waste disposal and utilization. The yield of biogas per 1 m³ of alcohol stillage can make for a grain alcohol plant 60 - 70 m³, with a methane content of 70-75% [1]. In addition, the processing of stillage using bioenergy facilities could help to reduce water consumption of the company, because it does not require the additional use of water resources. Currently, the problem of stillage utilization is solved by the production of dry fodder yeast or drying and pelletizing it on the number of alcohol plants in the Republic of Tatarstan. On a large-scale biotechnological production the problem of a large consumption of natural water takes place. Consumption of natural water to produce 1 ton of dry yeast - more than 100,000 liters of water and more than 10 tons of steam. On the example of alcohol plant with capacity of 3000 dal/day can be estimated volumes of the annual water consumption for technological purposes in the processing of stillage. If the volume of production of dry fodder yeast 4134.955 tons/year, total water consumption is about 413,495,500 liters/year [2].

However, the alcohol industry enterprises, which have in their work cycle biological treatment facilities are faced with disposal of sewage sludge, which can also be used as a bioenergy feedstock plants.

Practice shows that companies operating wastewater treatment plants housing and communal services, sewage sludge can act as a valuable raw material to produce electricity and thermal energy in the bio-energy facilities. Operating experience of the working bioenergy plant on sewage sludge of urban wastewater treatment plant - JSC "Chelnyvodokanal" in the Republic of Tatarstan proves that 1 ton of raw material in fermentation biogas digesters is possible to develop from 10 to 12 m³, with a methane content of 60 to 70% .

The analyze of the prospects of the use of local waste water biological treatment plant (BTP) as the branch of JSC "Tatspirom" "Mamadyshsky alcohol plant" by adding bioenergy facilities is done. These BTPs are able to recycle up to 560 m³ of industrial and domestic wastewater per day. Industrial waste water generated in the development of alcohol on the cleaning and sterilization of fermentation tanks, with rectification of alcohol, cleaning and sterilization of process equipment gate separation, in the production of dry fodder yeast waste from alcohol production. Waste water from the distillation of alcohol at the outlet have a temperature up to 105 ° C, so before finally submitting to the biological treatment is cooled to a temperature of 30-35 ° C.

Industrial effluents contain significant amounts of dissolved, colloidal and suspended organic pollutants. Household waste water coming from the residential development and contain various inorganic and organic contamination (mechanical impurities, dissolved salts, fats, proteins, carbohydrates, etc.). The resulting precipitation in wastewater treatment plants at the facility of mechanical dehydration is dehydrated and stored at the sites of composting.

In order to determine the possibility of using waste activated sludge sewage of local treatment plants, the experiment on a pilot biogas installation in an accredited environmental chemistry laboratory of the department "Engineering ecology and environmental management" of KSPEU (accreditation certificate № ROSS RU 0001

517 412) was set up. The aim of the experiment was to determine the duration of the period of anaerobic fermentation of sewage sludge with an estimation of the total volume of biogas for the entire period of fermentation. The methane content in biogas was determined by gas chromatography "Kristallyuks – 4000M." The change of the volume of biogas was observed on the level of its accumulation in the experimental gas-holder. The experimental results were recorded daily with registration in tabular and graphical forms.

The duration of the experiment was 90 days and the total volume of biogas was 1760 ml from 3 liters of the substrate. The formation of biogas was observed on the second day after the loading of the substrate. The combustion of biogas methane content was fixed at 40%. Allocated gas was giving a stable flame with light blue color. The dependence of temperature in the experimental digesters on the course of the fermentation substrate was allocated. When the optimum temperature of 22 C decreases by 1-2 C that reduces the intensity of biogas production in the 1.5 - 2 times. During the first two months of the experiment the content of methane in the biogas production was increasing and reaching a maximum, after which the concentration slowly was decreasing.

Overall, the results that are cared out from the experiment confirm the possibility and prospects of using the waste activated sludge of biological treatment facilities of the local alcohol industries as a biological raw material for biogas production. The use of biogas facilities in biological wastewater treatment plants effectively in a number of factors: a small increase in the excess sludge in the digester; improve the water properties of digested sludge, safety in the course of the sanitary according sludge, production of large quantities of biogas, energy independence of enterprise, reduction energy costs and environmental payments, reduction of harmful emissions into the atmosphere, etc.

The use of biogas as a fuel can be carried out in the boiler plant, physical and chemical properties of purified biogas is almost identical to the natural, so it can be used to the fuel equipment, too, as for natural gas. From 1 m³ of biogas in the

generator can be accumulated not less than 2 kW of electricity. Capital expenditures for construction of biogas plants could be recovered within 1.5 - 2 years

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UDC 551.468 (262)

Shtshev V. A.

**THE MAIN REGULARITIES OF LARGE – SCALE CIRCULATIONS
GENERATIONS IN THE OCEANS AND SEAS**

Institute of Water Problems of RAS

This report examines the possibility of large-scale anticyclonic and cyclonic circulation formation in the oceans and seas under the influence of tidal forces of the Moon and the Sun.

Key words: large-scale anticyclonic and cyclonic circulation, tidal forces of the Moon and the Sun.

Since 60 years of the last century, oceanographers have started to register in the long-period ocean waves, first by changing the level, and then on the variability of speed and direction of currents.

It should be noted that the possibility of long-period waves formation in the ocean was first time shown by theoretical calculations: Kelvin waves (1880); low-frequency current fluctuations, called planetary waves and Rossby waves (1938),

long shelf waves, continental shelf waves, coastal-trapped waves, the equatorial trapped waves.

The main difference between the observed waves from the theoretically calculated it is that the observed waves have a large mass transport of water, while the theory shows that the mass transport of water in the wave is small.

So long-term of mooring currents observations in seas and oceans in the past 50 years show that the currents have a wave nature. Lappo S. S. (Director of Institute of Oceanology Russian Academy of Sciences in 1993 - 2006) based on analysis of the previous 20 years of observations (POLYMODE, MODE etc.). concluded: "Analysis of currents observations found substantial variability in the dynamic state of water, especially at depths exceeding 1000 meters, which is very sharply at odds with the existing theoretical concepts. These observations have led to a radical revision of ideas about the dynamics of the ocean. **Came the wave period in the study of the oceans currents**" [1]. This conclusion is illustrated by the author figure 1 (left), which shows the spectral characteristics of current velocity at three depths and wind. The spectra of currents can be seen a small peak at the tide frequency, a much larger peak at periods of inertial waves and strong peak at periods of 1-2 months. It is during such periods have wave currents in the ocean.

The main regularities of the observed wave motions in the ocean it is advisable to study, analyzing the instrumental observations.

In the southern and northern parts of the oceans are gigantic anticyclonic gyre around the center of the subtropical atmospheric anticyclone [2]. The period of treatment in these circulations of a few years (5 years).

Let us consider examples of registration currents anticyclonic circulation of Pacific and Atlantic oceans. It is advisable to start with the equatorial zone.

Weisberg R. H., (1984) shows the packets of surface waves traveling in a westerly direction generated barotropic instability observed in the equatorial Atlantic during 1983 (Fig. 2, left).

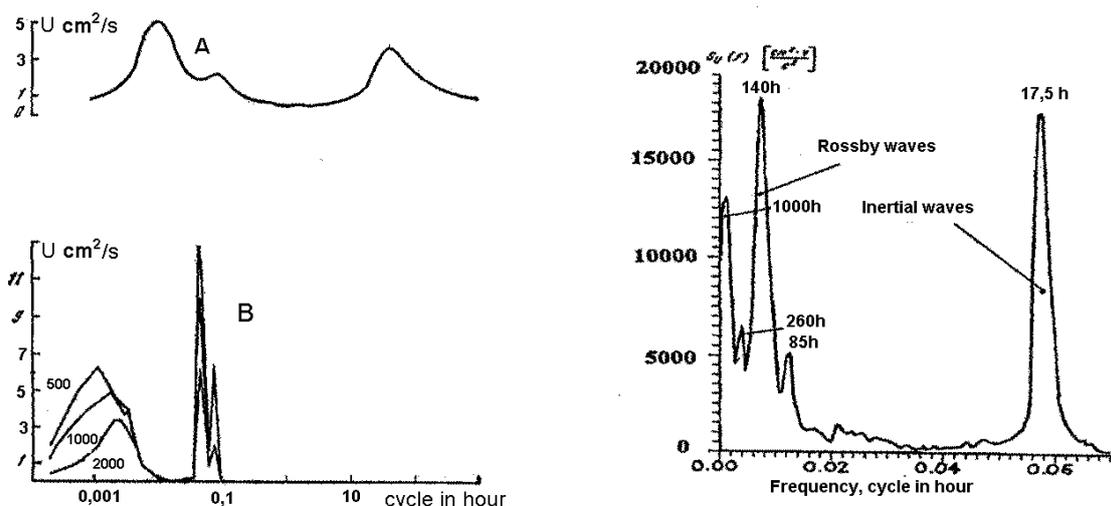


Fig. 1. Spectra of the variability of wind speed and current velocity (Lappo, 1979) (left). A) wind speed in the lower atmosphere (Van der Hoven, 1957), and B) the current velocities at depths of 500, 1000, 1500 m in the western Atlantic Ocean (Rhines P. 1971); Spectral density function of the variability current velocity in point Neftyanie Kamni, Middle Caspian sea. [4], (right).

Deep current profiles made in the Equatorial Atlantic, the show captured the deep equatorial jet streams (Gouriou Y., Bourles B., Mercier H., Chuchla R. 1999). Zonal velocity profiles recorded at the equator, 35 ° W in April 1996 show a complex vertical structure with alternating minima and maxima of the velocity (Fig. 2 right).

Strong current in an westerly direction for 80 meters depth - it is the equatorial current. Current to the east - is the equatorial countercurrent (from 200 m. to 800 m).

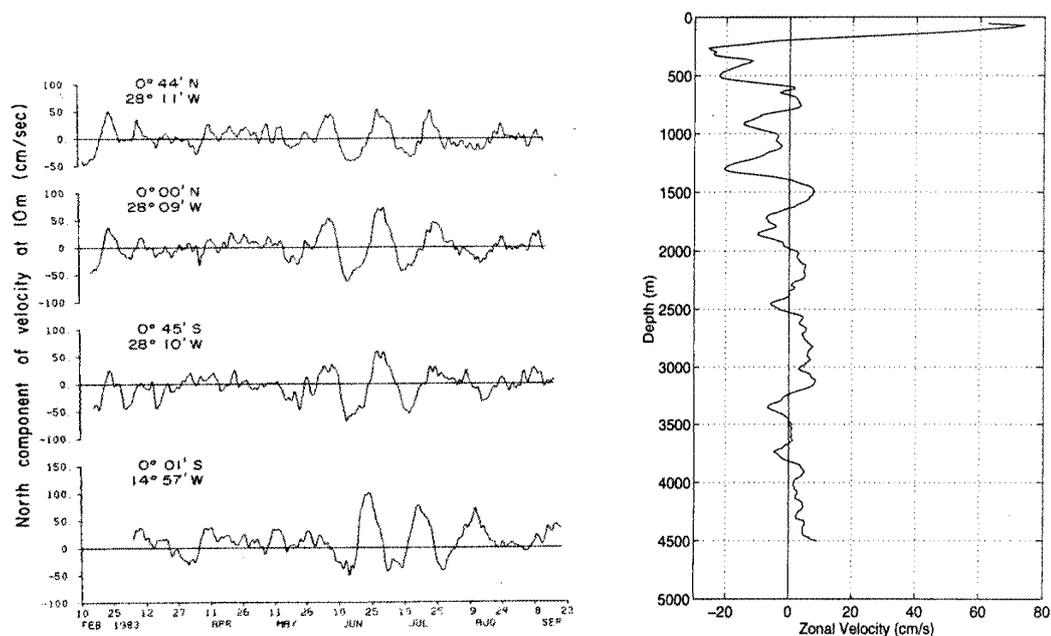


Fig. 2. Meridional component of the equatorial current in the form of Rossby waves at a depth of 10 meters (Weisberg R. H. 1984), (left); Depth profile of the zonal component of velocity, in cm/s, at 0°-35°W, on April 29, 1996, during the Elambor 2 cruise. (Gouriou Y., Bourles B., Mercier H., Chuchla R. 1999),(right).

Below these two well-known manifestations of the equatorial circulation is observed alternation of maximum and minimum speed. It is shown that up to a depth of 200 m in the main current of the west. These measurements can confirm that the zonal scale of the jets is comparable to those observed in the Indian and Pacific oceans.

For more information about the nature of these waves are an example currents measurement in the equatorial Pacific in point 0 °, 110 ° W, at a depth of 10 m. These observations continue for more than 15 years (TOGO-TAO).

Figure 3 represented the meridional component of the same currents. In analyzing this record, we can draw the following conclusions: Speed and direction of the zonal currents have a periodic variation with a period of 17 days, the amplitude of variability from 0 to 100 sm/s. against the backdrop of the

changing current in a westerly direction. Period currents change in a westerly direction for about a year, the velocity varies from 0 to 160 cm/sec.

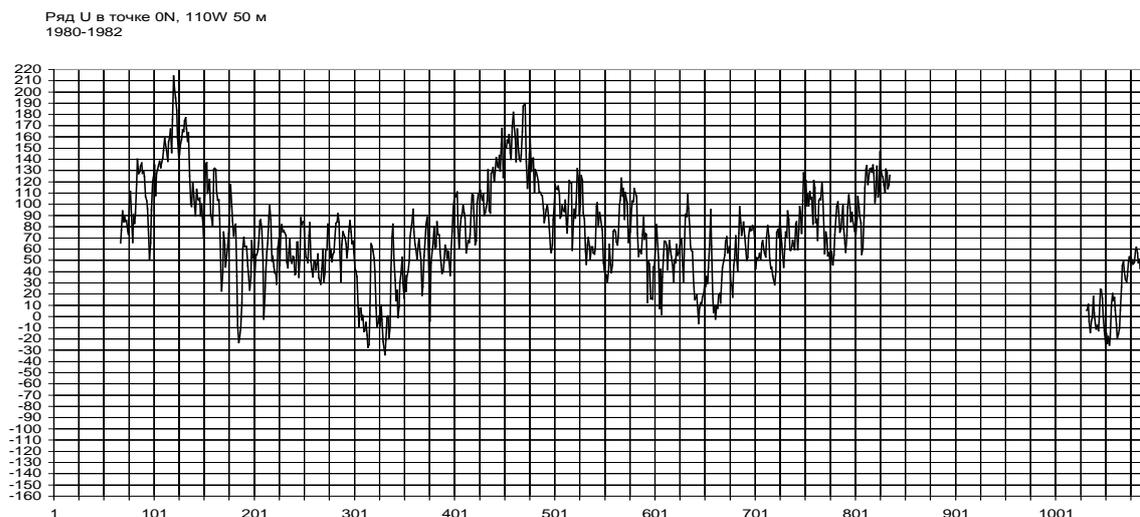


Fig. 3. The example currents measurements on the equator in the Pacific point of 0° , 110° W, at a depth of 10 m. The zonal component (W - E) (TOGO-TAO).

Continue consideration of the further advancement of wave currents in a westerly direction in the Atlantic Ocean.

Equatorial Current reaches the coast of Brazil and is called the deep western boundary current (DWBC), is divided into two branches. One branch is a continuation of the equatorial currents in the direction to the western shore of the Atlantic.

The second branch after crossing the equator at 44° W (Fischer J., Schott F. A. 1997) were observed in the deep records from 44° W, 2° N to 33° W, $3,5^{\circ}$ S (fig.4). Currents within the DWBC core indicated that mayor contribution to the DWBC variability near the equator was due to pulsing rather than meandering. Inspection on the current time series (fig.4) shows variability of periods 60-day and 25-to 30-day periods, dominates variance in all three levels of the DWBC (1500, 1800 and 2100 m.).

Further evolution of the properties of the waves show the trajectory of drifters in the Gulf of Mexico, where there are intense anticyclonic rings propagating loop

currents. These rings carry heat and salt in the western Gulf of Mexico, and also convey a significant amount of time forces (Lewis JK, Kirwan AD, 1985).

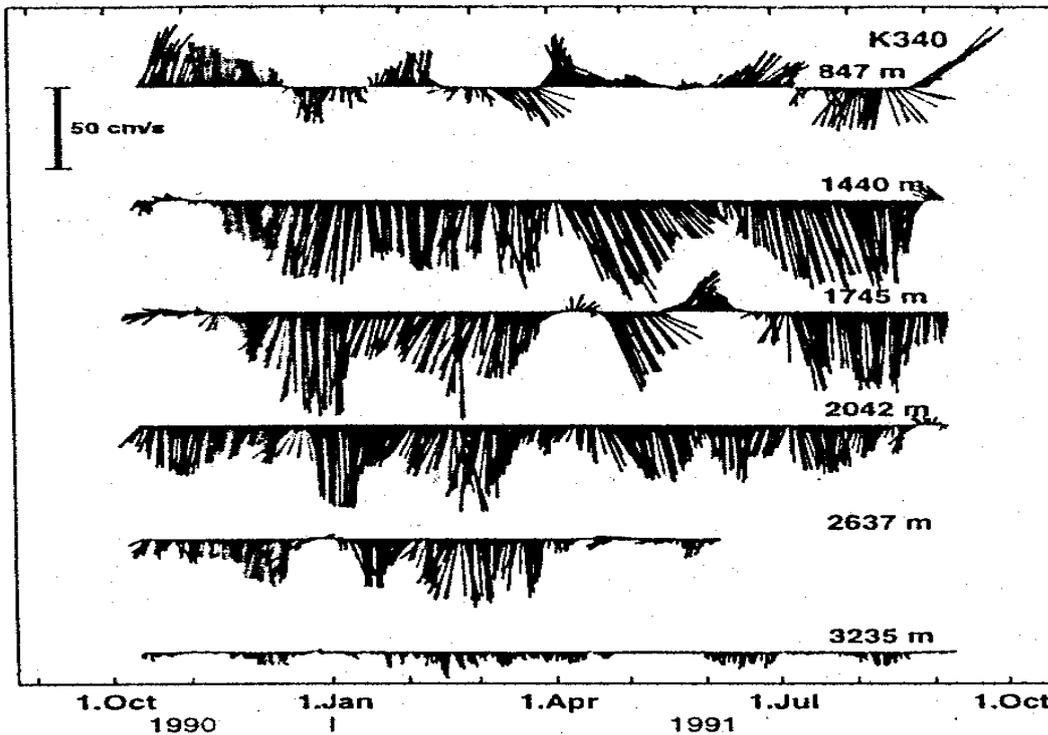


Fig. 4. Variability of current velocity on the coast of Brazil. (Fischer J., Schott F. A. 1997)

Further movement of large-scale circulation is shown in [5]. In Fig. 5 shows the trajectories of 230 drifters running from 1972 to 1989 at depths down to 2000 m in the North Atlantic in the Gulf Stream and its surrounding. The article begins with the phrase: "There's something amazing about the trajectories of surface drifters". What surprised the authors? Despite the fact that one picture shows all the paths, making it impossible to trace the trajectory of each drifter configuration, it is clear that for a vortex and the wave nature. From the text of the article implies that half of the drifters made the rotary motion in a clockwise direction, the other half against it, the authors call them Eddys.

But you can more accurately show the nature of the observed movements of the Gulf Stream, if we can show changes in the velocity of the drifters along the trajectory. If the drifter moved in a vortex, the speed of its movement would change little. In Fig. 6 shows that the rate of change in the wave currents [4]. The velocity increases to a maximum (1-2 m / s), then decreases to 5 cm / s., sometimes the flow

almost stops, then begins to move. Thus there is a movement in the wave flows. The most common name of these currents - the Rossby waves.

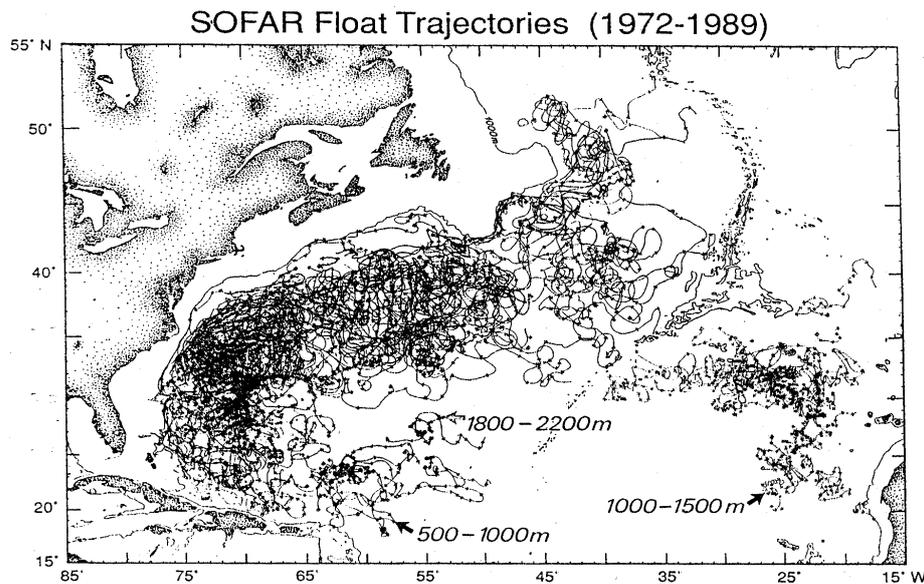


Fig. 5. 240 SOFAR (. Sound Fixing And Ranging) float of data in the North Atlantic at depths from 700 to 2000 meters. (Philip L. Richardson 1991).

From these examples currents observed can draw the following conclusions.

Large-scale circulation in the oceans is the resultant movement of long-period waves. Waves are observed anywhere in these circulations. Correct to say: there are large-scale circulation in the form of long-wave currents (LWC). Presumably LWC formed at the equator, and then spread westward. Upon reaching the shore, to spills northwards and southwards, forming an anticyclonic circulation in the northern and southern parts of three oceans.

The question arises, what is the force driving the water near the equator in a westerly direction, and why there are long-period wave currents (the currents of the wave nature)? In the literature we find the answer to these questions.

The vast majority of researchers believe that the ocean circulation occur partly under the influence of momentum transferred to the ocean winds, and partly as a result of thermohaline processes.

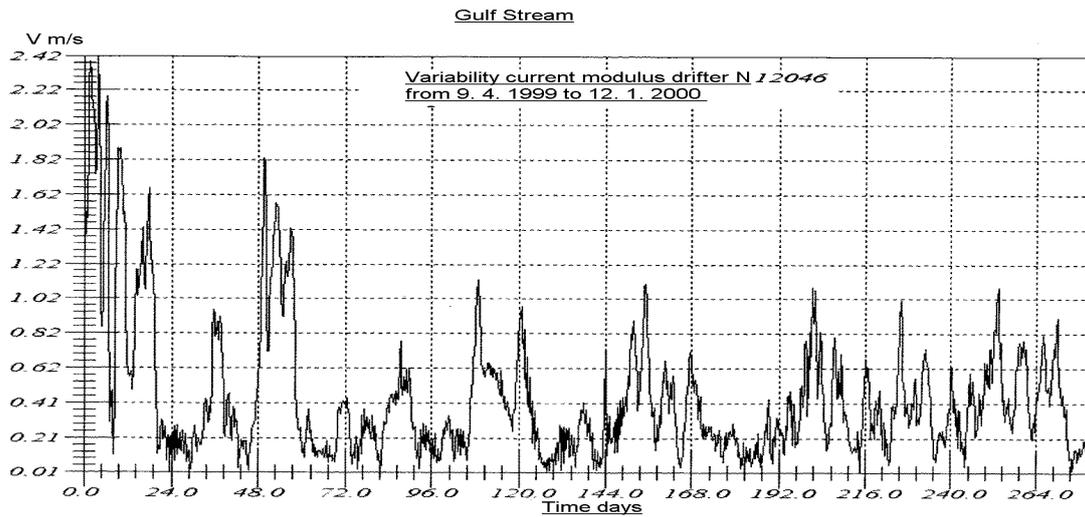


Fig 6. Variability velocity along trajectorye drifter №12046 [4].

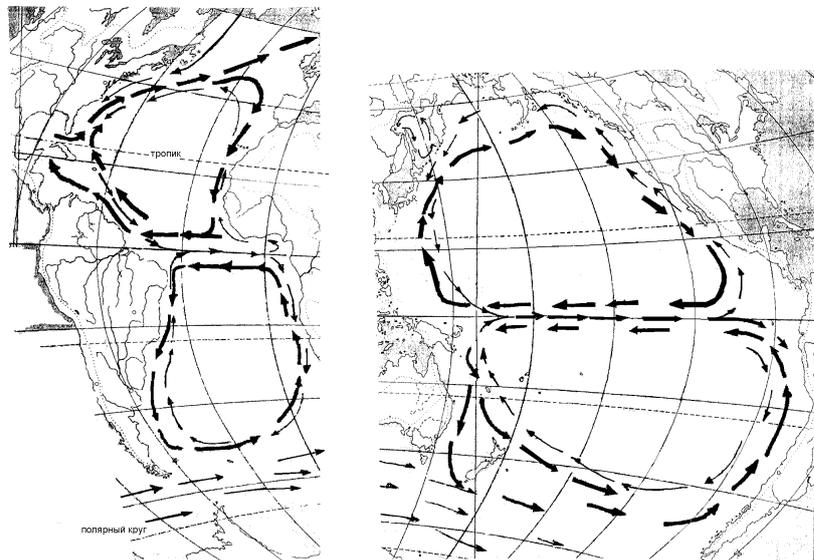


Fig. 7. Large-scale anticyclonic (thick lines) and cyclonic (thin lines) circulation in the Atlantic Ocean. Large-scale anticyclonic (thick lines) and cyclonic (thin lines) circulation in the Pacific Ocean [17].

And only about 20 investigators are considering the formation of ocean circulation due to the impact forces of attraction of the moon and the sun on the water mass. (Avsyuk N., I. Suvorova, Svetlozanova I.; Dobroluybov A. I. 1996, Garetsky RG, Monin and Shishkov Yu; Kant I.; Le Blond P. H., Mysak L. A., Broche ,

Sündermann J.; Groves G. V.; Morner N. A.; Munk W., Wunsch C.; Egbert G. D., Ray R. D.).

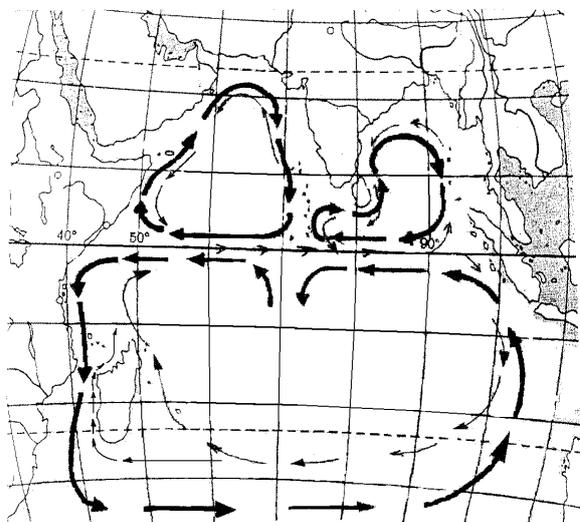


Fig. 8. Large-scale anticyclonic (thick lines) and cyclonic (thin lines), circulation in the Indian Ocean [17].

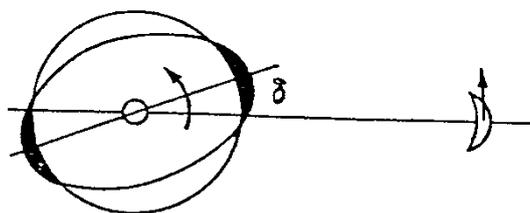


Fig. 9. The delay of the maximum tide towards the climax of the Moon.

For the first time the idea that the action of the tides slow Earth's rotation rate expressed Immanuel Kant in 1754 has now been proved that it is tidal friction that occurs in the Earth's oceans and inland parts of the Earth, is the main factor leading to the slow rotation of the Earth (theory of tidal evolution of the Earth - Moon) [8].

In Fig. 9, which has already become a classic, this hypothesis explains the example of the moon. As a result of gravity of the moon on the ocean water mass are formed tidal humps. Because of the inertia and friction of water against the bottom the maximum flow occurs at the point of the Earth shortly after the culmination of the moon at this point. The delay can be expressed by an angle δ retardation of the tides.

Due to this angle, the force of attraction of the Moon has a horizontal component along the surface of the ocean. There is a moment of force that pulls water along the equator from east to west.

Le Blon, P., Maysek L. (1981) consider the possibility of formation of the observed long-period wave actually currents as a result of the impact of tidal forces of the Moon and the Sun: "The response of ocean waves on the tide-body forces must have the form of long barotropic waves. In the same article reads: "A simple theory based on the assumption of spreading to the west of planetary waves in the absence of mean currents, gives an excellent agreement with observations.

Further we find pointing upon settlement, and essentially for creation of mathematical model of process of education and addition by energy of the observed waves. Speaking about affecting of gravity attraction on water mass, authors write: "Tide acceleration very small as compared to the acceleration of the own gravity field of Earth ($9,8 \text{ cm/c}^2$). Radial component of tide acceleration conduces to the insignificant change of local gravitation. A tangent acceleration is similarly small, but it is substantially unstable and creates motive force which drives water along an earthly surface.

Because of relative fineness of ocean tide force is practically permanent on a depth and operates as mass force which it is necessary to put in right part of equalizations :

$$U_T - (v + g(x = - 1/((\Pi_x + (K_M v U_z) z \quad (1)$$

$$V_T + (u + g(y = - 1/((\Pi_y + (K_M v V_z) z \quad (2)$$

$K_M v$ -vertical vortices viscosity.

The forced field of pressure $\Pi = \Pi(x, y, z)$ takes into account both the change of atmospheric pressure and astronomic tide forces of attraction".

Thus, the above examples show that there is a strong likelihood that the result of exposure gravitation of the Moon and Sun in the water masses in the equatorial region formed long-period wave currents directed from east to west. The resulting movement of long-period wave it is a large-scale anticyclonic flow circulation (Figure 7.8).

The existence of anti-cyclonic (clockwise in the northern hemisphere, and against the south), large-scale circulation in the northern and southern parts of three oceans few who doubt. Existence the same parts of three oceans cyclonic (counterclockwise in the northern hemisphere and clockwise in the south) circulation much less is known.

The most famous parts of the cyclonic circulation are the equatorial countercurrents, which were open in the 50-60s years of the last century (Lomonosov on Atlantic, Tareev on Indian ocean, Cromvell on Pacific). Another parts these circulations such a one known.

In 1969th the Antilean-Guiana countercurrent is open by an extent 3900 miles from the Bahama Islands to the equator (5s and 12s voyage surveis "Academician Kurchatov", leader V. Kort) [10]. It is a permanent stream of south-east direction, opposite to Antillean and Guiana currents. from 5°S to 23°S. His width is a 200km, depth a from 200m to 1000m, volum transport is half as Gulf Stream. In opinion of scientists, opening the Antilean-Guiana countercurrent, it serves to one of basic sources of deep Lomonosov countercurrent.

In 1968th in south-west part of the Atlantic ocean a powerful cyclonic rotation was educed and on his east periphery is the Angolan current of southward [8]. On a surface this flow is disguised by thin (a to 20 m) by the layer of trade wind flow, going a north. The Angolan current occupies a level to the depths a 800-1000 m. It is continuation of Lomonosov current southward.

In 1968th by the French oceanologists it was found out the Guinean deep countercurrent, to the westward at a depth 40m-200 m from 0° to 8°W. It is the continuation of Lomonosov current on a north and westward [8].

Cause of large-scale cyclonic circulation in the northern and southern parts of three oceans research helps to understand the nature of currents of the inside seas and large lakes.

There is a basic common feature of circulating currents of the inland seas and large lakes of the northern hemisphere - the cyclonic nature of large-scale circulations of these reservoirs (Fig. 10).

The collaborators of Institut of Water Problem Russean Academy of Science (Moscow) engage in experimental researches currents nature the Caspian Sea with 1982th (leader Bondarenko A. L.). Measuring, produced in 1989 in 5 points at east shore of Middle Caspian sea, showed the presence of long-period wave currents with the period of 140 h., and inertia wave with the period of 17,5 h. [Bondarenko 1993]. Currents was observed more than two months. The measurement results have been filtered by a filter with the filtration time 62 hours. (Bondarenko A. L. 1993).

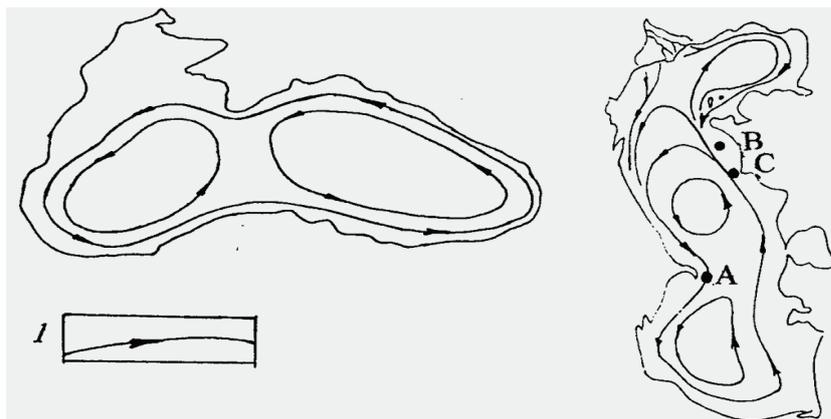


Fig. 10. Large-scale cyclonic circulation in the Black (left) and in the Caspian Sea (right). 1 - the line current. C and B - the measurement points (16 and 17, respectively, in Fig. 10) [3].

About the period of long-period waves it is possible to judge on the distinguished separate variations (fig 11). Comparison of vectograms of flows in two points 16 and 17 showed, that motion of wave of identical phase in one point came on 60 h. later what in other, that evidently on the difference of time between the moments of registration of crest of wave in these points. The distance between points of observation is 75 km. Then phase speed will be equal a 0,35 m/c., i.e. distance between points divided by time to fall behind of phase (60 h). A wave-length is equal an about 200 km (multiplication of phase speed on the period of wave) (fig. 11).

The important, very informing stage of researches is an analysis of four one in day observations in a point “Neftyanie kamni” in the Caspian Sea (fig. 20, right, point A) [9, 10]. Spectral analysis of alongshore currents shows types of currents in the Middle Caspian sea. On figure (1 right) we can see a powerful peak is presented on

inertia period (17,5 h.), and very powerful peak on a period 140 hours. Energy of currents is concentrated in continental shelf waves (arrested topographic waves) and in waves inertia.

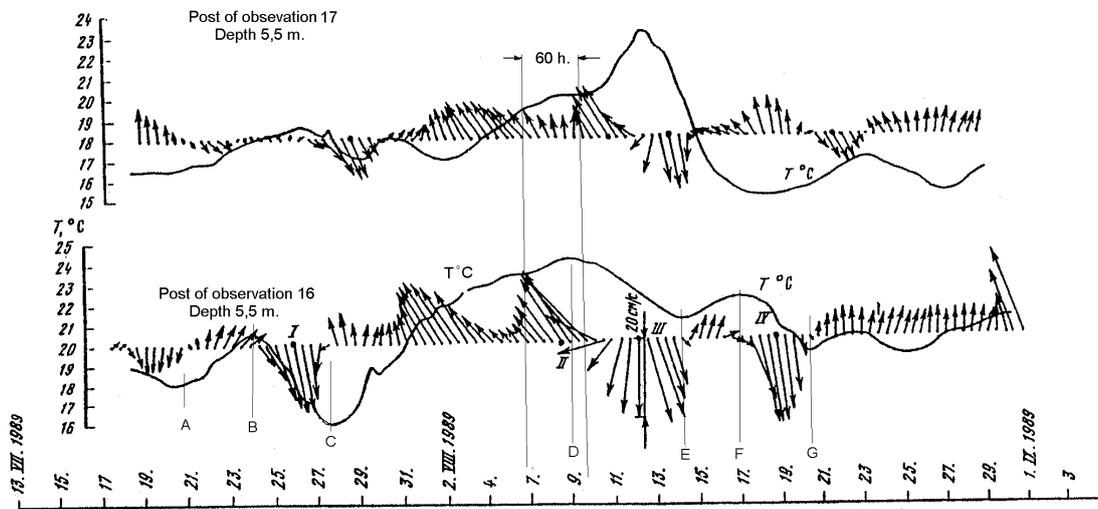


Fig 11. Variability of flows in point 16, 17 (C and B respectively in fig. 19) [3].

The period of variability velocity long-period waves and inertia are very to differ, therefore them it easily to distinguish and study regularity separately. On the fig. 12a the graph of variability of low-frequency alongshore constituent of current is presented in a point “Neftyanie kamni” for a year, filtered with the interval of smoothing out 48 hours. Normal to the boundary a constituent is small and not examined. On a figure well evidently, that current speed changes a from 0 (sometimes has minus quantity) to 15 cm/c. with a period 140 hours. It there are long-period or topographic waves currents, the most common name - the Rossby waves.

In Figure 12b the same alongshore constituent is presented, but filtered with the interval of smoothing out 240 hours. Essentially we see the speed variability quasi-steady large-scale circulation. On the Figure 12c the same constituent is presented, but after 3 years. Time of filtered $T = 240$ h. By means of polynomial to take regularity variability of quasi-steady large-scale circulation throughout 3 years (fat line).

We see regularity variability of mean quasi-steady large-scale circulation current throughout 3 years period (1962-1964 г.г.). At the beginning of 1962th mean speed decreased from 7 cm/c. a to 5 cm/c., then speed increased a to 12 cm/c. to the middle 1963th and in subsequent interval of time mean speed decreased a to 6 cm/c. It is possible to mark that it is not periodicity seasonal and annual.

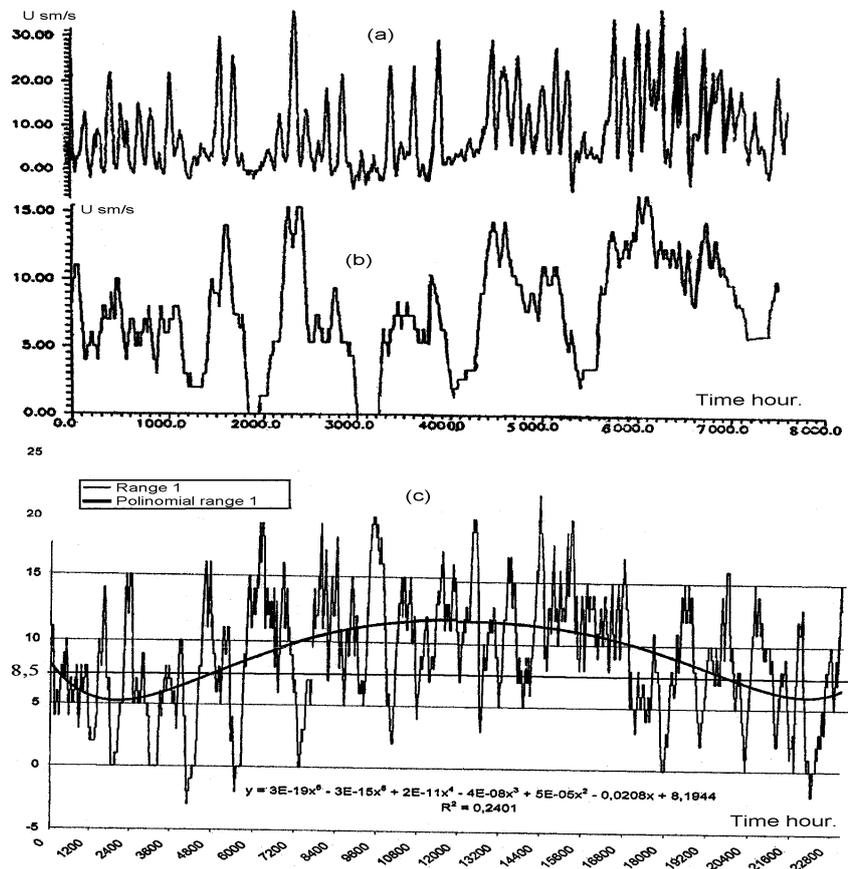


Fig. 12. Averaged time series of longshore velocity component for the year in in a point “Neftyanie kamni” for a year, filtered with the interval of smoothing out 48 hours Averaging time $T_{ap} = 48$ h. a); the same number of moving averaged filter equilibrium average with an averaging time $T = 140$ h. represents the variability rate of quasi-flow of the Middle Caspian b); the same time series, but for 3 years. Averaging time of 48 hours. By means of polynomial to take regularity variability of quasi-steady large-scale circulation throughout 3 years (fat line).

Study datas observing in Caspian sea, datas described in the literature about insides seas and large lakes (see above) allows to do next conclusions.

1. Caspian sea circulations, other insides seas and large lakes exist mainly as the long period waves, the period of which depends on length of circuit (shelvy area) of reservoir. In Middle Caspian sea their period is equal 140h, in South Caspian sea – 120h. amplitude a to 30-40 cm/s, in the Black sea a period is equal 240h, amplitude a 40-50 cm/s.

2. Quasi continuous currents or cyclonic circulations in all internal seas and large lakes are a resulting movements of the long period currents.

3. The second on power meaningfulness type of currents are inertia wave currents. A period of inertia currents is in Middle Caspian sea - 17,5h., amplitude variability to 70 cm/s.

4. Role of wind from all energy of the Caspian sea currents we estimate in the limits of 10%. [3].

As shown above, in the oceans, as well as in inland seas, there are cyclonic circulation. It is logical to assume that the cause of formation for the cyclonic circulation in the inland seas and oceans is the same.

By theoretical basis of reason formation of long-period wave currents at seas and oceans, having a cyclonic orientation of motion can serve channel theory of Eree (1842), which considered the result of influence of forces attracting Moon and Sun on the water masses in channels oriented on parallels and meridians of Earth. In the first there are forward tidal waves, and in narrow meridional channels - stand-up waves. In environmental conditions combination of waves of different type takes place depending on the form of reservoir.

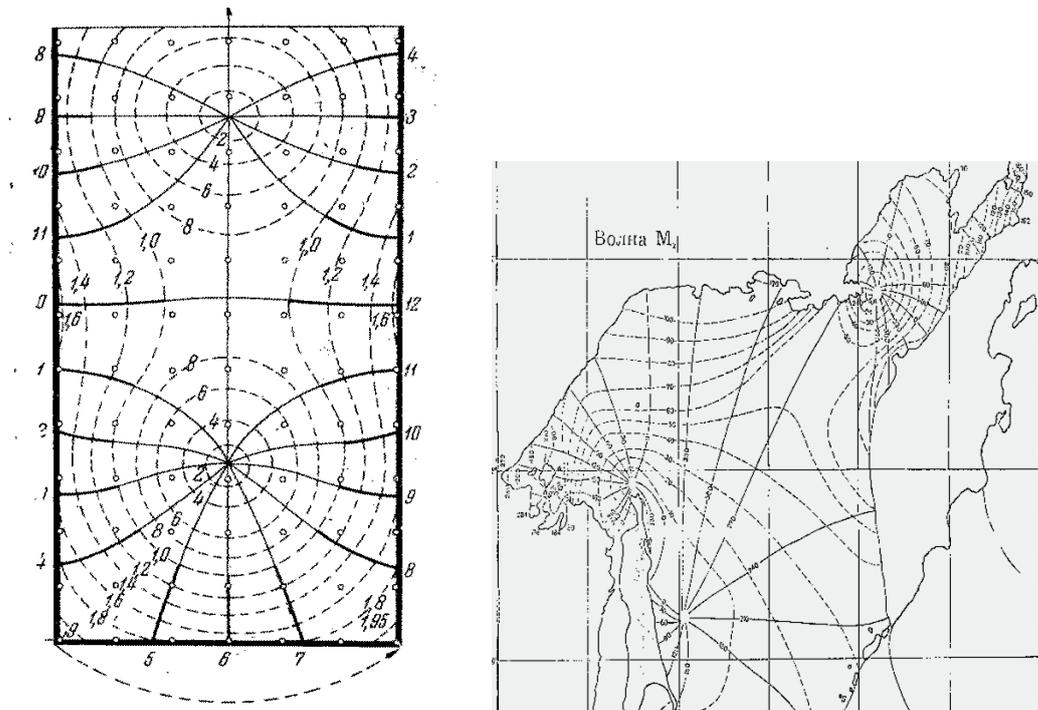


Fig. 13. Cotidal line in the field Coriolis force (Shuleikin V. V.1968) (left), cotidal line in the Okhotsk Sea [Bogdanov Yu. T.].

In the basin of rectangular shape as a result of the impact of tide force is rotational movement of the inclined surface of the sea around a fixed point. (Fig. 13 left).

As a result of tidal forces on the water mass of the Okhotsk Sea is the rotational movement of the inclined surface of the sea around a fixed point. It is this movement shows the location of cotidal lines (Fig. 13 right) (Bogdanov T.). They show that every day makes a cyclonic tidal wave round the perimeter of the sea. This is an every day exposure may lead to the formation of the trapped wave shore currents.

Instrumental observations in the Okhotsk Sea [11] to help understand the nature of long-wave flows inland and marginal seas.

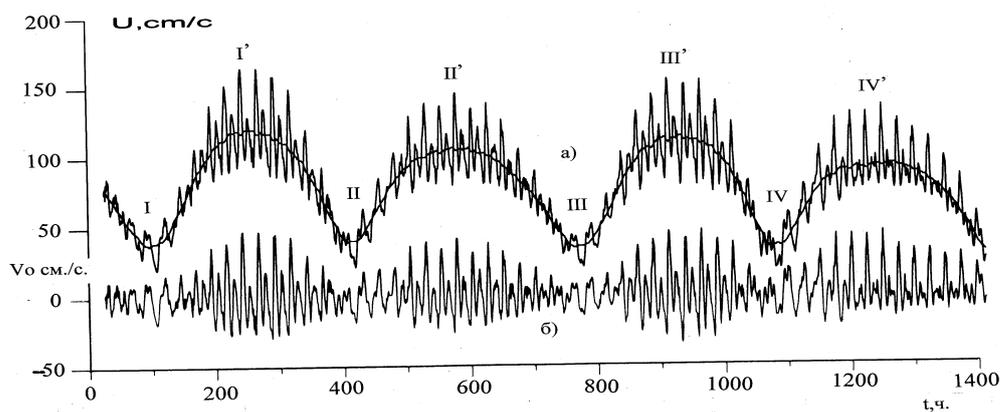


Fig.14. Currents of the Okhotsk Sea in the bank Kashevarova [11] (a), the inertial currents on the bank Kashevarova (b).

Current observations on the bank Kashevarova (western part of Okhotsk sea) by duration 3 months on a depth a 140 m (14 m from a bottom) presented on figure 24a. We see basic period of current speed variations 13,66 days. A current is directed from a north to the south, circulation is registered anticlockwise (as in all seas of north hemisphere). High speed of long-wave current arrives at a 140 cm/s., minimum speed is 35 cm/s. On a background a long-wave current the high-frequency oscillates of currents are well visible. We accepted them at first (as well as authors of the article) for flood-tide motions. Amplitude of them in a sum with long-wave arrives at a 170 cm/s. The additional analysis showed that the period of these vibrations (13,44 h.) is near to calculation inertia waves (13,63-15,38 h.). On figure 24b inertia wave flows are shown separately. It is good evidently, that large amplitudes of inertia wave currents correspond large amplitudes of long-period circulation currents.

The currents presented in such kind show evidently, that as a result of affecting of attractive of Moon and Sun powers water mass of Okhotsk sea there are long-wave, trapped by a shore currents with a period a 13,66 days, which run all over a sea reservoir anticlockwise. The location of kotidal lines it confirms.

Motion of long-period currents deviates of Coriolis force. Inertia waves appear.

Presented in this form the current clearly show that exposure to the attractive forces of the Moon and Sun on the Okhotsk Sea water mass having long-period wave captured shore current with a period of 13.66 days, which runs around the sea basin

counterclockwise. Location cotidal line confirms this. Tidal forces of the moon and the sun are periodically and generate long-period wave currents in the Caspian Sea, Black Sea, in large lakes and borderland seas.

All these examples, looked above allow to draw conclusion, that nature of wave long-period motions is in Caspian sea, Black sea, in large lakes and borderland seas is similar. Reason of origin and addition to energy of wave currents is affecting of attraction powers of Moon and Sun water mass of these reservoirs. Logically to suppose, what north (south) parts of three oceans cyclonic circulations have the same nature.

Analysing the results of numerous instrumental observed, and theoretical investigations [Avsyuk Yu. N., Suvorova I. Svetlosanova Z. 2009; Garetskii R. G., Dobrolubov A. I. 2006.; Monin A. S., Shishkov Yu. A. 1979; Broche P., Sundermann J. 1971; Le Blond P. H., Mysak L. A. 1978; Kelvin, Lord W 1879;] it is possible to do next conclusions:

Reason of arise and existence of long-period waves in ocean is the daily influence Moon and Sun force of attraction in a water mass.

There are two phenomena:

a) Moon and Sun force of attraction in a water mass equatorial zone to form long period waves Rossby with resultant transfer from east to west in Atlantic, Indian, Pasific oceans. Currents arrive at the western shore of oceans, further turn on a northward and southward, forming large-scale anticyclonic circulations.

б) Moon and Sun force of attraction influence in a water mass of oceans out of equatorial zone, internal seas and large lakes and form the wave currents (a period depends on the sizes of reservoir) which in the motion westward reach shore, and walk around a reservoir along with the coast anticlockwise (cyclonic circulation). A resulting transfer of it is cyclonic large scale circulation.

The currents of long waves deviate force of Coriolis and form inertia wave currents [12,13,14,15,16,17,18].

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The main regularities of the formation of large-scale circulations in the oceans and seas.

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**EVALUATION OF QUALITATIVE AND QUANTITATIVE
CHARACTERISTICS OF THE GROUNDWATER FLOW IN RURAL AREAS**

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Ukraine*

In the paper the results of hydrodynamic and ecological-geochemical researches of groundwater for example of territory of rural locality are presented. Excess contents of potassium, nitrates and organic matter in waters are detected. The amounts of other components do not exceed maximum permissible concentration for drinking-waters. Directions of groundwater flow are determined and velocity of filtration is calculated. Rate of groundwater flow and values of flows of the dissolved in groundwater components are assessed.

Key words: Ukraine, groundwater flow, ecological-geochemical features, hydrodynamic conditions.

INTRODUCTION

In Ukraine groundwater is the main source of drinking water-supply of the rural areas. Water-supply is based on the wells (dug wells) and shallow boreholes. The quality of groundwater is a decisive factor of the sanitary and epidemiological welfare of the rural population.

Because of hydrogeological openness groundwater is subject to a considerable anthropogenic impact, which is reflected in the pollution of the components of chemical and bacterial nature: pathogenic micro-organisms, the components of the nitrogen group, heavy metals, complex compounds, toxic organic compounds, etc. Sources of pollution are domestic waste water, the waste water of the cattle-breeding farms and industrial enterprises, runoff from agricultural lands, etc. Infiltrating in the dissolved state through the unsaturated zone, pollutants are getting in the water horizon, not encountering significant barriers.

Our preliminary research of groundwater of the Yavoriv district (Lviv region) revealed their significant contamination (90 % water sampling) components, the contents of which are several times higher than maximum permissible concentration and therefore they are not suitable as drink water. The main pollutants are potassium, components of nitrogen group, organic substances, mangan, ferrum [1].

The intensity of the spread of pollution is fixed mainly by the hydrodynamic characteristics of the horizon. Dynamics of water caused the intensity of the power supply and discharge of groundwater, as well as porous and filtration parameters of the water-bearing rocks.

The aim of this work is to evaluate the qualitative and quantitative characteristics of the groundwater flow of rural areas into the river basin.

AREA OF RESEARCH

The area of research was village Novosilka (Pustomyty district, Lviv region), which at the place of location belongs to the cross-border with Poland territories (Fig. 1).

The village is located on the right coast of the river Zubra, which falls into a river Dniester. The village consists of 53 buildings. Water supply of the village is not centralized, based on the wells, maintaining the groundwater horizon. Sewerage system is absent.

The village Novosilka is placed within Opillya (Podil Hills). Opillya is one of the highest and the most distributed parts of the Podil upland. It extends to the south-east from the city of Lviv.

River floodplain Zubra within the village is formed alluvial quaternary sediments (sands with a certain portion of clay material), which cover the eroded



Fig. 1. Localization of the research area

thickness of the Maestrichtian layer of Upper Cretaceous (strong marls and limestones). The watersheds are formed by sandstones and sands of the Opillya suite of Early Badenian.

Groundwater within the village Novosilka are mainly in the alluvial deposits of the river.

METHODS OF RESEARCH

The methods of the research were the measuring of the groundwater levels in the wells of the village during long drought period, bringing these levels in absolute marks and building hydrodynamic model of the horizon, according to which one can determine the directions of the groundwater flow.

In the taken water samples from wells were determined the contents of the macro- and micro-components with the help of chemical and physico-chemical methods in the laboratory of the problems of geocology (Institute of Geology and Geochemistry of Combustible Minerals of NAS of Ukraine).

In the valley of the river were sampled the alluvial deposits, for which according to the methodology of Kamensky [2] in laboratory conditions were defined the coefficients of the filtration. Sampled groundwater was used for determination of this coefficient. Correction to the temperature of the water also was considered.

Velocity of filtration and rate of flow of groundwater into the river were estimated according to the Darcy's linear law of filtration.

The results of the definitions were worked out by methods of mathematical and graphic software (Statistica, Surfer, Corel Draw).

RESULTS OF RESEARCH

The plane hydrodynamic zonality of the water table of the village Novosilka is presented in Fig. 2. The depth of the water in the wells is reduced from 7.4 to 0.2 m in the eastern and south-eastern directions. In general the water table reflects the morphology of the relief. However there are hypsometric lows within those areas where conducted the most intensive extraction of water was coplucted. The general vector of groundwater flow is directed into the side of the river Zubra, which is the source of their discharge (Fig. 3).

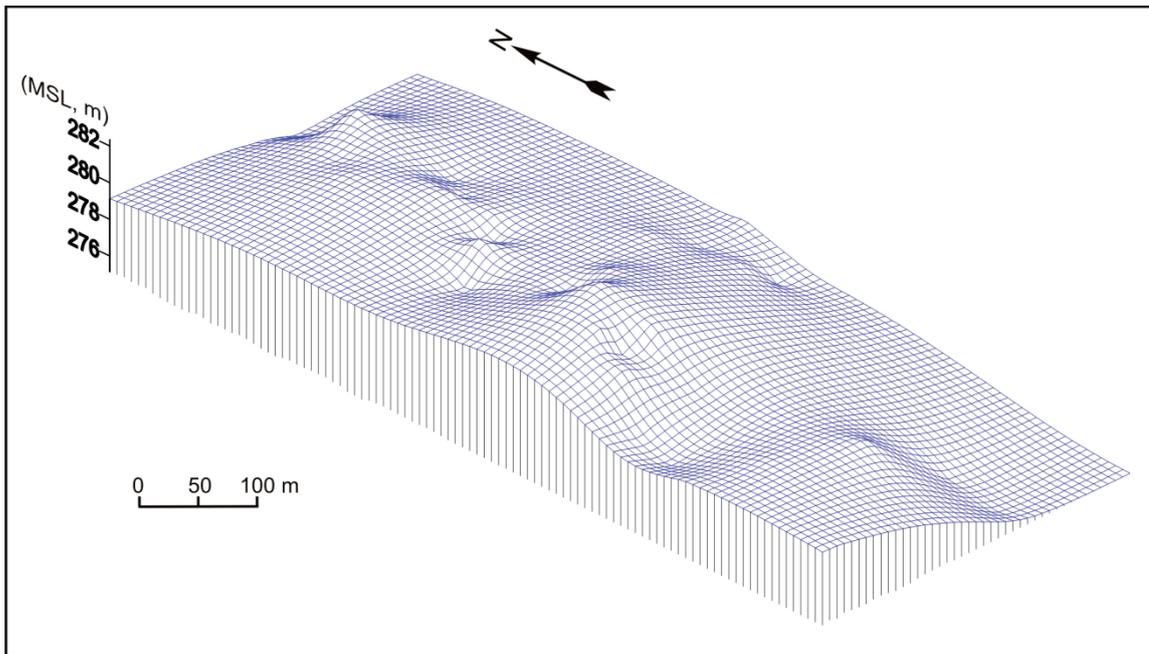


Fig. 2. Plane hydrodynamic model of the groundwater horizon of the village Novosilka

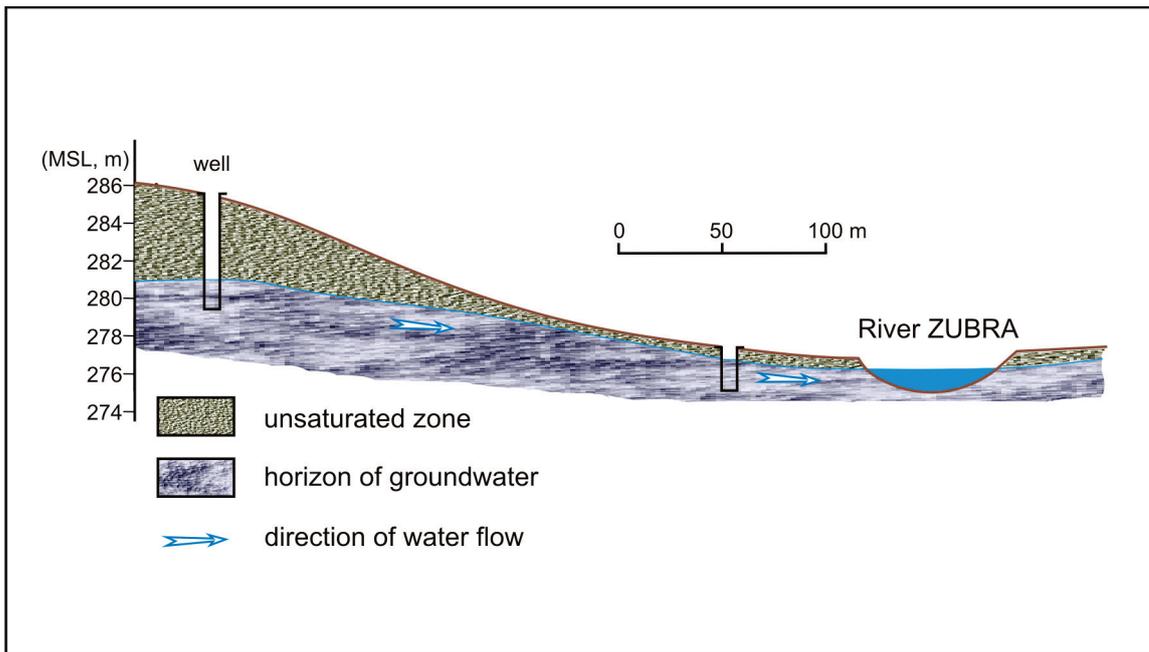


Fig. 3. Cross-section along general vector of hydraulic gradient

The vector map of the hydraulic gradient of the water table gives the possibility to estimate their value both locally and in the general scale. The maximum value of the hydraulic gradients is 0.259, minimum – 0.018. The value of the general vector of hydraulic gradient is 0.027.

Total dissolved solids (TDS) of groundwater change in the limits of 266-1536 mg/dm³. Its value is correlated with the extraction of water to some extent, which determines the intensity of the dynamics of water and, in turn, processes of leaching water-bearing rocks. Among the macrocomponents Cl⁻, Na⁺, SO₄²⁻ are most closely correlated among themselves. The content of Ca²⁺ is closely correlated with the concentration of HCO₃⁻.

Waters are hydrocarbonate and hydrocarbonate-sulphate, sulphate-hydrocarbonate calcium, less calcium-sodium and, even, calcium-potassium or potassium-calcium by composition.

The peculiarity of groundwater of the village Novosilka is high contents of the potassium ion, the concentration of which sometimes exceeds the sodium content. Although the content of potassium for drinking water in our country is not rationed, however, it exceeds the standards of the EU several times.

Naturally groundwater is concentrated with potassium due to leaching or ion exchange with the water-bearing rocks. Technogenic source is potassium mineral fertilizers and livestock waste waters. Despite the relatively close relationship potassium content with the amount of nitrate-ion, we see the reason in the technogenic pollution.

The concentration of nitrate-ions in the groundwater in most of the samples largely exceeds the maximum permissible concentration for drinking water.

The mechanism of occurrence of nitrate in the water goes through the chain:



Given the small contents of the ions of ammonium and nitrites in the waters it can be stated that the sources of the pollution is a relatively long-standing and permanent.

Contents of the phosphates are in the range of 0.02-of 0.43 mg/dm³ and do not exceed state standards, which are regulated by the value of 3.5 mg/dm³. The amount of fluoride (0.04–0.14 mg/dm³) also does not exceed maximum permissible concentration (1.5 mg/dm³). Permanganate oxidability in the majority of samples

exceeds the regulated content (5.0 mg/dm^3), which points to significant pollution of groundwater of the village of organic components.

Concentrations of metals (Li, Sr, Fe, Mn, Cu, Zn, Pb, Co, Ni) in the waters do not exceed maximum permissible concentration, only in some cases, manganese content exceeds permissible norms.

The coefficients of filtration of three samples of alluvial sediments (fine-grained sand with various content of the clay material) with the account of the correction to the temperature were respectively 1.12, 3.21 and 3.6 m/day.

To calculate the average velocity of filtration flow of the groundwater into the river Zubra were taken averaged data on rates of coefficient of filtration (2.64 m/day) and the value of the hydraulic gradient along the general vector (0.027). The velocity of filtration flow according to the calculation was 0.07 m/day.

Given that the power of the river in the low-water period is mainly due to groundwater runoff, its thickness was identified at an average depth of the river within the limits of the research area. It was 0.8 m (Fig. 4). The length of the drainage basin within the village Novosilka is 720 m (Fig. 2). Thus calculated cross-sectional area of the groundwater flow, which is drained by the river, is 576 m^2 .

Rate of flow (discharge) in the period of studies according to the calculations was $40.3 \text{ m}^3/\text{day}$.

Data of flow rate and mean values of salinity and main components in the waters (Table 1) allow estimating (in a certain approximation and without regard to the physics-chemical mechanisms of delay) the supply of these components into the river during a certain period (Table 2).

Table 1

Average values of total dissolved solids (TDS) and contents of the main components in the groundwater of the village Novosilka, mg/dm^3

TDS	Na^+	K^+	Ca^{2+}	Mg^{2+}	NH_4^+	Mn^{3+}	Cl^-	SO_4^{2-}	HCO_3^-	NO_2^-	NO_3^-	F^-	$(\text{PO}_4)^{3-}$	Si
790.9	19.3	74.7	117.4	12.3	0.08	0.2	32.0	40.6	407.5	0.027	92.6	0.05	0.3	7.9

Table 2

Values of flows of the dissolved in groundwater components from the village Novosilka into the river Zubra, kg/day

TDS	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	NH ₄ ⁺	Mn ³⁺	Cl ⁻	SO ₄ ²⁻	HCO ₃ ⁻	NO ₂ ⁻	NO ₃ ⁻	F ⁻	(PO ₄) ³⁻	Si
31.9	0.8	3.0	4.7	0.5	0.003	0.008	1.3	1.6	16.4	0.001	3.7	0.002	0.01	0.3

CONCLUSIONS

Flow of groundwater of the village Novosilka is directed toward the river Zubra. The water table represents relief morphology. The maximal values of hydraulic gradients are 0,259, minimum - 0,018. Value of hydraulic gradient on a general vector is 0,027.

Total dissolved solids of groundwater hesitate within the limits of 266-1536 mg/dm³. Waters are hydrocarbonate and hydrocarbonate-sulphate, sulphate-hydrocarbonate calcium, less calcium-sodium and, even, calcium-potassium or potassium-calcium by composition.

Peculiarities of groundwater of the village Novosilka are high contents of the potassium ion, nitrate ion and organic substance, that predefined by infiltration of sewages from farms and agricultural lands. Their concentrations in the most samples considerably exceed maximum permissible concentration for drinking-waters.

Rate of groundwater flow in the river during law-water is 40.3 m³/day.

Values of flows of the dissolved in groundwater components are presented in the table 2.

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